14th WFITN 2017 Congress
14th Congress of the World Federation of Interventional and Therapeutic Neuroradiology

October 16 – 19, 2017

Pesti Vigadó, Budapest, Hungary
www.wfitn2017.hu

PROGRAM & ABSTRACT BOOK

Journal of Peritherapeutic Neuroradiology, Surgical Procedures and Related Neurosciences
Official Journal of:
WFITN - World Federation of Interventional and Therapeutic Neuroradiology
AAFITN - Asian & Australasian Federation of Interventional & Therapeutic Neuroradiology
SAFITN - South American Working Group in Interventional and Therapeutic Neuroradiology
The Chinese INR Coordinating Committee of the Chinese Doctor Association
INSHCM - Interventional Neuroradiology Society of HCM City, Viet Nam

Journal sponsored by
JSNET - Japanese Society of Neuro Endovascular Therapy
FIO - Italian Federation of Ozone Therapy

Interventional Neuroradiology is published in cooperation with the American Journal of Neuroradiology
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## 14th Congress of the World Federation of Interventional and Therapeutic Neuroradiology

Program of Symposium for Nurses, Technicians and Radiographers in cooperation with ESMINT

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Past WFITN Meetings

1991     Zurich – Anton Valavanis
1993     Vancouver – Luc Picard
1995     Kyoto – Waro Taki
1997     New York – Alejandro Berenstein
1999     Algarve – Jorge Campos
2001     Seoul – In Sup Choi
2003     Recife – Ronie Leo Piske
2005     Venice – Marco Leonardi
2007     Beijing – Ling Feng
2009     Montreal – Jean Raymond and Daniel Roy
2011     Capetown – Allan Taylor and David Lefeuvre
2013     Buenos Aires – Pedro Lylyk and Luis Lemme Plaghos
2015     Gold Coast – Winston Chong, Hal Rice and Laetitia de Villiers
2017     Budapest – István Szikora, Zsolt Kulcsár
Welcome Message from the President of WFITN 2017

Dear Colleagues, dear Friends,

In the second decade of the XXI-st century, our community is on the verge of growing from a small group of enthusiastic pioneers to a large body of highly organized professionals. While integrating ourselves within the disciplines of neurosciences in these revolutionary years, it is our responsibility to preserve the spirit of interventional neuroradiology. As the global society of interventional neuroradiology, WFITN serves to maintain this spirit world round. In 2017, the key missions of the 14th Congress of WFITN is to lay down a road map of further growth in the ischemic stroke field, summarize current results and set future goals in the hemorrhagic portfolio and overview our potentials in spinal neurointerventions and neuro-oncology.

WFITN invites all colleagues: doctors, nurses, technicians, radiographers, scientists and engineers from all around the world to join efforts, to share experiences, to reinforce and build networks.

WFITN invites you to join at a symbolic place of connections. Having its 9 bridges over the Danube, Budapest connects the East and the West. Hungary, having its over 1000 years of history connects the Past and Present. WFITN connects neurointerventionists worldwide.

In 2017, the city of bridges will host the society of connections.

We wish you an exciting and fruitful congress as well as a wonderful visit in Budapest.

Welcome to WFITN2017, welcome to Budapest!

Zsolt Kulcsar
Vice President
14th Congress of WFITN

Istvan Szikora
President
14th Congress of WFITN
Ladies and Gentlemen; friends and colleagues,

During the past few years, INR/ENS has expanded significantly in many countries all over the world with Neurointerventional practitioners. Major advances in development of new tools have occurred in short succession highlighting the need for close collaboration between our profession and Industry.

Rapid evolution of the global practice in INR in the past few years have resulted in a shift towards scientific collaboration between the continental, international and national INR/ENS societies in terms of their scientific meetings, educational course as well as fostering the opportunity of research collaborations.

This upcoming 14th WFITN scientific meeting in Budapest October 2017, under the Congress President Istvan Szikora and all the congress committees, will be the important event for our specialty to learn and share our important basic knowledges and invaluable experiences and ideas to facilitate the Neurointervention to continue to move together into the proper direction, balancing the challenges arising from making earlier disease diagnoses, the development of new tools, to applicability to standard health care environments follow and participate in recent clinical trials as well as modern researches. Young Neurointerventionists can have chances to share their early experience while senior ones can generously share their valued techniques.

Coordinated research pertaining the outcome of the treatment of neurovascular diseases is critical and to be encouraged as it may result in changes in practice and improved patient care as exemplified in the endovascular management of acute stroke. Participation and leadership by interventional practitioners to performing such research is critical.

WFITN have been continuing to work and discuss about this issue. In Goldcoast meeting 2015 together with many societies in the world we co-published the “Training Guidelines for Endovascular Ischemic Stroke Intervention: An International Multi-Society Consensus Document”.

After these publication, major changes in AIS practice occur all over the world, creating some “new” problems concerning levels of standard training to practice by other professional groups in this condition. Multi-societies have agreed to meet again in this Budapest meeting to continue to discuss this existing issue, hoping that we will have proper outcome from our meeting will benefit to all our patients.

As we all realize that only doctors cannot make our specialty grow. Another major assisted team are INR Radiographers and Nurses. In this coming scientific meeting is, for the first time, opening up chances for these assisted groups to meet and share their knowledge and experiences too.

The purpose of our biannual scientific meeting are not only the mentioning above, but the main aim is for us who come from every parts of the world to meet and create our global network and endless friendship which will definitely benefit to better health of all mankind.

However, our society cannot function without its members. Going forwards we need to increase WFITN membership further, we will not be able to maintain and support scientific research endeavors as well as teaching support at global INR meetings and courses. We are now looking forward to the continuation of more participation within our society throughout the scientific Budapest Meeting in this coming October which there will be also new voting election of the ex. Com member as well as the next hosting venue (2021)there.

As the current President of WFITN and on behalf of the exec. Committee, we thank you all for your continuing support and intention to collaborate with WFITN. We are looking forward to welcoming all of you very soon in the beautiful city of Budapest, Hungary for our 14th Congress of WFITN during 16th–19th October 2017.

Best wishes to all,

Professor Sirintara PONGPECH Singhara, M.D.
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Karel TERBRUGGE  Editor-in-Chief, Interventional Neuroradiology

WFITN Secretariat
The Information Desk of WFITN’s Secretariat will be available throughout the Congress to provide information about WFITN, membership, new applications, INR Journal, payment of membership fee (etc.) during the congress.

Sabine Heckmann
WFITN Secretariat
Email: secretary@wfitn.org
Phone: +49 171 261 6661
web: www.wfitn.org
WFITN 2017 14th Meeting
Budapest, Hungary, 2017 October 16 - 19

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Ministry of Human Capacities (EMMI), Hungary

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National Institute of Clinical Neurosciences, Hungary

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Cindy SADIKIN - Indonesia
Nobuyuki SAKAI - Japan
PROGRAM AT A GLANCE

Sunday (October 15.)

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<td>Back to the basics Thrombosis and antithrombotic treatment</td>
<td>Back to the basics Clinician-scientist collaboration to improve the efficacy of science</td>
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<td>08:30 – 13:00 Symposium for nurses, technicians and radiographers in cooperation with ESMINT</td>
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Monday (October 16) - Stroke

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Tuesday (October 17) - Stroke & Spine

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<tr>
<td>07.15-08.00</td>
<td>Back to the basics Spine: pain and percutaneous treatment</td>
<td>Back to the basics Non-atherosclerotic cerebral vascular disease: adults and children</td>
<td>Back to the basics Thrombectomy: how to choose patients and techniques</td>
<td>Plenary Session 3 Stroke care organization</td>
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<td>10.55-12.15</td>
<td>Plenary Session 4 Non-embolic stroke</td>
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<td>14.00-15.45</td>
<td>Parallel abstract Session AVM: Development and pathology</td>
<td>Parallel abstract Session AVM Embolization techniques</td>
<td>Parallel abstract Session AVM: arterial and venous embolization</td>
<td>Parallel abstract Session DAVF Aneurysm research</td>
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<td>16.30-18.00</td>
<td>Plenary Session 5A Minimally invasive spine treatment</td>
<td>Plenary Session 5B Pediatric neurointerventions: acute stroke in children</td>
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<tbody>
<tr>
<td>07:15-08:00</td>
<td>Back to the basics AVM: evolution and elimination</td>
<td>Back to the basics DAVF: evolution and occlusion</td>
<td>Back to the basics The invisible factor: aneurysm wall</td>
<td>Back to the basics The slimy enemy: vasospasm</td>
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<td>08:00-08:35</td>
<td>Plenary Session 6. AVM research</td>
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<td>08:30 – 13:00 Symposium for Nurses, Technicians and Radiographers in cooperation with ESMINT</td>
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<td>08:35-10:15</td>
<td>Plenary Session 7. AVM embolisation</td>
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<td>10:45-11:15</td>
<td>Plenary Session 8. Memorial Lecture</td>
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<td>Hands on course for nurses, technicians and radiographers</td>
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<td>11:15-12:15</td>
<td>Plenary Session 9. The human factor...</td>
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<td>16:45-17:05</td>
<td>Plenary Session 10. Best papers</td>
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<td>17:05-17:45</td>
<td>Plenary Session 11. Expanding the horizon</td>
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### Thursday (October 19): Aneurysm

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<tbody>
<tr>
<td>08:30-10:00</td>
<td>Parallel abstract Session Aneurysm clinical: coil supporting techniques and miscellaneous</td>
<td>Parallel abstract Session Aneurysm clinical: WEB</td>
<td>Parallel abstract Session Aneurysm clinical: aneuplatelet treatment and miscellaneous</td>
<td>Parallel abstract Session Aneurysm clinical: Miscellaneous</td>
<td>Parallel abstract Session Aneurysm clinical: Flow diversion 3</td>
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<td>10:00-10:30</td>
<td>Coffee break</td>
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<td>10:30-11:15</td>
<td>Plenary session 12. Aneurysm biology</td>
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<td>11:15-12:15</td>
<td>Plenary session 13. Predicting aneurysm treatment results by simulation</td>
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<td>12:15-13:15</td>
<td>Industry</td>
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<td>13:15-14:15</td>
<td>Lunch break</td>
<td>Poster session</td>
<td>Lunch break</td>
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<td>14:15-16:00</td>
<td>Plenary session 14. Aneurysm: value of different treatment modalities</td>
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<td>16:00</td>
<td>Adjourn &amp; Closing Ceremony</td>
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</table>
Monday, 16th of October: Stroke
Plenary Room, level 2

07:15 – 08:00 Breakfast Seminar
Plenary Room/Monday

Back to the basics: Stroke: epidemiology and imaging
Chairperson: Dániel Bereczki
Semmelweis University, Budapest, Hungary

INV01
Epidemiology of stroke
Csaba Ováry
National Institute of Clinical Neurosciences, Budapest, Hungary

INV02
Ischemic stroke imaging
Rüdiger von Kummer
Universitätsklinikum Carl Gustav Carus, Neuroradiology, Dresden, Germany

08:15 – 10:15 Plenary Session 1.
Plenary Room/Monday

Stroke: What haven’t been learned from the RCT-s
Chairperson: Patrick Brouwer
Karolinska University Hospital, Sweden
Moderators: Rafael Rodriguez Mercado
University of Puerto Rico
Rüdiger von Kummer
Universitätsklinikum Carl Gustav Carus, Neuroradiology, Dresden, Germany

08:15 – 08:20 How would you do this case? Demonstrative case presentation & audience poll

08:20 – 08:35 INV03
Pre-thrombectomy imaging
Mayank Goyal
University of Calgary, Radiology, Calgary, Canada

08:35 – 08:50 Is IVT still needed?
Marc Ribo
Hospital Vall d’Hebron, Neurology, Barcelona, Spain

08:50 – 09:05 Expanding time window & wake up stroke
Tudor Jovin
UPMC Stroke Institute, UPMC Center for Neuroendovascular Therapy, USA

09:05 – 09:20 Alternate thrombectomy techniques: Retrieval versus aspiration
Siddiqui Adnan
SUNY University at Buffalo & Kaleida Health, Buffalo, USA

09:20 – 09:35 Thrombectomy in posterior circulation stroke:
Johannes C. Gerber
University Hospital Carl Gustav Carus Dresden, Neuroradiology, Dresden, Germany

09:35 – 09:45 INV04
Sedation versus general anaesthesia for thrombectomy
9:45 – 10:00  |  INVO5  
| Periprocedural antithrombotic treatment  
| Lucie Thibault  
| Montreal, Canada

10:00 – 10:10  |  Panel discussion

10:10 – 10:15  |  How would you do this case now? Demonstrative case presentation & audience poll

10:15 – 10:30  |  Opening ceremony  
| Plenary Room/Monday

10:30 – 11:00  |  Coffee break

11:00 – 12:15  |  Plenary Session 2.  
| Stroke: Where are we going? Ongoing research  
| Chairperson: Jan Gralla  
| Inselspital, University Hospital, Berne, University Institute of Diagnostic and Interventional Neuroradiology, Bern, Switzerland  
| Moderators: Orlando Diaz  
| The Houston Methodist Hospital, USA  
| Akira Ishii  
| Kyoto University, Japan

11:00 – 11:15  |  Progress of the international clot research project:  
| Simon De Meyer  
| KU Leuven Kulak Campus Kortrijk, Kortrijk, Belgium

11:15 – 11:30  |  INVO6  
| New recanalization techniques  
| Matthew J. Gounis  
| University of Massachusetts Medical School, Radiology, Worcester, USA

11:30 – 11:45  |  Neuroprotective bridging and endovascular treatment beyond recanalization: hyperoxygenation and intra-arterial cooling  
| Sven Poli  
| Deptartment of Neurology & Stroke, Hertie Institute for Clinical Brain Research, University of Tübingen, Germany

11:45 – 12:00  |  Tissue regeneration: intra-arterial stem cell infusion  
| Eva Mezey  
| National Institute of Health, Bethesda, USA

12:00 – 12:15  |  Panel discussion

12:15 – 13:15  |  Industry symposia  
| Plenary Room/Monday

13:15 – 14:15  |  Lunch break

14:15 – 16:00  |  Parallel abstract sessions – Stroke  
| Plenary Room/Monday  
| Moderators: Osama O. Zaidat  
| St Vincent Mercy Medical Center, Toledo, United States  
| Michel Piotin  
| Fondation Rothschild, Interventional Neuroradiology, Paris, France
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</table>
| 14:15 – 14:25| Influence of Balloon, Conventional, or Distal Catheters on Angiographic and Clinical Outcomes in the STRATIS Registry  
| 14:25 – 14:35| Prior IVT in Mechanical Thrombectomy for Acute Ischemic Stroke: Benefit or Not?  
Parra-Farinas Carmen, Tomasello Weitz Alejandro, Cardona Portela Pere, De Miquel Maria Angeles, Gomis Cortina Meritxell, Castaño Duque Carlos, Blasco Jordi, Urra Xavier, Ribó Jacobí Marc |
| 14:35 – 14:45| Safety and Efficacy of the “SOFITAIRE” approach in the Endovascular Treatment of Acute Ischemic Stroke  
Pabon Boris, Jorge Lopez, Díaz Carlos, Vargas Oscar, Torres Victor |
| 14:45 – 14:55| Wireless ADAPT (WADAPT) Thrombectomy  
Miskolczi Laszlo |
| 14:55 – 15:05| Endovascular revascularization with contact aspiration versus stent retriever in acute Ischemic stroke with large vessel occlusion. The ASTER TRIAL  
Piotin Michel, Blanc Raphaël, Gory Benjamin, Labreuche Julien, Marnat Gauthier, Saleme Suzanna, Costalat Vincent, Bracard Serge, Desal Hubert, Consoli Arturo, Lapergue Bertrand |
| 15:05 – 15:15| Correlation of Tmax volumes with clinical outcome in anterior circulation stroke  
Seker Fatih, Pfaff Johannes, Potreck Arne, Mundiyanapurath Sibu, Ringleb Peter A., Bendszus Martin, Möhlenbruch Markus A. |
| 15:15 – 15:25| Impact of vertebral patency and anatomy on reperfusion success of mechanical thrombectomy in acute basilar artery occlusions: Do we need contralateral flow-arrest?  
Boeckh-Behrens Tobias, Prothmann Sascha, Pree David, Zimmer Claus, Wunderlich Silke, Kaesmacher Johannes |
| 15:25 – 15:35| Y-configuration double-stent thrombectomy for acute intracranial bifurcation occlusion refractory to conventional thrombectomy  
Li Zifu |
| 15:35 – 15:45| Safety and efficacy of the “Push and fluff” technique for Trevo deployment: comparison with standard unsheathing technique  
Limbucci Nicola, Nappini Sergio, Renieri Leonardo, Rosi Andrea, Laiso Antonio, Widerk Andrea, Consoli Arturo, Mangiafico Salvatore |
| 15:45 – 15:55| Mechanical thrombectomy with microcatheter for distal occlusion  
Park Bumsoo, Kwon Hyon-Jo, Koh Hyeon-Song |
| 16:00 – 16:15| Parallel Industry symposia  
Plenary Room/Monday |
| 16:15 – 16:45| Coffee break  
Plenary Room/Monday |
| 16:45 – 18:35| Parallel abstract sessions – Stroke  
Plenary Room/Monday |
Moderators: Delgado Almandoz Josser
Abbott Northwestern Hospital, Neurointerventional Radiology, Minneapolis, USA
Mansour Ossama
Alexandria University Hospital, Stroke and Neuroendovascular unit, Alexandria, Egypt

16:45 – 16:55 011 Endovascular recanalization of proximal ICA occlusion in acute ischemic stroke: the stylet-balloon technique
Vajda Zsolt, Nagy Csaba, Balogh Gábor, Radnai Péter, Repa Imre, Nagy Ferenc

16:55 – 17:05 012 Tips and techniques for optimal stentriever placement in mechanical thrombectomy: The longer is better?
Kang Jongsoo, Shim Dong-Hyun, Roh Jieun, Yeom Jeong A, Jeong Hae Woong, Kim Young Soo, Baik Seung Kug

17:05 – 17:15 013 Clinical and Cost Effectiveness of Using Evolving ACE Reperfusion Catheters as First-line Treatment of Acute Ischemic Stroke Due to Large Vessel Occlusions
Kayen Yasha, Delgado Almandoz Josser E, Young Mark L, Fease Jennifer L, Scholz Jill M, Mulder Maximilian, Wallace Adam N, Tarrel Ronald M

17:15 – 17:25 014 A direct aspiration first-pass technique (ADAPT) versus stentriever thrombectomy in emergent large vessel intracranial occlusions

17:25 – 17:35 015 Frontline Therapy with the ACE Reperfusion Catheters in an Acute Ischemic Stroke Cohort
Delgado Almandoz Josser, Kayen Yasha, Young Mark, Fease Jennifer, Scholz Jill, Milner Anna, Roohani Pezhman, Hehr Timothy, Mulder Maximilian, Wallace Aaron, Tarrel Ronald

17:35 – 17:45 017 Role of different imaging modalities in acute ICA occlusion: A comparative study to endovascular catheterization in 65 patients
El Mekabyt Amgad, Hao Qing, Cheng-Ching Esteban, Hussain Shazam, Spiotta Alejandro, Hui Ferdinand

17:45 – 17:55 018 Thrombectomy with or without stenting of concurrent extracranial carotid disease
Nico Lorena, Yu Chen Bing, Stapf Christian, Poppe Alexandre, Kotowski Marc, Odier Celine, Deschaintre Yan, Roy Daniel, Giccia Laura, Raymond Jean, Jacquin Gregory, Daeault Nicole, Weill Alain

17:55 – 18:05 019 Direct aspiration first pass technique versus stent-retriever thrombectomy in acute basilar artery occlusion—Single center experience in 34 cases
Mansour Ossama, Hassan Tamer

18:05 – 18:15 020 Experimental evaluation of large bore aspiration catheters performance for endovascular treatment of acute ischemic stroke
Bernava Gianmarco, Pellaton Alain, Yilmaz Hasan, Brina Olivier, Muster Michel, Erceg Gorislav, Lövblad Karl-Olof, Machi Paolo

18:15 – 18:25 021 Permanent placement of self-expandable stent after refractory to recanalization with stent retriever thrombectomy in acute stroke
Ihm Eun Hyun, Lee Hyuk Gee, Woo Hyun Jin, Seo Ye Young

18:25 – 18:35 022
Contrast extravasation during thrombectomy for acute ischemic stroke: incidence, endovascular management and clinical outcome
Kotowski Marc, Nico Lorena, Weill Alain, Raymond Jean, Roy Daniel

19:30 Welcome reception Hotel InterContinental Budapest

Session Room 1, level Monday

07:15 – 08:00 Breakfast Seminar Session Room 1/Monday
Back to the basics: Thrombosis and antithrombotic treatment
Chairperson: László Szapáry
University of Pécs, Department of Neurology, Hungary

INV07
Clotting mechanisms related to embolic stroke
Krasimir Kolev
Semmelweis University, Budapest, Hungary

INV08
Clinical pharmacology of antithrombotic drugs
Lucie Thibault
Montreal, Canada

14:15 – 16:00 Parallel abstract sessions – Stroke Session Room 1/Monday
Moderators: Killer-Oberpfalzer Monika
University Hospital Salzburg, Austria
Berentei Zsolt
National Institute of Clinical Neurosciences, Budapest, Hungary

14:15 – 14:25 023
The value of perfusion CT as a prognostic factor after mechanical thrombectomy in anterior circulation large vessel occlusion patients
Jang Kyung-Sool, Moon Byung-Hoo, Park Sang-Kyu, Jang Dong-Kyu, Han Young-Min, Cho Byung-Rae

14:25 – 14:35 024
Utilization of acute vascular imaging and neurorintervention for acute ischemic stroke patients among 20 out of 39 Hungarian stroke centers

14:35 – 14:45 025
Reduced cerebral DWI lesions after carotid artery stenting with the Casper Device
Killer-Oberpfalzer Monika, Müller-Thies Broussalis Erasmia, Mutzenbach Sebastian J

14:45 – 14:55 026
Stroke protocol performed multiphase CT angiography: correlation between the CT results and the clinical outcome in case of endovascular treatment
Pozsár Kinga, Kiss Máté, Gati Georgia, Vadász Ágnes, Kis Balázs, Martos János, Szikora István
14:55 – 15:05 027
Findings and Clinical Usefulness of the C-arm CT (Xper) after Mechanical Thrombectomy of Acute Occlusion of the Anterior Circulation
Rho M.H., Chung E.C, Hong H.P

15:05 – 15:15 028
Diagnostic accuracy of 3D black blood MR imaging with high resolution T1 SPACE in the evaluation of intracranial arterial thrombosis
Al-Smadi Anas, Shokufar Tahaamin, Hurley Michael, Potts Mathew, Jahromi Baback, Shaibani Ali, Ansari Sameer

15:15 – 15:25 029
Value of Cone Beam CT in post-thrombectomy evaluation of acute stroke patients
VadáSZ Ágnes, Machovits Ágnes, Várallyay Péter, Berentei Zsolt, Gubucz Istvan, Nardai Sándor, Vajda Zsolt, Szikora István

15:25 – 15:35 030
Relation between infarct volume and location and 90 day functional outcome after acute ischemic stroke in pooled analysis of recent endovascular trials

15:35 – 15:45 031
Imaging in patients with chronic ICA occlusion for bypass surgery triage by BOLD-fMRI using apnoe in comparison with computed tomography perfusion
Horvath-Rizea Diana

15:45 -15:55 032
Endovascular therapy of acute ischemic stroke in clinical practice: results from the MR CLEAN Registry

16:00 – 16:15 Parallel Industry symposia
Session Room 1/Monday

16:15 – 16:45 Coffee break

16:45 – 18:35 Parallel abstract sessions – Stroke
Session Room 1/Monday
Moderators: Donald Frei
Swedish Medical Center, Englewood, USA
Ota Takahiro
Tokyo Metropolitan Tama Medical Center, Neurosurgery, Japan

16:45 – 16:55 033
ASPECTS 8-10 Patients Demonstrate Similar Clinical Outcomes from Thrombectomy with the 3D Revascularization Device vs Solitaire

16:55 – 17:05 034
Endovascular thrombectomy in patients with wake-up stroke or unknown symptom onset
Bücke Philipp, Aguilar Pérez Marta, Hellstern Victoria, Serna Candel Carmen, AlMatter Muhammad, Bhogal Pervinder, Bänzer Hansjörg, Henkes Hans
<table>
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<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
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<tbody>
<tr>
<td>17:05 – 17:15</td>
<td>035</td>
<td>Efficacy of endovascular thrombectomy with onset-to-puncture time less than three hours</td>
<td>Ota Takahiro, Nishiyama Yasuhiro, Koizumi Satoshi, Saito Tomohiro, Ueda Masayuki</td>
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<td>17:15 – 17:25</td>
<td>036</td>
<td>Impact of Chronic Comorbidities on Endovascular Thrombectomy</td>
<td>Park Sea Mi, Rosengart Axel</td>
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<td>17:25 – 17:35</td>
<td>037</td>
<td>Mechanical thrombectomy for in-hospital ischemic stroke</td>
<td>Kojima Takao, Ohta Keisuke, Asai Takumi, Uematsu Takashi, Yasui Keizo, Seki Yukio, Saito Kiyoshi</td>
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<td>17:35 – 17:45</td>
<td>038</td>
<td>Large intracranial vessel occlusion, IV thrombolysis, recanalization confirmed by DSA for intended but not required mTE: the clinical outcome</td>
<td>Serna Candel Carmen, Aguilar Pérez Marta, Al Matter Muhammad, Hellstern Victoria, Bhogal Paul, Bänzner Hansjörg, Henkes Hans</td>
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<td>17:45 – 17:55</td>
<td>039</td>
<td>Contralateral carotid artery stenosis is a predictor of a poor clinical outcome after mechanical thrombectomy and acute carotid stenting in patients with anterior tandem occlusion</td>
<td>Maus Volker, Behme Daniel, Kabbasch Christoph, Borggrefe Jan, Brouwer Patrick, Söderman Michael, Psychogios Marios, Möhlenbruch Markus, Liebig Thomas, Dohmen Christian, Fink Gereon, Mpotsaris Anastasios</td>
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<td>17:55 – 18:05</td>
<td>040</td>
<td>Mechanical Thrombectomy in Perioperative Strokes: A Case Control Study</td>
<td>Premat Kévin, Shotar Eimad, Bartolini Bruno, Di Maria Federico, Pistocchi Silvia, Sourour Nader, Clarençon Frédéric</td>
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<td>18:05 – 18:15</td>
<td>041</td>
<td>Late recanalization of basilar artery occlusion in a previously healthy 17 month-old child</td>
<td>Wilkinson D. Andrew, Chaudhary Neeraj, Pandey Aditya S., Savastano Luis, Griaudze Julius, Gemmete Joseph J.</td>
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<td>18:15 – 18:25</td>
<td>042</td>
<td>Long term results of stent-assisted coiling for ruptured intracranial vertebral artery dissections</td>
<td>Nakazawa Takuya, Tsuji Atsushi, Yokoi Toshihiro, Yoshimura Yayoi, Ysuji Keiichi, Nozaki Kazuhiro</td>
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**Session Room 2, level 4.**

**Monday**

**07:15 – 08:00** Breakfast Seminar

Back to the basics: How to improve the efficacy of science? Fertilizing the field of research by clinician-scientist collaboration

Chairpersons: György Paál, Budapest University of Technology and Economics, Department of Hydrodynamic Systems, Budapest, Hungary

Juhana Frösen, Kuopio University Hospital, Neurosurgery, Kuopio, Finland

15 years of translational aneurysm research – lesson learned and caveats to be avoided

Juhana Frösen, Kuopio University Hospital, Neurosurgery, Kuopio, Finland
Over 10 years of collaboration in aneurysms research
Gábor Janiga
University of Magdeburg, Laboratory of Fluid Dynamics and Technical Flows, Magdeburg, Germany

Interdisciplinarity at its best: how inanimate flow simulations are filled with life by MDs
György Paál
Budapest University of Technology and Economics, Department of Hydrodynamic Systems, Budapest, Hungary

13:15- 13:45 Poster Session
Session Room 2/Monday
Moderators: László Solymosi
University Hospital Würzburg, Germany
Gustavo Alejandro Foa Torres
Radiology Specialisation, Interventional Neuroradiologist, formel member of CANI
(Argentinian College of Neurointerventionist), Argentina

PP300
MTICI vs TICI scores in an external core-lab validated mechanical thrombectomy population using the same thrombectomy device
Yeo Leonard LL, Mpotasris Anastasios, Holmberg Ake, Söderman Michael, Holmin Staffan, Söderqvist Åsa Kuntze, Ohlsson Marcus, Bhogal Pervinde, Vamsi Gontu, Andersson Tommy, Brouwer Patricius A.

PP301
Utilization of balloon guide catheter improves recanalization rate in mechanical thrombectomy for acute stroke
Kim Byung Moon

PP302
Accuracy and predictive value of reader assessed and machine rated ASPECT scores on non-enhanced CT for mechanical thrombectomy in large vessel occlusion strokes
Kis Balázs, Vadász Ágnes, Gáti Geörgina, Várallyay Péter, Nagy András, Berentei Zsolt, Gubucz István, Nardai Sándor, Szikora István

PP303
Clinical Factors Affecting Cognitive Function after Carotid Revascularization: A Multivariate Analysis
Akioka Naoki, Kashiwazaki Daina, Takaïwa Akiko, Kuwayama Naoya, Kuroda Satoshi

PP304
Effective use of Balloon Guide Catheter in reducing incidence of mechanical thrombectomy related distal embolization
Lee Dong Hoon

PP305
Predictors for intracranial hemorrhage and 3 month mortality after intra-venous or intra-arterial revascularization in acute cerebral artery occlusion
Cho Byung-Rae, Jang Dong-Kyu, Park Sang-Kyu, Moon Byung-Hoo, Jang Kyung-Sool, Han Young-Min

PP306
Randomized assessment of safety and efficacy of intra-arterial infusion of autologous stem cells in ischemic stroke
Gupta Vivek, Bhatia Vikas, Dheeraj Khurana, Sharma R. R., Khandelwal N.

PP307
The consideration of the risk factors and the frequency of ocular symptoms accompanied with ruptured vertebral artery dissecting aneurysm
Withdrawn
Moteki Yosuke, Niimi Yasunari, Sato Shinsuke, Inoue Tatsuya, Kuwamoto Kentaro, Shima Shogô, Okada Yoshikazu

PP308
A low cost nextgen Telemedicine in Stroke Treatment with Smartphone
Takao Hiroyuki, Sakai Kenichiro, Yuki Ichiro, Ishibashi Toshihiro, Mitsumura Hidetaka, Terasawa Yuka, Iguchi Yasuyuki, Murayama Yuichi

13:45 – 14:15
Lunch break

14:15 – 15:45 Parallel abstract session – Stroke Session Room 2/Monday
Moderators: Johannes A. R. Pfaff Heidelberg University Hospital, Neuroradiology, Heidelberg, Germany
Anant Patel Icahn School of Medicine at Mount Sinai, Neuroradiology, New York, USA

14:15 – 14:25 044
Fesability, efficacy and safety of tromboaspiration technique in the endovascular treatment of acute ischemic stroke: comparison between data from RITA Italian registry and Mr. Clean trial
Romano Daniele G., Casseri Tommaso, Pero Guglielmo, Comai Alessio, Pampana Enrico, Stecco Alessandro, Causin Francescò, Paolucci Aldo, Vinci Sergio, Giorgianni Andrea, Giancì Giuseppe, Simonetti Luigi, Cioni Samuele, Bracco Sandra

14:25 – 14:35 045
Comparison of Stent Retriever and Contact Aspiration for Treatment of Acute Stroke in the Community Hospital Setting: Retrospective Analysis of 115 Cases
Leesch Wolfgang, Bazemore Christopher, Ramakrishnan Pankajavalli, Sanderson Frank

14:35 – 14:45 046
Fesability, safety and efficacy of direct tromboaspiration technique in acute ischemic stroke due to M2 segment occlusion: a retrospective multicenter study from Italian RITA registry
Romano Daniele G., Casseri Tommaso, Pero Guglielmo, Comai Alessio, Pampana Enrico, Stecco Alessandro, Causin Francescò, Paolucci Aldo, Vinci Sergio, Giorgianni Andrea, Giancì Giuseppe, Simonetti Luigi, Cioni Samuele, Bracco Sandra

14:45 – 14:55 047
The influence of conscious sedation vs. general anesthesia for mechanical thrombectomy on interventional workflow in a randomized trial – a post-hoc analysis of the SIESTA trial
Pfaff Johannes A. R., Schönenberger Silvia, Nagel Simon, Ringleb Peter A., Hacke Werner, Bendszus Martin, Bösel Julian, Mohlenbruch Markus A.

14:55 – 15:05 048
The Role of the Lenticulostriate Arteries in the Development of Basal Ganglia Infarction in Patients with an Acute M1 Occlusion Treated with Thrombectomy
Khumtong Rujimas, Schaafsma Joanna, Krings Timo

049
Preischemic Neuroprotective Effect of Minocycline and Sodium Ozagrel on Transient Cerebral Ischemic Rat Model
Park Sang Kyu, Song Myeong Soo

15:05 – 15:15 050
Work flow in a comprehensive stroke center: Results of a first referral program quality database in Istanbul
Koyuncu Bahar, Poor Mohammed Reza, Harabati Hulya, Kelleci Umit, Geyik Serdar, Tolun Reha, Krespi Yakup

15:15 – 15:25 051
Acute stroke management using image sharing on smart phones and tablet devices
15:25 – 15:35 052
Stent anchor with Mobile AspiRation Technique (SMART) for treating cerebral venous sinus thrombosis in high risk patients
Patel Anant, Oxley Thomas, Fifi Johanna, Sobotka Stanislaw, Mocco J, Berenstein Alejandro, De Leacy Reade

15:35 – 15:45 053
Endovascular management of intracranial sinus thrombosis
Hellstern Victoria, Aguilar-Perez MArta, AlMatter Mohammad, Bhogal Paul, Henkes Hans

16:00 – 16:15 Parallel Industry symposia
Session Room 2/Monday

16:15 – 16:45 Coffee break

16:45 – 18:35 Parallel abstract session – Stroke
Session Room 2/Monday
Moderators: Sugiu Kenji
Okayama University, Neurological Surgery, Okayama, Japan
Sa´ndor Nardai
National Institute of Clinical Neurosciences, Neurointerventions, Budapest, Hungary

16:45 – 16:55 054
Cerebrovascular drug eluting stent vs bare metal stent in the treatment of vertebral artery stenosis: a prospective randomized controlled clinical trial
He Yingkun, Li Tianxiao

16:55 – 17:05 055
Detailed analysis regarding cerebral hyperperfusion syndrome in patients scheduled for staged angioplasty in a retrospective, Japanese multicenter study
Hayakawa Mikito, Sugiu Kenji, Yoshimura Shinichi, Hishikawa Tomohito, Yamagami Hiroshi, Sakai Nobuyuki, Iihara Koji, Ogasawara Kuniaki, Oishi Hidenori, Ito Yasushi, Matsumaru Yuji

17:05 – 17:15 056
The Revised method of Angioplasty with Wingspan stent in Angioplasty for ICAS: Poststent Ballooning
You Seung Hoon, Su Hee Cho, Ku Hyun Yang, Woo Young Jang, Moon Kyu Kim, Kwang Deog Jo

17:15 – 17:25 057
Use of angioscopy for intravascular assessment of plaque protrusion after carotid artery stenting
Enomoto Yukiko, Kawasaki Masanori, Egashira Yusuke, Yamauchi Keita, Iwama Toru

17:25 – 17:35 058
Stent placement for internal carotid artery stenosis at the skull base
Tsuneoka Haruka, Naito Isao, Aihara Masanori, Tomita Yousuke, Shimizu Tatsuya, Kano Tadashige, Asakura Ken, Miyamoto Naoko, Yoshimoto Yuhei

17:35 – 17:45 059
30 Day Results from Revascularization of Extracranial Carotid Artery Stenosis (RECAS) in China Mainland: a Prospective Cohort Trial
Yang Bin, Ma Yan, Gao Peng, Wang Yabing, Chen Yanfei, Zhu Fengshui, Jiao Liqun, Ling Feng

17:45 – 17:55 060
Clinical Analysis Comparing Efficacy between a Distal Filter Protection Device and Proximal Balloon Occlusion Device during Carotid Artery Stenting
Chung Seung Young, Chang Se Hun, Park Moon Sun
Improved Clinical Outcome of Carotid Artery Stenting by Adequate Use of Tailored CAS and CEA in Elderly Patients
Morimoto Masafumi

Endovascular revascularization of chronic complete occlusion of the internal carotid artery
Nemoto Shigeru, Namba Katsunari, Shojima Masaaki, Yoshino Yoshikazu

Use of Casper stent in internal carotid artery angioplasty
Haas Leandro Jose, Della Giustina Evelyn, Moura Borille Thais, Piquet Sarmento Marina, Tozzi Marques Natalia, Ahmad Omar Omar, Scramocin Thaize Regina, Saori Tulida Letícia, Sartori Felipe, Camilo Liz Caroline, Lindner Stéphanie, De Lara Danielle

Potential of new generation double-layer micromesh stent for carotid artery stenting in patients with unstable plaque – A preliminary result using OFDI analysis
Yoshimura Shinichi, Shirakawa Manabu, Uchida Kazutaka, Yamada Kiyofumi, Miura Kazutomo

Session Room 3, level 4.
Monday

Parallel abstract sessions – Stroke

Impact of Mechanical Thrombectomy Device on Thrombus Histology in Acute Embolic Stroke
Horie Nobutaka, Morofuji Yoichi, Sadakata Eisaku, Yohei Tateishi, Izumo Tsuyoshi, Anda Takeo, Morikawa Minoru, Tsujino Akira, Matsuo Takayuki

Relationship between density of thrombus on admission CT scan and recanalization grade in mechanical thrombectomy with stent retrievers
Correia Manuel A. A., Mendonça Mário M, Raposo Francisco, Guerreiro Carla, Teotonio Pedro, Basílio Gonçalo, Caldeira Inês, Sequeira Paulo, Biscoito Luisa, Neto Lia L, Campos Jorge

Analysis by various methods of retrieved cerebral thrombi in acute ischemic stroke
Yoon ChangHyo, Park Ji Young, Lee Eun Hye, Kim Young Soo, Park Min-Gyu, Park Kyung-Pil, Yeom Jeong A, Roh Jieun, Baik Seung Kug

Impact of clot composition on efficacy of stent thrombectomy
Nagy András, Reiniger Lilla, Rajnai Hajnalka, Vadász Ágnes, Szikora István

Penetration depth of stent retrievers into clots is highly dependent on stent design
Lamprecht Sophie, Jansen Olav, Riedel Christian

Interaction between the stent strut and thrombus as characterized by contrast-enhanced high-resolution cone-beam computed tomography during deployment of the Solitaire stent retriever
Tsumoto Tomoyuki, Kurogi Ryota, Miyazaki Yuichi
072 Inter MRI machines agreement for the susceptibility vessel sign to predict in vitro thrombi composition
Bourcier Romain, Detraz Lili, Serfaty Jean Michel, Naggara Olivier, Desal Hubert, Toquet Claire

073 Endovascular venous sinus pressure measurements under conscious sedation and general anesthesia in idiopathic intracranial hypertension
El Mekabaty Amgad, Obusez Emmanuel, Chung Charlotte, Luciano Mark, Hui Ferdinand

074 Effect of venous sinus stenting on CSF opening pressure in patients with Idiopathic Intracranial Hypertension
Patsalides Athos, Wilcox Jessica, Boddu Srikanth, Brown Kenroy, Oliveira Cristiano, Dinkin Marc

075 A Case of Stent Placement for Intracranial Hypertension Associated with Venous Sinus Stenosis
Yamaguchi Rei

16:45 – 18:45 Parallel abstract sessions – Miscellaneous
Moderators: Wickly Lee
National Neuroscience Institute of Singapore, Department of Neuroradiology, Singapore
Jiao Liqun
Xuanwu Hospital, Neurosurgery, Beijing, China

076 Hybrid operations for the treatment of refractory vertebrobasilar insufficiencies
Lu Xia, Ma Yan, Yang Bin, Gao Peng, Wang Yabing, Jiao Liqun, Ling Feng

077 Safety and Efficacy of Transradial Neuroangiography and Intervention in Multiple Scenarios: Medellín Experience
Pabon Boris, Vargas Oscar, Torres Victor, Diaz Carlos, Lopez Jorge

078 Image Quality of Low Dose Cerebral Angiography and Effect on Paritient Radiation Dose in Management of Intracranial Aneurysm
Choi Jun-Sung, Kim Bum-Soo, Im Sang Hyuk, Choi Jae Ho, Song Ji Hye, Shin Yong Sam

079 Monoplane 3D Overlay Roadmap versus Conventional Biplane 2D Roadmap Technique for Neurointerventional Procedures
Jang Dong-Kyu, Stidd David A., Schafer Sebastian, Chen Michael, Moftakhar Roham, Lopes Demetrius

080 Usefulness of 3D rotational angiogram with MIP slab images for pre-embolization assessment of spinal dural AVFs
Niimi Yasunari, Sato Shinsuke, Inoue Tatsuya, Kuwamoto Kentaro, Moteki Yosuke, Mochizuki Yuichi, Shima Shogo, Mochizuki Tatsuya, Okada Yoshikazu, Matsui Mizuko

081 Role of 320-row subtracted dynamic volume CT venography in evaluating transverse sinus stent patency in patients with idiopathic intracranial hypertension
El Mekabaty Amgad, Solomon David, Moghekar Abhay, Gailloud Philippe
Utility of Arterial Spin Labelling 3.0-T Perfusion MR Imaging in Diagnosis of Dural Arteriovenous Fistula
Miyamoto Michiyuki, Ushikoshi Satoshi, Ito Akihiro, Yamada So, Yamane Fumitaka, Matsuno Akira

Percutaneous Sclerotherapy of Head and Neck Low Flow Vascular Malformations
Lucas-Neto Lia, Sequeira Paulo, Biscoito Luisa, Basílio Gonçalo, Teotônio Pedro, Correia Manuel, Campos Jorge

Small head and neck AVMs treated with preoperative embolization and surgery
Niimi Yasunari, Sato Shinsuke, Inoue Tatsuya, Kuwamoto Kentaro, Moteki Yosuke, Mochizuki Yuichi, Shima Shogo, Mochizuki Tatsuya, Okada Yoshikazu

Utilization of retrograde approach for various neuroendovascular procedures
Ito Yasushi, Hasegawa Hitoshi, Kikuchi Bumpei, Kitazawa Keiko, Sato Keisuke, Fujii Yukihiro

Endovascular embolization of hypervascular tumors of the skull base with Onyx using two-luminal DMSO-compatible balloon-catheter
Petrov Andrey

Mid-term results of bioresorbable vascular scaffolds in interventional neuroradiology
Arat Anil, Akmangit Ilkay, Daglioglu Ergun

Session Room 4, level 5. Monday

Symposium for nurses, technicians and radiographers
in cooperation with ESMINT (detailed program – see page:...)

Parallel abstract sessions – Pediatric neurointerventions
Moderators: Adam Rennie
Great Ormond Street Hospital for Children, London, UK
Fergus Robertson
Great Ormond Street Hospital for Children, London, UK

Course and outcome of post-neonatal presentations of vein of Galen malformation
Kanagarajah Lakshmi, Gopalan Vignesh, Schmitt Anne, Lecce Francesca, Toolis Claire, Robertson Fergus, Ganesan Vijeya, Rennie Adam TM

Dural sinus malformation with associated dural arteriovenous fistula: Single centre experience of 11 cases
Robertson Fergus J., Rennie Adam, Izzath Wazim, Ganesan Vijeya

Safety and Outcome of combined Endovascular and Surgical Management of Low Grade Cerebral Arteriovenous Malformations in Children compared to Surgery Alone
Al-Smadi Anas, Shokuhfar Tahaamin, Malani Aresha, Hurley Michael, Ansari Sameer, Shaibani Ali

10 Year Experience of Paediatric Aneurysm Treatment in a National Paediatric Centre
Schmitt Anne J, Lakshmi Kanagarajah, Vijeya Ganesan, Sanjay Bhave, Fergus Robertson, Adam Rennie
Intracranial pial arteriovenous fistulae: clinical characteristics, endovascular treatment and outcome
Medhi Gorky, H R Arvinda, Gupta Arun Kumar, Parida Subhendu, Pendharkar Hima, Saini Jitender

The technique of superselective ophtalmic artery chemotherapy (SOAC) for retinoblastoma: the Argentinian experience
Requejo Flavio, Marelli Juan, Ruiz Johnson Agustin, Cuevas David, Sampor Claudia

Paediatric supra-selective intra-arterial chemotherapy (SIAC): safety and efficacy as a salvage therapy in intraocular retinoblastoma
Robertson Fergus J, Rennie Adam, Kanagarajah Lakshmi

Outcomes in neonatal vein of Galen malformation
Rennie Adam TM, Schmitt Anne, Kanagarajah Lakshmi, Lecce Francesca, Toolis Claire, Brew Stefan, Bhattacharya Jo, Heuchan Anne Marie, Robertson Fergus, Ganesan Vijeya

Cerebral aneurysms in pediatric population: a multi-faceted entity
Requejo Flavio, Marelli Juan Manuel, Cuevas Daniel David

Onyx Embolization in Pediatric Neuro-interventional Procedures
Shokuhfra Tahamih, Al-Smadi Anas, Ansari Sameer, Hurley Michael, Jahromi Babak, Shaibani Ali

Spinal epidural arteriovenous fistulas: Clinical features and long-term outcomes of 15 cases
Song Yunsun, Suh Dae Chul

Case Series: Spinal Cord Infarction Due to the Diaphragmatic Crus Syndrome
Deib Gerard, Higginbotham Lenora, Pardo-Villamizar Carlos, Wolinsky Jean-Paul, Gailloud Philippe

Spinal Cord Macrofistulas – A series of 18 cases
Sebastian Leve Joseph Devarajan, Balasundaram Parthiban, Agarwal Himanshu, Garg Ajay, Mishra Nalini K, Gaikwad Shailish B

Endovascular treatment of spinal dural arteriovenous fistulas
Correia Manuel A. A., Basilio Gonçalo, Mendonça Mário M, Raposo Francisco, Neto Lia L, Sequeira Paulo, Biscoito Luisa, Campos Jorge

Novel augmented reality navigation technology with intraoperative 3D cone beam CT imaging in a hybrid operating room: Experience in open and minimally invasive spine surgery
Estimation of the number of feeding arteries of Spinal arteriovenous malformations by using three dimensional-digital subtraction angiography

Takamiya Soichiro, Osanai Toshiya, Seki Toshitaka, Fujima Noriyuki, Sasamori Toru, Hida Kazutoshi, Asano Tsuyoshi, Kawabori Masahito, Hamauchi Shuji, Terasaka Syunsuke, Houkin Kiyohiro

Pre-vertebrectomy arterial supply glue embolisation: relatively easy procedure to wide neurosurgical indications

Comelli Simone, Longo Alessandro, Comelli Chiara, Di Maggio Luca, Boghi Andrea, Savio Daniele, Grognardi Maria Luisa, Griva Federico, Vaudano Giacomo P.

Predictive factors of the management of Spinal cord Arterio-venous fistulas; center experience with literature review

Mansour Ossama, Ahmed Sultan, Hassan Tamer, Ibrahim Tamer

Technical Note: Image Guidance for Percutaneous Vertebroplasty using an Optical see-through head-mounted display (OST-HMD)

Deib Gerard, Johnson Alex, Osgood Gregory, Navab Nassir, Qian Long, Yu Kevin, Andress Sebastian, Unberath Mathias, Hui Ferdinand, Gailloud Philippe

Spinal CT angiography for the detection of feeding level of spinal dural arteriovenous fistulas

Várályay Péter, Berentei Zsolt, Gubucz István, Marosfő i Miklós, Szikora István

Percutaneous ozone nucleolysis for lumbar disc herniation

Mohamed Mohamed Ezeldin Amin, Cirillo Luigi, Dall’olio Massimo, Princiotta Ciro, Leonardi Marco

Tuesday, 17th of October: Stroke & Spine

Plenary Room, level 2

07:15 – 08:00 Breakfast seminar

Back to the basics: Spine: pain and percutaneous treatment
Chairperson: Péter Banczerowski
National Institute of Clinical Neurosciences, Budapest, Hungary

Pathomechanisms of spinal pain
Kieran Murphy
University Health Network, Canada

Percutaneous spinal procedures
Giuseppe Bonaldi
Hospital of Bergamo, Italy

08:00 – 10:25 Plenary session 3.

Stroke care organization
Chairperson: Jens Fiehler
University Medical Center Hamburg-Eppendorf, Germany

Moderators: Marc Ribo
Hospital Vall d’Hebron, Neurology, Barcelona, Spain
Italo Linfante
08:00 – 08:30
**Debate: Stroke care models**

08:00 – 08:10 INVO9
**Drip & ship or Mother ship**
Sónia Abilleira
Health Department of Catalonia, Stroke Programme, Barcelona, Spain

08:10 – 08:20
**Ship the patient or the doctor?**
Johanna Fifi
The Mount Sinai Hospital, Neurology, USA

08:20 – 08:30 INV10
**Impact of different models on treatment efficacy: a simulative technique**
Winston W.K. Chong, Asadi Hamed
Monash Medical Centre, Interventional Neuroradiology, Clayton, Melbourne, Australia

08:30 – 08:45 INV11
**Acute Stroke care in Europe**
Urs Fischer
University Hospital Bern, University of Bern, Department of Neurology, Switzerland

08:45 – 08:55
**Acute Stroke care in North America**
Raul Nogueira
Neuroendovascular Service, Marcus Stroke & Neuroscience Center, Grady Memorial Hospital, USA

08:55 – 09:05 INV12
**Acute Stroke care in Japan**
Nobuyuki Sakai
Department of Neurosurgery, KCGH Comprehensive Stroke Center, Kobe City Medical Center General Hospital, Japan

09:05 – 09:15 INV13
**Acute Stroke care in South-East Asia**
Wickly Lee
National Neuroscience Institute of Singapore, Department of Neuroradiology, Singapore

09:15 – 09:25
**Acute Stroke care in China**
Ling Feng
Department of Neurosurgery, Xuanwu Hospital, China

09:25 – 09:35
**Acute Stroke care in South America**
Lautaro Badilla
Clinica Santa Maria, Chile

09:35 – 09:45 INV14
**Acute Stroke care in Africa**
Allan Taylor
University of Cape Town, Neurosurgery, Cape Town, South Africa

09:45 – 09:55
**Acute Stroke care in Australia**
Peter Mitchell
The Royal Melbourne Hospital, University of Melbourne Radiology, Parkville, Australia

09:55 – 10:00
**Panel discussion**

10:00 – 10:20
**Debate: Who should run the show?**
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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| 10:00 – 10:10 | **Do you need help? Train the cardiologist**                          | **Adnan Siddiqui**  
*Neurosurgical Stroke Service, Kaleida Health, USA*                      |
|              | 10:10 – 10:20 **Do you need help? Train more neurointerventionists**   | **Shelley Renowden**  
*North Bristol NHS Trust, Southmead Hospital, UK Neuroradiology, Bristol, United Kingdom* |
| 10:20 – 10:25 | **Panel discussion**                                                   |                                                                          |
| 10:25 – 10:55 | **Coffee break**                                                       |                                                                          |
| **10:55 – 12:15** |   **Plenary Session 4.**     **Non-embolic stroke**                     | **Plenary Room/Tuesday**   
Chairperson: **Martin Bendzus**  
*Heidelberg University Hospital, Germany*  
Moderators: **Dae Chul Suh**  
*Asian Medical Center, Republic of Korea*  
**Cuong Tran Chi**  
*University of Medicine and Pharmacy, Ho Chi Minh, Vietnam* |
| 10:55 – 11:35 | **Revisiting intracranial stenting**                                   |                                                                          |
|              | 10:55 – 11:10 **Intracranial stenting in EU**                          | **René Chapot**  
*Alfried Krupp Hospital in Essen-Ruettenscheid, Department of Radiology and Neuroradiology, Germany* |
|              | 11:10 – 11:25 **Intracranial stenting in Asia**                        | **Jiao Liquan**  
*China* |
|              | 11:25 – 11:35 **Panel discussion**                                      |                                                                          |
| 11:35 – 12:15 | **Sinus disease**                                                      |                                                                          |
|              | 11:35 – 11:50 **Sinus thrombosis: the role of endovascular treatment** | **Jan Gralla**  
*Inselspital, University Hospital, Berne, University Institute of Diagnostic and Interventional Neuroradiology, Bern, Switzerland* |
|              | 11:50 – 12:05 **INV15**  **Sinus stenosis: should it be treated endovascularly?** | **Fergus J. Robertson**  
*National Hospital for Neurosurgery and Great Ormond Street Hospital for Children, London, United Kingdom* |
|              | 12:05 – 12:15 **Panel discussion**                                      |                                                                          |
| 12:15 – 13:15 | **Industry symposia**                                                  | **Plenary Room/Tuesday**                                                                 |
|              | 13:15 – 14:00 **Lunch break**                                           |                                                                          |
| 14:00 – 15:40 | **Parallel abstract session**                                          | **Plenary Room/Tuesday**                                                                 |
|              | **AVM: Development and pathology**                                     |                                                                          |
|              | **Moderators:** **Felipe Albuquerque**  
*Barrow Neurological Institute, Neurosurgery, Phoenix, USA*  
**Miyachi Shigeru**  
*Aichi Medical University, Neuroendovascular Center, Nagakute, Japan* |                                                                          |
### Scientific Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>14:00 - 14:10</td>
<td>Developmental considerations in Brain AVM</td>
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<tr>
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<td>de Miquel Maria A, Mirapeix Rosa, Aixut Sonia, Lüttich Alex, Aja Lucia, Barranco Roger, Chirife Oscar</td>
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<tr>
<td>14:10 - 14:20</td>
<td>Embryological consideration of dural arteriovenous fistulas</td>
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<td>Tanaka Michihiro</td>
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<td>14:20 - 14:30</td>
<td>Angioarchitecture of arteriovenous fistulas at the cranio cervical junction: a multicenter cohort study of 54 patients</td>
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<td>Sugiu Kenji, Hiramatsu Masafumi, Ishiguro Tomoya, Kiyosue Hiro, Kiyosue Hiro, Sato Kenichi, Takai Keisuke, Niimi Yasunari, Matsumaru Yuji</td>
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<tr>
<td>14:30 - 14:40</td>
<td>Microvascular anatomy of spinal dural arteriovenous fistulas: arteriovenous connections and their relationships with the dura mater</td>
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<td>Takai Keisuke, Komori Takashi, Saito Nobuhito, Taniguchi Makoto</td>
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<tr>
<td>14:40 - 14:50</td>
<td>A Multi-Institutional Analysis of the Untreated Course of Cerebral Dural Arteriovenous Fistulas</td>
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<td>Albuquerque Felipe, Gross Bradley A, Jankowitz Brian T</td>
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<td>14:50 - 15:00</td>
<td>Modified classification of spinal dural arteriovenous fistula new concept of subtype based on the location of shunt point</td>
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<td>Miyachi Shigeru, Matsuo Naoki, Kawaguchi Reo, Ohnishi Hiroyuki, Hiramatsu Ryo, Takayasu Masakazu</td>
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<tr>
<td>15:00 - 15:10</td>
<td>Demographic and Angioarchitectural features predictive of Brain Arteriovenous Malformations Seizures in Kwazulu-Natal, South Africa</td>
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<td>Motebejane Mogwale Samson, Harrichandparsad Rohen, Royston Duncan, Kabera Gaetan, Kaminsky Ian, Choi In Sup</td>
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<tr>
<td>15:10 - 15:20</td>
<td>Demographic and Angioarchitectural features predictive of Brain Arteriovenous Malformations hemorrhage in Kwazulu-Natal, South Africa</td>
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<td>Motebejane Mogwale Samson, Harrichandparsad Rohen, Royston Duncan, Kabera Gaetan, Kaminsky Ian, Choi In Sup</td>
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<tr>
<td>15:20 - 15:30</td>
<td>Venous analysis in posterior Fossa AVM presenting with hemorrhage</td>
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<td>de Miquel Maria A, Lüttich Alex, Barranco Roger, Aja Lucia, Aixut Sonia, Chirife Oscar, Siddiqui Aslam, Jenkins Sarah, Corbally Conal</td>
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<tr>
<td>15:30 - 15:40</td>
<td>A novel method determining the annual risk for hemorrhage in unruptured brain arteriovenous malformations</td>
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<td>15:45 - 16:00</td>
<td>Parallel Industry symposia</td>
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<td>16:00 - 16:30</td>
<td>Coffee break</td>
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<td>16:30 - 18:00</td>
<td>Parallel Plenary session S/A</td>
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<td>Minimally invasive spine treatment</td>
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</tbody>
</table>
16:30 – 16:50
Debate: Vertebroplasty versus vertebral augmentation in porotic disease

16:30 – 16:40 Pro Vertebroplasty
Mary Lee Jensen
University of Virginia School of Medicine, USA

16:40 – 16:50 Pro augmentation
Mario Muto
AORN Cardarelli Hospital, Naples, Italy

16:50 – 17:00 Panel discussion

17:00 – 17:15 Image guided spinal surgery
Luigi Manfre
AOE Cannizzaro Hospital, Catania, Italy

17:15 – 17:30 Percutaneous treatment of spine metastasis
Allan Brook
Interventional Neuroradiology, Montefiore Medical Center, USA

17:30 – 17:45 Percutaneous pain procedures
Kieran Murphy
University Health Network, Canada

17:45 – 18:00 Panel discussion

18:00 – 19:00 WFITN General Assembly
14:10 – 14:20 120 Curative and adjunctive AVM Onyx embolization of AVMs through the choroidal arteries
Lv Xianli, Hu Xiulan, Li Wei, He Hongwei, Jiang Chuhan, Li Youxiang

14:20 – 14:30 121 Contribution of preradiosurgical embolization for AVM may depend on its quality - Japanese registry of Radiosurgery following Embolization for AVM
Miyachi Shigeru, Hiramatsu Ryo, Matsubara Noriaki, Ohnishi Hiroyuki, Izumi Takashi, J-REAL study investigators

14:30 – 14:40 122 Squid Brain Arteriovenous Embolization using the Eclipse Balloon: About 15 patients
Petra Fernando, Larribau Miguel, Stefan Valentin, Stefan Guillermo, Chavez Victor, Aguado Andres

14:40 – 14:50 123 Cerebral AVM: Preliminary Experience with Phil Embolic Material in a Single Center
Pabon Boris, Diaz Carlos, Vargas Oscar, Torres Victor

14:50 – 15:00 124 Preliminary in-vivo experience with the new PHIL LV 25% (Precipitating Hydrophobic Injectable Liquid Low Viscosity) in a swine model
Samaniego Edgar, Burke Thomas H., Sutter Allison, Mehta Ami

15:00 – 15:10 125 The safety and efficacy of two BAVM embolization methods: with Glubran or Onyx
He Xuying

15:10 – 15:20 126 Endovascular AVM embolization using double lumen DMSO-compatible balloon-catheter
Petrov Andrey, Radgabov Said, Ivanov Alexey

15:20 – 15:30 127 Endovascular Treatment of Brain AVMs with the SQUID®
Gál Gyula

15:30 – 15:40 128 Double catheters technique for disconnecting very high flow intracranial arterial venous fistulas
Tran Chi Cuong

16:30 – 18:00 Parallel Plenary session 5/B
Pediatric neurointerventions – Acute Stroke in Children
Chairperson: Darren Orbach
Boston Children’s Hospital/Harvard Medical School, Neurointerventional Radiology, Boston, USA
Moderators: Georges Rodesch
Hopital Foch, France
László Bognár
Neurosurgery Clinic, Debrecen, Hungary

16:30 – 16:35 INV17
Acute Stroke in Children – Framing the Problem
Darren B. Orbach
Boston Children’s Hospital/Harvard Medical School, Neurointerventional Radiology, Boston, USA
16:35 – 17:05  
Large Vessel Occlusion in Children: Natural History and Neurological Overview, Risk vs Benefit  
Gabrielle DeVeber  
Hospital for Sick Children Division of Neurology, Toronto, Canada

17:05 – 17:25  
Imaging Protocols and Age Considerations for Acute Stroke in Children  
Todd Abruzzo  
Departments of Radiology, Neurosurgery, Pediatrics and Biomedical Engineering  
University of Cincinnati and Cincinnati Children’s Hospital Medical Center, USA

17:25 – 17:45  
Technique, Technical Approaches, and Judgement in Acute Stroke in Children  
Timo Krings  
University of Toronto, Neuroradiology, Toronto, Canada

17:45 – 18:00  
Panel discussion and questions

Session Room 2, level 4  
Tuesday

07:15 – 08:00  
Breakfast seminar - Session room 2/Tuesday  
Back to the basics  
Thrombectomy: how to choose patients and techniques  
Chairperson: Péter Barsi  
Semmelweis University, Hungary

INV18  
Patient selection by advanced imaging  
Karl-Olof Lovblad  
Geneva University Hospitals, Diagnostic and Interventional Neuroradiology, Geneva, Switzerland

Device selection  
Paolo Machi  
University Hospital Montpellier, Montpellier, France

13:15 – 13:45  
Poster session  
Session room 2/Tuesday

Moderators: Wickly Lee  
National Neuroscience Institute of Singapore, Department of Neuroradiology, Singapore

PP309  
Patient Radiation Dose from Neuroangiography: Effect of Serial Application of Dose Reduction Protocols  
Kim Bum-Soo, Im Sang Hyuk, Choi Jae Ho, Shin Yong Sam

PP310  
Long-term Results of Angioplasty using Stent-retrievers for Cerebral Vasospasm in SAH  
Kwon HJ, Koh HS

PP311  
Safety of nonprotected carotid artery stenting – a single centre experience  
Gardijan Danilo, Ozretić David, Starčević Katarina, Malojčić Branko, Poljaković Zdravka, Radoš Marko

PP312  
Anterior choroidal artery: anatomical-angiographic analysis  
Pereira Mariano, Navarro Fernando, Villasante Francisco, Moya Hernan, Saguier Fernando, Dorman Matias, Acuña Marcelo, Cecíliano Alejandro

PP313  
Pure N-butyl-cyanoacrylate Treatment for Pediatric Intracranial Nongalenic Pial Arteriovenous Fistulas
Lueangapapong Peerapong, Kobkitsuksakul Chai, Chanthanaphak Ekachat, Jiarakongmun Pakorn, Pongpech Sirintara

Intra-arterial chemotherapy for retinoblastoma: Initial experiences in Hungary
Maka Erika, Csóka Mónika, Szikora István

Dural sinus malformation in newborns: A report of an extremely rare congenital cerebrovascular malformation with favorable endovascular treatment outcome
Chanvanitkulchai Kannachod, Churojana Anchalee, Songsaeng Dittapong, Aurboonyawat Thaweesak, Chankaew Ekawut, Withayasuk Pattarawit, Sangpetngam Boonrerk, Bakin Salinawati

13:45 – 14:00 Lunch break

14:00 – 15:40 Parallel abstract sessions
Session room 2/Tuesday

AVM: arterial and venous embolization
Moderators: James Byrne
University of Oxford, UK
Georghe Rodesh
Hopital Foch, France

14:00 – 14:10 129
Comparison of Predictive Grading Systems for Procedural Risk in Endovascular Treatment of Brain Arteriovenous Malformations – Analysis of 104 Consecutive Patients
Pulli Benjamin, Stapleton Christopher J, Koch Matthew J., Patel Aman B.

14:10 – 14:20 130
Transvenous embolization of cavernous dural arteriovenous fistula via alternative routes instead of the inferior petrosal sinus
Toma Naoki

14:20 – 14:30 131
Advantages and limits of transvenous embolization of brain arteriovenous malformations
Limbucci Nicola, Nappini Sergio, Rosi Andrea, Leone Giuseppe, Renieri Leonardo, Consoli Arturo, Cirelli Carlo, Laiso Antonio, Mangiafico Salvatore

14:30 – 14:40 132
The combination of transarterial and transvenous approach in endovascular treatment of cerebral AVM
Kiselev Vitaly S, Sosnov Alexey O, Perfilev Artem M, Gafurov Rustam R

14:40 – 14:50 133
Outcomes Associated with Treatment of Unruptured Cerebral Arteriovenous Malformations
Tejada Juan G, Riley Kalen

14:50 – 15:00 134
A comparison of clinical outcomes between interventional management and observation in a 7-year review of unruptured brain arteriovenous malformations
Churojana Anchalee, Aurboonyawat Thaweesak, Chatpuwaphat Jitti, Chankaew Ekawut, Withayasuk Pattarawit, Sangpetngam Boonrerk, Songsaeng Dittapong

15:00 – 15:10 135
Perimedullary arteriovenous fistulas: Clinical presentation and imaging findings in regard to flow pattern in 33 patients
El Mekabaty Amgad, Gailloud Philippe
15:10 – 15:20 136
Locating the target for embolization of hemorrhagic spinal arteriovenous malformations using 3D-DSA and MRI fusion
Srivatanakul Kittipong

15:20 – 15:30 137
Combined endovascular and surgical treatment of spinal dural arteriovenous fistulas
Ozretic David, Vukić Miroslav, Marasanov Sergej, Gardijan Danilo, Djuric Kresimir S, Rados Marko

15:30 – 15:40 138
The analysis of the anatomic route of hypoglossal nerve within the hypoglossal canal using multidetector CT in case with anterior condylar confluence dural arteriovenous fistula
Mizutani Katsuhiro, Oishi Yumiko, Akiyama Takenori, Yoshida Kazunari

16:00 – 16:30 Coffee break

Session Room 3, level 4
Tuesday

14:00 – 15:10 Parallel abstract session: DAVF Session room 3/Tuesday
Moderators: Higashi Toshio
Fukuoka University Hospital, Neurosurgery, Fukuoka, Japan
Christophe Cognard
Centre Hospitalier Universitaire (CHU) de Toulouse, France

14:00 – 14:10 139
Everything its Possible in a Single Session: Improving Endovascular Treatment of Complex Intracranial Dural Arteriovenous Fistulas (dAVFs) Using a Dual Lumen Balloon Augmentation Technique
Pabon Boris, Vargas Oscar, Diaz Carlos, Torres Victor, Correa Ramiro

14:10 – 14:20 140
Intracranial Dural AVF: A Single Centre Experience
Gaikwad Shailesh B, Somorendra Singh, Anshul Jain, Joseph Leve, Parthiban Bala, Nishchint Jain

14:20 – 14:30 141
Treatment of Cavernous Sinus Dural Arteriovenous Fistula by Transvenous Onyx with Coil Embolization; A Case Series
Moo-Seok Park, Hyun Goo Lee, Taek Min Nam, Young Woon Lee, Je Young Yeon, Keon Ha Kim, Young Jeon

14:30 – 14:40 142
Endovascular Treatment of Intracranial Dural Arteriovenous Fistulas Involving Large Sinuses under Intrasinus Balloon Protection
Li Qiang, Li Jianan, Xu Yi, Liu Jianmin

14:40 – 14:50 143
Embolization of dural arteriovenous fistula with ultra-low concentration NBCA
Higashi Toshio, Wakuta Naoki, Fukumo Hironori, Iwaasa Mitsutoshi, Inoue Tooru

14:50 – 15:00 144
Direct percutaneous sclerotherapy for venous malformations of the face
Haas Leandro Jose, Della Giustina Evelyn, Moura Borille Thais, Piquet Sarmento Marina, Tozzi Marques Natalia, Ahmad Omar Omar, Scamocin Thaize Regina, Sartori Felipe, Saori Tulida Leticia, Camilo Liz Caroline, Perez Gabriel, Bernardes Celso

15:00 – 15:10 145
The usefulness of 3D venography in the treatment of dural arteriovenous fistulae
Aoki Rie, Srivatanakul Kittipong
Scientific Program

15:00 – 15:10 146
Dural arteriovenous fistulas of the anterior and posterior condylar vein: anatomy and treatment
Hellstern Victoria, Aguilar-Perez Marta, AlMatter Mohammad, Bhogal Paul, Serna-Wandel Carmen, Henkes Hans

16:00 – 16:30 Coffee break

Session Room 4, level 5
Tuesday

14:00 – 15:30 Parallel abstract sessions:
Aneurysm research
Session room 4/Tuesday

Moderators:

Gábor Janiga
University of Magdeburg, Laboratory of Fluid Dynamics and Technical Flows, Magdeburg, Germany

Christian Valen-Sendstad
Simula Research Laboratory, Fornebu, Norway

147
Hemodynamic Changes Caused by Multiple Stenting in Vertebral Artery Fusiform Aneurysms: A Patient-specific Computational Fluid Dynamics Study
Lyu Nan, Fang Yibin, Larrabide Ignacio, Liu Jianmin, Huang Qinghai

14:00 – 14:10 148
Emerging secondary flow patterns at the initiation site of sidewall aneurysms
Csippa Benjamin, Paál György, Závodszy Gábor, Vadász Ágnes, Szikora István

14:10 – 14:20 149
Impact of vessel geometry on flow diverter mesh density in curved arteries
Pogácsás Bettina, Nagy Péter, Bognár Eszter, Kovács Róbert, Vadász Ágnes, Czencz Máté, Kondor Máté, Szikora István

14:20 – 14:30 150
Hydraulic resistance of FD stents under varying conditions
Paál György, Csippa Benjamin, Závodszy Gábor, Szikora István

14:30 – 14:40 151
Comparing the flow diverting effects between double LVIS and single PIPELINE using CFD simulation
Shojima Masaaki, Hoshi Takeharu, Yagi Takanobu

14:40 – 14:50 152
Particle residence time for prediction of intracranial aneurysm rupture risk
Leemans Eva, Cornelissen Bart M.W., Rosalini Giorgia, Majoie Charles B.L.M., van Bavel Ed T., Marquering Henk A,

15:00 – 15:10 153
Fast patient-specific flow diverter deployment simulation
Závodszy Gábor, Szikora István, Vadász Ágnes, György Paál

15:00 – 15:10 154
Location specific inflow profiles for intracranial aneurysms
Cornelissen Bart M W., Sprengers Marieke E, Schneider Joppe J, van Ooij Pim, Slump Cornelis H, Marquering Henk A, Majoie Charles B L M

15:10 – 15:20 155
Newtonian viscosity model for CFD studies in cerebral aneurysms
Aziz Waseem H, Al Argha Hashem M., Hamdan Mohammed O., El Shawarby Amr A.
15:20 – 15:30
Hemodynamic effect of parent artery occlusion for giant intracranial aneurysm on surrounding arteries and aneurysm based on magnetic resonance fluid dynamics and computational fluid dynamics
Kropp Asuka Elisabeth, Izumi Takashi, Nishihori Masahiro, Tamari Yosuke, Tsukada Tetsuya, Ishida Mamoru, Isoda Haruo

Wednesday, 18th of October: AVM and miscellaneous

Plenary Room, level 2

07:15 – 08:00 Breakfast seminar
Plenary Room/Wednesday
Back to the basics: AVM : evolution and elimination
Chairperson: Karel TerBrugge
Neuroradiology, University of Toronto, Canada
Evolution of AVM
Hong Qi Zhang
Hong Kong Baptist University, China
Principles of AVM surgery
Robert Reisch
Hirslanden Private Hospital Group, Switzerland

08:00 – 08:35 Plenary Session 6.
AVM research
Plenary Room/Wednesday
Chairperson: Luis Lemme Phlagos
Consultorio Endovascular CENBA, Buenos Aires, Argentina
Moderators: Timo Krings
University of Toronto, Neuroradiology, Toronto, Canada
Michihiro Tanaka
Kameda Medical Center, Kamogawa City Japan
Panelists: Insup Choi
Interventional Neuroradiology, Lahey Hospital Medical Center, Boston, USA
Sirintara Pongpech
Ramathibodi Mahidol University, Bangkok, Thailand

08:00 – 08:15 INV19
Latest results in AVM pathogenesis research, Brain AVM: animal models, pathogenesis and new therapeutic options
Hua Su
University of California, San Francisco, Department of Anesthesia and Perioperative Care, San Francisco, USA

08:15 – 08:30 INV20
Latest results in DAVF pathogenesis research
Pervinder Bhogal
Klinikum Stuttgart, Stuttgart, Germany

08:30 – 08:35 Panel discussion

08:35 – 10:15 Plenary session 7.
AVM embolization: what is the aim?
Plenary Room/Wednesday
Chairperson: Laurent Spelle
Bicètre University Hospital-Paris Sud University France
Moderators: Ronie Piske
Beneficencia Portuguesa Hospital of Sao Paul, Brasil
Peter Rivera
Department of Neurosciences, College of Medicine and Philippine General Hospital, University of the Philippines Manila, Philippines
Panelists: 
Jacques Moret  
Bicetre University Hospital, France  
Alejandro Berenstein  
Mount Sinai Hospital, USA  
Saruhan Cekirge  
Koru Hospitals, Department of Interventional Neuroradiology, Ankara, Turkey  
Karel TerBrugge  
Neuroradiology, University of Toronto, Canada

08:35 – 08:40  
How would you do this case? Demonstrative case presentation & audience poll

08:40 – 08:55  
INV21  
Embolization should aim complete occlusion by using transarterial-transvenous approach  
István Hudák  
University of Pécs, Department of Neurosurgery, Pécs, Hungary

08:55 – 09:10  
INV22  
Embolization should aim complete occlusion by using transarterial approach  
Naci Kocer  
Neuroradiology, Istanbul, Turkey

09:10 – 09:25  
INV23  
Embolization should be used as a complementary method to surgery  
Edoardo Boccardi  
Niguarda Hospital, Milano, Italy

09:25 – 09:40  
Most AVM-s should be treated by microsurgery  
Peter Vajkoczy  
Department of Neurosurgery, Charité Universitätsmedizin Berlin, Germany

09:40 – 09:55  
INV24  
Non-Surgical AVM’s should be treated by radiosurgery without embolisation  
Matthias Radatz  
Royal Hallamshire Hospital, Neurosurgery/Radiosurgery, Sheffield, United Kingdom

09:55 – 10:05  
The European AVM treatment consensus proposal  
Marco Cenzato  
Ospedale Niguarda, Milan, Italy

10:05 – 10:15  
Panel discussion & Audience polling

10:15 – 10:45  
Coffee break

10:45 – 11:15  
Plenary session 8.  
The Pierre Lasjaunias Memorial Lecture  
Chairperson: Sirintara Pongpech  
Ramathibodi Mahidol University, Bangkog, Thailand  
Moderators: Luc Picard  
Centre Hospitalier Universitaire de Nancy, Laxou, France  
Michael Söderman  
Department of Neuroradiology, Karolinska University Hospital – Solna, Stockholm, Sweden  
Low magnetic field MRI imaging of cerebral vascular disease  
Gary Green  
The University of York, United Kingdom

11:15 – 12:15  
Plenary session 9.  
The human factor in the angiosuite: mental health and industry-physician interactions  
Chairperson: Michael Söderman
11:15 – 11:35
Mental health in the angiography suit
György Purebl
Semmelweis University, Budapest, Hungary

11:35 – 12:05
Partners or customers: physician – industry interaction
11:35 – 11:50 Industry:
Matt Fitz
Microvention, USA

11:50 – 12:05 Medicine: Patrick Brouwer
Karolinska University Hospital, Sweden

12:05 – 12:15 Panel discussion

12:15 – 13:15 Industry symposia
Plenary Room/Wednesday

13:15 – 14:15 Lunch break

14:15 – 16:05 Parallel abstract session – Aneurysm research
Plenary Room/Wednesday

14:15 – 14:25 157
Stromal cell-derived factor 1α facilitates aneurysm remodeling in elastase-induced rabbit saccular aneurysm
Li Zifu

14:25 – 14:35 158
Recombinant human SDF-1α administration accelerates aneurysm neck reendothelialization in rabbit saccular aneurysm after flow diverter treatment
Li Zifu

14:35 – 14:45 159
Development of Statin eluting coils to enhance neck endothelialization and thrombus organization in the aneurysm cavity
Kodama Tomonobu, Toda Mitsuaki, Arima Yusuke, Hitoshi Ozasa, Ogawa Atsushi, Murayama Yuichi

14:45 – 14:55 160
Development and evaluation of a statin-carrying embolization coils
Toda Mitsuaki, Ozasa Hitoshi, Ogawa Atsushi, Arima Yusuke, Kodama Tomonobu, Iwata Hiroo

14:55 – 15:05 161
Autologous Adipose-Derived Mesenchymal Stem Cells Improve Healing Of Coiled Experimental Saccular Aneurysms: An Angiographic and Histopathological Study
Rouchaud Aymeric, Brinjikji Waleed, Ding Yong Hong, Dai Daying, Spelle Laurent, Kallmes David, Kadirvel Ram

162
Vessel Wall MRI in Intracranial Aneurysms with High Rupture Risk Based on PHASES Score
Lyu Nan, Chen Shiyue, Wang Xiaojie, Li Jin, Xing Qinghua
Vessel Wall MR (VW-MR) Evaluation of the Aneurysm Wall Enhancement in Unruptured, Untreated Intracranial Brain Aneurysms
Echeverria Martinez Mario Daniel, Rivera M. Rodrigo, Caro Joseline, Bravo Fabian, Castro Mario

New hydrophilic stent coating inhibits platelet adhesion in vitro and in vivo
Henkes Hans, Martinez Moreno Rosa, Bannewitz Catrin, Henkes Elina, Lylyk Pedro, Hannes Ralf, Lenz-Habijan Tim

STAT: Stenting in the Treatment of Aneurysm Trial
Nico Lorena, Kotowski Marc, Iancu Dana, Weill Alain, Roy Daniel, Raymond Jean

The low profile LVIS Jr Stent in treatment with coiling of intracranial aneurysms. Initial 21 devices and follow up in a Brazilian single center experience
Cabral de Andrade Guilherme, Lesczynski Alexandre, Alves Helvercio F Polsaque, Climaco Valter, Pereira Eduardo

The influence of stent stiffness on vascular morphology and accompanying hemodynamic changes in intracranial sidewall aneurysms
Cornelissen Bart M W, Marquering Henk A, Slump Cornelis H, van den Berg René, Majoie Charles B L M

Endovascular management of intracavernous ICA aneurysms: Giant Problem – Smart Solution
Gaikwad Shailesh B, Parthiban Bala, Somorendra Singh, Joseph Leve, Nishchint Jain

Collateral status set the onset-to-recanalization time window for good outcome
Byung Moon Kim
Severance Hospital, Yonsei University College of Medicine, Interventional Neuroradiology, Seoul, South Korea

Flow Re-direction Endoluminal Device (FRED) for the treatment of cerebral aneurysms: results and outcomes in 2 centres
Neeraj R. Mahboobani, Wing Ho Chong, Boris KH Tse, Samuel SK Lam, Tony KT Chan, Lik Fai Cheng, Johnny KF Ma, Jimmy CW Siu, Chong Boon Tan, Yiu Chung Wong
Princess Margaret Hospital, Radiology, Kowloon, Hong Kong; Tuen Mun Hospital, Radiology, Hong Kong; Tuen Mun Hospital, Neurosurgery, Hong Kong; Princess Margaret Hospital, Neurosurgery, Hong Kong

Expanding the horizon: neurointerventional oncology
Chairperson: Alessandra Biondi
17:05 – 17:20
Retinoblastoma chemotherapy
Pierre Gobin
Weill Cornell Medicine, New York, USA

17:20 – 17:35
Intra-arterial chemotherapy for brain tumors: is there an indication?
Csanád Várallyay, Prakash Ambady, Edward A. Neuwelt
Oregon Health and Science University, Dept. of Radiology, Portland, USA; Oregon Health and Science University, Dept. of Neurology, Portland, USA

17:35 – 17:45
Discussion

17:45 – 18:45 Parallel abstract sessions – Aneurysm research
Plenary Room/Wednesday

17:45 – 17:55
Minor communicating malapposition has a major impact on aneurysm occlusion after flow diverter implant

17:55 – 18:05
The Flow Redirection Endoluminal Device (FRED) in treatment of intracranial aneurysms. Initial 28 devices and follow up in a single center Brazilian experience
Cabral de Andrade Guilherme, Lesczynski Alexandre, Alves Helvercio F Polsaque, Climaco Valter, Pereira Eduardo

18:05 – 18:15
Innovations in Endovascular Treatment Strategies for Large Carotid Cavernous Aneurysms – The Safety and Efficacy of a Flow Diverter
Miyachi Shigeru, Hiramatsu Ryo, Ohnishi Hiroyuki, Matsubara Noriaki, Izumi Takashi, Takayasu Masakazu

18:15 – 18:25
Wall apposition is more important than mesh density in flow diverters
Aquarius Rene, Smits Debby, Gounis Matthew, de Korte Antonius M, Verrijp Kiek, Driessen Léon, Leenders William, de Vries Joost

18:25 – 18:35
Retreatment of residual aneurysms after flow-diversion: An experimental study
Fahed Robert, Darsaut Tim E., Kotowski Marc, Salazkin Igor, Raymond Jean

18:35 – 18:45
AMD3100 accelerates reendothelialization of neointima formation in rabbit saccular aneurysm after flow diverter treatment
Li Zifu
Session Room 1, level
Wednesday

07:15 – 08:00
Breakfast seminar
Back to the basics: DAVF: Evolution and occlusion
Chairperson: Zsolt Berentei
National Institute of Clinical Neurosciences, Budapest, Hungary

Evolution of DAVF
Insup Choi
Interventional Neuroradiology, Lahey Hospital Medical Center, Boston, Massachusetts, USA

Endovascular treatment of DAVF
René Chapot
Alfried Krupp Hospital in Essen-Ruettenscheid, Department of Radiology and Neuroradiology, Germany

14:15 – 16:15 Parallel abstract sessions
Aneurysm clinical, Imaging, Outcomes, Miscellaneous
Moderators: Aguilar-Perez Marta
Hospital of Stuttgart, Neuroradiology, Stuttgart, Germany
Markus Möhlenbruch
Department of Neuroradiology, Heidelberg University Hospital, Germany

16:15 – 14:25
Review of size, morphology and location of ruptured cerebral aneurysms from a single center
AlMatter Muhammad, Aguilar Pérez Marta, Bhogal Pervinder, Hellstern Victoria, Serna Candel Carmen, Ganslandt Oliver, Bätzner Hansjörg, Henkes Hans

14:25 – 14:35
Can blister-like aneurysm disappear? Spontaneous occlusion of a side wall basilar aneurysm. Case report and review of the literature
Cavasin Nicola, Cagliari Enrico, Brollo Marco, Magrini Salima

14:35 – 14:45
Treatment of ruptured blister and blister-like aneurysms with flow-diverters: a dual centre experience
Gaudino Chiara, Kabbasch Christoph, Mpotsaris Anastasios, Bendszus Martin, Möhlenbruch Markus

14:45 – 14:55
Short-segment Internal Trapping for A Symptomatic Thrombosed Large Fusiform Vertebra Artery Aneurysm: Vermicelle technique
Nishihori Masahiro, Izumi Takashi, Tamari Yosuke, Ishida Mamoru, Tsukada Tetsuya, Kropp Asuka Elisabeth, Wakabayashi Toshihiko

14:55 – 15:05
Clinical and Angiographic Follow-Up Results of Endovascular Coiling using Triple Microcatheters for patients with relatively Wide-necked Aneurysm in Parent Artery Less than 1.5mm in diameter
Jang E Wook, Kim Hyung-In, Lee JaeSeong, Lee Byung-Hee

15:05 – 15:15
Features and results of endovascular treatment of ophthalmic segment aneurysms
Kiselev Vitaly S, Sosnov Alexey O, Gafurov Rustam R, Perfilev Artem M

15:15 – 15:25
Low dose 3D rotational angiography for intracranial aneurysm: analysis of image quality and patient radiation dose
Im Sanghyuk, Kim Bum-Soo, Shin Yongsam, Cho Jai Ho
15:25 – 15:35 182
Correlation of Vessel Wall MR Features of Intracranial Verterbral Artery Dissection to Intravascular Ultrasound Findings
Kim Hyung-In, Lee Byung-Hee, Lee Jae Seong, Jang E Wook, Kim Tae-Eun

15:35 – 15:45 183
Post-embolization Dual Energy CT (DECT) of brain: frequently noted contrast enhancing areas after endovascular treatment of unruptured intracranial aneurysm
Roh Jieun, Kang Jongsoo, Shim Dong-Hyun, Yeom Jeong A, Kim Young Soo, Baek Jin Wook, Baik Seung Kug

15:45 – 15:55 184
Subtraction CTA as a non-invasive alternative to angiography for the follow-up of Surpass flow diverter treated intracranial aneurysms
Duarte Conde Mariana P., de Korte Antonius Mattheus, Meijer Frederick J.A., Aquarius René, Boogaarts Hieronymus D., de Vries Joost

15:55 – 16:05 185
MRA for follow up of aneurysms after treatment with flow diverter stents
Agid Ronit, Renieri Leonardo, Geraldo Ana Filipa, Krings Timo, Pereira M Vitor

16:05 – 16:15 Coffee break

17:45 – 18:45 Parallel abstract sessions
Aneurysm clinical, Imaging, Outcomes, Miscellaneous
Moderators: Akira Ishii
Kyoto University, Japan
Lautaro Badilla
Clinica Santa Maria, Chile

17:45 – 17:55 187
Angiographic and clinical long-term follow-up in patients with acutely ruptured aneurysm undergoing web treatment
Gutte Henrik, Holtmannspötter Markus, Stavngaard Trine, Cortsen Marie, Benndorf Goetz

17:55 – 18:05 189
Long-term outcomes of coiled unruptured intracranial aneurysms: followed for up to 20 years
Koyanagi Masaomi, Ishii Akira, Imamura Hirotsoshi, Satow Tetsu, Yoshida Kazumichi, Hasegawa Hitoshi, Kikuchi Takayuki, Takenoue Youhei, Ando Mitsushige, Takahashi Jun C, Nakahara Ichiro, Sakai Nobuyuki, Miyamoto Susumu

18:05 – 18:15 190
Clinical outcome of Ruptured Aneurysm Treatment in the US: National Inpatient Sample Data (NIS) analysis
Lee Seon-Kyu, Yuan Cindy, Karrison Theodore

18:15 – 18:25 191
Preliminary Results from the ISAT-2 Trial
Darsaut Tim E., Roy Daniel, Weill Alain, Bojanowski Michel, Chaalala Chiraz, Chow Michael M, O’Kelly Cian, Arikan Fuat, Nolet Suzanne, Gevry Guylaine, Raymond Jean

18:25 – 18:35 224
Endovascular Treatment of Cerebral Aneurysms Using LVIS Jr Stent: Mid-term Clinical and Angiographic Results
Pabon Boris, Diaz Carlos, Correa Ramiro, Jorge Lopez, Torres Victor  
University of Alberta, Neurosurgery, Edmonton, Canada; CHUM Notre Dame, Neuroradiologie’,  
Montreal’, Canada; CHUM Notre Dame, Neurochirurgie, Montreal, Canada; Val d’Hebron Hospital,  
Neurosurgery, Barcelona, Spain; NRI – CHUM Notre Dame, Neuroradiologie, Montreal, Canada

18:35 – 18:45  225  
Endovascular treatment of unruptured aneurysm with LVIS and LVIS JR. stent  
Haas Leandro Jose, Sartori Felipe, Scramocin Thaize Regina, Piquet Sarmento Marina, Della  
Giustina Evelyn, Ahmad Omar Omar, Moura Borille Thais, Camilo Liz Caroline, Saori Tulida  
Leticia, Tozzi Marques Natalia, Perez Gabriel, Mello Luis Renato

Session Room 2, level 4  
Wednesday

07:15 – 08:00  
Breakfast Seminar  
Session room 2/Wednesday

Back to the basics: The invisible factor: the aneurysm wall  
Chairperson: András Büki  
Medical University Pécs, Neurosurgery Department, Pécs, Hungary

INV27  
Biology and histology of the intracranial aneurysm wall  
Juhana Frösen  
Kuopio University Hospital, Neurosurgery, Kuopio, Finland

Imaging of the aneurysm wall  
Timo Krings  
University of Toronto, Neuroradiology, Toronto, Canada

13:15 – 13:45  
Poster session  
Session room 2/Wednesday

Moderator: Winston Lim  
Singapore General Hospital, Singapore

PP316  
Dural Arteriovenous Fistulas as a Reversible Cause of Dementia: An analysis of Radiographic  
Features and Treatment Outcome  
Boonchai Tiplada, Churojana Anchalee, Auroonyawat Thaweesak, Chankaew Ekawut, Songsaeng  
Dittapong, Sangpetngam Boonrerk, Withayasuk Pattarawit, Chanvanitkulchai Kannacahod

PP317  
Angiographic and clinical characteristics of thoracolumbar spinal epidural and dural arterioven-  
osus fistulas  
Kiyosue Hiro, Matsumaru Yuji, Niimi Yasunari, Takai Keisuke, Ishiguro Tomoya, Hiramatsu  
Masafumi, Yoshimura Shinji

PP318  
Factors affecting the reachability of NBCA-lipiodol mixture to the arteriovenous shunt during  
transarterial embolization: a clinical study in intracranial dural arteriovenous fistulas  
Kiyosue Hiro, Tanoue Shuichi, Shimada Ryuichi, Ide Satomi

PP319  
The Effectiveness of Dural Venous Sinus Sacrifice as A Treatment of Aggressive Type Cranial Dural  
Arteriovenous Fistulas  
Chailerd Ornkamol, Mongkolratnan Atithep, Sangpetngam Boonrerk, Withayasuk Pattarawit,  
Chankaew Ekawut, Auroonyawat Thaweesak, Songsaeng Dittapong, Churojana Anchalee

PP320  
The “GROUTING TECHNIQUE” in high-grade Intracranial Dural Arteriovenous Fistulae  
Embolization  
Chou Wen-Chin, Wong Ho Fai
PP321
Increase of fluoroscopic radiation dose rate during multi-stage Onyx embolization of brain AVMs
Jiang Yuanyuan, Sheen Jae Jon, Lee Deok Hee, Kim Tae II, Kim YoungEun, Maeng Jun Young

PP322
Correlation between angioarchitecture and obliteration rate of the brain arteriovenous malformation (BAVM) after hypofractionated stereotactic radiotherapy (HSRT)
Chanthanaphak Ekachat, Hengriprasopchoke Suthinee, Kobkitsuksakul Chai, Jiarakmongmun Pakorn, Singhara Na Ayudhaya (Pongpech) Sirintara

PP323
 Determination of the natural history of neck remnants of cerebral aneurysms treated with detachable coils assessed with Magnetic Resonance Angiography
Paxton Mark, Redmond Kendal, Leggett David

PP324
Factors Related to Retreatment after Coil Embolization of Basilar Tip Aneurysm -Effect of Morphological Change Induced by Stent Placement
Mori Kentaro, Amano Tatsuo, Sato Masayuki, Matsumaru Yuji

PP325
 Determination of the natural history of cerebral aneurysms treated with detachable coils according to the Raymond-Roy Occlusion Classification assessed with Magnetic Resonance Angiography
Paxton Mark, Redmond Kendal, Leggett David

14:15 – 16:05 Parallel abstract sessions
Aneurysm clinical: Outcomes
Moderators: Peter Rivera
Department of Neurosciences, College of Medicine and Philippine General Hospital, University of the Philippines Manila, Philippines
Maciek Szainer
Department of Interventional Neuroradiology, Medical University of Lublin, Poland

14:15 – 14:25
193
Complex endovascular treatment of brain aneurysms in the acute period of subarachnoid hemorrhage
Mikeladze Ketevan, Yakovlev Sergey B., Bocharov Aleksey V., Bukharin Evgeny Y., Arustamyan Sergey R.

14:25 – 14:35
194
Endovascular treatment of aneurysm in elderly patients
Haas Leandro Jose, Moura Borille Thais, Della Giustina Evelyn, Piquet Sarmento Marina, Tozzi Marques Natalia, Ahmad Omar Omar, Scramocin Thaize Regina, Camilo Liz Caroline, Sartori Felipe, Saori Tulida Leticia, Boer Vitor Hugo, Oliveira Junior Amauri

14:35 – 14:45
195
Follow-up outcome of re-embolization in recanalized aneurysms after coiling: further recurrence rate and related risk factors
Lee Jeongjun, Kang Hyun-Seung

14:45 – 14:55
196
Endovascular coil embolization of internal carotid artery anterior wall aneurysms
Hirohata Masaru, Takeuchi Yasuharu, Orito Kimihiko, Fujimura Naoko, Yamashita Shin, Nakamura Yukihiko, Sakamoto Rokudai, Kajihara Soushou, Morioka Motohiro
<table>
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<tr>
<th>Time</th>
<th>Session</th>
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Zhou Yu                                                   |
| 15:05 - 15:15| Results of endovascular and microsurgical treatment of patients with unruptured asymptomatic cerebral aneurysms of intradural part of ICA  
He Xuying                                                  |
| 15:25 - 15:35| Ruptured middle cerebral artery aneurysms with a concomitant intraparenchymal hematoma: the role of hematoma volume  
Zijlstra IJsbrand                                           |
| 15:35 - 15:45| Long-term result of endovascular treatment with preservation of the vertebral artery in isolated dissecting aneurysms of the posterior inferior cerebellar artery  
Jang E Wook, Kim Hyung-In, Lee JaeSeong, Lee Byung-Hee   |
| 15:45 - 15:55| Endovascular management of distal anterior cerebral artery (DACA) aneurysms: A Retrospective Review Study  
Hakim Shakir Husain, Andhitara Yovita, Jena Somnath Prasad, Padilla Jorge, Aritonang S, Letsoin I |
| 15:55 - 16:05| Usefulness of motor-evoked potential monitoring (MEP) during embolization of anterior choroidal artery aneurysms  
Hayashi Morito, Iwabuchi Satoshi, Yokouchi Tetsuya, Sato Kenichiro, Ishii Masashi, Ikota Masashi, Saito Norihiko, Nakayama Haruo, Iwama Junya, Fujita Satoshi, Hirai Nozomi, Hiramoto Yu, Ito Keisuke, Aoki Kazuya |
| 16:15 - 16:45| Coffee break                                                                                |
| 17:45 - 18:45| Parallel abstract session                                                                   |
|              | Aneurysm clinical: Outcomes                                                                 |
|              | Moderators: Naci Kocer                                                                   |
|              | Neuroradiology, Istanbul, Turkey                                                           |
|              | Stefanita Dima                                                                              |
|              | Interventional Neuroradiology Department, ELIAS Hospital, Bucarest, Romania                |
| 17:45 - 17:55| Surgical Clipping or Endovascular Coiling for Unruptured Intracranial Aneurysms: A Pragmatic Randomized Trial  
| 17:55 - 18:05| Hybrid surgical and endovascular treatment of a giant cervical carotid aneurysm in a child  
Ocal Osman, Yilmaz Mustafa, Peker Ahmet, Bilginer Burcak, Peynircioglu Bora, Arat Anil |
18:05 – 18:15 207
Long-term Results of Endovascular Treatment for Ugly Aneurysms using Sandwich Technique
Kim Hyung-In, Lee Byung-Hee, Lee Jae Seong, Jang E Wook, Kim Tae-Eun

18:15 – 18:25 208
Endovascular treatment of tiny intracranial aneurysms: sixteen-year experience with 113 cases at a single institution
Lu Jun, Wang Da-Ming, Wang Li-Jun, Liu Jia-Chun, Qi Peng

18:25 – 18:35 209
Factors of Aneurysmal Rebleeding Differ Depending on Clipping and Coiling after Subarachnoid Hemorrhage
Horie Nobutaka, Sato Shuntaro, Kaminogo Makio, Sadakata Eisaku, Morofuji Yoichi, Izumo Tsuyoshi, Anda Takeo, Matsuo Takayuki

18:35 – 18:45 210
Prognostic factor for recurrence of coiled small intracranial aneurysms
Yoon Seokmann, Oh Jae-Sang, Shim Jae-Hyun, Oh Hyuk-jin, Bae Hack-Gun

Session Room 3, level 4
Wednesday

07:15 – 08:00 Breakfast Seminar
Session room 3/Wednesday
Back to the basics: The slinky enemy: vasospasm
Chairperson: Ferenc Köver
Department of Neurosurgery, University of Pécs, Hungary
Pathophysiology and non-endovascular treatment of vasospasm
Péter Vajkóczy
Department of Neurosurgery, Charité Universitätsmedizin Berlin, Germany
Endovascular Treatment options
Thomas Liebig
University of Cologne, Germany

14:15 – 16:15 Parallel abstract session
Aneurysm clinical: Coil and assisted coil
Session room 3/Wednesday
Moderators: Alejandro M. Spiotta
Medical University of South Carolina, Charleston, South Carolina, USA
Kamil Zelenak
Comenius University’s Jessenius Faculty of Medicine and University Hospital, Department of Radiology, Martin, Slovakia Slovakia

14:15 – 14:25 211
Aneurysm coil embolization using ED coil® and 1.5F Marathon® catheter
Asano Takeshi
Chiba Medical Centre Hospital, Neuroendovascular Therapy, Chiba, Japan

14:25 – 14:35 212
Initial Institutional Experience with the Axium Prime Extra Soft Coil for Treatment of Intracranial Aneurysms
Delgado Almandoz Josser E, Kayan Yasha, Scholz Jill, Milner Anna, Wallace Adam, Fease Jennifer, Mulder Maximilian

14:35 – 14:45 213
Second-generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: A Randomised Controlled Trial
Taschner Christian A., Chapot René, Costalat Vincent, Machi Paolo, Barreau Xavier, Jérôme Berge, Pierot Laurent, Kadziolka Krysztof, Jean Betty, Blanc Raphaël, Biondi Alessandra, Brunel Hervé,
14:45 – 14:55
A prospective, multicenter study assessing the embolization of neurovascular lesions using the Penumbra SMART COIL® System: Initial results from the SMART Registry
Spiotta Alejandro M., Liu Kenneth, Schirmer Clemens, Bellon Richard, Bohnstedt Bradley, Fiorella David

14:55 – 15:05
Extra-soft SMART (PENUMBRA) coils in the endovascular treatment of very small (<3mm) intracranial aneurysms
Padmanabhan Rajeev

15:05 – 15:15
Long-term follow-up results of the Penumbra SMART coil in the endovascular treatment of intracranial aneurysms
Justin Cappuzzo M., Stapleton Christopher J. Koch Matthew J., Raymond Scott B., Torok Collin M., Patel Aman B.

15:15 – 15:25
Does stent type impact coil embolization outcomes in extended follow-up of small-sized aneurysms (<10mm)?
Lee Jeongjun, Kang Hyun-Seung

15:25 – 15:35
Long-term angiographic outcome of stent-assisted coiling compared to non-assisted coiling of intracranial saccular aneurysms
Ozretic David, Rados Marko, Jovanovic Ivan, Poljakovic Zdravka

15:35 – 15:45
Atlas stent assisted coiling of unruptured middle cerebral artery aneurysms
Zelenak Kamil, Kolarovszki B., Zelenakova J.

15:45 – 15:55
NeuroForm Atlas stent-assisted coiling of intracranial aneurysms: preliminary results
Boogaarts Hieronymus, ten Brinck Michelle F., de Vries Joost, Bartels Ronald H.

15:55 – 16:05
Initial experience with the ATLAS microstent for the treatment of wide-necked aneurysms
Ulfert Christian, Herweh Christian, Bendszus Martin, Möhlenbruch Markus

16:05 – 16:15
Stent Assisted Coiling of Intracranial Aneurysms with the Low-Profile Neuroform Atlas Stent
Cay Ferdi, Peker Ahmet, Arat Anil

16:15 – 16:45 Coffee break

17:45 – 18:45 Parallel abstract session
Aneurysm clinical: Coil and assisted coil
Moderators: Timo Krings
University of Toronto, Neuroradiology, Toronto, Canada
Lucian Mărginean
Neurointerventional radiology, Tg Mures Emergency Hospital, Transylvania, Romania
223
T-configuration stenting technique with low-profile Visualized Intraluminal Support Junior (LVIS Jr) device in wide-necked and complex intracranial aneurysms
Duan Guoli, Li Qiang, Fang Yibin, Zhao Rui, Zuo Qiao, Yang Pengfei, Zhang Lei, Hong Bo, Xu Yi, Liu Jianmin, Huang Qinghai

224
Endovascular Treatment of Cerebral Aneurysms Using LVIS Jr Stent: Mid-term Clinical and Angiographic Results
Pabon Boris, Diaz Carlos, Correa Ramiro, Jorge Lopez, Torres Victor

225
Endovascular treatment of unruptured aneurysm with LVIS and LVIS JR. stent
Haas Leandro Jose, Sartori Feli, Soler Caro, L.S. Petrucci, Fiolin Sarmento Marina, Della Giustina Evelyn, Ahmad Omar Omar, Moura Borille Thais, Camilo Liz Caroline, Saori Tulida Leticia, Tozzi Marques Natalia, Perez Gabriel, Mello Luis Renato

226
Reconstructive endovascular treatment in vertebral dissecting aneurysms with the Low-profile Visualized Intraluminal Support (LVIS) device
Wang CC, Fang YB, Xu Y, Hong B, Liu JM, Huang QH

227
Preliminary experience with stent-assisted coiling of aneurysms arising from small (<2.5 mm) cerebral vessels using Low-profile Visualized Intraluminal Support (LVIS) device
Wang CC, Li W, Feng ZZ, Xu Y, Hong B, Liu JM, Huang QH

228
The safety and efficacy of low profile visualized intraluminal support (LVIS) stents in assisting coil embolization of small (>3mm, <10mm) intracranial aneurysms
Feng Zhengzhe, Hong Bo, Xu Yi, Huang Qinghai, Liu Jianmin

Session Room 4, level 5
Wednesday

08:30 - 10:45 Symposium for nurses, technicians and radiographers in cooperation with ESMINT

10:45 - 12:45 Hands on course for nurses, technicians and radiographers in cooperation with ESMINT

14:15 - 16:15 Parallel Abstract Session

Moderators: Francis Turjman
Hôpital Neurologique, Department of Interventional Neuroradiology, Lyon, France
Alessandra Biondi
Department of Neuroradiology and Endovascular Therapy Besancon University Hospital, France

14:15 - 14:25 Leo baby stent-assisted coiling in the treatment of challenging aneurysms: experience in 30 consecutive cases
Ceciliano Alejandro, Navarro Fernando, Villasante Francisco, Moya Hernan, Aguado Andres, Pereira Mariano

14:25 - 14:35 Long term follow up of widenecked and/or bifurcational aneurysms treated with the Leo Baby stent alone, or combined with loose coil packing
GáI Gyula, Diaz Anabel
14:35 – 14:45 231
Collateral Circulation Status Predicts Rate of Occlusion and Risk of Clinical Deficit in Branch Vessel Coverage
Raymond Scott B., Stapleton Christopher J., Koch Matthew J., Torok Collin M., Patel Aman B.

14:45 – 14:55 232
Aneurysm expansion can cause clinical deterioration after flow diverter treatment: A retrospective series of 16 intracranial aneurysms.
de Korte Antonius Mattheus, Aquarius René, Meijer Frederick J.A., Boogaarts Hieronymus D., de Vries Joost

14:55 – 15:05 233
The Silk Flow Diverter in the Endovascular Treatment of Intracranial Aneurysms: Results Diversion, a French multicenter, prospective registry
Turjman Francis, Berge Jerome, Spelle Laurent, Bonafe Alain, Piotin Michel, Cognard Christophe, Mounayer Charbel, Biondi Alessandra

15:05 – 15:15 234
Mid-term Results of the DERIVO Flow Diverter Stent in the Treatment of Cerebral Aneurysms
Akgul Erol, Onan Hasan Bilen, Akpinar Suha, Balli Huseyin Tugsan, Aksungur Erol Huseyin

15:15 – 15:25 235
Single center experience with a new generation flow diverter device (DERIVO Acandis Gmbh)
Asteggiano Francesco, Divenuto Ignazio, Ajello Daniele, Nuzzi Nunzio Paolo

15:25 – 15:35 236
First experience in Argentina with Derivo flow diverter device, midterm follow up
Ceciliano Alejandro, Villasante Francisco, Navarro Fernando, Moya Hernan, Aguado Andres, Pereira Mariano

15:35 – 15:45 237
The DERIVO Trial: a prospective multicentre register study. Clinical and angiographic mid-term results in forty patients
Taschner Christian A., Stracke Paul, Solymosi Laszlo, Reith Wolfgang, Prothmann Sascha, Beuing Oliver, Dorn Franziska, Turowski Bernd, Chapot René

15:45 – 15:55 238
Endovascular Treatment of Spontaneous Rupture Intracranial Aneurysms using the Derivo Embolization Device (DED)
Petra Fernando, Larribau ML, Stefan G, Stefan V, Chavez V, Grana M, Aguado A

15:55 – 16:05 239
Flow Diveters in Developing Countries: Endovascular Treatment of Intracranial Aneurysms with FRED. Mid-term Results
Pabon Boris, Diaz Carlos, Vargas Oscar, Torres Victor, Lopez Jorge, Correa Ramiro

17:45 – 18:45 Parallel Abstract Session
Session room 4/Wednesday
Moderators: Laurent Pierot
Maison Blanche Hospital, University Hospital of Reims, Reims, France
Markus Möhlenbruch
Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, Germany

17:45 – 17:55 240
Treatment of complex cerebral aneurysms using the FRED flow diverter: experience in a series of 25 aneurysms
Garbugino Silvia L, Sayavedra Ramiro, Goland Javier, Beldi Florencia, Lemme Plaghos Luis
European Multicenter Study for Evaluation of a Dual layer Flowdiverting Stent for Treatment of wide neck Intracranial Aneurysms: The EuFRED-Study
Killer-Oberpfalzer Monika

Aneurysm treatment with FRED and FRED Jr: Results of SAFE (Safety and Efficacy Analysis of Fred Embolic Device in Aneurysm Treatment) Study
Pierot Laurent, Gauvrit Jean-Yves, Lejeune Jean-Paul, Derelle Anne-Laure, Chabert Emmanuel

COMFORT - Colombian Multicenter Flow-diverter Observational Reconstruction Trial. Local Experience in the Endovascular Treatment of Intracranial Aneurysms with FRED stent
Pabon Boris, Holguin Jorge, Fonseca Marco, Diaz Carlos, Lobelo Nelson, Correa Ramiro

Multicenter experience with FRED Jr. Flow Re-Direction Endoluminal Device for Intracranial Aneurysms in Small Arteries
Möhlenbruch Markus A., Kizilkilic Osman, Killer Monika, Baltacioglu Feyyaz, Islak Civan, Bendszus Martin, Cekirge Saruhan, Saatci Isil, Kocer Naci

FRED stent for the treatment of intracranial aneurysms
Wong George KC, Yu Simon CH, Ho Faith LY

Thursday, 19th of October: Aneurysms
Plenary Room, level 2

Parallel abstract session
Aneurysm clinical: coil supporting techniques and miscellaneous
Moderators: Sourour Nader
Hopital Pitie salpetriere, INR, Paris, France
Paul Bhogal
Klinikum Stuttgart, Neuroradiology, Stuttgart, Germany

Up to 18 months DSA Follow up results using Medina® Embolization Device (MED) in the treatment of wide neck intracranial aneurysms.
Sourour Nader, Shoteir, Eimad, Di Maria Federico, Rollabigliani Claudia, Pistocchi Sylvia, Bartolini Bruno, Clarencon Frederic

The Medina Embolic Device - clinical experience in 34 aneurysms from a single center
Aguilar-Perez Marta, Hellstern Victoria, Almatter Mohammed, Bhogal Paul, Ganslandt Oliver, Bäzner Hansjörg, Henkes Hans

The efficacy of parent artery occlusion for internal carotid artery with a combination of coil and NBCA
Izumi Takashi, Nishihori Masahiro, Yousuke Tamari, Ishida Mamoru, Tsukada Tetsuya, Kropp Asuka, Miyachi Shigeru, Wakabayashi Toshihiko

Treatment of wide-necked bifurcation aneurysms with the pCONus1: procedural safety and long-term occlusion stability in 144 aneurysms
Aguilar-Perez Marta, AlMatter Mohammed, Hellstern Victoria, Serna-Candel Carmen, Ganslandt Oliver, Bäzner Hansjörg, Henkes Hans
09:10 – 09:20  250
The new pCONus: initial experience in 15 patients  
Aguilar-Perez Marta, Lylyk Pedro, Sahl Harald, Bhogal Paul, Ganslandt Oliver, Bäzner Hansjörg, Henkes Hans

09:20 – 09:30  251
Treatment of complex wide-neck MCA aneurysms using pCONUS device – 3 centers experience  
Miś Marcin M, Miś Maciej M

09:30 – 09:40  252
Visual outcomes of endovascular and microsurgical treatment for large or giant paraclinoid aneurysms  
Shimizu Tatsuya, Naito Isao, Aihara Masanori, Fujimaki Hiroya, Asakura Ken, Miyamoto Naoko, Yoshimoto Yuhei

09:40 – 09:50  253
Occlusion status on magnetic resonance angiography and risk of delayed ischemia after stent-assisted coil embolization  
Kikuchi Takayuki, Ishii Akira, Chihara Hideo, Ando Mitsushige, Takenobu Yohei, Okada Tomohisa, Takagi Yasushi, Miyamoto Susumu

09:50 – 10:00  254
Outcomes of endovascular treatment for vertebral artery dissection  
Nam Taek Min, Park Moo Seok, Lee Young Woon, Yeon Je Young, Kim Keon Ha, Jeon Pyoung

10:00 – 10:30 Coffee break

10:30 – 11:15 Plenary session 12.  
Aneurysm biology  
Plenary Room/Thursday

Chairperson: Miklós Marosfői  
University of Massachusetts Medical School, Department of Radiology, Worcester MA, USA

Moderators: Todd Abruzzo  
Departments of Radiology, Neurosurgery, Pediatrics and Biomedical Engineering  
University of Cincinnati and Cincinnati Children’s Hospital Medical Center, USA

Jorge Arturo Santos Franco  
Department of Neurosurgery, Hospital of Specialties of the La Raza National Medical Center, Mexican Social Security Institute., Mexico

10:30 – 10:45  
Mechanisms of aneurysm thrombosis  
Jean-Baptiste Michel  
INSERM UMR 1148 –LVTS, Laboratory for Vascular Translational Science, University Paris Diderot, Paris, France

10:45 – 11:00  
Aneurysm wall biology  
Juhana Frösen  
Kuopio University Hospital, Neurosurgery, Kuopio, Finland

11:00 – 11:15 Panel discussion

Predicting aneurysm treatment results by simulation  
Plenary Room/Thursday

Chairperson: Ajay Wakhloo  
Umass Memorial Medical Centre Worcester, MA, USA

Moderators: Gábor Janiga  
Laboratory of Fluid Dynamics and Technical Flows, University of Magdeburg, Germany

Akira Ishii  
Kyoto University, Japan
11:15 – 11:30 INV28
Flow simulation: is it clinically relevant?
Matthew J. Gounis
University of Massachusetts Medical School, Radiology, Worcester, USA

11:30 – 11:45 Flow simulation: have we learned anything new recently?
Gábor Závodszky
Budapest University of Technology and Economics, Department of Hydrodynamic Systems, Budapest, Hungary

11:45 – 12:00 INV29
How to validate simulation results
Kristian Valen-Sendstad
Simula Research Laboratory, Oslo, Norway

12:00 – 12:15 Panel discussion

12:15 – 13:15 Industry symposia

13:15 – 14:15 Lunch break

14:15 – 16:00 Plenary Session 14.
Aneurysm: value of different treatment modalities
Chairperson: James Byrne
University of Oxford, UK
Moderators: Peter Kim Nelson
Abbott Northwestern Hospital, Neurointerventional Radiology, Minneapolis, USA
Winston Chong
Interventional Neuroradiology, Monash Medical Centre, Australia
Panelists: Pedro Lylyk
ENERI and La Sagrada Familia Buenos Aires, Argentina

14:15 – 14:20 How would you do this case? Demonstrative case presentation & audience poll

14:20 – 14:35 Shall we plug the whole? (Is aneurysm packing still needed?)
René Chapot
Alfried Krupp Hospital in Essen-Ruettenscheid, Department of Radiology and Neuroradiology, Germany

14:35 – 15:50 Shall we fly with the flow? Have we improved flow diversion over the past decade? Debate
14:35 – 14:50 INV30
Yes
Ajay K. Wakhloo
University of Massachusetts Medical School, Neuroimaging and Intervention, Worcester, USA

14:50 – 15:05 No
Tommy Andersson
Karolinska Universitetssjukhuset Solna, Stockholm, Sweden
Intrasaccular flow modification: does it work? Debate

15: 05– 15:20 Yes
Laurent Pierot
Maison Blanche Hospital, University Hospital of Reims, Reims, France
15:20 – 15:35  No  
Christophe Cognard  
Centre Hospitalier Universitaire (CHU) de Toulouse, France

15:35 – 15:45  Panel discussion and audience polling

15:45 – 16:00  Vasospasm: any improvement in the past years?  
Thomas Liebig  
University of Cologne, Cologne, Germany

16:00  Adjourn & closing ceremony

Session Room 1, level Thursday

08:30 – 10:00  Parallel abstract session  
Aneurysm clinical: WEB  
Moderators:  
Edoardo Boccardi  
Niguarda Hospital, Milano, Italy  
Juhana Frösen  
Kuopio University Hospital, Neurosurgery, Kuopio, Finland

08:30 – 08:40  255  
Evaluation of the Safety and Efficacy of Aneurysm Treatment with WEB device in the cumulated population of 3 prospective, multicenter series (WEBCAST, French Observatory, WEBCAST-2)  
Pierot Laurent, Molyneux Andrew, Byrne James

08:40 – 08:50  256  
Initial experience with the new WEB 17 system in treatment of intracranial aneurysms  
Peluso Jo, van Rooij Sanne, van Rooij Willem Jan, Sluzewski Menno

08:50 – 09:00  257  
WEB Treatment of Ruptured Intracranial Aneurysms: a Single Center Cohort of 100 Patients  
vvan Rooij Sanne, Peluso Jo, van Rooij Willem Jan, Sluzewski Menno

09:00 – 09:10  258  
Aneurysm Treatment with WEB: Evaluation of the 21 and 17 Systems in a prospective, singlecenter series of 38 patients  
Pierot Laurent, Soize Sébastien, Gawlitza Matthias

09:10 – 09:20  259  
WEB Treatment of Unruptured Intracranial Aneurysms: a Single Center Cohort of 54 aneurysms  
Peluso Jo, van Rooij Willem Jan, van Rooij Sanne, Sluzewski Menno

09:20 – 09:30  260  
Endovascular treatment of wide-neck and bifurcation intracranial aneurysms using WEB embolization device – a single center 3 years experience  
Miś Marcin, Miś Maciej M.

09:30 – 09:40  261  
Clinical results of WEB treatment in previously treated intracranial aneurysms  
Peluso Jo, van Rooij Sanne, van Rooij Willem Jan, Sluzewski Menno

09:40 – 09:50  262  
The impact of oversizing on the efficacy of WEB intrasaccular flow disruptors  
Pogácsás Bettina, Asztalos Lilla, Nagy Péter, Bognár Eszter, Vadász Ágnes, Szikora István
09:50 – 10:00

Parent artery reconstruction for large or giant cerebral aneurysms using Tubridge flow diverters (PARAT): a multicenter, randomized, controlled clinical trial
Liu Jianmin, Zhou Yu, Huang Qiang, Yang Pengfei, Fang Yibin, Li Qiang, Zhao Rui, Xu Yi, Hong Bo

Session Room 2, level 4
Thursday

08:30 – 10:00

Parallel abstract session
Aneurysm clinical: antplatelet treatment and miscellaneous
Moderators: Tibor Becske
Rochester General Hospital, Rochester, NY, USA
Michael Söderman
Department of Neuroradiology, Karolinska University Hospital – Solna, Stockholm, Sweden
Special Expert: Lucie Thibault
Montreal, Canada

08:30 – 08:40

Treatment of challenging aneurysms by flow diverter: Summary series of 140 cases at Bach Mai Hospital
Vu Dang Luu, Pham Ming Thong, Tran Anh Tuan, Nguyen Quang Anh

08:40 – 08:50

Can a singular measurement with Verifynow under constant dual anitplatelet regimen categorize patient into a responder type?
Kropp Asuka Elisabeth, Izumi Takashi, Nishihori Masahiro, Tamari Yosuke, Tsukada Tetsuya, Ishida Mamoru

08:50 – 09:00

Intravenous administration of tirofiban versus loading dose of oral clopidogrel for preventing thromboembolism in stent-assisted coiling of intracranial aneurysms
Liang Xiaodong, Wang Ziliang, Li Tianxiao

09:00 – 09:10

Low-dose prasugrel is safe and effective for stent-assisted treatment of intracranial aneurysms
Kang Hyun-Seung, Lee Jeongjun, Cho Young Dae, Yoo Dong Hyun, Han Moon Hee

09:10 – 09:20

Initial response and Long term variation of response to clopidogrel in patients undergoing endovascular treatment
Sato Keisuke, Ito Yasushi, Hasegawa Hitoshi, Kikuchi Bumpei, Hondo Hiroaki, Kobayashi Tsutomu, Aoki Hiroshi, Fujii Yukihiko

09:20 – 09:30

Safety and efficacy of antiplatelet response assay and drug adjustment in stent-assisted coil embolization: A propensity score matching analysis
Kim Min Soo, Jo Kyung II, Yeon Je Young, Kim Jong Soo, Kim Keon Ha, Jeon Pyoun, Hong Seung Chyul

09:30 – 09:40

Endovascular Treatment of Posterior Fossa Spontaneous Intracranial Dissecting Aneurysms: Related outcomes of 56 Cases treated by intracranial Stenting or Parent Vessel Occlusion
Petra Fernando, Larribau ML, Aguado A, Stefan G, Stefan V, Chavez V, Grana M

09:40 – 09:50

Stents as Adjuncts to Flow Diveters
Ocal Osman, Peker Ahmet, Arat Anıl
09:50 – 10:00
Development of microporous covered stent for the treatment of intracranial aneurysms (NCVC-CS1): its functional features and commencement of investor-initiated clinical trial
Satow Tetsu, Nakayama Yasuhide, Sakai Nobuyuki, Yamamoto Haruko, Oishi Hidenori, Hamano Eika, Orita Yoji, Matsubara Hirofumi, Takahashi Jun C

13:15 – 13:45
Poster session
Session room 2/Thursday
Chairperson: Maciek Szainer
Department of Interventional Neuroradiology, Medical University of Lublin, Poland
Moderator: Winston Lim
Singapore General Hospital, Singapore

PP326
The natural history of unruptured intracranial aneurysms: A retrospective, single center study
Okawara Mai, Kanazawa Ryuzaburo, Yamaguchi Hiroyuki, Ueda Mikiya, Maeda Takahiro

PP327
Incidence and risk factors of intracranial aneurysm: A national cohort study in Korea
Kim Tackeun, Lee Heeyoung, Ahn Soyeon, Kwon O-Ki, Bang Jae Seung, Oh Chang Wan, Yoo Ji Young

PP328
Prevalence of Intracranial Aneurysm in Patients with Aortic Dissection
W.S. Jung, Sang Hyun Suh

PP329
Crescent sign following Enterprise stent-assisted embolization of distal internal carotid artery aneurysms
Yeon Je Young, Kim Keon-Ha, Jeon Pyoung

PP330
Endovascular Treatment of Complex Cerebral Aneurysms with a Branch Incorporated into the Sac
Kim Dae Won, Kang Sung Don, Park Jong Tae, Choi Si Sung

PP331
Aneurysmal Rupture during Embolization with Guglielmi Detachable Coils: Causes, Management, and Outcome
Hwang Daehyun, Hur Jun, Hur Choonwoong

PP332
Balloon Assisted Coil Embolisation with ECLIPSE (BALT) Balloon – Single Centre, Consecutive, Retrospective Series
Padmanabhan Rajeev, Hanson Mark

PP333
Quantitative assessment of cerebral aneurysm wall enhancement using MR imaging
Omodaka Shunsuke, Endo Hidenori, Niizuma Kuniyasu, Fujimura Miki, Inoue Takashi, Matsumoto Yasushi, Tominaga Teiji

PP334
Central fever in relation to perianeurysmal inflammation following endovascular embolization of intracranial aneurysm: case report
Padolecchia Riccardo, Ganci Giuseppe, Uccelli Massimiliano, Cagetti Bernarda, Calia Stefano, Valsania Valter
Session Room 3, level 4
Thursday

08:30 – 10:00  Parallel abstract sessions

Aneurysm clinical: Vasospasm and miscellaneous

Moderators: José Mendes Prereira Caldas
University of Sao Paulo, Neurointerventional, Sao Paulo, Brazil
Noboyuki Sakai
Neurosurgery, KCGH Comprehensive Stroke Center, Kobe City Medical Center General Hospital, Kobe, Japan

08:30 – 08:40  273
Aneurysms retreatment after over 20 years: the importance of a very long-time follow-up
Cirillo Luigi, Rustici Arianna, Princiotta Ciro, Dall’Olio Massimo, Bortolotti Carlo, Sturiale Carmelo, Agati Raffaele, Leonardi Marco

08:40 – 08:50  274
Endovascular and Surgical Options for Recurrent Aneurysms after Coil Embolization: A Single Surgeon’s Experience in Japan
Toyota Shingo, Kumagai Tetsuya, Kuroda Hideki, Takenaka Tomofumi, Kobayashi Maki, Goto Tetsu, Mori Kanji, Taki Takuyu

08:50 – 09:00  275
Flow diverter treatment of intracranial aneurysms and dissections during the acute phase after SAH
Henkes Hans, Hellstern Victoria, Henkes Elina, Schob Stefan, AlMatter Muhammad, Serna Candel Carmen, Bätzner Hansjörg, Ganslandt Oliver, Aguilar Perez Marta

09:00 – 09:10  276
Flow Diverter Stent Therapy in Acute Ruptured Cerebral Aneurysms
Lucas-Neto Lia, Sequeira Paulo, Biscoito Luisa, Basílio Gonçalo, Correia Manuel, Campos Jorge

09:10 – 09:20  277
Double-layer stent for treatment of dissecting carotid artery aneurysm
Almeida-Silva Joao M, Caldas Jose GMP, Junior Francisco R, Ferraz Fausto M, Silva Felipe GV

09:20 – 09:30  278
Significance of posthemorrhagic cerebral vasospasm on clinical outcome in 178 cases from a single center
AlMatter Muhammad, Aguilar Pérez Marta, Hellstern Victoria, Serna Candel Carmen, Ganslandt Oliver, Bätzner Hansjörg, Henkes Hans

09:30 – 09:40  279
Stent-plasty for Cerebral Vasospasm: A single center experience
Loh Yince, McDougall Cameron G, Monteith Stephen J, Patel Akshal S, Andersson Tommy, Brouwer Patrick A, Soderman Michael, Bhogal Pervinder

09:40 – 09:50  280
500 mm³ is the critical aneurysm volume determining stability after coil embolization
Kang Hyun-Seung, Han Moon Hee, Cho Young Dae, Lee Jeongjun, Yoo Dong Hyun

09:50 – 10:00  281
Predictive factors of medullary infarction associated with endovascular parent artery occlusion for vertebral artery dissecting aneurysms
Aihara Masanori, Naito Isao, Shimizu Tatsuya, Miyamoto Naoko, Yoshimoto Yuhei
### Session Room 4, level 5

**Thursday**

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<th>Time</th>
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| 08:30 – 10:00 | **Parallel abstract sessions**  
Moderators: Goel Gaurav  
*Medanta Hospital, Gurgaon, India*  
Yasha Kayan  
*Abbott Northwestern Hospital, Neurointerventional Radiology, Minneapolis, USA* |
| 08:30 – 08:40 | 282  
**Endovascular Reconstruction of Intracranial Large/Giant Wide-Neck Aneurysms: Surpass Flow Diverter Early Experience**  
Pabon Boris, Vargas Oscar, Diaz Carlos, Torres Victor, Lopez Jorge |
| 08:40 – 08:50 | 283  
**Surpass Flow diverter: the Greek experience from a single-center study in 25 consecutive patients**  
Mitsos Aristotelis P., Derakhshani Shahram |
| 08:50 – 09:00 | 284  
**Surpass flow diverter in the treatment of acutely ruptured aneurysms – Indian multicenter experience**  
Goel Gaurav, Mahajan Anshu, Das Biplab, Naran Karanjit Singh, Sapra Harsh, Goyal Sumit, Sahu Sanjay, Sahu Chandradev, Jha Ajaya Nand |
| 09:00 – 09:10 | 285  
**Use of Surpass device together with AXS Catalyst 5 distal access catheter**  
Topcuoglu O.Melih, Peker Ahmet, Arat Anil |
| 09:10 – 09:20 | 286  
**Safety and Efficacy of the Pipeline Embolization Device for Treatment of Posterior Circulation Intracranial Aneurysms**  
| 09:20 – 09:30 | 287  
**Endovascular treatment of large, giant and fusiform aneurysms of posterior circulation with PED**  
Sergey Arustamyan, Yakovlev Sergey, Belousova Olga, Kaftanov Aleksey |
| 09:30 – 09:40 | 288  
**Safety and Efficacy of the Pipeline Embolization Device for Treatment of Ruptured Intracranial Aneurysms**  
| 09:40 – 09:50 | 289  
**Yes, we can: Results of a Large Series of Intracranial Aneurysms Treated with Pipeline Flow Diverter Stent in a Developing Country**  
Pabon Boris, Diaz Carlos, Torres Victor, Vargas Oscar |
| 09:50 – 10:00 | 290  
**Safety and Efficacy of the Pipeline Embolization Device for Treatment of Recurrent Intracranial Aneurysms**  
Program of Symposium for Nurses, Technicians and Radiographers in cooperation with ESMINT

Monday, 16th of October

Session Room 4, level 5
08:30 – 13:00

Symposium for nurses, technicians and radiographers in cooperation with ESMINT – 1.

Chairperson: Adriaan van Es
Erasmus Mc, Rotterdam, the Netherlands

Moderators:

Kiffon Keigher
Rush University Medical Center hospital Chicago, USA

Ake Holmberg
Karolinska Universitetssjukhuset Solna, Stockholm, Sweden

08:30 – 08:40
Opening

08:40 – 09:00
The role of nurses, radiographers and technicians in the acute stroke era: challenges and expectations
István Szikora
National Institute of Clinical Neurosciences, Budapest, Hungary

09:00 – 09:20
Stroke workflows—the European and American experience
Kiffon Keigher
Rush University Medical Center hospital Chicago, USA

09:20 – 09:40
Organization, method of operation and performance of our thrombectomy procedure
Sebastian van Dirach
University Hospital Odense, Denmark

09:40 – 10:00
Mechanical thrombectomy: current indications
Laurent Pierot
Maison Blanche Hospital, University Hospital of Reims, Reims, France

10:00 – 10:20
Swedish quality register and EVAS
Åke Holmberg
Karolinska Universitetssjukhuset Solna, Stockholm, Sweden

10:20 – 11:00
Coffee break

11:00 – 13:00
Symposium for nurses, technicians and radiographers in cooperation with ESMINT – 2.

Chairperson: Adriaan van Es
Erasmus Mc, Rotterdam, the Netherlands

Moderators:

Fabienne Menu
Maison Blanche Hospital, University Hospital of Reims, Reims, France

Sébastien Soize
Maison Blanche Hospital, University Hospital of Reims, Reims, France

11:00 – 11:20
Endovascular treatment of Ischemic Stroke – What we know and what we don’t know
Wim van der Zwan
Maastricht University Medical Centre, Maastricht, The Netherlands

11:20 – 11:40
Imaging in Stroke
Adriaan van Es
Erasmus University Medical Center Rotterdam, The Netherlands
11:40 – 12:20 Influence of clot types, speed of retrieval and catheter position on mechanical thrombectomy efficacy: experimental study on a cerebrovascular model
Fabienne Menu & Sébastien Soize
Maison Blanche Hospital, University Hospital of Reims, Reims, France

12:20 – 13:00 It’s all about teamwork
Tommy Andersson
Karolinska Universitetssjukhuset Solna, Stockholm, Sweden

Wednesday, 18th of October
Session Room 4, level 5
08:30 – 13:00 Symposium for nurses, technicians and radiographers in cooperation with ESMINT – 3.
Chairperson: Adriaan van Es
Erasmus Mc, Rotterdam, the Netherlands
Moderators: Ariene Mastenbroek
LUMC, Radiology, Netherlands
Helen Genins
Uppsala University Hospital, Uppsala, Sweden

08:30 – 08:40 Opening

08:40 – 09:00 Antiplatelet/anticoagulation use for the aneurysm and stroke patient and reversal of these drugs
Kiffon Keigher
Rush University Medical Center hospital Chicago, USA

09:00 – 09:20 Current Treatment Options for Intracranial aneurysms
Jan-Hendrik Buhk
Universitätsklinikum Hamburg Eppendorf, Hamburg, Germany

09:20 – 09:40 Pre-hospital acute stroke screening and mobile stroke units
Demetrius Lopes
Rush University Medical Center hospital Chicago, USA

09:40 – 10:00 Significance and challenges of data collection for acute stroke management
Ágnes Vadász & Viktória Csike
National Institute of Clinical Neurosciences, Budapest, Hungary

10:00 – 10:45 Coffee break

10:45 – 12:45 Hands on course
Moderators: Johanna Doshé
Karolinska University Hospital, Stockholm, Netherlands
Kathryn Jones
Royal Hobart Hospital, Medical Imaging Department Tasmania, Australia

Hands on workshop for nurses, technicians and operators Provided by Medtronic Neurovascular, Stryker Neurovascular and Neuravi/Codman
This exclusive workshop will provide the participants with an excellent opportunity to gain an experience with stroke and aneurysm treatment as well as to learn about the structure and composition of different clots.
Oral Presentations

MONDAY

Monday, 16th of October – Plenary Room – 07:15 – 08:00 – Back to the basics: Stroke: epidemiology and imaging

INV01

Epidemiology of stroke

Óváry Csaba¹
¹National Institute of Clinical Neurosciences, Budapest, Hungary

Purpose: Stroke is the most important cause of disability among adults. The fact that mechanical thrombectomy has revolutionized the treatment of acute ischemic stroke with large vessel occlusion, amplifies the importance of valid local epidemiological data, when setting targets and planning stroke-care on a national level.

Methods: This presentation is a review of different epidemiological studies from various geographical areas and ethnic groups, comparing them to our studies in Hungary.

Results: The estimated standardized incidence of ischemic stroke in Hungary was 200.3/100 000 at the millennium. Though, crude incidence-rates have been steadily declining for more than 10 years, they are still two-folds higher in Hungary than in Western-Europe or Japan. Early, 28-day case-fatality rates for stroke in various studies from different areas of the World mainly depended on the level of acute care, and stroke units provided the best possible outcomes everywhere. Differences in the prevalence of vascular risk factors in the populations are mainly responsible for differences in stroke incidence, and stroke subtypes. Some of these risk factors, such as atrial fibrillation, might also predict higher rates of large vessel occlusions. In our population-based study in Northern Hungary hypertension, diabetes, atrial fibrillation (AF), regular alcohol consumption, depression (measured by Beck-scale), lack of physical exercise all had higher prevalence as compared to published data on Western European population. The prevalence of AF was extremely high, 5.6%.

Conclusion: Focusing on mechanical thrombectomy related health-care programs, local and valid epidemiological data is essential for planning educational programs for health-care professionals and allocating health-care resources in countries with varying level of stroke services and institutional possibilities.

INV02

Ischemic stroke imaging

Von Kummer Rüdiger¹
¹Universitätsklinikum Carl Gustav Carus, Neuroradiology, Dresden, Germany

Introduction: “Stroke” is a clinical entity that cannot be imaged, but recognized clinically by its typical central nervous system symptoms. Imaging is required to diagnose the specific cause of stroke and its current vessel and brain tissue pathology. In acute cerebral ischemia, the assessment of arterial obstruction and of irreversible injury is crucial for treatment decisions and the patient’s prognosis. Major brain artery occlusion as detected by CT- or MR-angiography or DSA is the precondition for endovascular therapy with thrombectomy. Whether thrombectomy and arterial recanalization will be clinically beneficial depends on the amount of brain tissue that can regain function with reperfusion. There is still uncertainty how imaging can safely differentiate reversible from irreversible ischemic brain tissue in the acute phase of stroke.

Methods: We review here experimental and clinical papers describing the pathology and pathophysiology of cerebral ischemia under controlled conditions.

Results: Within the first 6 hours of stroke onset, ischemic cell injury is subtle and hard to recognize under the microscope. Functional impairment is obvious, but can be induced by ischemic blood flow allowing recovery with flow restoration. The critical cerebral blood flow (CBF) threshold for irreversible injury is ~15 ml/100g/min. Below this threshold, ischemic brain tissue takes up water in case of any residual capillary flow (ionic edema). Because tissue water content is linearly related to x-ray attenuation, computed tomography (CT) can detect and measure ionic edema and thus determine ischemic brain infarction. In contrast, diffusion weighted magnetic resonance imaging (DWI) detects cytotoxic edema that develops at higher thresholds of ischemic CBF and is thus highly sensitive for milder levels of brain ischemia, but not specific for irreversible brain tissue injury.

Conclusion: CT and MRI are complimentary in the detection of ischemic stroke pathology and are valuable for treatment decisions.
Endovascular thrombectomy is now the standard of care for patients suffering from ischemic stroke due to large vessel occlusion in the anterior circulation. The effect size and benefit of treatment is massive in appropriately chosen patients. In addition, it is absolutely clear that 'time is brain'. Thus in the workflow of treatment of an acute stroke patient everything including imaging has to be optimized to get the maximum information in the least amount of time. The information gathered from imaging should be geared up towards decision making using Bayesian Principles. We have broadly speaking the option of doing imaging based on CT or MR. In this comparison, clearly CT is the winner for many different reasons that will be discussed in the presentation. Next question is of how to best perform CT imaging in the shortest possible time to move things along and take appropriate decision towards EVT. Various approached of CT based imaging shall be discussed including their pros and cons.

Is IVT still needed?
Marc Ribo
Hospital Vall d’Hebron, Neurology, Barcelona, Spain

Expanding time window & wake up stroke
Tudor Jovin
UPMC Stroke Institute, UPMC Center for Neuroendovascular Therapy, USA

Alternate thrombectomy techniques: Retrieval versus aspiration
Aquilla Turk
Medical University of South Carolina, Charleston, USA

Thrombectomy in posterior circulation stroke
Johannes C Gerber
University Hospital Carl Gustav Carus Dresden, Neuroradiology, Dresden, Germany

INV04
Sedation versus general anaesthesia for thrombectomy
Möhlenbruch Markus A¹ and Bendszus Martin¹
¹Heidelberg University Hospital, Department of Neuroradiology, Heidelberg, Germany

Thrombectomy has become the treatment of choice for stroke due to large vessel occlusion; however, there has been a lot of debate on the mode of patient management during thrombectomy. Recent retrospective data suggested a worse outcome in patients undergoing general anesthesia when compared to conscious sedation only; however, these data have been criticized due to a potentially severe selection bias. A post hoc analysis of the MR CLEAN trial also indicated a more favorable outcome in patients not undergoing general anesthesia but all of these studies compared either different patients or centers. These effects may have been much stronger than the mode of patient management during the intervention; therefore, a single center randomized controlled trial Sedation vs. Intubation for Endovascular Stroke Treatment (SIESTA) was conducted to compare general anesthesia and conscious sedation in patients with large vessel occlusion. All patients were treated by an experienced team of neurointerventionalists and stroke specialists, and randomization was performed prior to treatment. Primary outcome, i.e. early neurological improvement in the NIHSS after 24 h, was not significantly different between the general anesthesia group vs. the conscious sedation group. In the general anesthesia vs. the conscious sedation group, substantial patient movement was less frequent, but postinterventional complications were more frequent for hypothermia, delayed extubation, and pneumonia. More patients were functionally independent (unadjusted mRS score 0–2 after 3 months in 37.0% of the general anesthesia group vs. 18.2% of the conscious sedation group, P = 0.01). There were no differences in mortality at 3 months (24.7% in both groups). We concluded that the study findings do not support an advantage for the use of conscious sedation.

What consequences can be drawn for clinical practice from this trial? According to this trial both general anesthesia and conscious sedation are safe and feasible in neurothrombectomy, and there should not be an a priori preference for either technique. It should be left up to the neurointerventionalist to decide how to safely perform the procedure. On the other hand, it has to be considered that this study was conducted under optimized conditions (i.e. dedicated stroke physicians with experience in quick and effective handling of stroke patients). Under other conditions (e.g. long waiting time for anesthesia) the results may be different. In these instances, conscious sedation may be a better choice. The results of the SIESTA trial leave it up the choice of the interventionalist for either techniques of patient management.
Conclusion: Gp IIb/IIIa inhibitors include abciximab, tirofiban, and eptifibatide. They are used in neuroendovascular procedures. Available Gp IIb/IIIa (Gp IIb/IIIa) inhibitors have increasingly been shown to provide additional advantages. In addition, recently, the use of glycoprotein IIb/IIIa (Gp IIb/IIIa) inhibitors has been shown to provide further advantages. The more rapid onset and offset of platelet inhibition by the new generation direct-acting and reversible P2Y12 inhibitors may provide a more rapid onset and offset of platelet inhibition by the new generation direct-acting and reversible P2Y12 inhibitors. This is because the pharmacological and clinical profile of clopidogrel. The inadequate prevention of thromboembolic events without adequate platelet inhibition means that the physicians who care for patients with intracranial hemorrhage (ICH) understand these pathways and recognize how they can be reversed to restore hemostasis.

Materials and Methods: A literature search was conducted (1966–June 2017) using MEDLINE including in-process and other nonindexed citations, as well as Current Contents, Embase, Drugs & Pharmacology, and the International Pharmaceutical Abstract databases. This search prompts an understanding of the similarities and differences in the properties and mechanisms of action of the different antithrombotic agents, including the new drugs and the importance to optimize the development and use of these agents in clinical practice. Proper indications for the use of antplatelet agents during neurointerventional procedures will be reviewed. In addition, reasonable alternatives to pretreatment with aspirin and clopidogrel, useful in patients with intracranial hemorrhage (ICH) understand these pathways and recognize how they can be reversed to restore hemostasis.

Results: Clopidogrel has several drawbacks, which include delayed onset of action, large inter-individual variability in platelet response, genetic polymorphism of the metabolizing enzyme, drug-drug interactions (DDIs), and the two-step activation process catalyzed by a series of cytochrome P450 (CYP) isoenzymes. For these reasons, new P2Y12 receptor inhibitors have been developed in an attempt to improve on the pharmacological and clinical profile of clopidogrel. The newest P2Y12 receptor inhibitors: prasugrel, ticagrelor and cangrelor have individual properties and, according to their mechanism of inhibition, can be divided into irreversible (prasugrel) and reversible inhibitors (ticagrelor, cangrelor). The more rapid onset and offset of platelet inhibition by the irreversibly acting and reversible P2Y12 inhibitors may provide further advantages. In addition, recently, the use of glycoprotein IIb/IIIa (Gp IIb/IIIa) inhibitors has been shown to improve on the pharmacological and clinical profile of clopidogrel. The inadequate prevention of thromboembolic events without adequate platelet inhibition means that the physicians who care for patients with intracranial hemorrhage (ICH) understand these pathways and recognize how they can be reversed to restore hemostasis.

Conclusion: The adequate prevention of thromboembolic events is of paramount importance during stenting and flow diversion. Stenting techniques are increasingly used in the management of intracranial aneurysms. Flow divers are now routinely used for an expanding population of aneurysms. As new agents are being made available, care providers must be aware of the effective strategies to administer these pharmacologic agents.

**INV05**

**Periprocedural antithrombotic treatment**

**Thibault Lucie**

Montreal, Canada

**Purpose:** As the arsenal of antplatelet therapy expands, clinicians have the ability to choose the appropriate inhibitor according to patient-specific factors including risk of thrombosis, concomitant disease state and therapy, age, weight and clinical contraindications for adequate prevention of thromboembolic events. In clinical practice, the requirement for rapid inhibition of platelet activity means adequate prevention of thromboembolic events without increasing the chances of bleeding. As patients are increasingly treated with anticoagulants and antplatelet agents, it is also essential that the physicians who care for patients with intracranial hemorrhage (ICH) understand these pathways and recognize how they can be reversed to restore hemostasis.

**Materials and Methods:** A literature search was conducted (1966–June 2017) using MEDLINE including in-process and other nonindexed citations, as well as Current Contents, EMBASE, Drugs & Pharmacology, and the International Pharmaceutical Abstract databases. This search prompts an understanding of the similarities and differences in the properties and mechanisms of action of the different antithrombotic agents, including the new drugs and the importance to optimize the development and use of these agents in clinical practice. Proper indications for the use of antplatelet agents during neurointerventional procedures will be reviewed. In addition, reasonable alternatives to pretreatment with aspirin and clopidogrel, useful in patients with intracranial hemorrhage (ICH) understand these pathways and recognize how they can be reversed to restore hemostasis.

**Results:** Clopidogrel has several drawbacks, which include delayed onset of action, large inter-individual variability in platelet response, genetic polymorphism of the metabolizing enzyme, drug-drug interactions (DDIs), and the two-step activation process catalyzed by a series of cytochrome P450 (CYP) isoenzymes. For these reasons, new P2Y12 receptor inhibitors have been developed in an attempt to improve on the pharmacological and clinical profile of clopidogrel. The newest P2Y12 receptor inhibitors: prasugrel, ticagrelor and cangrelor have individual properties and, according to their mechanism of inhibition, can be divided into irreversible (prasugrel) and reversible inhibitors (ticagrelor, cangrelor). The more rapid onset and offset of platelet inhibition by the irreversibly acting and reversible P2Y12 inhibitors may provide further advantages. In addition, recently, the use of glycoprotein IIb/IIIa (Gp IIb/IIIa) inhibitors has been shown to improve on the pharmacological and clinical profile of clopidogrel. The inadequate prevention of thromboembolic events without adequate platelet inhibition means that the physicians who care for patients with intracranial hemorrhage (ICH) understand these pathways and recognize how they can be reversed to restore hemostasis.

**Conclusion:** The adequate prevention of thromboembolic events is of paramount importance during stenting and flow diversion. Stenting techniques are increasingly used in the management of intracranial aneurysms. Flow divers are now routinely used for an expanding population of aneurysms. As new agents are being made available, care providers must be aware of the effective strategies to administer these pharmacologic agents.

**Monday, 16th of October – Plenary Room – 11:00 – 12:05 – Plenary Session 2. – Stroke: Where are we going? Ongoing research**

**Progress of the international clot research project**

**Simon De Meyer**

KU Leuven Kulak Campus Kortrijk, Kortrijk, Belgium

**INV06**

**New recanalization techniques**

**Gounis Matthew J**, **Chueh Ju-Yu** and **Puri Ajit S**

1University of Massachusetts Medical School, Radiology, Worcester, United States

Mechanical thrombectomy (MT) for emergent large vessel occlusion in acute ischemic stroke offers a profound treatment effect. With nearly 90% of MT cases receiving successful recanalization, typically defined as Thrombolysis in Cerebral Infarction (TICI) greater than or equal to 2B, it may be difficult to imagine further improvements in the technical aspects of the procedure. However, data show the efficient and complete (TICI = 3) recanalization lead to further improved rates of good functional outcomes. The challenge for next generation thrombectomy technology is complete removal of the embolus without shedding distal fragments in the first pass for nearly all cases and without introducing any delays in workflow.

Pre-clinical research deployed a variety of in vitro and in vivo modeling to quantify efficacy and safety profiles of MT devices. With the introduction of stent-retrievers, the vast majority of these models demonstrated nearly perfect efficacy (the ability to retrieve an embolus) and acceptable vascular trauma. Since the completion of the overwhelming positive trials, modeling is now focused to further challenge the new generation thrombectomy technology to achieve the aforesaid clinical goals. These models include severely tortuous vascular replicas and clot analogs that resist stent-retriever/aspiration engagement or are prone to fragmentation. Under a simulated use environment, efficacy metrics include time and number of passes to complete recanalization (measured quantitatively by flow restoration) and the size distribution of shed fragments. In vivo safety metrics include histopathological evidence of vascular trauma and ischemia/infarction of downstream tissue following MT.

Despite advancements in vascular occlusion modeling, the obvious limitation is the absence of a true stroke model for MT. This limitation is more pronounced when looking at coupling endovascular technology with pharmacological interventions such as neuroprotection. Simulated MT in small animal models is an important screening tool, yet a translational model that encompasses all aspects of...
the procedure remains elusive. This lecture will review pre-clinical modeling efforts, and predictions made on new device technology and techniques to achieve the goal of optimized MT.

Neuroprotective bridging and endovascular treatment beyond recanalization: hyperoxygenation and intra-arterial cooling
Sven Poli
Department of Neurology & Stroke, Hertie Institute for Clinical Brain Research, University of Tübingen, Germany

Tissue regeneration: intra-arterial stem cell infusion
Éva Mezey
National Institute of Health, Bethesda, USA


001
Influence of Balloon, Conventional, or Distal Catheters on Angiographic and Clinical Outcomes in the STRATIS Registry
1St Vincent Mercy Medical Center, Toledo, United States
2Vanderbilt University Medical Center, Nashville, United States
3University of California, Los Angeles, Los Angeles, United States
4Brigham and Women’s Hospital, Boston, United States
5Methodist Hospital, Houston, United States
6Emory University, Atlanta, United States
7Grady Memorial Hospital, Atlanta, United States
8Florida Hospital, Orlando, United States
9University of Miami, Miami, United States
10Jackson Memorial Hospital, Miami, United States
11Norton Neuroscience Institute, Louisville, United States
12Advanced Neuroscience Network/Tenet South Florida, Delray Beach, United States

Background: Higher rates of successful revascularization with the least number of passes correlate with improved clinical outcomes in acute stroke endovascular treatment. Different adjunctive technical approaches, such as proximal flow arrest using balloon guide catheter (BGC), large bore conventional guide catheter (CGC), or distal large bore catheter (DLBC) with lesional or regional aspiration, are aimed at improving revascularization rates. We present an analysis of the influence of thrombectomy techniques on angiographic and clinical outcomes from the STRATIS Registry.

Methods: STRATIS is a prospective, multicenter, observational single-arm registry of patients with large vessel occlusion treated with Solitaire/Mindframe ≤8 hours of symptoms onset. Technical approaches were grouped based on the first technique implemented: BGC; CGC; and DLBC. Posterior circulation target vessel occlusion and subjects with combined BGC and DLBC approach were excluded. A Core Lab blinded to clinical outcome extrapolated the techniques from the procedural reports. The main technical outcomes were: 1) First pass effect (FPE) defined as successful recanalization of ≥TICI2b after first device pass, 2) True FPE defined as TICI 3 or 2c after first pass; 3) Number of passes. Good clinical outcome was defined as mRS 0–2 at 90 days.

Results: 936 anterior circulation subjects were analyzed. The initial technical approach was 54% BGC, 32% DLBC, 8% CGC, and 6% mixed techniques. The groups were well balanced in reference to baseline factors. The rates of FPE were: 68%, 55%, and 43% (P < 0.001), while the true FPE rates were: 48% vs. 34% vs. 26% (P < 0.001) with BGC, DLBC, and CGC, respectively. The mean number of passes were: 1.7 ± 1.1, 2.0 ± 1.3, and 2.2 ± 1.6 (P < 0.001), with BGC, DLBC, and CGC, respectively. The rates of successful recanalization of ≥TICI2b after all passes were 89% BGC, 88% DLBC, and 84% CGC (P = 0.51). Rate of good clinical outcome was 62%, 50% and 45% with BGC, DLBC and CGC respectively (p = 0.001).

Conclusion: Despite having similar final successful recanalization rates, BGC use as the first approach in STRATIS demonstrated a higher rate of good clinical outcome at 90 days compared to CGC and DLBC.

002
Prior IVT in Mechanical Thrombectomy for Acute Ischemic Stroke: Benefit or Not?
Parra-Farinas Carmen1, Tomasello Weitz Alejandro2, Cardona Portela Pere3, De Miguel Maria Angeles3, Gomis CortinaMeritxell4, Castaño Duque Carlos4, Blasco Jordi5, Urra Xavier5 and Ribó Jacobí Marc2
1Vall d’Hebron University Hospital, Department of Radiology, Barcelona, Spain
2Vall d’Hebron University Hospital, Interventional Neuroradiology, Barcelona, Spain
3Bellvitge University Hospital, Interventional Neuroradiology, Barcelona, Spain
4Hospital Universitari Germans Trias i Pujol (Can Ruti), Interventional Neuroradiology, Barcelona, Spain
5Clinic University Hospital, Interventional Neuroradiology, Barcelona, Spain
**Purpose:** Endovascular stroke therapy has revolutionized the management of patients with acute brain infarction. There is a lack of evidence-based data concerning the impact of including intravenous thrombolysis (IVT) before mechanical thrombectomy. This study aimed to assess the impact of IVT before mechanical thrombectomy in acute ischemic stroke patients.

**Materials and Methods:** We used data from a mandatory, population-based registry that includes external monitoring of completeness, which assesses reperfusion therapies for consecutive patients with acute ischemic stroke since 2011. We included the total number of thrombectomy cases from all participant centres to simulate a "real-world" clinical practice between January 2011 and December 2015. Analysis and outcome parameters: any recanalization (TICI ≥ 2a), complete recanalization (TICI ≥ 2b), procedural time, symptomatic intracranial haemorrhage (SICH), neurological improvement (≥4 points decrease in the NIHSS score at 24 hours), independent functional outcome (mRS ≤ 2), and mortality at three months.

**Results:** Among the 1640 patients included, 48.1% received IVT. Mean age at treatment was 67.5 ± 13.5 years old, 54.4% male. Diabetes mellitus (p = 0.024), atrial fibrillation (p < 0.001), and ischemic cardiomyopathy (p = 0.018) prevalence rates were higher in IVT patients. There were no other statistically significant differences in baseline characteristics between IVT treatment groups. Median NIHSS score was 17 (12–21) on arrival and 9 (3–18) at 24 hours. The overall recanalization complete rate was 77.8%. Complete recanalization rate was not different according to previous IVT: 79.8% IVT patients vs. 75.9% no IVT patients (p = 0.065). Nevertheless, patients who received IVT achieved higher any recanalization rate: 88.3% IVT patients vs. 84.2% no IVT patients (p = 0.006). IVT was associated with shorter procedural time: 70.1 min vs. 93.3 min (p = 0.002). No differences were observed in terms of SICH: 3.0% vs. 3.2%. There were no differences in early neurological improvement: 70.1% vs. 71.8% (p = 0.491), however patients receiving IVT achieved higher functional independence at 3 months: 53.3% vs. 43.9% (RR, 1.2; 95% CI 1.1–1.3; p = 0.046), and less mortality: 14.7% vs. 21.4% (RR, 0.7; 95% CI 0.6–0.8; p = 0.001).

**Conclusion:** IVT administration before mechanical thrombectomy is associated with better any recanalization rate, shorter procedural time, better clinical outcome, and less mortality. In addition, preceding IVT does not seem to influence in SICH development.

**003 Safety and Efficacy of the ‘SOFITAIRe’ approach in the Endovascular Treatment of Acute Ischemic Stroke**

**Pabon Boris**, **Jorge Lopez**, **Diaz Carlos**, **Vargas Oscar** and **Torres Victor**

1Angioteam/Clinica del Norte, Neuroendovascular Surgery, Medellin, Colombia

2Angiosur, Interventional Neuroradiology, Medellin, Colombia

3Clinica el Rosario, Neurovascular, Medellin, Colombia

**Purpose:** Prompt recanalization of occluded brain arteries in patients with stroke requires the use of multiple strategies. We report a retrospectively collected clinical experience in Medellin – Colombia using a combination of a direct first pass technique with Sofia 6 Plus (MicroVention-Terumo, Inc., Tustin, CA) Reperfusion Catheter in combination with SolitaireTM FR (SFR) (ev3 Inc, Irvine, California, USA) in the treatment of AIS.

**Materials and Methods:** Between March 2016 and March 2017 data from 31 patients treated with SofitaiRe approach within 8 h of AIS symptom onset were selected. Procedural data including TICI score, Timing, adverse events and outcome were analyzed

**Results:** “SofitaiRe” approach was successful in achieving complete recanalization in 27 patients (87%) with a final score of 3 according to the TICI. A partial recanalization (TICI 1 - 2a) was obtained in two patients (6.4%). Treatment failure was observed in two cases. 80.6% of strokes were in anterior circulation. Five cases presented with tandem lesions involving cervical ICA. Median time from groin puncture to revascularization was 39 minutes. None adverse events were recorded. One patient, not re-vascularized died during the hospitalization due to massive MCA infarction. Marked improvement of National Institutes of Health Stroke Scale from baseline to 24 h after recanalization was obtained in all survivors.

**Conclusion:** “SofitaiRe” approach was effective and fast in achieving a high rate of complete artery recanalization with a low rate of complications. The combined use of reperfusion catheters with retrievers may be considered a promising tool for endovascular revascularization.

**004 Wireless ADAPT (WADAPT) Thrombectomy**

Miskolczi Laszlo

1Holy Cross Hospital, Interventional Neuroradiology, Ft Lauderdale, United States

**Purpose:** All currently existing thrombectomy methods involve crossing the embolus with a coaxially assembled microcatheter and microwire combination, according to their respective manufacturer’s instructions. The purpose of this report was to evaluate a modified, much faster technique of thrombus aspiration. A large bore aspiration catheter is advanced via the guide catheter, all along to the embolus, without a coaxial assembly or even a wire if possible.

**Materials and Methods:** The baseline biplane view of the carotid siphon and the target blood vessel helps to estimate the size of catheter needed, and to assess tortuosity. The thrombectomy catheter is then advanced alone, under roadmap guidance, using tactile feedback to assess safety of the forward force. When forward tracking was prevented by any obstacle, a wire or a catheter-wire combination was opened
Endovascular revascularization with contact aspiration versus stent retriever in acute Ischemic stroke with large vessel occlusion. The ASTER TRIAL

Pirotin Michel1, Blanc Raphaël2, Gory Benjamin2, Labreuche Julien2, Marnat Gauthier3, Saleme Suzanna5, Costalat Vincent4, Bracard Serge5, Desai Hubert9, Consoli Arturo8 and Lapergue Bertrand10

1Fondation Rothschild, Interventional Neuroradiology, Paris, France
2Hospices Civils de Lyon, Interventional Neuroradiology, Bron, France
3University of Lille, CHU Lille, EA 2694 - Santé publique : Epidémiologie et Qualité des Soins, Department of Biostatistics, Lille, France
4CHU Pellegrin, Neuroradiology, Bordeaux, France
5CHU Limoges, Interventional Neuroradiology, Limoges, France
6CHU Montpellier, Neuroradiology, Montpellier, France
7CHU Nancy, Neuroradiology, Nancy, France
8CHU Nantes, Neuroradiology, nantes, France
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10Hôpital Foch, Neurology, Suresnes, France

Purpose: Benefits of endovascular revascularization with contact aspiration technique versus stent retriever in acute ischemic stroke remains unknown due to lack of evidence from randomized trials. To assess whether thrombectomy with contact aspiration (CA) is superior to stent retriever (SR) for successful reperfusion among acute stroke patients with large vessel occlusion.

Materials and Methods: ASTER (contact Aspiration versus Stent Retriever for successful reperfusion) is a prospective, randomized, controlled, open-label, blinded end-point (PROBE) clinical trial conducted across eight comprehensive stroke centers in France (October 2015-October 2016). Included 391 patients with acute ischemic and isolated/combined occlusion at any level of the intracranial internal carotid or middle cerebral artery within six hours of stroke onset. Primary outcome was the percentage of patients with successful recanalization defined as a modified Thrombolysis In Cerebral Infarction [mTICI] score of 2 b [perfusion ≥50% of the vascular distribution of the occluded artery] or 3 [full perfusion with filling of all distal branches] at the end of angiography (i.e. after the assigned treatment and any further treatment deemed necessary). Secondary outcomes were global disability assessed by overall distribution of the modified Rankin scale (mRs) at 90 days (shift analysis combining scores of 5 and 6), the functional independence as defined by a 90-day mRs ≤2, the change in National Institute of Health Stroke Score (NIHSS) score at 24 hours and the percentage of deaths due to any cause at 90-days, and procedure-related serious adverse events and safety.

Result: The mean age of the 381 study patients was 69.9 (SD 14.3), 54.3% (n = 207) were men, the mean baseline NIHSS score was 16.2 (SD 6.2) and the median time from symptom onset to groin puncture was 227 min (IQR, 180 to 280). The primary efficacy outcome was achieved similarly in CA and SR arms (85.4% versus 83.1%, Table 2); the corresponding estimates of risk difference and risk ratio were −2.4% (95%CI, −9.7 to 5.4%) and 1.03 (95%CI, 0.93 to 1.13), respectively. Similar result was found in sensitivity analysis using mTICI score assessed at study site, or when successful reperfusion was defined as mTICI score 3. Among 363 patients (95.3%) with modified Rankin scale assessment at 3-month, we found no significant difference in the proportion of patients who were functionally independent (modified Rankin scale score 0–2). There was no significant shift in the distribution of modified Rankin scale score in favor of CA, with a common odds ratio for 1 point improvement of 0.76 (95%CI, 0.53 to 1.10).

Conclusion: Among patients with acute ischemic stroke in the anterior circulation undergoing thrombectomy, frontline
thrombectomy with CA vs SR did not result in greater successful reperfusion rate at the end of the procedure, but achieved similar efficacy and safety.

Correlation of Tmax volumes with clinical outcome in anterior circulation stroke

Seker Fatih1, Pfaff Johannes1, Potreck Arne1, Mundiyanapurath Sibu2, Ringleb Peter A.2, Bendszus Martin1 and Möhlenbruch Markus A.3
1Heidelberg University Hospital, Neuroradiology, Heidelberg, Germany
2Heidelberg University Hospital, Neurology, Heidelberg, Germany
3Heidelbeg University Hospital, Neurology, Heidelberg, Germany

Background and Purpose: The recent thrombectomy trials have shown that perfusion imaging is helpful in proper patient selection in thromboembolic stroke. In this study, we analyzed the correlation of pretreatment Tmax volumes in MR and CT perfusion with clinical outcome after thrombectomy.

Methods: 41 consecutive patients with middle cerebral artery occlusion (MCA) or carotid T occlusion treated with thrombectomy were included. Tmax volumes at delays of >4, 6, 8 and 10 seconds as well as infarct core and mismatch ratio were automatically estimated in preinterventional MRI or CT perfusion using RAPID software. These perfusion parameters were correlated with clinical outcome. Outcome was assessed using modified Rankin Scale at 90 days.

Results: In patients with successful recanalization of MCA occlusion, Tmax > 8 and 10 seconds showed the best linear correlation with clinical outcome (r = 0.75; P = .0012 and r = 0.73; P = .0019). Univariate binary logistic analysis showed that chances of good clinical outcome decrease below 50%, if Tmax volume at a delay of >8 seconds exceeds about 70 ml. Above 150 ml, good outcome was highly unlikely. In terminal internal carotid artery occlusions, none of the perfusion parameters showed a significant correlation with clinical outcome.

Conclusions: Tmax at delays of >8 and 10 seconds is a good predictor for clinical outcome in MCA occlusions. In carotid T occlusion, however, Tmax volumes have no predictive value regarding outcome.

Impact of vertebral patency and anatomy on reperfusion success of mechanical thrombectomy in acute basilar artery occlusions: Do we need contralateral flow-arrest?

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Purpose: Factors influencing successful and complete recanalization without residual thrombus burden in acute basilar artery occlusion (BAO) are largely unknown. Thrombus length and early initiation of endovascular therapy have been proposed as possible influencing factors and a small case series has suggested that the flow-pattern and patency of the vertebral arteries may impact recanalization success.

Methods: A retrospective single-center analysis of 103 basilar artery occlusion treated with 2nd generation thrombectomy devices was carried out. Occlusion pattern, thrombectomy characteristics and reperfusion success including occurrence and location of persistent emboli were evaluated in detail. Reperfusion success was evaluated by grading the level of vertebral-basilar-posterior artery axis (VBPAAX) reperfusion as well as side branch reperfusion (AICA, PICA, SUCA) separately. Anatomy and patency of the vertebral artery contralateral to the endovascular access was dichotomized in hypoplastic/aplastic and patent/normal caliber. Functional and neurological outcomes were evaluated using the modified Rankin Scale (mRS) and National Institutes of Health Stroke Scale (NIHSS) at discharge, respectively. A favorable functional outcome was defined as mRS of 0–3, while good neurological outcome was defined as NIHSS < 5.

Results: Patients with an aplastic or hypoplastic VA contralateral to the endovascular access had higher rates of full VBPAAX reperfusion as opposed to patients with large caliber contralateral VA (88.2% vs. 62.9%, p = 0.004). Correspondingly, patients with contralateral large caliber VA tended to have more side branch occlusions. After correcting for occlusion level, partial occlusion, age, gender, pretreatment with IV rtPA and time to treatment, contralateral VA hypoplasia/aplasia was independently associated with full VBPAAX reperfusion (aOR 4.369, 95%-CI 1.332–14.332). Patients with full VBPAAX reperfusion had higher rates of favorable functional outcomes 43.9% vs. 19.0%, p = 0.046) and good neurological outcomes (42.7% vs. 9.5%, p = 0.005). Further, full VBPAAX reperfusion was associated with lower mortality (20.7% vs 42.9%, p = 0.050).

Conclusion: The presence of a hypo-/aplastic contralateral vertebral artery in the setting of mechanical thrombectomy of vertebrobasilar artery occlusions is clearly associated with improved recanalization success, which in turn leads to a better patient outcome. Therefore, a prospective study
should confirm a possible patient benefit of a balloon-occlusion of the contralateral vertebral artery during vertebrobasilar mechanical thrombectomies.

008
Y-configuration double-stent thrombectomy for acute intracranial bifurcation occlusion refractory to conventional thrombectomy
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Purpose: To investigate the feasibility, safety and effectiveness of Y-configuration double-stent thrombectomy for acute intracranial bifurcation occlusion refractory to conventional thrombectomy.

Materials and Methods: Clinical and imaging data were retrospectively collected and analyzed in patients with bifurcation occlusion treated with the Y-configuration double-stent technique.

Results: Twelve cases (mean age 72 years) refractory to single stent retriever thrombectomy were collected, including 7 cases in the internal carotid artery terminus (ICA-T), 4 in the middle cerebral artery (MCA) bifurcation, and 1 in the basilar terminus. The single pass Y-configuration double-stent thrombectomy was performed in 10 cases (83%), 2 passes (17%) in 2 cases. All the patients achieved an arterial occlusive lesion score of 3, among which 6, 4, and 2 achieved angiographic reperfusion of 2b, 3, and 2a according to the modified thrombolysis in cerebral infarction scale, respectively. The recanalization rate of using this technique for ICA-T occlusion is higher than for MCA bifurcation occlusion (100% vs. 50%). Subarachnoid hemorrhage occurred in 2 cases of MCA bifurcation occlusion, severe vasospasm in 1 case of ICA-T occlusion. One patient died of parenchymal hematoma. At 3 months, good clinical outcome was achieved in 5 cases (41.7%).

Conclusion: Y-configuration double-stent retriever thrombectomy was technically feasible for acute intracranial bifurcation occlusion, and high successful recanalization rate was achieved as a salvage technique when conventional mechanical thrombectomy fails. This technique seems to be safer for carotid terminus than for MCA bifurcation occlusion in our study.

Key Words: Thrombectomy; Stroke; Artery; Stent; Intervention

009
Safety and efficacy of the “Push and fluff” technique for Trevo deployment: comparison with standard unsheathing technique
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Purpose: The standard deployment technique of stentriever is based on classic pull-back unsheathing manoeuvre. The availability of a fully radiopaque closed cell stentriever (Trevo Pro Vue, Stryker) helped the development of a simple alternative deployment technique, the so called “Push and Fluff” technique. With this approach, the very first part of the device is deployed by unsheathing to provide vessel wall anchorage, then the device is deployed by pushing on the delivery wire and, in the clot area, forward pressure is applied on the microcatheter to allow full expansion of the device. The aim of this technique is to provide high vessel wall apposition and to tightly engage the clot, in order to improve the chance of clot retrieval.

The aim of our study is to compare the standard unsheathing technique and the push and pluff technique for Trevo thrombectomy.

Materials and Methods: We retrospectively reviewed 134 patients with acute ischemic stroke treated by mechanical thrombectomy by three experienced neurointerventionalists. In 12 cases (8.9%) the occluded vessel was the basilar artery, and in all other cases the stroke involved the anterior circulation. The standard technique was used in 58 cases (group A) and the push and fluff technique in 76 cases (group B). The two groups were homogeneous regarding occlusion site and clinical aspects. In most of cases, the retriever used for the standard technique was the non-radiopaque Trevo (37 cases), while all push and pluff cases were performed with the radiopaque device.

Results: Adequate recanalization (TICI 2B/3) was obtained in 58.6% of group A patients and 84.2% of group B patients (P < 0.001). The rate of first pass recanalization was 41.4% in group A and 51.3% in group B, but it was not statistically significant. Three months good outcome (mRS 0–2) was more favourable in group B (P < 0.01).

Conclusions: The push and fluff technique can significantly improve the recanalization rate and clinical outcome after thrombectomy performed with a closed cell retriever. The fully visibility and the cell geometry of Trevo Pro Vue are suitable for this technique. The different retriever characteristics do not allow exporting this experience to other devices. The retrospective evaluation is a main limit of this study.

010
Mechanical thrombectomy with microcatheter for distal occlusion
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Introduction: Stent retriever and suction thrombectomy are both mainly used techniques to treat patients with acute large-vessel occlusion. And there are increasing number of cases requiring mechanical thrombectomy to remove small-vessel occlusions. This study was conducted
to report that microcatheter can be used to go further into distal vessels to effectively eliminate any migrated microthrombi.

Methods: We retrospectively reviewed 8 patients with distal small-vessel occlusions treated with suction using microcatheter. Half of them had acute large-vessel obstruction with distal migration during procedures. Treatment devices used were Stent retriever or Penumbra 5Max or 4Max suction catheter for large-vessel obstruction followed by aspiration with XT-27 or Prowler microcatheter for distal revascularization. The rest cases were distal artery clog by drift of thrombi formed during coil embolizations for aneurysms. Outcome measures were recanalization rate and mRS before and after the procedures.

Results: All of the 4 patients with acute ischemic stroke had proximal MCA occlusions. Three of them showed distal MCA shift of thrombi while one of them had thrombi fled to distal ACA during thrombectomy. Four aneurysms patients had aneurysms at A-com (2), Lt MCA and Rt ICA. They showed acute thrombus formation and distal migration duringcoil embolizations. Two of them had multiple occlusions, one at distal MCA and ACA and the other at the two distal branches of MCA. The rest 2 had distal ACA occlusions. Among the total 10 occluded distal branches, 9 were revascularized successfully by microcatheter suction. Recanalization rate was 90.0%. Mean NIHSS scores for acute ischemic stroke was initially 9.75±2.4 [range: 8–13] which was improved to 5.5±5.6 [range: 0–13]. mRS was 0 for 2 unruptured aneurysm patients and 2 for 2 SAH patients. No additional complications associated with microcatheter suction procedures occurred.

Conclusion: Distal migration of thrombi during interventions are not rare. Based on our experience, microcatheter can be used as a therapeutic option for distal artery flow arrest by migrated thrombus.

Monday, 16th of October – Plenary Room – 16:45 – 18:45 – Parallel abstract session: Stroke

011

Endovascular recanalization of proximal ICA occlusion in acute ischemic stroke: the stylet-balloon technique

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Purpose: Proximal ICA occlusion resulting in carotid-T or proximal MCA blockage is responsible for up to 20% of acute ischemic stroke cases and is associated with severe neurological symptoms and poor prognosis, with mortality rates more than 40% if rapid recanalization cannot be achieved. Rapid recanalization of the proper ICA lumen by reopening the ruptured and thrombosed ICA plaque without dissecting the vessel wall is the cornerstone of success in these cases. We present our initial experience with the stylet-balloon technique in a retrospective analysis of 15 cases with acute ICA and MCA occlusion.

Materials and Methods: Endovascular treatment of 15 acute ischemic stroke patients with proximal ICA and carotid-T/proximal MCA occlusion with an average initial NIHSS of 16.2 was performed using the stylet-balloon technique in our institution between 2013 and 2017. Recanalization of the occluded ICA was performed through a 8F softtip guidewire-catheter using a slightly shaped 0.014 microwire for careful penetration of the ruptured and occluded plaque. This was followed by angioplasty of the plaque using a low profile 4 mm balloon, which was then left half-inflated and used as a stylet for the advancement of the 8F guidewire across the ruptured plaque into the cervical segment of ICA. The balloon was then removed and the ICA was recanalized by careful manual thrombiaspiration through the 8F guidewire, followed by stent-retriever thrombectomy of the carotid-T and MCA through a tri-axial system using a 5 or 6F intermediate catheter. In order to avoid antplatelet medication in the acute phase of stroke, stent covering of the proximal ICA plaque was performed in case of high-grade residual stenosis or flow limiting dissection only.

Results: Successful recanalization of the ICA was achieved in 100% of the cases. The average recanalization time of the ICA was 32 minutes. MCA recanalization was achieved with TICI grade 2a in 4 (26%) and TICI grade 2b/3 in 11 (74%) cases, with an average groin-to-recanalization time of 70 minutes. Stent implantation in the proximal ICA was required in 5 (34%) cases. There was no dissection or peri-procedural hemorrhage. Functional outcomes at 3 months follow-up were mRS 0–2 in 10 (67%), mRS 3–5 in 1 (7%) and mRS 6 in 4 (26%) cases.

Conclusion: In this pilot study, rapid recanalization of proximal ICA occlusion in acute stroke could be achieved safely and effectively with the stylet-balloon technique.

012

Tips and techniques for optimal stentriever placement in mechanical thrombectomy: The longer is better?

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Purpose: An increasing number of patients with acute large artery occlusion (LAO) are being treated by mechanical thrombectomy. Optimal preprocedural planning and estimation of the real thrombus position are essential to achieve a successful recanalization in these patients. In this study, we analyzed an expected thrombus location and the real thrombus location after first stentriever deployment using high resolution flat panel CT and angiography.

Materials and Methods: We reviewed the medical records of 250 mechanical thrombectomy performed in 250 patients between January 2009 and May 2017. This study included 72 patients harboring large artery occlusion of the middle cerebral artery who underwent stentriever based mechanical thrombectomy. All cases were divided into success and fail groups by successful recanalization after first pass thrombectomy. We analyzed distance between stentriever proximal marker and thrombus, total stentriever length, total thrombus length, angiographic gap of pre-post stent deployment, and susceptibility vessel sign on MRI. The each parameter was measured using an ImageJ program. We also assessed symptoms onset, time of arrival at the Emergency Department, National Institute of Health Stroke Scale (NIHSS) assessment, time to CT scan, and time to endovascular treatment. NIHSS was collected daily during the hospital stay and at discharge.

Results: We achieved TICI 2b/3 reperfusion rates of 80.5% (58/72). The mean age of the patients was 65 years and mean NIHSS score was 16.2. LAO were managed using 67 Solitaire (56 6x30, 3 6x20, 8 4x20) and 5 Trevo (all 4x20). The rate of successful recanalization after first pass thrombectomy was 47.2% (success group 34, fail group 38). The only statistically significant difference between the two groups is thrombus length (success group 7.72 ± 4.85 mm, fail group 12.37 ± 7.67 mm, P < 0.05). Each thrombus lengths were dichotomized into 2 categories (over 10 mm or not). The odds ratio for successful recanalization after first pass thrombectomy in the cases of under 10 mm compared with the cases of over 10 mm was 3.3. To achieve a successful recanalization with minimal attempts on the angio table, our procedures need to be efficient and optimal even first attempt. Another reason to strive for early procedure is that the clot change after first attempt. The fragmented clot remains in place or migrate distally. Also, when the clot is compressed by stentriever, it changes its soft properties to become more firm and dehydrated. After multiple attempts, the clot becomes more difficult to remove.

Conclusion: Over 10 mm sized thrombus was difficult for recanalization after first stentriever attempt. Catching the entire thrombus is important to achieve the successful recanalization of TICI 2b or higher. Therefore, when the end of thrombus was uncertain with available image modality, longer stentriever may help entire capture thrombus and successful recanalization with less attempt.

013
Clinical and Cost Effectiveness of Using Evolving ACE Reperfusion Catheters as First-line Treatment of Acute Ischemic Stroke Due to Large Vessel Occlusions

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Introduction: Larger bore reperfusion catheters have been designed to increase the effectiveness of direct aspiration for treatment of acute ischemic stroke due to large vessel occlusions. The present study has two goals: 1. To compare the reperfusion rate of the newest large bore reperfusion catheter, ACE68, with previous generations of ACE catheters, ACE64 and ACE60, and 2. To compare the cost associated with three first-line approaches to mechanical thrombectomy: ADAPT using evolving ACE technology, Solumbra, and stent-retriever (SR) with balloon-guide catheter (BGC).

Methods: The prospectively populated acute stroke intervention database at our institution was retrospectively reviewed for mechanical thrombectomies performed using the ADAPT technique as a first-line approach from July 2013 through February 2017. Successful reperfusion (defined as TICI 2b/3) rates amongst the successive generations of ACE reperfusion catheters were compared. The costs of the procedures were also compared, including the costs of salvage therapy using adjunctive devices when necessary (additional reperfusion catheters or SR). These costs were then compared to the costs of hypothetically performing these procedures using Solumbra or SR as first-line approaches.

Results: Between July 2013 and February 2017, 131 ADAPT cases were performed using ACE reperfusion catheters. There were 42 cases using the ACE68 as first-line, with a successful reperfusion rate using aspiration alone of 90% (38 of 42). This was significantly higher than with previous generations of ACE as first-line, where the rate of successful reperfusion was 73% using aspiration alone (65 of 89 cases, p = .02). The rate of successful reperfusion with a single aspiration pass was higher with ACE68 compared to previous generations (50% versus 37%) but this difference was not statistically significant (p = .19). Overall successful reperfusion was similar when SR was used as salvage therapy (95% with ACE68 as first-line versus 85% with previous ACE generations, p = .14). Out of 131 patients, 15% (n = 20) required the use of SR after aspiration alone, with an improvement to TICI 2b/3 in 13 patients (65%). For ADAPT cases with salvage therapy included, the average device cost per case was not significantly different comparing previous ACE devices with ACE68: $6,669 and $6,650, respectively.
An ADAPT approach with any ACE catheter including the cost of salvage therapy resulted in significant cost savings compared to having hypothetically performed these procedures using Solumbra or SR as first-line with costs per case of $12,440 and $10,195, respectively, not including salvage therapy.

Conclusion: ADAPT with the ACE68 reperfusion catheter resulted in a significantly higher rate of successful reperfusion using aspiration alone (90%) compared to previous generation ACE catheters. ADAPT also resulted in significant cost savings compared to Solumbra or SR first-line approaches.

**014**

A direct aspiration first-pass technique (ADAPT) versus stentriever thrombectomy in emergent large vessel intracranial occlusions

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**Background:** Endovascular thrombectomy in patients with acute ischemic stroke caused by occlusion of proximal anterior circulation arteries is superior to standard medical therapy. Stentriever thrombectomy with or without aspiration assistance was the predominant technique utilized in the five randomized controlled trials that demonstrated superiority of endovascular thrombectomy. Other studies have highlighted the efficacy of a direct aspiration first-pass technique (ADAPT).

**Methods:** To compare the angiographic and clinical outcomes of ADAPT versus stentriever thrombectomy in patients with emergent large vessel occlusions (ELVO) of the anterior intracranial circulation, the records of 134 patients from June 2012 to October 2015 were reviewed.

**Results:** Within this cohort, 117 patients were eligible for evaluation. ADAPT was utilized in 47 patients, 20 (42.5%) of whom required rescue stentriever thrombectomy, while primary stentriever thrombectomy was performed in 70 patients. Patients in the ADAPT group were slightly younger than patients in the stentriever group (63.5 versus 69.4 years; P = 0.04); however, there were no differences in other baseline clinical or radiographic factors. Procedural time (54.0 versus 77.9 mins; P < 0.01) and time to TICI 2b/3 recanalization (294.3 versus 346.7 mins; P < 0.01) were significantly lower in patients undergoing ADAPT versus stentriever thrombectomy. Rates of mTICI 2b/3 recanalization were similar between the ADAPT and stentriever groups (82.9% versus 71.4%; P = 0.19). There were no differences in rates of symptomatic intracranial hemorrhage or procedural complications. Rates of good functional outcome (modified Rankin Scale [mRS] 0–2) at 90 days were similar between the ADAPT and stentriever groups (48.9% versus 41.4%; P = 0.45), even when accounting for the subset of patients in the ADAPT group who required rescue stentriever thrombectomy.

**Conclusion:** The present study demonstrates that ADAPT and primary stentriever thrombectomy for acute ischemic stroke due to ELVO are equivalent with respect to rates of TICI 2b/3 recanalization and 90-day mRS scores. Given reduced procedural time and time to TICI 2b/3 recanalization with similar functional outcomes, an initial attempt at recanalization with ADAPT may be warranted prior to stentriever thrombectomy.

**015**

Frontline Therapy with the ACE Reperfusion Catheters in an Acute Ischemic Stroke Cohort

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**Purpose:** In aspiration thrombectomy, a large bore catheter can offer the essential force needed for effective removal of thrombus from large vessel occlusions (LVO). The aim of this study is to determine the effectiveness of the ACE reperfusion catheters as frontline therapy, or with adjunctive stent retrievers, in patients with LVOs.

**Materials and Methods:** We retrospectively identified 100 consecutive patients from our center treated for LVO in the anterior circulation wherein aspiration thrombectomy was employed as initial approach. The range of available reperfusion catheters included the ACE60, ACE64, and ACE68. Main study outcomes captured include revascularization success, defined by a score of mTICI 2b/3, procedural time metrics, and the rate of patients achieving mRS 0–2 at 90 days.

**Results:** Thrombectomy with ACE reperfusion catheters alone was performed in 84 patients; 92.9% (78/86) were able to achieve successful revascularization to mTICI 2b/3. In detail, successful reperfusion was achieved with ACE60 in 65%, ACE64 in 88%, and ACE68 in 100% of patients (p < 0.001). Single-pass reperfusion was achieved in 33%, 38%, and 50% of patients treated with ACE60, ACE64, and ACE68, respectively. Puncture to reperfusion time for the utility of ACE60 was 48.2 minutes, ACE64 was 29.9 minutes, as was with ACE68 (p = 0.002). At 90 days, 49% (41/84) of patients demonstrated favorable clinical outcomes of mRS 0–2.

Combination stent retriever thrombectomy was performed in the remaining 16 patients; 28% of cases following frontline treatment with ACE60, 3% following ACE64, while no additional intervention was needed when ACE68 was employed. mTICI 2b/3 was achieved in 75% (12/16). Favorable clinical outcome was observed in 31% (5/16) of cases. Accordingly, the puncture-to-reperfusion time was significantly shorter for those successfully revascularized with ACE alone (30.5 minutes) compared to patients needing
adjunctive therapy (81.8 minutes, \( p < 0.0001 \)). In total, 90% (90/100) of patients were successfully revascularized to mTICI 2b/3 with a mean time of 38.7 minutes from puncture. Notably, adjunctive therapy was more frequently employed in the first 20 patients (45%), with 50% achieving mTICI 2b/3 flow from ACE alone (\( p = 0.002 \)). Only 9% in the latter 80 patients required adjunctive therapy, and 85% were demonstrated to achieve successful reperfusion with ACE alone (\( p = 0.0004 \)).

**Conclusion:** The evolution of stroke thrombectomy devices have afforded greater efficacy in revascularization of acute ischemic stroke from large vessel occlusion. The array of large bore ACE reperfusion catheters permit quick and effective therapy frontline, particularly following a brief learning period, while still maintaining flexibility for combination therapy.

017

**Role of different imaging modalities in acute ICA occlusion: A comparative study to endovascular catheterization in 65 patients**

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**Purpose:** Internal carotid artery (ICA) occlusion is often encountered in acute stroke patients with reported prevalence of approximately 24%. Such occlusion is usually defined preprocedureal on non-invasive imaging (CT or MR angiography “CTA/MRA”) if available or intraprocedural during endovascular stroke treatment (digital subtraction angiography “DSA”). However, there is discrepancy between the site of the ICA occlusion on CTA/MRA compared to DSA and even to findings on endovascular intervention (i.e. catheterization of the ICA). On imaging, a tapered narrowing of the ICA, the so-called “flame-shaped” occlusion is commonly seen. ICA pseudo-occlusion is therefore defined as non-opacification of the ICA on CTA/MRA but presence of flow on DSA. In our study we aim to examine the accuracy of different imaging modalities in accurately localizing the site of the ICA dissection, compared to direct catheterization of the ICA.

**Methods:** We performed a retrospective analysis of acute stroke patients undergoing endovascular stroke treatment who exhibited ICA occlusion in 4 participating centers between January 2015 and March 2017. All patients had imaging studies (CTA or MRA), diagnostic DSA and endovascular intervention. Patients’ demographics and comorbidities were noted. Images were reviewed by the interventional team in their respective center for the following parameters; extent of ICA occlusion (proximal contrast opacification cutoff and distal appearance of contrast opacification) and “flame shaped” pattern of ICA occlusion on imaging (CTA / MRA / DSA) as well as level of contrast opacification and pattern of ICA occlusion (“flame shaped”, “stump” occlusion or intraluminal defect) during the endovascular intervention.

**Results:** A total of 65 patients satisfied the inclusion criteria. The mean age was 70 years (standard deviation “SD” 13). There were 33 (51%) males and 32 (49%) females. Sixty (92%) patients had hypertension, 49 (75%) had hyperlipidemia, 23 (35) had coronary artery disease and 18 (28%) patients had diabetes mellitus. Flame-shaped occlusion pattern of the ICA was present in 12 (18%) of patients on CTA/MRA and in 19 (29%) on DSA. Only 2 (3%) patients had ICA dissection though.

During the ICA catheterization the site of the occlusion was at the common carotid artery in 1 (2%) patient, ICA origin in 13 (43%), cervical ICA in 28 (43%), petrous ICA in 2 (3%), cavernous ICA in 3 (5%), supracliniod ICA in 11 (17%), communicating segment ICA in 2 (3%) and ICA T-segment in 5 (8%) patients, while 29/57 (51%) of patients had “stump” ICA occlusion pattern, 13/57 (23%) had a “flame shaped” occlusion, 11/57 (19%) had a filling defect in the ICA and 4 (7%) patients had delayed opacification of the ICA.

**Conclusion:** Endovascular catheterization of the ICA is often required for the exact characterization and localization of the carotid occlusion in acute stroke.

018

**Thrombectomy with or without stenting of concurrent extracranial carotid disease**

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**Background:** In patients undergoing thrombectomy for acute ischemic stroke, the benefit of immediate endovascular treatment of concurrent cervical carotid disease (stenosis or occlusion) has not been demonstrated. Our aim was to compare clinical outcome at 3-month (mRS) in patients with or without ACI stenting during the acute treatment session.

**Methods:** Over a 2 year period, 324 consecutive thrombectomy for anterior circulation stroke were performed at our institution. 69 (21%) patients had a concurrent ipsilateral extracranial internal carotid disease defined as: occlusion or stenosis >70%. Medical chart were reviewed and MRS at
3 months were prospectively collected by a neurologist or a MRS certified nurse.

**Results:** Angiography demonstrated n = 43 (62%) extracranial ACI occlusions and n = 26 (38%) ACI stenosis/subocclusions. Underlying mechanisms included 15 dissections (22%). Stenting of the cervical ICA was performed in 25 (36%) patients during the acute endovascular treatment session, while for the remaining 44 (66%) internal carotid disease management was deferred. Baseline characteristics (age, sex, NIHSS) and technical success of intracranial clot removal were similar between treatment groups. Clinical outcome at 3 month was similarly favourable in patients treated with (mRS 0–2: 12/24 patients, 50%) or without (mRS 0–2: 14/35, 40%) (p = 0.59) acutely stenting of the cervical ICA disease.

**Conclusion:** In this series there was no significant difference in the clinical outcome (mRS 0–2) between the two groups. The positive trend in the clinical outcome in favor of the acute stenting group is difficult to interpret since stenting or no stenting decision was not randomized. A clinical randomized trial comparing acute versus deferred cervical carotid stenting treatment is therefore legitimized.

**020**

**Experimental evaluation of large bore aspiration catheters performance for endovascular treatment of acute ischemic stroke**

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**Background and Purpose:** A number of controlled trials recently appeared in literature demonstrated that early mechanical thrombectomy offered to patients presenting with acute ischemic stroke is related to improved functional outcome. In the present study we experimentally analyzed performances of large bore aspiration catheters.

**Materials and Methods:** All large bore aspiration catheter available in Europe up to June 2017 were evaluated by in-vitro tests aimed to investigate their trackability and clot removal efficacy. Devices were tested using experimental stiff clots reproducing real white human clots. In-vitro thrombectomies were conducted using a silicon vascular model representing two different anatomical patterns in order to reproduce a tortuous and a straight MCA.

**Results:** Mechanical tests showed different behavior in terms of trackability and clot removal. Better trackability was related to a better interaction with the clot and higher rate of clot aspiration. All large bore catheters failed in clot removal when the clot was not reached or the interaction with the catheter was not favorable.

**Conclusions:** Sofia 5–6F (Terumo, MicroVention,Tustin CA) showed better performances in terms of trackability and clot removal. Results of our study have to compared with those of larger experimental and clinical trials.
Purpose: Sudden major cerebral artery occlusion often resists recanalization with currently available techniques or can result in massive symptomatic intracranial hemorrhage (sICH) after thrombolytic therapy. The purpose of this study was to examine the permanent placement of self-expandable stent after refractory recanalization with stent retriever thrombectomy in acute intracranial artery occlusion.

Materials and Methods: Twenty-five consecutive patients with acute intracranial artery occlusions were treated with deployment of permanent self-expandable stent after failed successful recanalization with stent retriever thrombectomy. The angiographic outcome was assessed by Thrombolysis in Cerebral Infarction (TICI) and the clinical outcomes were assessed by the National Institutes of Health Stroke Scale (NIHSS) and the modified Rankin Scale (mRS). Complications related to the procedure and outcome at 3 months were assessed.

Results: At baseline, mean age was 72.4 years old and mean initial NIHSS score was 16.84. A recanalization to TICI 2b or 3 was achieved in all patients after refractory to recanalization with stent retriever thrombectomy in acute intracranial artery occlusion. At 90-day follow up, 18 patients (72%) had a good outcome (mRS ≤ 2). Stent placement was feasible in all procedures and no vessel perforation, vessel dissection, subarachnoid hemorrhage, sICH occurred.

Conclusion: Permanent placement of the self-expandable stent device as a rescue therapy in acute intracranial artery occlusion especially in case of unsuccessful recanalization after stent retriever thrombectomy was safe and effective. Recanalization rate was high and the rate of major complication was low.

022

Contrast extravasation during thrombectomy for acute ischemic stroke: incidence, endovascular management and clinical outcome

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Background: Intracranial vessel perforation is a rare complication of thrombectomy for acute ischemic stroke.

Objective: To review our database of patients that underwent mechanical thrombectomy complicated by vessel perforation with particular emphasis on endovascular management and clinical outcome.

Methods: All patients, from April 2014 to December 2016 that underwent thrombectomy for acute ischemic stroke and had contrast extravasation during the procedure were included. Clinical data, details of the procedure, rescue strategies, radiographic findings and clinical outcome were collected.

Results: Contrast extravasation occurred in 13 patients (3.6%) of 364 patients during a mechanical thrombectomy procedure. Eight patients received i.v. thrombolysis, 4 patients were on anticoagulants and 1 patient was on Aspirine. Clot location was: carotid-T in 4 patients and M1 in 9 patients. Two distinct contrast extravasations occurred in different locations during the same procedure in one patient. We suspected that the perforation was due to the manipulation of the microwire in 8 cases and to the manipulation of the microcathèter in 2 cases. The cause for extravasation could not be determined in 4 patients. Reperfusion (TICI 3 and 2b) was achieved in 5 patients, TICI 2a in 4, and no reperfusion (TICI 1 and 0) in 4 cases. Suspected perforation site was: distal ICA in 1 case, proximal M1 in 1 case, M2 in 5 cases, M3 in 2 cases and A2/A3 in 1 case. Twelve perforations occurred distal to or at the level of the clot and 2 proximal to it. We observed spontaneous resolution of contrast extravasation in 5 cases without any specific management. Rescue strategies, when needed, were: balloon hemostasis in 1 case and coiling of the perforated branch in 6 cases. One microcatheter was left in the subarachnoid space.

The modified Rankin scale at 1–5 months: was: 4 (31%) patients had good outcome (mRS 0 to 2), 4 (31%) patients had significant disability (mRS 3 to 5) and 4 (31%) patients died. One (7%) patient was lost for follow-up. Despite perforation, thrombectomy was continued in 6 (46%) patients. Of those, 4 had a favorable outcome, one patient died and one was lost to follow-up. Thrombectomy was abandoned in 7 (54%) patients. In this group, no patient had a favorable outcome, 4 patients had significant disability and 3 patients died, presumably from causes of ischemia. All patients underwent a head CT after the thrombectomy procedure. No patient suffered from significant intracerebral hemorrhage with mass effect.

Conclusion: Vessel perforation during thrombectomy is not necessarily associated with bad outcome. Abandoning thrombectomy with the idea of decreasing the flow at the level of perforation remains questionable. In this short case series bad outcomes were more often related to ischemia than hemorrhage. The limited number of cases in our series precluded any statistical analysis.

Monday, 16th of October – Session room 1. – 07:15 – 08:00 – Back to the basics: Thrombosis and antithrombotic treatment

INV07

Clotting mechanisms related to embolic stroke

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The scaffold of intravascular clots is composed of fibrin forming a meshwork which entraps cellular elements (platelets, red blood cells, leucocytes), the interactions of which with fibrin modulate the mechanical stability of thrombi and their susceptibility to enzymatic lysis with ultimate effects on their propensity to embolization. Recent studies have improved our understanding of the mechanisms, through...
which each cell type affects the structure and consequently the stability of thrombi. Platelets present at the time of fibrin formation modulate the structure chemically (through effects on thrombin concentration) and mechanically (through contractile force). Acceleration of the fibrinogen-fibrin conversion at higher concentrations of thrombin favours the longitudinal growth and branching of protofibrils over their lateral association with consequent resistance to plasmin. The contraction of fibrin-bound platelets and the mechanical shear generated by circulating blood profoundly alters the fibrin architecture generating fibers that are longitudinally aligned with smaller diameter and pore size. Factor XIIa originating from platelets tightens the lateral attachment of proteofibrils and decreases the volume of the vacant fluid space within the fibers, thus restricting the plasmin movement in the fibers. Red blood cells (RBC) are involved in active interactions with fibrin through an integrin receptor. Thus, fibrin can transmit the contractile force of activated neighboring platelets to RBC causing a change of their shape from biconcave to polyhedral with consequent almost perfectly gap-free compaction of RBC in the vacant space between fibers forming a stronger diffusion barrier to plasmin. Neutrophil extracellular traps (NETs) are networks of DNA, histones and other proteins, released by neutrophils upon their activation and are recognized as a focus of cross-talk between immunity, inflammation and haemostasis. NETs have been detected in the structure of both venous and arterial thrombi. They have been shown to promote clotting and form a secondary scaffold intertwined with fibrin within clots which causes thickening of fibrin fibers through increase in the interprotofibril distances resulting in a both mechanically and enzymatically less vulnerable fibrin. NETs bind platelets directly or indirectly through von Willebrand factor, and thus they serve as an alternative scaffold for platelet adhesion and activation reinforcing the platelet effects on thrombus stability. These findings indicate that thrombus stability is determined by a complex interplay of mechanical, chemical and cellular mechanisms which should be considered for improving the therapeutic strategies in thromboembolic diseases (e.g. including DNase or non-anticoagulant heparins added to plasminogen activators may improve thrombolysis).

Clinical pharmacology of antithrombotic drugs

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Purpose: Antithrombotics are indicated in most cerebral ischemic mechanisms or etiologies. The important distinction is whether the mechanism of cerebral ischemia requires an antiplatelet agent or an anticoagulant. In addition, the evaluation of the clot structure remains a pivotal step to predict the therapeutic responsiveness of the drug. The objectives of this presentation are to summarize the pharmacokinetics, pharmacodynamics, and pharmacogenetics of the different antithrombotic agents and to discuss the clinical implications for treatment of patients.

Materials and Methods: A literature search was conducted (1966–June 2017) using MEDLINE including in-process and other nonindexed citations, as well as Current Contents, EMBASE, Drugs & Pharmacology, and the International Pharmaceutical Abstract databases. In addition a retrospective review of endovascular database of AIS patients treated was done. This search prompts to an understanding of the similarities and differences in the properties and mechanisms of action of the different antithrombotic agents, including the new drugs and the importance to optimize the development and uses of these agents in clinical practice.

Results: Thrombin is becoming a logical target because of its multiple roles in coagulation. The currently available anticoagulant agents all target thrombin or FXa, either indirectly or directly. Regarding antiplatelets, clopidogrel has several drawbacks, which include delayed onset of action, large inter-individual variability in platelet response, genetic polymorphism of the metabolizing enzyme, drug-drug interactions (DDIs), and the two-step activation process catalyzed by a series of cytochrome P450 (CYP) isoenzymes. For these reasons, new P2Y12 receptor inhibitors have been developed to improve on the pharmacological and clinical profile of clopidogrel. The newest P2Y12 receptor inhibitors: prasugrel, ticagrelor and cangrelor have individual properties and, according to their mechanism of inhibition, can be divided into irreversible (prasugrel) and reversible inhibitors (ticagrelor, cangrelor). The more rapid onset and offset of platelet inhibition by the directly acting and reversible P2Y12 inhibitors may provide further advantages. Thrombin is also becoming a logical target because of its multiple roles in coagulation.

Conclusion: The development of multiple antithrombotic agents during the past 15 years, has generated significant uncertainty among neurointerventionalists as to the optimal therapy for cerebrovascular intervention. An understanding of the pharmacologic differences between these therapeutic agents is key for the proper prevention and the management of thromboembolic complications.
Utilization of acute vascular imaging and neurointervention for acute ischemic stroke patients among 20 out of 39 Hungarian stroke centers

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17Soproni Erzsébet Hospital, Department of Neurology, Sopron, Hungary
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Purpose: We aimed to investigate the everyday use of acute vascular imaging to detect large vessel occlusion and the utilization of mechanical thrombectomy for acute ischemic stroke patients.

Materials and Methods: We collected data via e-mail survey from the Hungarian stroke centers on acute vascular imaging and neurointervention referral and treatment of intravenously thrombolized patients in 2016. Each center was asked to analyze 20 consecutive patients before 31st August 2016. Finally 20 out of 39 centers answered the survey, data were collected on 410 patients. We also collected the mechanical thrombectomy case numbers and the availability of service from neurointervention centers in Hungary.

Results: Only 40,4% (166/410) of the reported patients underwent CT angiography. This way 80/410) patients with intracranial large vessel occlusion were identified. Altogether 85/410 patients were referred to neurointervention centers. Ultimately 44/410 patients were treated by mechanical thrombectomy (10.7%). In the reports the...
main reasons for denying neurointervention were extensive early ischemic signs and lack of capacity in neurointervention centers. At the time being there were 8 neurointervention centers in Hungary, only 3 of them were available 7/24, three of the 20 stroke centers did not have access to any neurointervention center at all.

**Conclusion:** Our careful estimation of eligible acute ischemic stroke patients for mechanical thrombectomy is around 800 cases per year (2.8% of all acute ischemic stroke patients). In 2016 the actual mechanical thrombectomy case number was 267. The discrepancy may come from less than optimal onset-to-door time, the scarce utilization of acute vessel imaging, the limited access to neurointervention in Hungary and the possible limitations in evaluation of early ischemic stroke signs.

**025**

**Reduced cerebral DWI lesions after carotid artery stenting with the Casper Device**

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**Introduction:** Although many different approaches to protect distal embolization during Carotid artery stenting (CAS) are known periprocedural ischemic lesions are occurring. This study evaluates the possibility of the new Casper stent to reduce the frequency of periprocedural cerebral DWI lesions in comparison to former carotid stent systems.

**Methods:** Degrees of stenosis and plaque configuration were determined. All patients were pre-treated with dual anti-platelets and cerebral MR pre- and postprocedural was performed. Angiographic procedures were done using the same technique by a single operator.

**Results:** Within 239 patients 41% were treated with CASPER and 59% with other available stents. Mean length of steno-sis was the same (10 mm), as well as the mean degree of stenosis (81%). Echolucent plaques were recorded in 26% of patients in the CASPER group and 12% of the others (p = 0.001). Postproceduraly, only 4% of the patients in the CASPER group and 15% of patients treated with other stents were documented with asymptomatic, but fresh ischemic DWI lesions seen on cerebral MR. At discharge there was no significant difference regarding NIHSS (1.1).

**Conclusion:** CAS with the new CASPER device is safe and the plaque coverage is effectively done based on a significantly lower rate of periprocedural distal embolization.

**026**

**Stroke protocol performed multiphase CT angiography: correlation between the CT results and the clinical outcome in case of endovascular treatment**

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**Purpose:** Multiphase CT angiography (CTA) provides relevant information about the large vessel occlusions and leptomeningeal collaterals. In this study we demonstrate how the multiphase CTA helps to determine the clinical outcome after endovascular thrombectomy.

**Materials and Methods:** 58 patients were participated in this study, mean age was 61.2 years. Every patient had large vessel (middle cerebral artery, internal carotid artery) occlusions. All CT examinations were performed within 6 hours- and all endovascular interventions were completed within 8 hours after the onset of the symptoms. Every patient underwent an endovascular thrombectomy achieved a TICI score 2b or 3. Based on the ASPECT score (on non-contrast CT scans) patients were divided into three groups (patients with high (8–10); n = 34, intermediate (6–7); n = 19 and low (0–5); n = 5 ASPECT score). We also grouped the patients regarding to the multiphase CTA

**Results:** good collateral state (good collateral filling starting in the first contrast phase; n = 38), intermediate state (good collateral filling starting in the second contrast phase; n = 16) and poor collateral state (without significant collateral filling; n = 4). We also evaluated the clinical outcome, regarding to the NIHSS score (7–10 days after thrombectomy). We examined the connection between these results.

**Results:** Good clinical outcome (mean NIHSS: 2.86) was detected when patients had high ASPECT score (≥ 8). Poor clinical outcome was detected when patients had low ASPECT score (0–5). In these cases the mean NIHSS score was 14.6. Patients with good collateral circulation (good CTA group) showed also good clinical outcome (mean NIHSS: 2.28). In case of the poor collateral state unfavourable clinical outcome was detected (mean NIHSS: 15.5) Our results demonstrate that good clinical outcome was associated with good ASPECT score and good collateral circulation, among these, the result of the multiphase CTA was more remarkable. Nevertheless, we have to mention that the mean NIHSS score can refer to more variable clinical outcome in the intermediate ASPECT and collateral state.

**Conclusion:** ASPECT score and multiphase CTA help to predict the clinical outcome. We found consistence between these semi-quantitative scores and NIHSS score. High variability was detected during our analysis – especially in the intermediate group. For defining the statistically significant correlation further investigations are indicated.
Oral Presentations

027

Findings and Clinical Usefulness of the C-arm CT (Xper) after Mechanical Thrombectomy of Acute Occlusion of the Anterior Circulation

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Purpose: To evaluate X-per CT findings and their clinical usefulness after mechanical thrombectomy of acute anterior circulation occlusion.

Methods: A retrospective review was conducted in 72 patients undergoing mechanical thrombectomy using stent retriever during last 2 years. Final 56 patients were included excluding posterior circulation occlusion and patients without Xper CT. Basic demographic data, occlusion site, angiographic successful recanalization (TICI 2b and 3) were accessed. Xper CT findings such as hemorrhage, contrast enhanced thrombi, and parenchymal enhancement were evaluated. Final infarction on MRI and CT and Xper CT findings were compared.

Results: Mean age was 72.9 years (±11) and male and female ratio was 1.15:1. Mean trials of stent retriever was 1.63 (±1.4) and right and left side occlusion ratio was 1.07:1. MCA occlusion was 39 patients (69.6%) and ICA occlusion (30.4%). Successful recanalization was achieved in 34 patients (60.7%). Partial perfusion (TICI 2a) was seen in 16 patients (28.5%). Recanalization failure was 4 (7%) including 1 M1 catheterization failure and 1 basal cisternal SAH. Localized SAH was seen in 6 patients (10.7%) and SAH in the basal cisterns was 1 (1.8%) patient and localized ICH in the 1 patient (1.8%). Thrombi with contrast media staining were seen in 13 patients (23.2%, mean number 2.1). Parenchymal enhancement due to BBB break-down was 21 patients (37.5%). Cortical and subcortical enhancement was 6 with 1 significant swelling of the enhancing area (17.7%). Striatal enhancement was noted in 11 patients with 1 significant swelling of the enhancing area (9.1%). Four cortical and striatal enhancing patients showed 1 delayed striatocapsular ICH and 3 significant swelling in ipsilateral side (75%) with 2 hemorrhagic transformation.

Conclusions: A localized SAH on Xper CT was frequent and showed no symptomatic serious complication. The cortical enhancement with striatal enhancement demonstrated severe brain swelling and hemorrhagic transformation. Xper CT just after mechanical thrombectomy was helpful for predicting severe brain swelling and hemorrhagic complication.

028

Diagnostic accuracy of 3D black blood MR imaging with high resolution T1 SPACE in the evaluation of intracranial arterial thrombosis

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Background and Purpose: 3D black blood (BB) MRI using a T1 sampling perfusion with application-optimized contrast using different flip angle evolutions (SPACE) sequence allows high resolution, vessel wall imaging to evaluate the intracranial arterial wall and its associated pathologies. We investigated the diagnostic features and accuracy of 3D BB MRI in the detection of intraluminal arterial thrombosis.

Materials & Methods: We retrospectively identified seventeen patients with intracranial arterial thrombosis that underwent 3D BBMRI with non-enhanced and contrast enhanced high resolution T1 SPACE sequences. 3D BBMRI findings were evaluated by 2 independent neuro-radiologists blinded to all other angiographic studies, conventional MRI sequences, and clinical indications for imaging. Nineteen total intracranial vessel segments (ICA terminus, A1/A2 ACA, M1/M2 (superior and inferior division) MCA, vertebral, basilar, and P1/P2 PCA) per patient were evaluated and graded on a three-point scale (grade 0–2) for intraluminal T1 SPACE hyperintensity (0: none, 1: partially visualized, 2: clearly visualized / hyperintense signal equal or more than the intra-orbital fat) and contrast enhancement(0: none, 1: partial enhancement, 2: clear enhancement compared to pituitary stalk). Images were considered positive for arterial thrombosis when focal intraluminal T1 SPACE hyper-intense signal and/or enhancement on 3D BBMRI were graded as 1 or 2 by the independent readers. Arterial occlusion was confirmed by digital subtraction angiography (DSA) or computed tomographic angiography (CTA). In limited cases (n = 5) without DSA/CTA availability, susceptibility weighted imaging (SWI) in combination with time of flight (TOF) MR angiography (MRA) confirmed the diagnosis of complete vessel occlusion.

Results: seventeen patients (7M:10F, mean age 64 ± 10 years, range 39–77 years) with 24 intracranial arterial occlusions were studied. The median interval between presentation and BBMRI scanning was 6 days (range 0–270 days). Substantial inter-observer agreement for intraluminal T1 SPACE hyperintensity (unweighted Kappa = 0.7) and Perfect inter-observer agreement for contrast enhancement (unweighted Kappa = 1) was noted. The sensitivity and specificity for intracranial arterial thrombosis of intraluminal T1 hyperintensity were 100% for both. The sensitivity and specificity of contrast enhancement were 100% for both as well, taking Observer 1 as gold standard and Observer 2 as test when both partial and clear visualization (combined grades 1 and 2) suggested vessel thrombosis/occlusion.

028
Conclusion: 3D BBMRI with T1 SPACE imaging is a valuable sensitive and specific technique for the evaluation of intracranial arterial thrombosis. This technique provides an adjunctive mechanism to confidently diagnose complete arterial occlusions in the setting of low resolution conventional MRI findings and absent flow enhancement on TOF-MRA imaging prone to overestimation.

029

Value of Cone Beam CT in post-thrombectomy evaluation of acute stroke patients

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Purpose: Definitive ischaemia and hemorrhagic complications are important factors in determining post-procedure medical treatment following mechanical thrombectomy (MT). Multislice CT (MSCT) may require unnecessary patient transport following procedure, while Cone Beam CT (CBCT) can be performed on the table without any delay. We studied the diagnostic accuracy of CBCT in excluding such complications following mechanical MT.

Methods and Materials: Seventeen consecutive patients were studied by CBCT (GE, Innova IGS 631) immediately following MT for acute Large Vessel Occlusion (LVO) under an IRB approved protocol. Results were compared to Multislice CT (MSCT, Siemens Definition AS+-, 128 slices) performed within less than 20 minutes following CBCT. All scans were independently reviewed by two experienced neuroradiologists retrospectively in a blinded fashion. Ability to identify the Internal Capsule (IC) was used as a measure of image quality. Any signs of either subarachnoid (SAH) or parenchymal hemorrhages (ICH), pathological contrast enhancement (CE) as well as fresh ischaemic hypodensities (IH) were recorded. Any of those signs were rated as unequivocal and scans as unsatisfactory if such lesions could not be either proved or excluded.

Results: On the noninvolved side, the IC was well visualized on all MSCT-s and in 16 (94%) cases by one, and 14 (82%) by both readers on CBCT scans. No SAH was found on MSCTs and it was accurately excluded by one reader in 15 (88%) and by two in 14 cases (82%). ICH was excluded by one reader in all (100%) and by both readers in 14 (82%) cases both by MSCT and CBCT. On MSCT, CE was found in 14 (82%) cases by one and in 12 (71%) cases by two readers and findings were unequivocal in 2 (12%) cases. On CBCT, CE was accurately identified by one reader in 13 (76%) and by two readers in 10 (59%) cases, and 2 cases (12%) were rated as unequivocal. Fresh IH-s were identified on 15 (88%) MSCT-s by one and on 8 (47%) by two readers. Out of those, only 7 (42%) were confirmed by one, and 2 (12%) by two radiologists using CBCT and 7 (42%) CBCT scans were found unsatisfactory for accurate evaluation of ischaemia.

Conclusion: In this pilot study, CBCT provided an acceptable image quality more than 80% of cases. It was proved to have high sensitivity and high interobserver agreement in excluding post-thrombectomy hemorrhagic lesions. Its specificity was relatively low in differentiating CE from ICH but not significantly different compared to MSCT. Both its sensitivity and interobserver agreement was low in diagnosing IH.

This study was supported by a grant from GE Healthcare.

030

Relation between infarct volume and location and 90 day functional outcome after acute ischemic stroke in pooled analysis of recent endovascular trials

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Purpose: It is unclear to what extent improved functional outcome after endovascular therapy (EVT) can be explained by tissue outcome. In the process of striving for a better patient selection paradigm, it is necessary to elucidate how tissue outcome translates to functional outcome.

Materials and Methods: We analyzed clinical and imaging data as part of the HERMES collaboration. Primary outcome was mRS at 90 days. Follow-up infarct volumes (FIV) and locations were measured on follow-up CT or MR imaging.
range 12h – 10 days. Location was defined as laterality and involvement in the 10 ASPECTS regions. Intracranial hemorrhages were scored according to the Heidelberg Classification. Multivariable ordinal logistic regression was used to assess the association between tissue fate and ordinal mRS. Regression analyses included pre-specified prognostic variables (age and baseline NIHSS) and FIV. Four models were constructed; Model A included FIV, Model B: FIV and location, Model C: FIV and hemorrhage type, and Model D: FIV, location, and hemorrhage type. Likelihood function tests (Akaike and Bayesian Information Criterion) were used to determine the best predictive model. Mediation analysis was performed to investigate if a reduction in FIV is the underlying mechanism of the beneficial effect of EVT and partitioning sums of squares was used to quantify how much of effect of EVT on functional outcome is explained by FIV.

Results: Data was obtained from 1665 patients (821 intervention and 844 control). Median FIV was 41 mL (IQR:14–120), and 39% (651/1650) achieved mRS 0–2. In all models, mRS was independently associated with FIV (p < 0.001) in addition to age (p < 0.001), baseline NIHSS (p < 0.001) and EVT (p < 0.001). Model D was the superior model. Most important predictors of outcome were involvement or not of the Internal Capsule (OR 0.45; p < 0.001) and to a lesser extent M5 (OR 0.77; p = 0.042) in the outcome ASPECTS regions, and to the influence of intraventricular hemorrhage (OR 0.29; p = 0.002) and hemorrhagic infarct type 2 (OR 0.71; p = 0.043). L Laterality (p = 0.36) was not an independent predictor. Patients in the EVT arm did significantly better than controls even after controlling for FIV. This effect was more pronounced in patients with smaller infarcts. Mediation analysis showed that reduction of FIV explains 35% of the beneficial effect of EVT on functional outcome.

Conclusion: In HERMES, tissue outcome was an independent predictor of functional outcome. While FIV is a strong independent predictor, the success of EVT is only partially explained by a reduction of FIV; location and hemorrhagic transformation were additional predictors.

Imaging in patients with chronic ICA occlusion for bypass surgery triage by BOLD-fMRI using apnoe in comparison with computed tomography perfusion

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Objective: Validation of BOLD-fMRI using apnoe for the determination of cerebrovascular reserve capacity (CVRC) in comparison to the “gold standard” computed tomography perfusion for patients with high-grade stenoses or occlusive cerebrovascular disease of the anterior circulation.

Methods: We included 42 patients with high-grade stenoses or occlusive cerebrovascular disease of the anterior circulation to evaluate CVRC using both, acetazolamid loading computed tomography perfusion (CTP) imaging (64 MSCT, rCBF in resting condition and 10 minutes after i.v. application of 1 g acetazolamid) and BOLD-fMRI (3T, TR 4000, TE 50, FoV 1152 x 1152, “Breath Hold” (BH) paradigm: 10-seconds breath holding epochs interleaved with 30 seconds free breathing epochs). The statistical parametric mapping was fused with anatomical mapping (MPRAGE) and thereupon compared with CTP. CVRC was evaluated as sufficient in case of an rCBF-increase of 20% in acetazolamid loading CTP, as reported previously.

Results: Among the 42 patients, 24 (57.1%) had a vascular occlusion of the left Internal Carotid Artery (ICA), 3 (7.1%) of both sides and 15 (35.7%) of the right ICA. Based on PCT, 15 patients (35.7%) exhibited normal CVRC, 6 patients (14.3%) showed reduced CVRC and 21 patients (50%) had insufficient CVRC. The results of BOLD-fMRI were coherent to CTP in 28 patients (66.7%). 13 of them had a normal CVRC and 11 showed insufficient CVRC; 25 patients (89.3%) of those with coherent results had only one compromised vessel.

Conclusion: Compared with acetazolamid loading CTP, BOLD-fMRI using apnoe as challenge has a high reliability regarding CVRC-determination for patients with unilateral disease.

Endovascular therapy of acute ischemic stroke in clinical practice: results from the MR CLEAN Registry

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Purpose: Endovascular therapy (EVT) is being implemented worldwide as important treatment option for acute ischemic stroke (AIS). We studied whether effectiveness and safety results that have been reported in MR CLEAN are sustained in everyday clinical practice.

Monday, 16th of October – Session room 1. – 16:45 – 18:45 – Parallel abstract session: Stroke
Conclusion: In 6.8% of patients, sICH was MR CLEAN EVT group). Sixty-three percent reached eTICI after 24 to 48 hours. Secondary radiological outcomes include reperfusion (eTICI) on DSA and symptomatic intracranial hemorrhage (sICH) on follow up NCCT, according to the Heidelberg criteria.

Results: In total, 1628 patients were registered between March 2014 and June 2016. Of these, 1318 patients were included in the core dataset. Median age was 70 (IQR 59–78) and 55% were male. Eighty-five percent underwent EVT, and 15% DSA only. Median baseline NIHSS was 16 (IQR 11–20). Median time from symptom onset to groin puncture was 205 minutes (IQR 160–265), compared to 260 in MR CLEAN. Distribution of mRS was as follows: 0 = 89 (7%), 1 = 180 (14%), 2 = 270 (21%), 3 = 199 (15%), 4 = 178 (14%), 5 = 84 (6%), and 6 = 318 (24%). By comparison, proportion of mRS 0–2 was 33% in MR CLEAN EVT group. After 24 to 48 hours, median NIHSS was 11 (IQR 4–18) (13 in MR CLEAN EVT group). Sixty-three percent reached eTICI 2b–3 (59% in MR CLEAN). In 6.8% of patients, sICH was seen (7.7% in MR CLEAN EVT group).

Conclusion: Despite reperfusion and sICH rates similar to the MR CLEAN trial, the proportion of patients with good functional outcome after EVT in AIS has substantially improved since trial conclusion, most likely due to shorter time to EVT.

ASPECTS 8–10 Patients Demonstrate Similar Clinical Outcomes from Thrombectomy with the 3D Revascularization Device vs Solitaire

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Purpose: Acute ischemic stroke therapy has benefited from the addition of mechanical thrombectomy to the repertoire of IV thrombolytics, particularly in large vessel occlusions. Herein, we aim to determine the efficacy of the Penumbra 3D Revascularization Device in treatment of small core infarcts (ASPECTS 8–10).

Materials and Methods: To determine the safety and efficacy of the 3D Revascularization Device, the 3D Trial sought to compare the treatment of combination therapy of 3D with the Penumbra System (3D/PS) versus the Penumbra System alone (PS). The efficacy of these treatment options in small core infarcts were further explored, wherein patients presenting with ASPECTS 8–10 were identified for analysis and compared with a congruent cohort from a meta-analysis by Campbell et al. on the use of the Solitaire device.1 Despite similar baseline characteristics of the 3D ASPECTS 8–10 cohort with the entire population in Campbell’s analysis, only patients with small core infarcts were extrapolated from the meta-analysis for comparison of favorable clinical outcome, defined as mRS 0–2 at 90 days.

Results: Of the 173 patients meeting the per protocol criterion for analysis, 105 were identified as presenting with ASPECTS 8–10. While baseline characteristics for ASPECTS 8–10 of the Campbell study were unable to be ascertained, the median NIHSS and ASPECTS score were observed to be more similar between the entire Campbell cohort (NIHSS 17 [IQR 13–20]; ASPECTS 7 [IQR 7–10]) and the 3D ASPECTS 8–10 (all patients: NIHSS 17 [IQR 12–21]; ASPECTS 9 [IQR 8–10]; 3D/PS: NIHSS 16.5 [IQR 12.5–20]; ASPECTS 9 [8–10]; PS: NIHSS 17 [IQR 12–22]; ASPECTS 9 [IQR 8–10]), than to the entire 3D population (all patients: NIHSS 18 [IQR 14–22]; ASPECTS 8 [IQR 7–10]). Nonetheless, only ASPECTS 8–10 patients for both studies were used for analysis to maintain consistently. Available data on good clinical outcome (mRS 0–2) for patients with ASPECTS 8–10 from the Campbell study included rates from SWIFT PRIME 67%, REVASCAT 50%, and ESCAPE 55.5%, which were extrapolated to yield a combined weighted outcome of 57.7% at 90 days. Compared to patients from the 3D cohort, a similar rate of favorable clinical outcome was observed (all patients: 52.5%; 3D/PS: 53.2%; PS: 51.9%).

Conclusion: In patients with small core infarcts, thrombectomy with the 3D Revascularization Device can achieve similar clinical outcomes consistent with outcomes from other stent retriever devices.
Endovascular thrombectomy in patients with wake-up stroke or unknown symptom onset

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Purpose: Mechanical thrombectomy (mTE) in acute ischemic stroke due to large vessel occlusion within the first six hours after symptom onset is effective and safe. However, in a considerable number of patients, symptom onset is unknown. Onset can be either during the wake-up period in the early morning hours (wake-up stroke, WUS) or at an unknown time-point during daytime (UOS). Little is known about outcome and complications after mTE in those patients.

Methods: We analyzed 1075 patients with anterior circulation stroke receiving mTE in our institution between 2010 and 2016. Patients suffering from WUS or UOS were compared with those treated according to current recommendations and guidelines. We assessed the frequency of good functional outcome (mRS ≤ 2 at 3 months), mortality rates and the frequency of symptomatic intracranial hemorrhage in the overall cohort as well as in subgroups receiving advanced CT-perfusion imaging or MRI.

Results: 38.3% of patients in the control group had a good functional outcome compared to 35.9% of WUS and 27.3% of UOS. The frequency of good functional outcome increased to 47.7% (WUS) and 35.4% (UOS) considering only patients undergoing CT-perfusion imaging or MRI. Allowing for MRI only, the frequency of mRS ≤ 2 at 3 months was 51.1% and 37.7% for WUS and UOS respectively.

Conclusions: In highly selected patients, mTE in WUS can result in a frequency of good functional outcome that is comparable to standard care. There seem to be considerable differences between WUS and UOS.

Impact of Chronic Comorbidities on Endovascular Thrombectomy

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Purpose: Recent advances in emergent endovascular mechanical thrombectomy for patients with emergent large vessel occlusions (ELVO) have greatly advanced ischemic stroke care. A major prognostic factor for predicting good clinical outcome is mostly related with a prompt intervention from symptom onset to successful recanalization. However, the impact of chronic patient comorbidities on outcome has not been evaluated in large stroke populations.

Materials and Method: We utilized the Healthcare Cost and Utilization Project Nationwide Inpatient Sample database (2006 to 2013; 58,805,848 patients in USA). We selected 5,289 adult, acute ischemic stroke patients with ELVO who underwent endovascular thrombectomy using ICD-9 codes.
for acute stroke and endovascular thrombectomy. We then
analyzed patient outcome stratifying by the following
comorbidities: hypertension (HTN), diabetes mellitus (DM),
hyperlipidemia (HLD), coronary artery disease (CAD), con-
gestive heart failure (CHF), chronic renal failure (CRF), atrial
fibrillation/flutter (AF), peripheral vascular disease or vis-
eral atherosclerosis (PVS), tobacco/alcohol dependence,
morbid obesity. Adjustment for demographics differences
included age and gender.
Applying logistic regression analyses (SAS 9.4; SPSS 22) and
adjusting for confounding factors. We defined in-hospital
outcome in terms of mortality, discharge disposition, need
for long term facility placement, length of hospital stay and
hospital costs.

**Result:** Mean age of endovascular thrombectomy patients
with acute ischemic stroke was 66.4 years (SD ± 15.2 years)
with 58.7% > 65 years old; 50.6% male; 72.8% Whites,
10.1% Blacks and 6.7% Hispanics. Chronic condition or
comorbidities, 64.1% had HTN, 28% DM, 43% HLD, 27%
CAD, 19.6% CHF, 15.7% CRF, 61.8% AF, 5.3% PVS,
16% tobacco dependence, 1.5% alcohol dependence and
2.5% morbid obesity. Unfavorable outcomes were in-patient
mortality 20.1%, discharge to long term facility 70.9%.
Mean hospital length of stay 10.2 days (SD 3 10.2) and
mean hospital costs $477,606 (SD $145,202). After adjust-
ment patients with poor discharge outcome had the follow-
ing statistically significance differences: age more than 65,
male, HTN, DM, CHF, CAD and CRF. Risk factors for high
mortality included age more than 65, CHF, CAD and CRF.

**Conclusion:** In acute stroke patients, prognosis after endo-
vascular mechanical thrombectomy is mostly related with
time to intervention, however, other conditions such as
age more than 65, male, HTN, DM, CHF, CAD and CRF are
significant prognostic outcome factors which can be used for
the development of outcome prediction model for emergent
endovascular thrombectomy in ELVO.

**037**

**Mechanical thrombectomy for in-hospital ischemic stroke**

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**Purpose:** A background of acute ischemia for in-hospital
stroke is different from out-hospital stroke. A quality gap,
such as delay to evaluation and treatment, represents a
distinct difficulty for treatment. The objective of this study
was to clarify the clinical characteristics of in-hospital onset
ischemic stroke treated with mechanical thrombectomy.

**Materials and Methods:** We performed a retrospective ana-
lysis between April 2015 and December 2016 using the
common database from 3 comprehensive stroke centers.
Patient characteristics, comorbid illnesses, procedures, and
outcomes were analyzed.

**Results:** A total of 36 patients received mechanical thrombect-
omy for acute ischemic stroke with in-hospital onset (mean
age 73 years; 61% male, median NIHSS 21). Cardiovascular
disease was the most frequent comorbid illness. Four patients
(11%) received intravenous tissue plasminogen activator
(IV-tPA) prior to mechanical thrombectomy. All procedures
were performed under the local anesthesia and sedative.

The median time from symptom onset to qualifying image
and symptom onset to groin puncture was 86 and 190 min-
utes, respectively. The site of intracranial artery occlusion
was internal carotid artery (9), middle cerebral artery (22), and
vertebral/basilar artery (5). Successful reperfusion (TICI 2b or
3) was achieved in 26 patients (72%). The median time
from symptom onset to recanalization was 195 minutes.
Symptomatic intracranial hemorrhage occurred in 3 patients
(8%). The functional independence (mRS 0–2) at 90 days was
achieved in 14 patients (39%).

**Conclusion:** For patients with in-hospital ischemic stroke,
high percentage of contraindication to IV-tPA due to comor-
bid illnesses misses an opportunity for recanalization.
Mechanical thrombectomy may be beneficial for better func-
tional outcomes if the patients could achieve successful
reperfusion without time delay.

**Key words:** acute ischemic stroke, in-hospital, mechanical
thrombectomy

**038**

Large intracranial vessel occlusion,
IV thrombolysis, recanalization confirmed
by DSA for intended but not required mTE:
the clinical outcome

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**Background:** Patients with acute ischemic stroke due to the
occlusion of a large intracranial artery are frequently treated
by IV thrombolysis (IVT) prior to mechanical (mTE) and/or
aspiration thrombectomy (aTE). In some of these patients
IVT will result in a recanalization of the previously occluded
proximal artery, and aTE/mTE will not be necessary or pos-
sible. Little is known about the clinical outcome of these
patients and we tried to better understand this and compare
these patients with those who underwent aTE/mTE.

**Material and Methods:** From a prospective stroke data
base with 2345 patients with acute ischemic stroke due to
a large vessel occlusion, 695 patients (21%) received
IVT prior to DSA. A total of 439 patients (88%) underwent catheter angiography and endovascular treatment. Of those patients treated with IVT, 56 patients (11%) had a recanalization of the proximal artery (ICA only n = 3; ICA bifurcation n = 1; M1 n = 30; M2 n = 10; VA n = 1; BA n = 8) due to IVT and aTE/mTE was not necessary or possible. In these patients recanalization was complete (TICI2b/3) in 88%. In retrospect we compared the patients who were recanalized by IVT (Group 1 = 54) with those who underwent aTE/mTE (Group 2, n = 1175).

**Results:** The 90-day clinical outcome was as follows: mRS (0) to (6):
- Group 1: (0) 13%, (1) 23%, (2) 30%, (3) 13%, (4) 9%, (5) 2%, (6) 11%;
- Group 2: (0) 13%, (1) 12%, (2) 10%, (3) 16%, (4) 12%, (5) 6%, (6) 30%.

Other parameters included: mean age G1 71.5 vs G2 72.7; median NIHSS G1 5 vs G2 15; median time onset to DSA G1 222 vs 228 min; Recanalization (TICI 2b/3); G1 89% (TICI 2b 71%, TICI 3 18%) vs G2 88% (TICI 2b 26%, TICI 3 63%); Parenchymal hemorrhage rate in G1 was 3.6%.

**Conclusions:** Recanalization after IVT in patients with acute proximal large intracranial vessel occlusion is rare. A good clinical outcome (mRS 0–2) is more frequent than in patients who underwent primary or secondary aTE/mTE (n = 1175, TICI 0–3, mRS 0–2: 35%) and in patients who underwent successful aTE/mTE (n = 741, TICI 2b-3, mRS 0–2: 47%).

**039**

**Contralateral carotid artery stenosis is a predictor of a poor clinical outcome after mechanical thrombectomy and acute carotid stenting in patients with anterior tandem occlusion**

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**Background:** Cerebral ischemic strokes due to extra-/intracranial tandem occlusions of the anterior circulation are eligible for mechanical thrombectomy. The influence of concomitant contralateral carotid stenosis remains unclear in this stroke subtype.

**Methods:** Retrospective analysis of prospectively collected databases of four comprehensive stroke centers from different countries between 2011 and 2017. 197 consecutive patients with anterior tandem occlusion were treated with mechanical thrombectomy and acute carotid artery stenting. Clinical (including demographics and National Institutes of Health Stroke Scale (NIHSS)), imaging (including angiographic evaluation of concomitant contralateral carotid stenosis), and procedural data were evaluated. Favorable clinical outcome was defined as modified Rankin Scale (mRS) ≤2 at 90 days.

**Results:** In 186/197 TO patients pre-interventional CT-angiography was available for analysis, thereof 49 (26%) presented with concomitant contralateral carotid stenosis. Median admission NIHSS and procedural timings did not differ between groups. Reperfusion was successful in 38/49 (78%) vs. 113/148 (76%) respectively. Rate of favorable outcome at 90 days differed significantly between groups (22% vs. 44%; p < 0.05). The presence of concomitant contralateral carotid stenosis in patients with anterior tandem occlusions was associated with an unfavorable clinical outcome independent of age and NIHSS in multivariate logistic regression (p < 0.05). Neither all-cause mortality rates (25% vs. 17%) nor frequency of peri-interventional symptomatic intracranial hemorrhage (sICH) differed between groups (7% vs. 6%).

**Conclusion:** For patients with anterior tandem occlusion undergoing mechanical thrombectomy in conjunction with acute carotid artery stenting the presence of a concomitant contralateral carotid stenosis ≥50% is an independent predictor of poor clinical outcome.

**040**

**Mechanical Thrombectomy in Perioperative Strokes: A Case Control Study**

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**Background and Purpose:** Perioperative strokes (POS) are rare but serious complications for which mechanical thrombectomy (MT) could be beneficial. We aimed to compare the technical results and patients’ outcomes in a population of POS versus non-perioperative strokes (nPOS) treated by MT.

**Methods:** From 2010 to 2016, 19 patients with POS (i.e. acute ischemic stroke occurring during or within 30 days following a procedure) who underwent MT (POS group) were enrolled and paired with 19 consecutive patients with nPOS (control group), based on the occlusion’s site, NIHSS and age.

**Results:** Respectively, mean age was 68.8 ± 14.9 versus 66.8 ± 15.2 yo (p = 0.75) and median NIHSS score at admission was 20 (IQR: 15–26) versus 18 (IQR: 17–22) (p = 0.68). The causative procedures were as follows: Cardiovascular (12; 63.2%), Orthopedic (3; 15.8%), Neurosurgery (2; 10.5%) and Visceral (2; 10.5%). The occlusions location were as follows: Basilar Artery (BA) (1; 5.3%), cervical Internal Carotid Artery (ICA) (1; 5.3%), M2 segment (n = 3; 15.8%), carotid-T (ICA-T) (3; 15.8%) and M1 segment (n = 11; 57.9%). Good clinical outcome (mRS 0–2 at 3 months) was achieved by 41.2% (POS)
versus 66.7% (nPOS) of patients (p = 0.12). Successful reperfusion (mTICI score ≥ 2b) was obtained in 73.7% (POS) versus 78.9% (nPOS) of cases (p = 0.36). Mortality at one month was higher in the POS group (23.5%) versus none (nPOS) (p = 0.04). One (5.3%) vascular perforation was noted in each group, none were lethal. Average time from symptoms’ onset to reperfusion was 5.1 (POS) versus 4.6 hours (nPOS) (p = 0.27).

Conclusion: Successful reperfusion seems accessible in POS within a reasonable amount of time and with a good level of safety. However favorable outcome was achieved with a lower rate than in nPOS, owing to a higher mortality rate.

041 Late recanalization of basilar artery occlusion in a previously healthy 17 month-old child

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This report describes a case of a previously-healthy 17 month-old who presented with vertebral thrombosis and cerebellar stroke requiring posterior fossa decompression, later progressing to basilar thrombosis which was treated with mechanical thrombectomy 48 hours after last known well. At 3-month follow-up patient has a mRS of 0.

Case Presentation: A 17 month-old previously healthy girl presented to an outside hospital with lethargy and vomiting after an upper respiratory infection with mild imbalance three days earlier. Initial MRI/MRA revealed multiple acute cerebellar, occipital, and thalamic infarcts, with occlusion of the left vertebral artery. She became increasing lethargic over the next 24 hours requiring intubation, and was taken emergently for a suboccipital decompression of her cerebellar stroke. Her exam did not improve after suboccipital decompression, and CTA demonstrated progression of the vertebral occlusion to now completely occlude the basilar artery. She was taken for mechanical thrombectomy 48 hours after clinical decline.

Intervention: After initial groin access and using a Rebar 18 microcather through a Cello balloon-guide catheter, two passes were made using a 4 mm x 20 mm Solitaire stent (Medtronic) extending from the proximal right P2 segment to the distal basilar artery, resulting in TICI 2B reperfusion of the basilar artery with a small filling defect within the right P1. Given the extent of the thrombus within the left vertebral artery and existing infarct in the PICA distribution, further embolectomy was not attempted. The balloon guide was removed and hemostasis was obtained.

Outcome and Follow-up: Therapeutic heparinization and 81 mg ASA was initiated four hours post-thrombectomy. Heparin was held temporarily and the EVD was removed post-thrombectomy day 3. She was extubated post-thrombectomy day 5 and low-molecular weight-heparin was continued for a three-month course. At three months, she was walking with occasional falls, with a resolving left 6th nerve palsy, speaking words appropriate for age and attending preschool. MRA showed a patent basilar artery.

Conclusion: We report successful basilar artery thrombectomy in a 17-month old 48 hours after last known normal. Mechanical thrombectomy in children has been performed with good outcomes in some cases, though the complication risk and comparison to medical management is lacking. In the absence of good data in the pediatric population of an ideal time limit for intervention, we would advocate individualized, image-based decision making. All attempted thrombectomies in this population should be reported to better understand the success and complication rates without publication bias.

042 Long term results of stent-assisted coiling for ruptured intracranial vertebral artery dissections

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Intradural vertebral artery dissection is well known a cause of subarachnoid hemorrhage among Asian people and its high rebleeding rate. Although, as same as surgical trapping with/without bypass, internal trapping with endovascular therapy is one of the most effective procedures, it may cause the small branch occlusion resulting in the severe ischemic symptom. The reconstructive treatment with stent-assisted coiling or only stent placement for PICA involved lesion or dominant VA dissection is challenging, but its good results have been reported in short term. Since November 2004, we started to apply a coronary stent for dissected vessels involving PICA or dominant side VA, we will report the result in long term. Following approval by the Institutional Review Board, patients treated with stent-assisted coiling for ruptured VA dissecting retrospectively identified and reviewed from 2004 to 2011. Adoption of stent limited the vertebral artery dissection harbored the aneurysmal-like dilatation and the dissecting lesion involved posterior inferior cerebellar artery or bilateral lesion or excessive dominant side lesion. Ten Patients were deployed stents and coils. Although 2 patients died in acute phase, 8 patients returned to the social life before onset. Stent-assisted coiling for ruptured intracranial vertebral artery dissection with aneurysmal dilatation involving PICA or in dominant side is effective over long periods. However, close observation was needed, because the growth of aneurysmal dilatation, which was needed additional procedure, occurred sometimes. Proper follow-up care and no bleeding beyond early stage resulted in good outcome.
Importance of thrombuslocation in mechanical thrombectomy and systemic thrombolysis in acute MCA occlusion

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Purpose: Endovascular mechanical thrombectomy (MT) has become the de facto standard in the treatment of ischemic stroke due to large vessel occlusion. In previous works a correlation between good clinical outcome and the exact occlusion site, measured by the ‘distance to thrombus’ (DT) after intravenous thrombolysis (IVT) alone could be shown. In the present study we analyze the differences between the chances of a good clinical outcome in respect of DT between patients treated with IVT vs. MT.

Methods: A dual center database analysis including patients with ischemic stroke due to isolated occlusion of the middle cerebral artery (MCA) was performed. DT was measured in pre-treatment images. DT was correlated with the mRS at 90 days stratified according to the different treatment methods.

Results: A total of 280 patients could be included. We were able to show a clear correlation between the chances of good clinical outcome defined by 90d mRS ≤ 2 and the exact occlusion site measured by DT after IVT. In contrast, the outcome after MT showed no correlation to DT (p = 0.227). After a DT of 26 mm the chances of a good clinical outcome after IVT alone exceeded those after MT.

Conclusion: In patients with MCA occlusion the probability for a good clinical outcome after endovascular stroke treatment is independent of the exact occlusion site. If the occlusion occurred in the periphery of the M2 region (DT > 26 mm) IVT alone was superior to MT in achieving a good clinical outcome.

Over 10 years of collaboration in aneurysms research

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Interdisciplinarity at its best: how inanimate flow simulations are filled with life by MDs

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MTICI vs TICI scores in an external core-lab validated mechanical thrombectomy population using the same thrombectomy device

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Purpose: Reperfusion of the entire territory distal to vascular occlusions is the aim of acute ischemic stroke (AIS) treatment. Recent studies have compared various reperfusion scoring systems in a retrospective fashion, however there has been no study with an external core-lab validated comparison of reperfusion scores in a cohort of AIS patients treated with the same thrombectomy device.

Method: We evaluated a prospectively collected registry of AIS patients treated with the Embotrap revascularization device from 2013 to 2016. Imaging revascularisation parameters and timings, including the modified treatment in cerebral ischemia (mTICI) and the original treatment in cerebral ischemia (TICI) score, were verified by an external core-lab radiologist who was blinded to the clinical data. The mTICI score includes additional categories (mTICI 2a, b and c): to account for better reperfusion or near complete perfusion except for slow flow or distal emboli in a few distal cortical vessels. We compared mTICI versus TICI in various cut-off definitions of reperfusion (mTICI 2b-3,
mTICI-2c-3, mTICI3, TICI 2b-3, TICI 3) using receiver operating curves (ROC) in predicting 3-month outcome parameters including good functional outcomes (modified Rankin scale (mRS) 0–2), bleeding risk and mortality. **Results:** We included 168 consecutive patients in our analysis. 133 (79.2%) patients achieved mTICI 2b–3 reperfusion while 83.9% achieved mTICI 2b/3 reperfusion, 85 (50.6%) patients achieved good functional outcomes (mRS 0–2) and 21 (12.5%) died at 3 months. mTICI 2b-3, mTICI 2c-3 and TICI 2b-3 were significantly associated with good functional outcomes at 3 months. When comparing the receiver operating curves (ROC) for mRS 0–2 and mortality, mTICI 2c/3 was significantly frequent with stent retriever (61.2%) than with Penumbra (11.7%) or with stent retriever plus Penumbra (50.0%) (p < 0.001). National Institute of Health Stroke Scale was higher in BGC (15.0) than in non-BGC group (14.1). Number of stent retriever passes was significantly smaller in BGC (mean, 2.1 ± 1.5) than in non-BGC (mean, 2.5 ± 1.8) (p = 0.007). In univariate analysis, utilization of stent retriever, BGC, and carotid artery stenting were associated with recanalization success. In binary logistic regression, utilization of BGC remained the only predictor of recanalization success (OR, 1.687; 95%CI, 1.111–2.563; p = 0.016) **Conclusion:** Utilization of BGC significantly increased recanalization success rate in AC-LAO. BGC utilization seemed to be recommended in EVT for AC-LAO.

**PP302**

Accuracy and predictive value of reader assessed and machine rated ASPECT scores on non-enhanced CT for mechanical thrombectomy in large vessel occlusion strokes

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**Purpose:** Fast and accurate imaging selection of patients for mechanical thrombectomy (MT) is a prerequisite of successful and cost effective treatment of acute ischemic stroke (AIS) caused by large vessel occlusion (LVO). We studied the predictive value of ASPECT score on non-enhanced CT scans and the value of machine ratings comparing the readings by neuroradiologists and by an automated image analyzing software.

**Materials and Methods:** Non-enhanced CT scans of anterior LVO related AIS patients were retrospectively and independently analyzed by three experienced neuroradiologists as well as by a CE mark approved automated software (eASPECT, Brainomix, Oxford, UK). A standardized protocol including 1.5 and 5 mm slice thickness and dual windowing (W:80 – C:35 and W:45-C:35) was applied by the neuroradiologists. Clinical outcome was measured on the modified Rankin scale at 30 days by office visits or telephone inquiries. For statistical analysis the Microsoft Excel Analysis Toolpack was used. Interobserver agreement was studied first among the three readers and a “readerASPECT” (rASPECT) was generated as the mean value of the three ratings in each case. A second interobserver agreement was analyzed between the rASPECT and eASPECT scores. Both rASPECT and eASPECT scores were related to 30 days outcome. ASPECT > 6 was considered as good scores mRS < 2 as good outcome.

**Results:** Out of 251 patients treated by MT for LVO AIS between January, 2015 and April, 2017, a total of 42 were identified having a non-enhanced CT scan performed in our Institute and a 30 day clinical follow up available. Those who had CTA prior to transportation to our Institute were excluded for residual contrast contamination. Interobserver agreement among readers was above 70% in all cases.
rASPECT and eASPECT scores correlated well, having a rate of 76%. The predictive value for good outcome of either eASPECT or rASPECT could not be confirmed, but good eASPECT was related to good outcome in 14.3% more cases than rASPECT.

**Conclusion:** In this small cohort, there was a high correlation between professional readings and machine ratings regarding ASPECT scores in LVO caused AIS confirming the accuracy of this technique. The predictive value of ASPECT on non-enhanced CT for clinical outcome following MT was low using either method. This study is limited by its retrospective nature and the small sample size.

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**PP303**

**Clinical Factors Affecting Cognitive Function after Carotid Revascularization: A Multivariate Analysis**

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**Purpose:** It is still unclear through which mechanisms cognitive function is impaired in patients with carotid stenosis. This study was aimed to clarify the predictors of cognitive dysfunction in carotid stenosis and of its recovery after carotid revascularization.

**Patients and Methods:** This prospective study included 129 patients with carotid stenosis who underwent carotid endarterectomy (CEA, n = 45) or carotid artery stenting (CAS, n = 84). There were 116 men and 13 women. Their mean age was 71 years. Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) was employed to assess cognitive function before, one week and three months after CEA/CAS. Using [123I]-IMP-SPECT, cerebral blood flow (CBF) and cerebrovascular reactivity (CVR) to acetazolamide were quantitatively measured before CEA/CAS. Multivariate analysis was performed to evaluate the predictors to affect cognitive function in them.

**Results:** Before CEA/CAS, total RBANS score in 62 patients was significant lower than the age-matched controls. Total RBANS scores significantly improved in 17 patients at one week, in 71 patients at three months after CEA/CAS. Multiple regression analysis demonstrated that high-grade stenosis (P = 0.017), cerebral infarction (P = 0.016), and blood flow decline (P < 0.001) independently predicted cognitive impairment. The absence of DWI-positive lesions (P < 0.001) and CAS (P < 0.001) significantly correlated with recovery of cognitive function one week after CEA/CAS, but only preoperative decline of CVR (P = 0.033) predicted it three month after CEA/CAS.

**Conclusion:** These findings strongly suggest that high-grade carotid stenosis and persistent ischemia impairs cognitive function. CEA/CAS improves cognitive function and the beneficial effects are most notable in poor CVR patients.

**PP304**

**Effective use of Balloon Guide Catheter in reducing incidence of mechanical thrombectomy related distal embolization**

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**Purpose:** The clinical benefit of endovascular stroke therapy has been demonstrated in several prospective randomized trials. However, in a relevant percentage of patients, mechanical thrombectomy bears the risk of causing new infarction in initially unaffected vascular territories through thrombus fragmentation and migration of clot debris. The goal of this study was to evaluate the use of the balloon guide catheter (BGC) to effectively achieve flow arrest and thrombus aspiration during the intervention in order to avoid distal embolization.

**Materials and Methods:** A retrospective study was performed in 139 patients between October 2010 and May 2016, to analyze occlusions in the middle cerebral artery (MCA) or internal carotid artery (ICA) by using a stent retriever with a BGC (n = 73) or a non-BGC (n = 66). The following data were collected: patient age and gender, along with history of diabetes mellitus, hypertension, atrial fibrillation, smoking, obesity, dyslipidemia, and previous ischemic stroke. Data on procedure time, number of passes, and angiographic findings were also collected. The final reperfusion score was rated based on the Thrombolysis in Cerebral Infarction (TICI) grading scale. Successful recanalization was defined as TICI grade 3 or 2b.

**Results:** A total of 139 patients underwent mechanical thrombectomy with the stent retriever. Of the 139 patients, 73 (52.5%) underwent placement of a BGC. The mean age was 65.8 ± 13.5 years, and the median National Institutes of Health Stroke Scale (NIHSS) score was 11. The average initial NIHSS score was lower in the BGC group compared with the non-BGC group (mean, 11.2 ± 5.6 vs. 13.2 ± 5.6; P = 0.03). Patients with BGC had fewer incidences of previous ischemic stroke (12.3% vs. 28.8%; P = 0.01). The numbers of passes were similar between the two groups. The procedure time (99 ± 49.4 minutes vs. 124 ± 72.2 minutes; P = 0.02) and the time from onset of symptoms to procedure end (302 ± 102 minutes vs. 357.2 ± 136.1 minutes; P = 0.009) were shorter in the BGC group. TICI grade 2b and 3 recanalization scores were higher in the BGC group compared with the non-BGC group (63/73, 86.3% vs. 48/66, 72.7%; odds ratio (OR), 0.6; 95% confidence interval (CI), 0.2–1.4; P = 0.04). Importantly, distal embolization was less frequent in the BGC group (4/73, 5.5% vs. 21/66, 31.8%; OR, 7.2; 95% CI, 2.3–22.5; P < 0.001).

**Conclusions:** The risk of distal embolization was significantly decreased with the use of a BGC.
PP305

Predictors for intracranial hemorrhage and 3-month mortality after intra-venous or intra-arterial revascularization in acute cerebral artery occlusion

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Purpose: This study was conducted to evaluate predictors for intracranial hemorrhage and long-term mortality in patients who underwent intra-venous (IV) or intra-arterial (IA) revascularization therapy in acute cerebral artery occlusion.

Materials and Methods: From 2011 to 2015, we analyzed the prospective gathered data of 183 consecutive patients treated with IV thrombolysis or IA procedure in a single center. Demographic, clinical, laboratory, and radiologic factors for intracranial hemorrhage within 2 weeks and 3-month mortality were assessed.

Results: Symptomatic intracranial hemorrhages occurred in 24 (13.1%) patients and asymptomatic in 40 (21.9%). Mortality at 3 months in patients with intracranial hemorrhage was 35.9%. International normalized ratio (INR) (Odds Ratio [OR], 8.613; 95% CI, 1.776–41.765; p = 0.008), serum glucose (mmol/L) (OR, 1.108; 95% CI, 1.007–1.218; p = 0.035), initial infarct volume (mL) (OR, 1.016; 95% CI, 1.003–1.016; p = 0.005), and angioplasty or stenting (OR, 5.125; 95% CI, 1.441–18.223; p = 0.012) were predictors for any intracranial hemorrhage. INR (OR, 7.234; 95% CI, 1.295–40.405; p = 0.024), maximum mean blood pressure within 1 day (OR, 1.066–1.197; p = 0.037), and infarct volume (OR, 1.017; 95% CI, 1.008–1.026; p < 0.001) were predictors for symptomatic intracranial hemorrhage. Hypertension (OR, 4.1; 95% CI, 1.099–15.297; p = 0.036), infarct volume (OR, 1.016; 95% CI, 1.007–1.025; p = 0.001), and symptomatic intracranial hemorrhage (OR, 8.38; 95% CI, 2.167–32.4; p = 0.002) were predictors for 3-month mortality.

Conclusion: As of previous studies, serum glucose and infarct volume were predictors for intracranial hemorrhage after IV or IA revascularization in acute cerebral artery occlusion. We suggest a new predictor of INR to reduce symptomatic intracranial hemorrhage as a mediator for long-term mortality.

PP306

Randomized assessment of safety and efficacy of intra-arterial infusion of autologous stem cells in ischemic stroke

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Background and Purpose: This study was carried out to evaluate the safety and the efficacy of intra-arterial infusion of the bone marrow derived mononuclear cells (BMMNC’s) in the middle cerebral artery (MCA) ischemic stroke patients.

Methods: A prospective, randomized, open-label, blinded-endpoint study (PROBE) was carried out. Out of the total of 229 acute stroke patients seen during this period, 20 patients who satisfied the inclusion/exclusion criteria were included and randomized into the control and intervention groups. Intra-arterial stem cell infusion into the ipsilateral MCA was done in the intervention group patients at 8–15 days post stroke ictus. All the patients received standard post stroke care as per the institutional protocol. Final analysis at 6 months was done for primary (safety) and secondary outcomes (efficacy).

Results: Both the groups were closely matched in relation to the demographic, clinical, biochemical and the initial radiological findings. When comparing the primary endpoint of the study, no procedure related mortality, complication, new infarct or symptomatic intracranial hemorrhage (ICH) was seen in the intervention group. When comparing the secondary endpoint of good clinical outcome, 8(80%) of patients in intervention group had shown good clinical outcome [modified Rankin Scale (mRS) <2] with 4(40%) patients in the control group achieving this (p = 0.068).

Conclusion: Intra-arterial infusion of stem cells can be carried out safely in the sub-acute stage of ischemic stroke patients. Improved clinical outcomes are observed with intra-arterial stem cell therapy however studies with larger cohort are needed to validate the results.

PP307

The consideration of the risk factors and the frequency of ocular symptoms accompanied with ruptured vertebral artery dissecting aneurysm

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Purpose: Although ruptured vertebral artery dissecting aneurysms (VADA) are often associated with ocular symptoms, such as abducent nerve palsy and Terson’s syndrome (TS), its frequency and risk factors in comparison with ruptured aneurysms of other locations have not been reported.

Material and Methods: A total of 343 patients of non-traumatic subarachnoid hemorrhage were treated in our hospital from April 2002 to May 2016, among which 35 had VADA as the origin of hemorrhage (10.2%). They were retrospectively analyzed for risk factors of ocular symptoms.

Results: In 343 patients, 26 had eye movement disturbance (7.6%) and 22 patients had TS (6.4%). In VADA group, both
eye movement disturbance (14 patients, 40.0%, p < 0.0001) and TS (10 patients, 28.6%, p < 0.0001) occurred more frequently than those in non-VADA group. All eye movement disturbances associated with ruptured VADA was abducen nerve palsy, although it occurred in 50% of 12 affected patients with ruptured aneurysms of other locations. They improved within 3 months in 4 patients (28.6%) and within 1 year in 8 patients (66.7%). In multivariate logistic regression analysis, ruptured VADA was indicated as a risk factor for both eye movement disturbance (p < 0.0001, 95% confidence interval (CI) of odds ratio (OR): 3.41–29.5) and TS (p = 0.0033, 95% CI of OR: 1.72–14.33)

Conclusion: Eye movement disturbance and TS occurred more frequently in ruptured VADA patients than in other locations. Early evaluation by ophthalmologist is needed in ruptured VADA patients.

PP308
A low cost nextgen Telemedicine in Stroke Treatment with Smartphone
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Purpose: “Join” is a communication application for healthcare professionals in the line of social networking services (SNS) format and user behavior, such as Whatsapp or iMessages, with specific medical oriented tools such as DICOM viewer and Protocol Tracker and HIPAA compliant secured text message and video chat

Methods: In this study, data from 1 year before and after the introduction of telemedicine for stroke care using this smartphone application were compared in Japan, to objectively evaluate the cost-effectiveness of such solution. A case-matched comparison of inpatients with acute cerebral infarction who had undergone stroke surgery from 5:00PM to 9:00AM for cerebrovascular diseases, including cerebral infarction, subarachnoid hemorrhage, and cerebral hemorrhage, was performed. Sex, age, days of hospitalization, medical treatment costs, number of surgeries, time from CT or MRI until surgery, and number of deaths were also compared.

Result: A direct data comparison may not be valid as there was a significant difference in age between the groups (70.02 ± 14.24 years vs. 66.38 ± 14.32 years), however, the total medical expenses per patient decreased by 88,439 yen, while daily medical expenses increased by 5,328.45 yen. The mean time from stroke diagnostic imaging (CT or MRI) to the start of surgery was 1 h 52 min; though it decreased by a mean time of 15 min. The medical expenses decreased by a mean of 1.01 million yen. And finally, the mean number of days of hospitalization decreased significantly by 19.2 days.

Conclusion: The use of smartphone app in remote diagnosis is a much affordable hardware than traditional telemedicine system, and the user behavior appears to help reducing the medical cost, making this solution promising as the next generation format for this field.


044
Fesability, efficacy and safety of tromboaspiration technique in the endovascular treatment of acute ischemic stroke: comparison between data from RITA Italian registry and Mr. Clean trial
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Purpose: Mr. Clean trial stated that the combined endovascular and intravenous approach is useful in improving the outcome in patients with acute ischemic stroke (AIS) due to occlusion of proximal arterial branches. Direct thromboaspiration (TA) technique is getting more and more affirmed within endovascular approach. The aim of the present study is to evaluate feasibility, efficacy and safety of TA technique.

Matherials and Methods: All the patients included in the Italian multicenter retrospective registry of thromboaspiration for AIS (RITA) have been analysed. Inclusion criteria were the same as Mr. Clean trial, in particular occlusion of an arterial branch of anterior circulation. The first EVT for all the patients was direct TA, reserving the use of a stent-retriever (SR) in case of failure of TA. Technical end-point was TICI 2b-3 at the end of the endovascular treatment (EVT) and clinical endpoint was mRS 0–2 at three months follow-up

Results: 227 patient who underwent direct TA as first EVT step were included in the analysis. 24% needed to use a SR because direct TA failed.
Rates of primary and secondary endpoint, symptomatic intracranial hemorrhage (sICH) and mortality didn’t differ between the two groups (direct TA-only and TA + SR).

Our rates of technical and clinical endpoint are higher in comparison to the results of Mr. Clean trial, despite fewes patients underwent intravenous fibrinolysis. In particular, technical endpoint rates in direct TA group were higher than Mr. Clean intervention group (66.3% vs 58.6%). However, TICI 2b/3 rates showed no differences between TA + SR group and Mr. Clean intervention group. This means that direct TA technique could be as (or more) effective as the use of a SR in the setting of EVT for AIS.

Time from onset to groin puncture and rates of sICH weren’t different between our and Mr. Clean results, while mortality rates were higher in Mr. Clean trial.

Conclusions: Direct TA technique is safe and effective in the setting of the EVT for AIS, and it seems to be as at least as effective as the use of SR.

045
Comparison of Stent Retriever and Contact Aspiration for Treatment of Acute Stroke in the Community Hospital Setting: Retrospective Analysis of 115 Cases
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Introduction: The use of a stent retriever (SR), contact aspiration (CA), or a combined approach are most commonly utilized for intra-arterial thrombectomy treatment of acute stroke. A recent randomized controlled trial has ascertained no statistical difference in the safety and efficacy of the SR compared to CA (ASTER trial: B. Lapergue et al., International Stroke Conference 2017, Houston, TX). We compared SR, CA and the combined approach in a retrospective community hospital cohort.

Methods: Medical records and radiographic images of patients undergoing endovascular stroke therapy at our institution between 2012 and 2017 were reviewed for the following data points: Patient age, sex, NIH stroke scale (NIHSS) at presentation and discharge, intravenous and IA t-PA use (group 1: 55%/25%; group 2: 52%/27%) and gender distribution (45% male) were similar in the groups. A majority of occlusions affected the internal carotid artery terminus (group 1/2: 23%/15%) and M1 segment (group 1/2: 58%/61%). TICI 2B/3 reperfusion grade was achieved in 34 patients in group 1 (64%) and 47 patients in group 2 (76%), with a single pass in 30% in group 1 and 44% in group 2. However, the average number of passes in both groups was similar (2.5). Discharge NIHSS was similar in the groups (9/8). Modified Rankin Scale 0–2 at discharge or 90 days was similar in the groups (34%/31%), as were any recorded complications (9%, 8%). In the subgroup of catheter aspiration alone there was a robust single pass effect (76%), correlating with a higher degree of TICI 2B/3 reperfusion (91%) and better outcomes (42% MRS 0–2).

Conclusions: In our retrospective cohort the two groups of SR and CA with or without SR performed similar in the categories of NIHSS score at discharge, average number of passes, procedural complications, and outcome. There was a greater number of single pass procedures in group 2. In patients where catheter aspiration was successful a robust single pass effect was observed with a high degree of TICI 2B/3 reperfusion and trend towards better outcomes, making CA a feasible first-line approach. Potential limitations of the analysis include the retrospective data collection and variability of outcome data collected from discharge records and follow up surveys.

046
Fesability, safety and efficacy of direct thrombastherapy technique in acute ischemic stroke due to M2 segment occlusion: a retrospective multicenter study from Italian RITA registry
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Purpose: Acute ischemic stroke (AIS) due to M2 segment occlusion is challenging for endovascular treatment because of major technical difficulties and reperfusion rates are usually lower than M1 occlusion. The use of stent-retrievers seems to be effective in reaching good recanalization at the end of the procedure and functional outcome at 3 months. The aim of this study is to evaluate feasibility, safety and efficacy of direct thromboaspiration (TA) technique as first approach in M2-occlusion AIS.

Materials and Methods: RITA is an Italian Multicenter Registry which includes 227 patients with AIS treated by TA as first step. In this retrospective study we analyzed 35 patients with M2-occlusion from RITA. Technical endpoint was TICI 2b-3 at the end of the endovascular treatment (EVT) and clinical endpoint was mRS 0–2 at 3 months follow-up.

Results: 22 patients performed TA only without the use of a second device while 11 needed to use a stent-retriever (SR). Technical endpoint was reached in 69% of the patients, in particular 82% in TA-only group and 45% in SR group. Rates of clinical endpoint was similar between the two groups, but were higher in patients who reached TICI2b-3. Interestingly, only 1 patient (5%) who reached TICI 2b-3 needed to use SR because TA failed, while 5 patients (55,6%) who had TICI < 2b needed to use a SR.

Age was slightly higher in SR group, instead endovenous fibrinolysis and mortality rates were slightly higher in TA-only group. However, patient who reached the clinical endpoint were younger, instead age wasn’t associated with technical endpoint.

3 patients with symptomatic intra-cranial hemorrhage was observed in TA-only group while none in SR group. All the patients with siCH reached the technical endpoint but only 1 the clinical endpoint.

No differences was seen in ASPECTS, NIHSS and rates of general anesthesia between the two groups.

Time from groin to revascularization didn’t differ between TA-only and SR groups, but time from onset to revascularization was shorter in TA-only group.

Conclusion: TA technique is safe and effective as the use of SR in M2-occlusion.

Higher rates of technical endpoint were observed in TA-only group, while younger age seems to be associated with higher rates of clinical endpoint. TICI2b-3 at the end of EVT was associated with good functional outcome at 3 months follow-up. Delayed time from onset to revascularization seems not to be associated with worst functional outcome. We believe that the observed rates of siCH are not significant because of the limited number of the sample.

The influence of conscious sedation vs. general anesthesia for mechanical thrombectomy on interventional workflow in a randomized trial - a post-hoc analysis of the SIESTA trial

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Background and Purpose: The mode of sedation (i.e. general anesthesia (GA) vs. conscious sedation (CS)) applied for mechanical thrombectomy (MT) affects patient-related factors. The influence on interventional workflow is yet controversial. In this post-hoc analysis of the Sedation vs. Intubation vs. for Endovascular Stroke TreAtment (SIESTA) trial, we aimed to investigate whether the sedation mode affects the interventional workflow.

Methods: SIESTA was a randomized, monocentric, prospective, parallel-group, open-label treatment trial with blinded endpoint evaluation approved by the local institutional review board to compare CS with GA for MT in 73 vs. 77 patients. Using data from SIESTA, the impact of the mode of sedation on interventional workflow during MT (e.g. procedure times) and other radiological outcome parameters (e.g. grade of reperfusion) were assessed.

Results: The time from groin puncture to the final angiographic result (in minutes, median (IQR): CS: 98 (64–135), GA: 72 (45–109), p = 0.006) and fluoroscopy time (in minutes, median (IQR): CS: 49 (25–85), GA: 35 (20–74), p = 0.037) were longer in patients treated under CS. Complete reperfusion (TICI 3) was achieved less often in patients with M1-occlusions treated under CS (CS: n = 10 (24.4%), GA: n = 22 (64.7%), p < 0.0001). For M1-occlusions, a tendency towards a higher stent-retriever maneuver count was observed in patients treated in CS (mean (SD): CS: 2.8 (2), GA: 1.9 (1.6), p = 0.059).

Conclusions: The results of the SIESTA trial seem to favor general anesthesia for endovascular stroke treatment as reperfusion results, overall procedure time and number of thrombectomy maneuver appear to be positively influenced by this mode of sedation.

Clinical trial registration: The trial is registered with ClinicalTrials.gov, NCT02126085.
048
The Role of the Lenticulostriate Arteries in the Development of Basal Ganglia Infarction in Patients with an Acute M1 Occlusion Treated with Thrombectomy

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Purpose: To determine the relationship between variable degrees of patency of the lenticulostriate arteries (LSAs) on preinterventional CT angiography source images (CTA-SI) and basal ganglia (BG) infarction in patients with an acute M1 occlusion.

Methods: We retrospectively reviewed CTA-SI of patients with M1 occlusion presenting within 12 hours after symptom onset who had complete recanalization after thrombectomy. To determine the degree of clot extension, we divided the M1 segment into 3 portions: proximal, middle, and distal, and scored the M1 occlusions as the number of portions involved by clots. To determine the degree of patent LSAs, we discriminated 3 groups of LSAs: 1) medial LSAs, 2) proximal lateral LSAs, and 3) distal lateral LSAs, and scored the LSA patency accordingly. To determine degree of ischemia, we distinguished 3 regions within the BG supplied by those LSAs groups, respectively: 1) caudate head and the rostral tip of the putamen, 2) caudate body and anterior tail, and the anterior putamen, and 3) posterior caudate tail and posterior putamen. Ischemic regions on CTA-SI were defined as nonenhanced regions without patient LSAs. We assessed the total number of ischemic regions on CTA-SI as well as on pre and post interventional non-contrast computed tomography (NCCT). We then compared CTA-SI ischemic scores with NCCT ischemic scores, LSAs scores, and M1 occlusion scores (Wilcoxon signed rank test and Spearman’s rank-order correlation). Predictive factors for post recanalization BG hemorrhage and clinical outcome at 3 months were analyzed (Fisher’s exact test).

Results: Fifty-two patients between October 2014 and November 2016 were enrolled. The median ischemic scores on preinterventional CTA-SI and the post intervention NCCT were similar (p = 0.083). The median ischemic score on the preinterventional NCCT, however, was lower than those on CTA-SI and post interventional NCCT (p < 0.001). Additionally, the CTA-SI ischemic scores had a strong negative correlation with LSAs scores (rs (50) = −0.731, p < 0.001) indicating that patients with a larger degree of patent LSAs were less likely to develop BG infarcts. In contrast, no significant correlation was found between CTA-SI ischemic scores and M1 occlusion scores (rs(50) = 0.099, p = 0.487) and between LSAs scores and M1 occlusion scores (rs(50) = −0.148, p = 0.292). Poor clinical outcome was related to combined BG ischemia with cortical ischemia on CTA-SI (p = 0.003) but not related to isolated BG ischemia on CTA-SI (p = 0.093). The presence of a CTA-SI ischemic score of 3 (all BG regions) was related to BG hemorrhage after recanalization (p = 0.014).

Conclusion: The degree of patent LSAs in M1 occlusion on preinterventional CTA-SI seems to predict the development of BG infarction and clinical outcome better than the degree of clot extension in the M1 segment. The presence of a CTA-SI ischemic score of 3 increases the risk of post recanalization hemorrhage.

049
Preischemic Neuroprotective Effect of Minocycline and Sodium Ozagrel on Transient Cerebral Ischemic Rat Model

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Background: We investigated the neuroprotective properties of single doses of minocycline and ozagrel when administered prior to stroke.

Methods: Male Sprague-Dawley rats were assigned randomly to one of the following groups: (1) control (Con) group (n = 10), (2) minocycline (Mino) group (n = 10), (3) sodium ozagrel (SO) group (n = 10). Rats were treated with a single dose of minocycline or ozagrel at 30 minutes before stroke. A middle cerebral artery occlusion (MCAO) was made at 30 minutes after drug administration and a 1 hour perfusion was done. The rats were subjected to a neurobehavioral test at days 1, 3 and 7, and a TTC staining. The cerebral ischemic volume was quantified by MetaMorph imaging software after TTC staining. The neuronal cell survival and astrocytes expansion were assessed by the NeuN and GFAP immunohistochemistry staining. Apoptosis was detected by the TUNEL assay. We statistically analyzed and compared the results with each other.

Results: Mino and SO groups had neuroprotective effect and showed a better behavioral performance of adhesive removal and treadmill test at 7 days after stroke. Mino and SO groups also showed a smaller infarct volume than control group at 7 days after stroke. Immunohistochemistry staining showed a higher number of NeuN positive cells, lower activated astrocytes in GFAP and a lower apoptosis in TUNEL staining.

Conclusion: This study showed that single doses of minocycline and ozagrel prior to stroke had neuroprotective effects. These agents will be useful not only in post-stroke therapy but also in stroke prevention in several cerebrovascular procedures like carotid endarterectomy, bypass procedure, endovascular angioplasty, thromboembolectomy or thrombolysis.
050
Work flow in a comprehensive stroke center: Results of a first referral program quality database in Istanbul
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Purpose: In Istanbul acute stroke patients are generally first transported to nearby “not stroke ready” hospitals. Memorial Comprehensive Stroke Program (MCSP) is the first treatment referral program serving public and private hospitals in Istanbul. The objective of this study was to examine the endovascular treatment (EVT) work flow data, after a pilot lead-in phase.

Methods: The program is integrated within the emergency medical system (EMS). Hospitals and EMS can have direct access and prenotify to the neuro-hospitalist through the emergency stroke line. Once stroke code is given, acute stroke team (neurologist + stroke nurse) receive the patient at the emergency room (ER), lead him/her to radiology department (RD), meanwhile angiography room is switched to standby mode. While the informed consent is signed on the way to RD, thrombolytic therapy is started right to standby mode. While the informed consent is signed, department (RD), meanwhile angiography room is switched at the emergency room (ER), lead him/her to radiology.<
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Results: The database include 1056 patients, 46 of which didn’t have valid onset to door time (ODT) data. Fifty-nine percent of the cases (571) were admitted within the first 4.5 hours after onset. The mean age was 65 and 55% was male. Mean ODT was 168 minutes. Over the years mean ODT prolonged significantly (p<0.000). Revascularization therapy (209 only IV r-TPA (IVT) (64%), 82 bridging (25%), 34 only EVT (11%) were performed in 325 of 1056 patients (33.5%). This rate was 49% in the 4.5 hour group (185 only IVT (66%), 76 bridging (27%), 19 only EVT (7%)). The frequency of both IVT and EVT had increased over the years (p=0.000). From the eligible patients 90 % received IVT and 77,8% received EVT. The DNT was 32 minutes. Mean door to end of imaging time (DelT), IFP, and FPR time were 35, 42 and 77 minutes, respectively. Over the years, DelT and IFP decreased significantly (p<0.000 and 0.038 respectively). The rate of IFP below 30 min and DFP below 60 were 39,6% and 37.2% respectively and increased (p:0.038 and 0.001) in time. There was no any significant change in FPR.

Conclusion: This was the first experience of a referral treatment program in a megapol like Istanbul. Patient referral got more selective and included late-onset patients over time probably due to recruitment from geographically widely dispersed ER’s. Close monitorization showed improvements in time benchmarks after synchronisation of the team work and timely readjustments. Operator dependent factors deserve close attention to improve FPR.

051
Acute stroke management using image sharing on smart phones and tablet devices
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Prompt diagnosis and treatment of cerebral stroke patients are essential for their recovery. With the increasing demands for management of stroke, shortening the time of decision making through telemedicine is becoming important. Based on this hypothesis, we introduce an experience using telestroke system (commercial name “JOIN”) for faster access to diagnostic images and clinical information. JOIN functions are as follows: A call function informing staff of an incoming stroke patients, An image viewing function Video streaming during surgery or IVR, Tweeting to fellow specialists, Inter-hospital cooperation. During last five years, we shared more than 1600 patients’ data with this system. Door to puncture time of endovascular revascularization for acute ischemic stroke achieved to make 1 hour shorten. This system contributed to improve patients’ outcome and physicians’ quality of life. Some issues such as cost, security and responsibility should be still discussed.

052
Stent anchor with Mobile AspiRation Technique (SMART) for treating cerebral venous sinus thrombosis in high risk patients
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Purpose: Data on endovascular therapy for sinus thrombosis remains limited. Moreover, the literature mostly focuses on local thrombolyis and older rheolytic catheters. We present our experience utilizing a novel Stent anchor with Mobile
AspiRation Technique (SMART) in high risk patients and summarize the literature on treatment approaches for this condition.

**Materials and Methods:** A retrospective analysis to identify all patients presenting with sinus thrombosis associated with high risk features using an institutional review board approved protocol was performed. High risk features included intracranial hemorrhage, worsening deficit, and venous infarction. IV heparin was started in all cases upon diagnostic confirmation with imaging and early endovascular treatment (within 24 hours) was planned. Patients undergoing treatment between January 2015 and January 2017 were included. All patients underwent SMART. No local thrombolysis was administered. A total of six cases were identified.

We published the only previous report of SMART in a 2015 case report. The technique involves placing a 6F Berenstein in the IJ. A 5 MAX ACE catheter, 3 MAX catheter, and Fathom 16 microwire are then used as a triaxial system to reach the distal portion of the occluded sinus(es) of interest. Subsequently, a stent retriever device is deployed through the 3Max. The Stent Retriever functions as an anchor distally. The 3Max is removed and the 5 Max ACE is passed back and forth with suction through the occluded sinus. Data on age, mRS at presentation, location(s) of thrombosis, periprocedural complications, and degree of recanalization were collected. Interventionalists grading recanalization were blinded to any identifying information. Periprocedural complications, postprocedure neurological status, and mRS at followup were recorded.

We did a literature review on PUBMED and summarize our findings.

**Results:** Complete or near-complete neurological recovery (mRS 0–2) seen in four out of six patients. Complete or near complete recanalization was achieved in all cases. Technical success noted in a variety of scenarios across operators.

SMART appears safer and more effective than previously reported methods. No periprocedural intracranial hemorrhage or periprocedural complication was observed. The literature estimates up to 40% of high risk patients have an mRS worse than two when only heparin is used, an assumption also used in the ongoing TO-ACT trial. More studies are needed to clarify treatment window and risk stratify patients by either presenting clinical or radiological features.

**Conclusion:** SMART reliably achieves recanalization and can lead to favorable post procedure mRS scores when applied early in high risk patients. A randomized trial comparing early thrombectomy without intra-arterial lysis in high risk patients versus intravenous heparin and/or local tPA should be pursued.

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**053**

Endovascular management of intracranial sinus thrombosis

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Intracranial venous sinus thrombosis is a potentially devastating condition. Efficacious treatment requires early and extensive thrombus resolution or removal. Based on four selected cases, the following will be demonstrated:

- delay of treatment onset and failure to recanalize the occluded sinuses is associated with poor outcome
- early treatment and effective thrombus removal by means of rheolysis allows for good clinical outcome, even in patients with massive intracranial venous sinus thrombosis. Technical details of rheolysis will be explained.

**Monday, 16th of October – Session room 2 – 16:45 – 18:45 – Parallel abstract session - Stroke**

**054**

Cerebrovascular drug eluting stent vs bare metal stent in the treatment of vertebral artery stenosis: a prospective randomized controlled clinical trial

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**Purpose:** To evaluate the safety and preliminary efficacy of a new cerebrovascular drug eluting stent for the treatment of vertebral artery stenosis.

**Materials and Methods:** This was a single center, open-label, prospective, randomized, controlled trial between September 2014 and October 2016. Patients aged 18 years or older with vertebral artery stenosis of at least 70%, were randomized in 1:1 ratio to undergo stenting with the new cerebrovascular drug-eluting stent or with the bare metal. Primary outcome including surgical complications within 30 days after operation and the incidence of in-stent restenosis within 6 months after operation, and secondary outcome including incidence of ipsilateral stroke, cardiocerebral vascular and serious adverse events within 12 months after operation were compared.

**Results:** 40 met the eligibility criteria and were randomly divided into two groups to receive stenting with either cerebrovascular drug-eluting stent (n = 20) or cerebrovascular bare metal stent (n = 20). No procedure complications or adverse events occurred within 30 days after the procedure and the times between procedure and randomization. The median follow-up time for catheter angiography after stenting was 6.5 (6.1, 7.2) months for all randomized patients in DES-G and 6.4 (6.1, 6.8) days in BMS-G (P = 0.456). During this period, 1 case had in-stent restenosis in the DES-G (5%, 95% CI 0.1 to 24.9) and 5 cases in BMS-G (25%, 8.7 to 49.1)
with a difference of $-20\%$ (95% CI $-41.3$ to $1.3\%$, \(P = 0.182\)) demonstrating non-inferiority. The mean clinical follow-up after stenting was $18.0 \pm 3.6$ months for DES-G and $18.8 \pm 6.0$ for BMS-G with a difference of $-0.8$ (95% CI $-3.2$ to $1.62$), \(P = 0.511\). During follow-up, adverse events occurred in two patients (10%, 95% CI 12.3–31.7) in the DES group and seven (35%, 15.4–59.2) in the BMS group with a difference of $-25\%$ (95% CI $-49.7$ to $0.3\%$, \(P = 0.127\)). Serious adverse events occurred in one patient (5%, 95% CI 0.1–24.9) in the DES group and three (15%, 3.2–37.9) in the BMS group with a difference of $-10\%$ (95% CI $-28.3$ to $8.3\%$) \(P = 0.605\). The 1-year incidence rates for cerebrovascular and cardiovascular events including angina and stroke were 5% (95% CI 0.7–30.5) in DES group and 15% (5.1–39.6) in BMS group (Log-Rank Test, \(P = 0.317\)). The 1-year incidence rates for stroke in the supply territory of the target vertebral artery were 0% in DES group and 10% (95% CI 2.6–34.4) in BMS group (Log-Rank Test, \(P = 0.152\)).

Conclusion: This study showed that the new drug eluting stent was feasible and safe for the treatment of patients with severe vertebral artery stenosis, although statistically insignificant, it showed a tendency to reduce the incidence of restenosis (5% and 25%). This study has laid the foundation for phase III multicenter clinical study in the future.

055

Detailed analysis regarding cerebral hyperperfusion syndrome in patients scheduled for staged angioplasty in a retrospective, Japanese multicenter study

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Background and Purpose: We previously conducted a retrospective multicenter study, the STOP-CHS study, which retrospectively registered 535 patients at high risk for cerebral hyperperfusion syndrome (CHS) from 44 Japanese centers who underwent endovascular carotid revascularization between October 2007 and March 2014. The rates of CHS were 4.4% in 113 lesions scheduled for staged angioplasty (SAP), under-sized balloon angioplasty followed by delayed carotid artery stenting (CAS) and 10.2% in 419 lesions scheduled for regular CAS (p = 0.047), respectively, and multivariate-adjusted OR of SAP for CHS was 0.32 (95% CI, 0.12–0.83). These results suggested SAP being an effective procedure to avoid CHS. The aim of this analysis was to clarify the procedural characteristics associated with CHS in patients scheduled for SAP.

Materials and Methods: We investigated the occurrence of CHS and procedural details of 113 patients scheduled for SAP in the STOP-CHS study.

Results: Of 113 patients scheduled for SAP (14 women, 72.8 ± 8.5 years old), 102 (90.3%) successfully underwent SAP (SAP group), 9 underwent first-stage angioplasty with an additional stenting (single-stage CAS group) and 2 underwent first-stage angioplasty alone. Pre- and postprocedural angiographic stenosis in single-stage CAS group was 89.9 ± 6.4% and 29.1 ± 17.6%, respectively. In SAP group, angiographic stenosis changed from 90.1 ± 6.3% to 65.9 ± 17.4% after first-stage angioplasty using balloon catheter of which median maximal diameter was 3.0 mm (interquartile range [IQR], 2.5–3.0). Second-stage CAS was performed at a median of 23 days (IQR, 15–35) after first-stage angioplasty. The target lesions were slightly restenosed during the interval (angiographic stenosis, 65.9 ± 17.4% to 71.6 ± 15.3%, \(p = 0.003\)) and were sufficiently revascularized to 16.9 ± 13.1% stenosis after second-stage CAS. CHS occurred in 5 patients (4.4%); 1 in single-stage CAS group and 4 in SAP group (2 after first-stage angioplasty and 2 after second-stage CAS). A relatively abrupt dilatation of the target lesion (postprocedural stenosis of 50–55%) was observed in the patient with additional stenting-related CHS and one of two patients with angioplasty-related CHS. Regarding second-stage CAS-related CHS, one patient underwent CAS on the day following angioplasty because an ischemic stroke occurred and another underwent CAS with a postangioplasty stenosis of 82% and subsequent restenosis.

Conclusions: Angioplasty-related CHS was presumed to result from a relatively abrupt dilatation of the target lesion. Additional stenting-related CHS also arose from an abrupt dilatation due to rescue stenting, probably for insufficient dilatation, and/or vessel wall dissection after angioplasty. Second-stage CAS-related CHS might be attributable to an abrupt dilatation after CAS for the insufficiently dilated and/or re-stenosed target lesion. Simply stated, SAP-related CHS could be attributable to inappropriate dilatation at first-stage angioplasty.
**056**

**The Revised method of Angioplasty with Wingspan stent in Angioplasty for ICAS: Poststent Ballooning**

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**Purpose:** The purpose of this study is to investigate the treatment results, and procedure-related complications of stent-angioplasty for symptomatic intracranial arterial stenosis with Wingspan stent and Gateway balloon.

**Materials & Methods:** From May, 2010 to Dec. 2015, 95 patients (64 males, 31 females, mean age: 66.5 ± 8.9 years) with symptomatic intracranial arterial stenosis were treated. Inclusion criteria are acute and/or subacute symptomatic infarction or repeated transient ischemic attack (TIA) (infarction vs. TIA: 53 vs. 42) and severe stenosis related to symptoms confirmed with catheter angiography. The numbers of stenotic lesions were 38 cases on ICA, 38 on MCA, and 19 on verteobasilar (V-B) artery. All of the used stents for treatment were Wingspan self-expanding stent and Gateway balloon. Present stenting was done in 73 cases and only poststent ballooning in the other 22 patients. Meanwhile poststenotic ballooning was done in 70 patients regardless of the present ballooning. Mean NIHSS at admission was 1.4 ± 1.7, and mean stenosis rate was 76.8 ± 6.1%. Clinical status (including NIHSS) and angiographic results were assessed retrospectively.

**Results:** Stents were successfully deployed at first trial in almost all cases except only one cases due to tortuous ICA course (98.9%), and in that case, ballooning was done only. Periprocedural complications occurred in 13 cases (13.7%), and symptomatic cases were only 6 (6.3%, transient vs. permanent: 4 vs. 2). Of 95 cases 85 were followed clinically over 6 months (89.5%) and the mean follow-up period was 28.4 ± 22.0 months. CVA occurred in only two patients in the FU period. The mean NIHSS after stent-angioplasty was 0.8 ± 1.7 and 0.3 ± 1.3 at the last clinical follow-up day. Angiographic follow-up over 6 months was performed in 80 cases (84.2%), and the mean FU periods was 20.7 ± 16.9 months. Post-stenting residual stenosis was 7.5 ± 13.4%, and 20.5 ± 26.1% at the last angiographic follow up. In-stent restenosis over 50% occurred in 11 cases (11/80, 13.8%), but symptomatic one was only 6 patients. In the analysis depending on poststenotic ballooning, angiographic restenosis occurred in 5 of 19 cases (26.3%) in which poststenal ballooning was not performed, but 6 of 61 (9.8%) in which poststenal ballooning was performed \((p = 0.120)\). Meanwhile symptomatic restenosis occurred in 4 of 19 cases (21.1%) without poststenal ballooning, but 2 of 61 (3.3%) with poststenal ballooning \((p = 0.026)\).

**Conclusion:** Stent-angioplasty with Wingspan self-expanding stent appeared to be safe and effective for intracranial arterial stenotic disease especially with the aid of poststenal ballooning. However, it should prompt more strict selection criteria and desperate angiographic follow-up for better clinical results.

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**057**

**Use of angioscopy for intravascular assessment of plaque protrusion after carotid artery stenting**

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**Purpose:** Thromboembolic complications caused by a distal embolism after carotid artery stenting (CAS) remain an unsolved problem. Several intravascular imaging tools have been proposed for assessment of these events. Among them, angioscopy provides a dynamic and clear intravascular imaging method. We report a CAS case series with evaluation of the post-procedural intravascular findings obtained by angioscopy.

**Methods:** Between April 2016 and April 2017, twelve patients with carotid artery stenosis were treated at our institution using CAS under flow reversal system. After stent placement, an angioscope (VISIBLE, iHeart Medical, Tokyo, Japan) was introduced via a guiding catheter and used to assess the intravascular condition under continuous irrigation with saline.

**Results:** Plaque protrusion beyond the stent struts was observed in 11 (92%) patients. One of the patients, who was initially treated with an open-cell stent, developed prominent plaque protrusion and mobile fragments. Owing to the risk of distal embolism, another closed-cell stent was placed overlapping with the previous stent. Finally, fixation of the ruptured plaque fragment was confirmed by angioscopy.

**Conclusion:** Angioscopy played a crucial role in the assessment of plaque protrusion after CAS. Further, it could be used to determine the need for additional rescue treatment.
Stent placement for internal carotid artery stenosis at the skull base

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Purpose: Percutaneous transluminal angioplasty and stenting (PTAS) for arteriosclerotic stenosis of intracranial artery is still controversial. Perioperative complications and high restenosis rate are not resolved. As far as internal carotid artery (ICA) stenosis at the skull base (C4–C5), the complication rate is low and there are many cases that PTAS is considered effective. We retrospectively analyzed a series of the ICA stenosis in the skull base treated with PTAS between 1999 and 2016.

Materials and Methods: Fifty-six lesions of 54 cases were included in this study. Thirty-nine lesions were symptomatic and 17 were asymptomatic. The indication of PTAS was over 70% stenosis. PTAS was performed under the reversal of flow using a balloon-mounted guiding catheter to prevent distal embolism in most cases. Balloon-expandable coronary stents were used in all patients except one treated with Wingspan. Angiographic success rate, perioperative complications, restenosis and recurrence of infarction in the territory of treated vessels were evaluated.

Results: The stents were successfully deployed in the stenotic lesions (98.2%) except one, in which the stent delivery system could not be accessed to the lesion because of severe arteriosclerosis. Cerebral infarction detected by MRI-DWI was observed in 8 cases (1 symptomatic). Hyperperfusion was observed in 5 cases including 2 cases, who were simultaneously treated with carotid artery stenting and died. Systemic complication occurred in two cases including angina and acute renal failure. Restenosis occurred in two patients, who required balloon angioplasty. The recurrence of cerebral infarction occurred in 6.5% (mean follow-up period 56.4 mo.).

Conclusion: PTAS for ICA stenosis at the skull base has high angiographic success rate with few complications and can be a treatment option.

30 Day Results from Revascularization of Extracranial Carotid Artery Stenosis (RECAS) in China Mainland: a Prospective Cohort Trial

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Purpose: Carotid endarterectomy is more effective than medical management in the prevention of stroke in patients with severe symptomatic or asymptomatic atherosclerotic carotid artery stenosis. Stents are an alternative treatment to carotid endarterectomy for carotid stenosis, many trials including ICSS and CREST have established equivalent safety and efficacy. Many hospitals have developed CEA and CAS in China mainland, but the data of safety and efficacy is rare.

Materials and Methods: The revascularization of extracranial carotid artery stenosis (RECAS) study is a multicentre, prospective cohort trial. Patients with symptomatic ≥50% carotid artery stenosis and asymptomatic ≥70% carotid artery stenosis in 36 centers were continuously assigned to receive carotid artery stenting or carotid endarterectomy. Patients were followed up by independent clinicians not directly involved in the treatment. The primary end point of the study was the cumulative incidence of a major cardiovascular event at 1 year - a composite of death, stroke, or myocardial infarction within 30 days after the procedure or death or ipsilateral stroke between 31 days and 1 year. This study was registered, number NCT01994187.

Results: The trial enrolled 2762 patients (CAS group, n = 1543; CEA group, n = 1176; CEA + CAS group, n = 43). The primary end point was achieved in 4.47% (69/1543) in patients treated with carotid artery stents, and 4.93% (58/1176) in patients treated with carotid endarterectomy, an absolute difference of 0.46%. There was no statistically significant difference between the two groups. Risks of any stroke (3.50% vs 3.32%) was higher in the stenting group than in the endarterectomy group, but the risks of any death (0.39% vs 0.51%) was lower in the stenting group than in the endarterectomy group. Seven procedural myocardial infarctions (0.65%) were recorded in the stenting group, compared with thirteen in the endarterectomy group (1.10%).

Conclusion: There is no difference in the safety of CEA and CAS for carotid artery stenosis. Completion of long-term follow-up is needed to establish the efficacy of carotid artery stenting compared with endarterectomy.
Clinical Analysis Comparing Efficacy between a Distal Filter Protection Device and Proximal Balloon Occlusion Device during Carotid Artery Stenting

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Objective: The main concern during transfemoral carotid artery stenting (CAS) is preventing cerebral embolus dislodgement. We compared clinical outcomes and intraprocedural embolization rates of CAS using a distal filter protection device or proximal balloon occlusion device.

Methods: From January 2011 to March 2015, a series of 58 patients with symptomatic or asymptomatic internal carotid artery stenosis ≥70% were treated with CAS with embolic protection device in single center. All patients underwent post-CAS diffusion-weighted magnetic resonance imaging (DW-MRI) to detect new ischemic lesions. We compared clinical outcomes and postprocedural embolization rates.

Results: CAS was performed in all 61 patients. Distal filter protection success rate was 96.6% (28/29), whose mean age was 70.9 years, and mean stenosis was 81%. Their preprocedural infarction rate was 39% (11/28). Subsequent DW-MRI revealed 96 new ischemic lesions in 71% (20/28) patients. In contrast, the proximal balloon occlusion device success rate was 93.8% (30/32), whose mean age was 68.8 years and mean stenosis was 86%. Preprocedure infarction rate was 47% (14/30). DW-MRI revealed 45 new ischemic lesions in 57% (17/30) patients. Compared with distal filter protection device, proximal balloon occlusion device resulted in fewer ischemic lesions per patient (p = 0.028). In each group, type of stent during CAS had no significant effect on number of periprocedural embolisms. Only 2 neurologic events occurred in the successfully treated patients (one from each group).

Conclusion: Transfemoral CAS with proximal balloon occlusion device achieves good results. Compared with distal filter protection, proximal balloon occlusion might be more effective in reducing cerebral embolism during CAS.

Endovascular revascularization of chronic complete occlusion of the internal carotid artery

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Purpose: Chronic total occlusion (CTO) of the internal carotid artery is not a good candidate for CEA or CAS. By-pass surgery proved to be not effective. No definite treatment is available. Our experience with endovascular revascularization of these lesions is presented.

Material and Method: Of 81 CTO patients 72 were male and 9 were female with age ranged 37 to 83 years old. 55 were symptomatic and 26 asymptomatic. 35 patients (43.2%) had severe carotid stenosis on the opposite side. Endovascular revascularization was performed in 33 with symptomatic stage 2 ischemia. A guide wire was advanced through the occluded internal carotid artery. With proximal and distal protection sequential angioplasty was performed. Carotid stent and coronary stents were deployed to the residual stenosis. Patients were followed up with angiography or 3DCT.

Results: Technical success was obtained in 29 out of 33 (87.9%). Complications were observed in three (9.1%). One with retinal ischemia and two with transient hemiparesis. In the follow-up, re-occlusion occurred in 3 without
serious complication. Ischemic stroke occurred in one (3%) with annual stroke ratio 0.8%. Other patients were free from stroke after treatment.

**Conclusion:** Endovascular revascularization is promising for CTO of the internal carotid artery.

**063**

**Use of Casper stent in internal carotid artery angioplasty**

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**Purpose:** Carotid atherosclerosis represents around 10 to 20% of the cerebrovascular insults. Clinical trials have been showing similar results between endarterectomy and endovascular procedure. Therefore, the efforts are now towards perfecting the materials used in angioplasties, increasing its efficiency. The Casper stent has as purpose to lower the embolic release risks during and after the procedure, as well as having a good wall apposition and so reducing the folding chance. Expose our experience in rechanneling carotid arteries with the new stent model, Casper (Microvention, Terumo). This stent features are closed cell, double layer, higher density micromesh and a smaller stent cell size in comparison with other commonly used stents.

**Material and Methods:** Data were collected from January 2016 to April 2017. The study group was composed by 50 patients who underwent internal carotid arterial angioplasty procedure, all of them with 70% stenosis or higher, treated with CASPER RX stent. The analyzed variables include age, sex, comorbidities - amongst them - arterial hypertension, diabetes mellitus, dyslipidemia, cardiac disorders and smoking. We also evaluated whether there was previous cerebrovascular ischemic insults or not, previous symptoms, stenosis percentage, complications and death after procedure. We used the following filters: Spider RX (ev3), FilterWire EZ (Boston Scientific) and AngioGuard (Cordis).

**Results:** Regarding the epidemiologic data, the average age was 70.52 years old with standard deviation of 8.45%. 60% (30) were men and 40% (20) women. About the comorbidities, 94% (47) of the patients were hypertensive, 38% (19) diabetic, 96% (48) dyslipidemic, 34% (17) cardiac disorders, and 20% (10) were smokers. The symptomatology has also been analyzed, regarding this aspect 72% (36) of the patients were experiencing symptoms of dizziness and 28% (14) of the study group presented to the service with previous ischemic stroke. After the angioplasty procedure, 2% (1) presented with complications, TIA. There were no deaths.

**Conclusion:** The CASPER stent is made of braided Nitinol which adapts with the tortuous anatomy and provides excellent apposition on the artery wall. The complication rates were low, suggesting procedure safety with the given stent.

**064**

**Potential of new generation double-layer micro-mesh stent for carotid artery stenting in patients with unstable plaque - A preliminary result using OFDI analysis**

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**Background:** One of the disadvantages of carotid artery stenting (CAS) is high incidence of distal embolism (DE) during or after the procedure. It has been reported that patients with unstable plaque are at high risk of DE and plaque protrusion (PP) after stent placement, which lead to post-procedural ischemic complications.

**Objective:** The purpose of this study was to compare the rate and size of PP between a new generation double-layer micromesh stent (CASPER, Terumo), and conventional stents using optical frequency domain imaging (OFDI) and to elucidate the efficacy of micromesh stent for unstable plaques.

**Methods:** Forty-six consecutive patients with unstable plaque defined by MRI were enrolled in this study and scheduled for CAS with OFDI imaging. Cross-sectional OFDI images within the stented segments were evaluated at 0.125 mm intervals and the rate and size of PP were compared between micromesh and conventional stents.

**Results:** Micromesh and conventional stents were used in 9 and 37 patients, respectively. No procedural complications occurred in both groups. On OFDI analysis, presence of PP was apparently lower in micromesh stent group than conventional stents group (44% vs 88%, p = 0.022). Also, mean PP area was significantly smaller in micromesh stent group than conventional stents group (Mean PP area: 0.013 ± 0.034 mm² vs 0.057 ± 0.09 mm², p = 0.006).

**Conclusion:** On OFDI evaluation after stenting, the degree of PP was significantly smaller in micromesh stent than conventional stents. This result indicates new insights of CAS for the treatment of carotid artery stenosis with unstable plaque.
Impact of Mechanical Thrombectomy Device on Thrombus Histology in Acute Embolic Stroke

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Background and Purpose: This study was performed to assess the impact of two major mechanical thrombectomy devices on thrombus composition with respect to their actions on thrombus recanalization and outcomes: a Penumbra aspiration catheter (Penumbra 5MAX ACE or 4MAX; Penumbra Inc., Alameda, CA) and a stent retriever (Solitaire; Covidien, Mansfield, MA or Trevo; Stryker Neurovascular, Mountain View, CA).

Methods: Thrombi were collected from consecutive patients who had undergone endovascular mechanical recanalization for large intracranial vessel occlusion. The mechanical thrombectomy device used was either an aspiration catheter or a stent retriever. The hematoxylin- and eosin-stained specimens were quantitatively analyzed with respect to the relative fractions of the main constituents (erythrocytes and fibrin). Clinical and radiological findings were also evaluated.

Results: Of 65 patients, the Penumbra aspiration catheter was used in 27 patients and a stent retriever was used in 38 patients. There were no significant differences in age, sex, occluded vessel, National Institutes of Health stroke scale score, or onset to reperfusion time between the two groups. The thrombus volume was significantly larger in the Penumbra group than in the stent group (4.58 ± 1.20 cm³ vs. 1.35 ± 0.30 cm³, respectively; P < 0.01). Conversely, the fibrin component was significantly higher in the stent group (34.7% ± 3.1% vs. 66.3% ± 3.2%, respectively; P < 0.001). The presence of a preoperative susceptibility vessel sign on magnetic resonance imaging was not correlated with the percentage of erythrocytes in either group. Interestingly, preoperative intravenous administration of recombinant tissue plasminogen activator reduced the size of the thrombus in the stent group but not in the Penumbra group (P < 0.05).

Conclusions: Aspiration catheters and stent retrievers promote thrombus recanalization by different actions. Stent retrievers crush the thrombus and reduce its size, which may have a synergistic effect with recombinant tissue plasminogen activator.

Relationship between density of thrombus on admission CT scan and recanalization grade in mechanical thrombectomy with stent retrievers

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Purpose: Ischemic stroke is one of the major causes of death and disability. The present guidelines state that vessel opening is one of the goals of treatment and earlier recanalization correlates with better outcomes. In our experience we noticed that in some patients many of our pulls were unsuccessful, despite the same technique and devices.

The main objective of this work is to find if there is any thrombus characteristic on the admission CT scan, such its density measured in Hounsfield Unit (HU), that can predict failure of recanalization (patients with Thrombolysis in Cerebral Infarction (TICI) 1) following Mechanical Thrombectomy.

Material and Methods: We selected the patients with anterior circulation acute stroke that underwent Mechanical Thrombectomy in our centre during one year. For all the patients we performed two measurements in the admission CT scan: the absolute density (HU) of the thrombus and its relative density to the contralateral MCA.

Then we assigned those patients to the group of successful thrombectomy (TICI > 2) or to the group with failure in recanalization (TICI < 1).

Results: We identified 117 patients with anterior circulation stroke treated with mechanical thrombectomy. In the TICI < 1 group we observed lower absolute and relative density values of the clot vs the TICI > 2 group.

Conclusion: In our series we observed that failure of recanalization during mechanical thrombectomy was related with lower absolute and relative density values of the thrombus. This aspect may be related to the composition of the thrombus, formed mostly of fibrin and platelets in opposition to those constituted mainly by red blood cells. A histology/density correlation study is ongoing in order to confirm this. Such information could be used in decision making in endovascular treatment approaches.
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Analysis of various methods of retrieved cerebral thrombi in acute ischemic stroke
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Purpose: There is still a lack of discussion of the determination of stroke subtypes through the morphological analysis of thrombus. The aim of this study was to assess whether we could distinguish stroke subtype by analyzing the size, weight, shape, and color characteristics of the retrieved thrombus.

Materials and Methods: From October 2013 to January 2016, among the 60 thrombi obtained by mechanical thrombectomy from acute ischemic stroke, 28 were classified as cardioembolism and 16 were large artery atherosclerosis by modified TOAST classification. The size, shape, and color characteristics of the formalin-fixed thrombus were analyzed using the Image(J) program. The weight of total thrombi of each case was measured. After that, the weight, length, and sectional area of the largest thrombus of each case was measured again. For shape, we compared the degree of circularity, roundness, aspect ratio, and solidity of the largest thrombus. In the case of color analysis, the color image of the largest thrombus was analyzed by the mean values of Red, Green, and Blue using RGB histograms.

Results: The large artery atherosclerosis group was younger (69.07 ± 10.82 vs. 60.69 ± 12.13, p = 0.023) and has a lower NIHSS score (19.22 ± 6.81 vs. 15.56 ± 6.89, p = 0.041) than cardioembolism group. Remnant stenosis after thrombectomy (29.6% vs. 71.4%, odds ratio 5.938; p = 0.019) was more prominent in the large artery atherosclerosis group. In multivariate logistic regression analysis including all univariate predictors with p < 0.05, the mean Green value of RGB (OR 1.488, 95% CI 1.032–2.146; p = 0.033) was independently associated with large artery atherosclerosis.

Conclusion: According to the result of our study, the shape of the thrombus did not help to determine the stroke subtype. However, the weight, cross-sectional area, and color difference of the thrombus helped to distinguish cardioembolism and large artery atherosclerosis, and the mean Green value of RGB was found to be the most significant predictor.

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Impact of clot composition on efficacy of stent thrombectomy
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Purpose: Mechanical Thrombectomy (MT) has been proved effective in the treatment of Acute Ischemic Stroke (AIS) caused by anterior Large Vessel Occlusion (LVO). Histological structure of the clots may affect their physical features which in turn may impact the efficacy of procedures. We analyzed clot composition in relation to procedural and clinical outcome in a consecutive series of AIS cases treated with MT.

Materials and Methods: The cellular composition of clots removed by balloon tipped guide cathether assisted stent thrombectomy was prospectively analyzed in a consecutive series of LVO AIS patients. Solitaire (Medtronic Neurovascular), Trevo (Stryker Neurovascular) and Preset (Phenoxy) thrombectomy stents were randomly used. The composition was characterized by the ratio of red (RBC) and white (WBC) blood cells, platelets (PL) and fibrin (FI) and expressed as percentages. TICI 2b-3 recanalization was considered as procedural success and any other morphological results as failure. Successfully recanalized cases were further divided into two subgroups of Easy Recanalization (ER) with one or two thrombectomy steps and Complex Recanlization (CR) that required 3 or more steps. Early clinical outcome was measured upon discharge and rated on the modified Rankin scale (mRS). Grades of 0–2 were considered good and 3 or more as poor outcome.

Results: Samples of clots were consecutively collected in a series of 43 cases between October, 2016 and March, 2017.
Penetration depth of stent retrievers into clots is highly dependent on stent design

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The aim of this study was to investigate the interaction between retriever stents and clots of different composition regarding the penetration depth of stent struts into the clot. We designed four different clot types from human whole blood that histologically resembled clot categories found in acute ischemic stroke patients. These experimental clots were filled into vascular models of the proximal middle cerebral artery and we flushed the remaining inner lumen of these vessels with contrast medium. Finally, these occluded vessel segments were recanalized using five different stent retrievers (Trevo, Solitaire, Aperio, Separator 3D and Preset LT) during constant high resolution biplane angiographical imaging in order to obtain negative contrast images of the clot and the interaction with the stent struts. These images were subsequently analyzed by measuring the penetration depth of stent struts into the clot. In four stent retrievers (Trevo, Solitaire, Aperio, Separator 3D) we observed only partial penetration of stent struts into the clots with a mean penetration depth of 1.1 mm (±0.3 mm), even after waiting for 5 min after deployment. Only the Trevo and Solitaire device were capable to penetrate one clot model that was rich in red blood cells and built under conditions of blood stasis. The Preset LT stent retriever penetrated nearly all clots completely. We measured a mean penetration depth of 1.9 mm (±0.4 mm) for this device. The complete penetration of the clot by stent struts is observed to be associated with a higher number of clot fragments. Four of our five investigated retriever stents fix most of the clot volume on the outer stent surface due to the fact that the stents struts penetrate only less than 50% of the clot diameter. Only the Preset LT retriever with very thin stent struts is capable of enclosing the entire thrombus due to complete penetration. While a complete entrapment of the clot seems more safe for clot retrieval, more clot fragments might even out this advantage.

Interaction between the stent strut and thrombus as characterized by contrast-enhanced high-resolution cone-beam computed tomography during deployment of the Solitaire stent retriever

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Background and Purpose: The mechanism by which the stent retriever removes intraluminal thrombus from an occluded vessel has not been discussed in humans. This study performed contrast-enhanced high-resolution cone-beam computed tomography (CE-HRCBCT) during deployment of the stent retriever to observe the interaction between the strut and intraluminal thrombus intraoperatively. We also discuss the mechanism by which the thrombus is retrieved.

Materials and Methods: In eleven patients, mechanical thrombectomy was performed with the Solitaire stent retriever. The presence or absence of flow restoration (FR) was evaluated immediately and at least 5 minutes after deployment. Stent retriever findings on CE-HRCBCT was divided into two groups: (1) complete expansion, and (2) incomplete expansion.

Results: FR was observed in all eleven cases (100%) immediately after deployment of the Solitaire stent retriever. Complete expansion was observed only in one case, and incomplete expansion was observed in ten cases. The thrombus was observed mainly near and out of the strut of a stent retriever in CE-HRCBCT. Loss of FR was recognized only in one of eleven cases. Regardless, successful recanalization was achieved only with the stent retriever in nine of eleven cases.

Conclusion: CE-HRCBCT showed that the Solitaire stent retriever rarely expanded fully and thrombus was mainly near and out of the strut. It may not be necessary to wait a long time to allow the stent to expand fully into the thrombus because the main capture mechanism seems to be engagement of the clot between the crossings of the struts of the Solitaire.
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Inter MRI machines agreement for the susceptibility vessel sign to predict in vitro thrombi composition

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Background: The susceptibility vessel sign (SVS) on MRI is related to thrombus location, composition and size, in acute stroke. No study has questioned its inter MRI machines agreement. We aimed to compare in vitro the diagnostic accuracy of 4 different MRI machines for thrombus histological characterization.

Materials and Methods: 35 thrombi analogs of different composition that was histologically categorized as fibrin-dominant, mixed, or red blood cell (RBC)-dominant. We scanned these thrombi on four different MRI machines with T2* sequence according the constructor parameters. Nine radiologists, blinded to thrombus composition and MRI machine model, classified twice, in a two-week interval, the SVS of each thrombus as absent, questionable, or present. Weighted kappa was calculated with 95% confident interval (CI). We calculated the sensitivity, specificity and accuracy of the SVS on each MRI machines to detect RBC dominant thrombus and compared it between MRI machines.

Results: The SVS was present in 42%, absent in 33%, and questionable in 25%. The inter-machine agreements were moderate to good, ranging from 0,45 (CI: 0.37–0.52) to 0,67 (CI: 0.61 - 0.74). The correlation between the SVS and the thrombus composition was moderate κ: 0.50 (CI: 0.44 - 0.55) to good κ: 0.76 (CI: 0.72–0.80). Sensitivities, specificities and accuracy to identify RBC-dominant clots were significantly different between MRI machine (p < 0.001)

Conclusion: The diagnostic accuracy of the SVS to determine thrombus composition varies significantly among MRI machines. Normalization of T2*-sequences between vendors is probably needed to better predict thrombus

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Endovascular venous sinus pressure measurements under conscious sedation and general anesthesia in idiopathic intracranial hypertension

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Purpose: Idiopathic intracranial hypertension (IIH) is a yet not fully understood disease, which is more commonly encountered in obese, young age women. The presence of venous hypertension is often implicated as the pathophysiological origin of IIH, which is postulated to arise as a sequel to intracranial venous stenosis or intrathoracic origin. Intracranial venous stenosis has been described in up to 90% of IIH patients. Recently, a case series examined the effect of conscious sedation (CS) and general anesthesia (GA) on endovascular venous pressure gradient measurements. Their results suggest that there is a sizable difference between measurements taken under CS and those under GA, which has an effect on the selection process of IIH patients. In this report, we aim to examine effect of GA of endovascular pressure gradient measurements in IIH patients as well as the decision to go on with stenting.

Methods: We performed a retrospective chart review of all patients, who received endovascular transverse sinus stenting due to medical treatment refractory IIH between August 2013 and March 2017 in our institution was performed. Patients who received an endovascular venous pressure measurement during conscious sedation and under general anesthesia in the same setting were then identified. Chart analysis included: patients’ demographics anesthetic agents used in CS and GA endovenous pressure measurements during CS, GA and after stent placement stent type and size and whether the decision to place the stent was revised based on the change in pressure measurements. The threshold for stenting was a pressure gradient across the transverse sinus stenosis of >8 mm Hg.

Results: We identified 12 patients who received endovascular pressure gradient measurements under CS and GA. All patients (100%) were female. The mean age was 30.7 years (SD 8.8 and rage 15 – 42) and the mean BMI was 40.7 (SD 10.1, range 28 – 63.7). Anesthetic agents used during CS were midazolam, fentanyl and propofol and during GA propofol and vapor anesthetic (Sevoflurane in 6 patients, Desflurane in 4 patients, and Isoflurane in 2 patients). Mean pressure gradient under CS was 21.7 mmHg (SD 8.5) and 15.8 mmHg (SD 7.9) under GA. Eight (66%) patients showed a pressure gradient reduction after initiation of GA (average 10 mmHg, range 1 - 20), 2 (18%) patients showed an increase of pressure gradient under GA (2 and 9 mmHg) and 2 (18%) patients had a stable gradient. Post-stenting the pressure gradient was successfully reduced to an average of 2.1 mmHg (SD 2.6).

Conclusion: When performed in the same setting, endovascular pressure gradient across transverse stenosis in IIH patients performed under GA shows a sizable reduction (6 mmHg) compared with measurements taken under CS. Further studies are needed to examine the role anesthetic agents and different accompanying factors in regard to the optimal pressure gradient threshold for transverse sinus stenting in IIH patients.
Effect of venous sinus stenting on CSF opening pressure in patients with Idiopathic Intracranial Hypertension

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Venous sinus stenting is gaining acceptance as a surgical treatment for patients with Idiopathic Intracranial Hypertension (IIH). Despite >300 cases reported in the literature, only in the minority of patients the changes in CSF opening pressure before and after stenting are documented. We present our results in 50 consecutive patients (age range 7–59 years, male = 3) with IIH who underwent venous sinus stenting at our institution. All patients had CSF opening pressure measurements within 3 months prior to stenting. 45/50 patients had had CSF opening pressure measurements 3 months after the stenting procedure. Five patients refused post-stent CSF opening pressure measurements. All CSF opening pressure measurements were performed with a spinal tap in the left lateral decubitus position. In one patient general anesthesia was used due to his age (7 years old).

At the 3-month post stent spinal tap, the CSF opening pressure decreased from 36.3 to 20.8 cm H2O. In patients with extrinsic stenosis (n = 28) the CSF opening pressure decreased by 14.9 cm H2O, whereas in patients with intrinsic stenosis the CSF opening pressure decreased by 16.3 cm H2O. At 3 months post-stenting, the average daily acetazolamide dose decreased from 980 mg to 284 mg, with 35/45 patients taking no acetazolamide. At 3 months post-stenting, the patient’s average weight increased from 96.2 to 103 kg and the BMI increased from 35.5 to 36.1. Amongst the 5 patients who refused post-stent spinal tap, 3 had resolution of papilledema, 1 had resolution of headaches and pulsatile tinnitus (no papilledema) and 1 had no improvement in headaches (no papilledema).

Our experience with venous sinus stenting for patients with IIH, shows that there is meaningful decrease in CSF opening pressure at 3 months after the stent. This change does not seem to be related to medications or weight loss.

Hybrid operations for the treatment of refractory vertebrobasilar insufficiencies

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Purpose: Tortuous or occluded vertebral arteries (VAs) can lead to endovascular treatment of vertebrobasilar insufficiency impractical. Bypass surgery is optional, but craniotomy of posterior fossa is complicated while physiological vessels have to be abandoned. Hybrid operation can be a better solution.

Materials and Methods: We report 3 cases of refractory vertebrobasilar insufficiencies with different situations of unavailable approach. Patients were treated by different hybrid operation strategies.

Results: Case 1 was a right vertebral artery ostium (VAO) severe stenosis with right V1 segment tortuosity, and was treated by right VAO transposition, during which proximal subclavian artery (SubA) was blocked by balloon guiding catheter. Case 2 had basilar artery (BA) severe stenosis and bilateral VAs tortuosity. V1 segment was exposed and cut open, so that an available approach for endovascular procedures was created. Case 3 had bilateral VAs occlusion. After exposure of left V1 segment, left VA was recanalized under the cooperation of interventional radiologist and surgeon. All of them got hemodynamics improved and symptoms alleviated without major complications.

Conclusion: For refractory vertebrobasilar insufficiencies, hybrid operations of combining surgical manipulation of V1 segment and endovascular technique can be safe and effective.
Safety and Efficacy of Transradial Neuroangiography and Intervention in Multiple Scenarios: Medellín Experience

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Purpose: Radial artery access for coronary procedures is a safe and beneficial technique. However, this approach has not been considered routinely in INR. A believe of higher risk for neurovascular procedures or major access site related complications restrict its use. This study was conducted to investigate the feasibility and safety of transradial neuroangiography including neurointervention for a variety of pathologies.

Materials and Methods: Since 2015 we implemented a radial access to diagnostic neuroangiography and therapeutic interventions under special considerations. A total of 132 patients from our centers were analyzed. Patients were divided into diagnostic group (n = 95) and therapeutic group (n = 37). Patient demographics, technical data, intervention time, type of intervention, complications and a patient perception assessment were registered.

Results: In the diagnostic group mean age was 54.3 ± 10.3 years and 63.5 ± 3.3 years in the therapeutic group. A 5 Fr. Radial Introducer and Simmons catheter were used in all diagnostic procedures. Two patients presented catheter retention due to vasospasm and resolved using sedatives and vasodilators. Mean average time to diagnostic neuroangiography was 14.5 min. (ranged 9–29 min) None bleeding complication observed. One patient manifested sensibility disturbance and transient neuropraxia. A 6 Fr. Radial introducer was used for all therapeutic cases but one case where a 5Fr. Introducer and 5Fr Sofia distal catheter access were employed. Of those 37 therapeutic group: nine cases of carotid artery stenting , twelve for aneurysms coiling , five for Flow Diverter deployment, six interventions to treat symptomatic intracranial atherosclerotic disease, three cases of cerebral AVM embolization and two cases of acute ischemic stroke. Major radial access complications or procedure related mortality was not observed.

Conclusion: Transradial neuroangiography or intervention was safe and feasible in selected patients. A multiple variety of neurovascular conditions would be treated successfully by this way improving the learning curve. Complication rates and clinical outcomes were comparable with those in trans femoral approach.

Image Quality of Low Dose Cerebral Angiography and Effect on Patient Radiation Dose in Management of Intracranial Aneurysm

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Purpose: The purpose of this study was to evaluate image quality of low dose cerebral angiography and effectiveness of clinical implementation of dose reduction strategies in diagnostic and neurointerventional procedures for intracranial aneurysms.

Materials and Methods: Retrospective review of the prospectively collected database of the 1137 patients (799 females, 338 males; median age, 56 years; range, 13–88 years) between January 2012 and June 2014 was performed. Since April 2013, dose reduction strategy was applied as follows; 1) low dose angiographic protocol (from 3.6 μGy/f to 1.8 μGy/f) for cerebral angiography, 2) roadmap image saved for the evaluation of femoral arterial puncture site, instead of femoral angiography. Subjective image quality assessment of 506 standard and 560 low dose cerebral angiographies was performed by two neurointerventionalists using a 5 point scale. Radiation dose area product (DAP) in Gy-cm2 and air kerma (AK) in Gy of 1046 diagnostic and 317 therapeutic procedures for intracranial aneurysms were analysed. Between groups before (group 1) and after (group 2) clinical implementation of dose reduction strategy, subjective image quality scores of cerebral angiography were analyzed by noninferiority statistics. DAP and AK in group 1 and group 2 were statistically compared for diagnostic and neurointerventional procedures respectively.

Results: Image quality of the low dose cerebral angiography was not inferior by 2 readers, as demonstrated by the 95% confidence interval of the difference, which did not cross the pre-defined noninferiority margin of −0.1. For diagnostic cerebral angiography, mean DAP and AK were 140.8 Gy-cm2 and 1.0 Gy in group 1 and 82.0 Gy-cm2 and 0.6 Gy in group 2 (41.8% and 40.0% reduction for DAP and AK respectively). For neurointerventional procedure, mean DAP and AK were 246.0 Gy-cm2 and 3.7 Gy in group 1 and 169.8 Gy-cm2 and 3.3 Gy in group 2 (31.0% and 10.8% reduction for DAP and AK respectively).

Conclusion: Low dose cerebral angiography maintained image quality, and implementation of dose reduction strategies significantly contributed to the reduced radiation doses of patients with diagnostic and neurointerventional procedures for intracranial aneurysm.
Monoplane 3D Overlay Roadmap versus Conventional Biplane 2D Roadmap Technique for Neurointerventional Procedures

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Purpose: We investigated whether a 3D overlay roadmap using monoplane fluoroscopy offers advantages over a conventional 2D roadmap using biplane fluoroscopy during endovascular aneurysm treatment.

Materials and Methods: A retrospective chart review was conducted for 131 consecutive cerebral aneurysm embolizations by three neurointerventionists at a single institution. Allowing for a transition period, the periods from January 2012 to August 2012 (Time Period 1) and February 2013 to July 2013 (Time Period 2) were analyzed for radiation exposure, contrast administration, fluoroscopy time, procedure time, angiographic results, and perioperative complications.

Two neurointerventionists (Group 1) used a conventional 2D roadmap for both Time Periods, and one neurointerventionalist (Group 2) transitioned from a 2D roadmap during Time Period 1 to a 3D overlay roadmap during Time Period 2.

Results: During Time Period 2, Group 2 demonstrated reduced fluoroscopy time (p < 0.001), procedure time (P = 0.023), total radiation dose (p = 0.001), and fluoroscopy dose (P = 0.017) relative to Group 1. During Time Period 2, there was no difference of immediate angiographic results and procedure complications between the two groups. Through the transition from Time Period 1 to Time Period 2, Group 2 demonstrated decreased fluoroscopy time (p < 0.001), procedure time (p = 0.022), and procedure complication rate (p = 0.041) in Time Period 2 relative to Time Period 1.

Conclusion: The monoplane 3D overlay roadmap technique reduced fluoroscopy dose and fluoroscopy time during neurointervention of cerebral aneurysms with similar angiographic occlusions and complications rate relative to biplane 2D roadmap, which implies possible compensation of limitations of monoplane fluoroscopy by 3D overlay technique.

Usefulness of 3D rotational angiogram with MIP slab images for pre-embolization assessment of spinal dural AVFs

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Purpose: Before the treatment of spinal dural AVF (SDAVF), it is important to identify the exact shunt point and the spinal cord artery if it is originating from the same pedicle as the feeder to the SDAVF. We assessed usefulness of three dimensional rotational angiogram with MIP slab images (3DRA with MIP) for the pre-embolization evaluation of the SDAVF.

Materials and Methods: There were 6 consecutive SDAVFs treated after introduction of Artis Q Interventional Angiography System (Siemens Healthineers) to the hybrid operating room in our institution in April 2015. There were 4 males and 2 females with the age ranging 58 to 81 years old (mean 65.8). The lesion was located in cranio-cervical junction (CCJ) in 1, thoracic in 4, and lumbar in 1. All cases were assessed by 5 seconds 3DRA with MIP (1 mm slab thickness) using 300mgI/ml non-ionic contrast.

Results: In two cases, 3DRA with MIP demonstrated a spinal cord artery which was not identified by conventional angiography, of which one case underwent surgical treatment. All other cases underwent embolization with complete occlusion of the SDAVF using n-butyl cyanoacrylate as an embolic agent except one CCJ lesion which was embolized with Onyx and resulted in partial occlusion. One case showed dural collateral artery above and below the shunt point, helping identify the exact location of the fistula site. Volume rendering image was also useful to select the best feeder to embolize in the cases of multiple feeders. In the CCJ case, superselective angiography was necessary to rule out the lateral spinal artery originating from the C1 feeder to the lesion.

Conclusions: 3DRA with MIP is very useful and should be routinely used for pre-embolization evaluation for the SDAVF. Five seconds 3DRA with MIP provides sufficient resolution for this purpose.
Role of 320-row subtracted dynamic volume CT venography in evaluating transverse sinus stent patency in patients with idiopathic intracranial hypertension

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Introduction: Dural sinus stenting has recently emerged as a new treatment modality for patients with idiopathic intracranial hypertension (IIH) caused by an underlying bilateral transverse sinus (TS) stenosis. However, stent patency in dural sinuses is not well documented. The purpose of this project was to evaluate the anatomic result of TS stenting at 6 months using 320-row subtracted dynamic volume CT venography (CTV).

Materials and Methods: A retrospective analysis of a prospectively collected database of patients undergoing TS stenting was performed. In the time period between January 2008 and January 2017, 77 patients received TS stenting in our institution. Long-term follow-up 320-row subtracted dynamic CTV was available for 63 patients, which were included in this study. All patients had exhausted conventional medical management and had progressive visual impairment. CTV was obtained with a standard protocol using a 320-row detector CT scanner (Aquilion One CT and Vision CT, Toshiba, Japan). Image analysis was performed using three-dimensional, multiplanar native and subtracted MIP reconstructions. Significant

Results: At the 6-month follow-up CTV, all 63 patients had fully patent stents (100%). CTV of good quality was successfully obtained in all patients without technical or medical issues. Subtracted MIP reconstructions showed no evidence of intraluminal abnormalities, such as clot formation or neo-intimal hyperplasia, while native MIP reconstructions documented the absence of structural stent anomalies, such as kinking, fracture or displacement. De novo stenosis was noted proximal to the stent in 9 patients (7 juxta-stent TS stenosis, 1 straight sinus stenosis and 1 juxta-stent TS and straight sinus stenosis). The mechanism behind this phenomenon remains unclear, and could be linked to sinus deformation secondary to stent oversizing early in the series. In the univariate analysis both BMI and large stent size (>6 mm) were associated with the development of de novo dural sinus stenosis; OR 1.12 (95% CI: 1.01–1.25, \( p = 0.037 \)) and OR 5.63 (95% CI: 1.16–27.22, \( p = 0.032 \)), respectively. In the multivariate analysis only large stent size (>6 mm) was significant; OR 7.19 (95% CI: 1.03–50.01, \( p = 0.046 \)).

Conclusion: TS stenting is an effective and clinically durable modality for the treatment of IIH in an appropriately selected patient population. 320-row subtracted dynamic CTV provides a high quality, non-invasive imaging method for the assessment of stent integrity and patency. At the 6-month follow-up evaluation, all the imaged stents were patent, without evidence of in-stent stenosis. In our cohort, large stent size (>6 mm) was independently correlated with the development of de novo dural sinus stenosis.

Utility of Arterial Spin Labelling 3.0-T Perfusion MR Imaging in Diagnosis of Dural Arteriovenous Fistula

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Purpose: 3T-ASL showed the good signal to noise ratio CBF imaging in a lot of arterial disease including brain main trunk occlusion or internal carotid artery stenosis. However, ASL is not general study to evaluate Dural Arteriovenous Fistula (DAVF). This study was aimed that ASL can estimate pre-operative DAVF and post-operative DAVF with high sensitivity, and short time PLD is effective to diagnose DAVF.

Materials and Methods: This study included 13 patients who were diagnosed as DAVF by angiography. There were 6 males and 7 females. Their age ranged from 58 to 100 years. 2 cases were anterior condylar confluence DAVF, 4 cases were cavernous sinus DAVF, 5 cases were transverse-sigmoid DAVF, and 2 cases was superior sagittal sinus DAVF. Short time post labelling delay was defined 1024 ms after pulsing in ASL MR imaging. The regions of interest (ROI) were set using Osirix. The intensity ratios (IR) in the ipsilateral to contralateral ROI were calculated. We compared pre-operative IR and post-operative IR, and IR of short time PLD and IR of normal time PLD.

Results: ASL showed the shunt lesion as increased blood flow in all cases. 9 cases had the indication of coil embolization and increased blood flow was not found after treatment in all cases. Short time PLD is more sensitive than normal time PLD in pre-operative ASL using IR.

Conclusion: Blood flow of shunt diseases including DAVF tend to exhibit low pressure and fast blood flow. SPECT could not show the shunt lesion, however, ASL, especially short time PLD ASL, could demonstrate the shunt lesion, because labelled normal blood flow doesn’t arrive to cerebral cortex yet. ASL may be a very useful sequence to diagnose and follow up the DAVF.
Percutaneous Sclerotherapy of Head and Neck Low Flow Vascular Malformations

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Purpose: Low-flow vascular malformations (LFVM) are congenital anomalies that consist of thin-walled vascular channels lined by quiescent endothelium. They present as venous, lymphatic or combined venolymphatic malformations and the patient symptoms depend on the predominant vascular channels. Swelling, pain, compression/invasion of adjacent structures, hemorrhage, consumptive coagulopathy and cosmetic deformity are the main clinical presentations. The diagnosis is based on a thorough clinical history and physical examination. Imaging techniques help to confirm the diagnosis and display the extent of the lesion. The treatment of LFVM, especially in the head and neck region, remains a great challenge for clinicians. Surgical resection can be hazardous, leading to injuries to the facial nerve, incomplete resection, aesthetic problems and intraoperative bleeding. Direct intralesional injection of a sclerosing agent is established as the treatment of choice in LFVM. The sclerosant agent causes sludging of the erythrocytes, perivascular inflammatory reaction and a rapid subsequent thrombosis of the injected vessels, followed by fibrosis within several weeks.

The purpose of this study is to present our initial experience in the treatment of LFVM using intralesional injection of sclerosing agents by direct puncture.

Material and Methods: We present a retrospective review of 13 patients treated, from August 2011 to April 2017, at our institution. All the procedures were performed in an angiographic suite, under general anesthesia and phlebographic control. In addition to the sclerosing agent, all the patients received a prophylactic dose of antibiotic and steroids. The control. In addition to the sclerosing agent, all the patients received a prophylactic dose of antibiotic and steroids. The results of treating relatively small AVMs by combination of preoperative embolization and surgery.

Materials and Methods: Eight patients (6 males, 2 females) whose age was between 18 to 20 in 6 and 29 and 59 years old were treated. The location of the lesion was forehead in 3, scalp in 1, lip in 1, submental in 1, lower eyelid in 1, and nose in 1. They were all relatively small and Schobinger stage II lesions only because of enlargement without other symptoms. Endovascular treatment was performed by transfemoral trans-arterial approach and/or direct puncture in one or 2 sessions. NBCA was used in all cases with additional coils, particles or ethanol if necessary. Surgery was performed with 18 day after the last embolization with one exception in which the patient was operated 7 months after the last embolization.

Results: They all resulted in aesthetic resection by a linear skin incision with minimal blood loss ranging from 5cc to 110cc (mean 34cc). Operation lasted from 48 ines to 133 minutes (mean 89 minutes). Complication of embolization included post procedure inflammatory swelling lasted for 6 months in 1 and self-limited skin necrosis in 1. Asymptomatic recurrence of the lesion was clinically noted in 1 scalp case.

Conclusions: With thorough planning and careful patient selection, sclerotherapy is a simple, safe and effective treatment for the low-flow vascular malformations.
Utilization of retrograde approach for various neuroendovascular procedures

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As recent advance of neuroendovascular material, there still exist difficulties of microcatheter and other devices delivered to the appropriate position. In that case, retrograde approach using Pcom is one of choice. 4 cases of neuroendovascular therapy (NEVT) using retrograde approach are reported.

We report 4 cases of NEVT using retrograde approach using Pcom from PCA to ICA or ICA to PCA at our institution, 3 aneurysmal treatment and one acute thrombectomy.

Case1: Lt VA fusiform aneurysm previously treated with VA internal trapping recanalized at the distal end of the aneurysm. Retreatment of distal part of aneurysm was planned. Access to Lt VA through Rt VA could not be achieved because of acute angle of VA union. Then, microwire and microcatheter was introduced from rt ICA through Pcom and rt P1 to BA tip. Microwire was caught by snare introduced from rt VA and microcatheter was pull down to just distal of VA union, advanced to distal part of Lt VA and coil packing was performed.

Case2: BA tip aneurysm once treated with single stent, placed from rt PCA to BA, was recanalized. Attempt of Y stent was failed through former stent. Microcatheter could be introduced from lt ICA through Pcom, lt P1 to rt P1 and T stent and additional coiling was performed.

Case3: Flow diverter treatment was planned for rt cavernous giant aneurysm. Multiple subsequent attempt failed to navigate Markesman across aneurysmal neck. Retrograde access of microwire and microcatheter through Pcom, distal ICA to aneurysmal sac was performed. Microwire was grasped in the aneurysmal sac with snare through Markesman advanced from rt ICA, Markesman was pull up to the orifice of Pcom and Pipeline was successfully opened antegrade.

Case4: Lt PCA occlusion case. Acute thrombectomy from VA route failed because of tortuous VA orifice. Thrombectomy system was introduced from lt ICA through Pcom to lt PCA. There was small aneurysm at IC-Pcom junction, penumbra system, not stent retriever was chosen and recanalized successfully 3 of 4 cases presented no complication related to retrograde approach. In case 3, small infarction of posterior circulation was observed without any neurological deficit. Retrograde approach utilizing Pcom from posterior circulation to anterior circulation or anterior to posterior for NEVT is one of choice in case of difficulties with usual antegrade approach. However, potential risk of ischemia or vessel injury with this approach should be considered carefully before treatment.

Endovascular embolization of hypervascular tumors of the skull base with Onyx using two -luminal DMSO-compatible balloon-catheter

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Purpose: In the treatment of hypervascular tumors of the skull base and neck pre-embolisation is a necessary option. In our study we assessed primary results of pre-embolisation of tumors with significant vascular component with Onyx using 2 luminal DMSO compatible balloon catheters.

Materials and Methods: 10 patients were operated (4- as the first stage before surgical removal) in 2015–2017. 7 paraganglioma, which were concerned non-removable (jugular - 4, middle -ear - 2 (jugulotympanic), vagal - 1), 3 meningiomas (2 giant - of skull base, 1 convexital). For embolisation we used DMSO compatible balloons Scepter (7) and Astsent (6) through the ECA.

Results: Meningiomas were embolyzed during one session and successfully removed with minimal blood loss (200 ml). In the case of paraganglioma in 2 cases it was possible to achieve total embolization (1in 1 session, one in 2 sessions), in 4 cases - subtotal embolization during 1 session (3 of them were sent to radiation therapy, 1 was surgically removed with minimal blood loss). The average volume of ONXY was 5.0 ml per stage. One paraganglioma was embolyzed for 75% during 3 sessions (total volume of Onyx 19 ml). We used ONXY 18. In all cases it was possible to save brain vessels (ICA and PA) using the branch of ECA and controlling the zone of dangerous anastomoses between the ECA and ICA/PA. In the cases of paraganglioma we were able to stop their growth, to achieve involution, atrophic and scar degeneration and as a consequence reduce them in size, which was especially important in cases of jugulotympanic tumors with intracranial growth and brain stem compression. In one case we observed the restoring of the facial nerve function.

There were no cases of embolic complications or intracranial haemorrhage. Morbidity, Mortality – 0

In case of perforation of the tumor vessel we performed total embolization of the vessel covering the area of perforation by inflated balloon. After performing the embolization, the balloon was deflated, lowered to the level of the perforation, inflated again and the damaged area was sealed.

Conclusion: ONXY emboyzation through a balloon catheter is an effective, convenient and quite safe method for the treatment of hypervascular tumors of the skull base and neck. Using this method it is possible to achieve deep distal distribution of embolyzate in the vascular network of the tumor up to a total embolization. In cases of paraganglioma it promises to be not only an assisting method in combination with radio- therapy or surgical removal, but probably an independent method of treatment.
Mid-term results of bioresorbable vascular scaffolds in interventional neuroradiology

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Introduction: We report the first mid-term results with bioresorbable vascular scaffolds (BVS) in interventional neuroradiology.

Materials and Methods: A retrospective review of clinical presentations, imaging findings and follow-up results of all patients treated using a BVS by our neurovascular team was carried out using hospital charts and hospital radiographic archive system. Patients who were likely to benefit the advantages of BVS were carefully selected and the scaffold was deployed only if the patient had a non-tortuous cerebrovascular anatomy suitable for the navigation of the BVS.

Results: 9 patients were treated with Absorb or DeSolve scaffolds without permanent morbidity or mortality and technical success. Five had cerebrovascular stenosis, 4 underwent scaffold-assisted coiling for aneurysms. At 2 years, 1 parent artery in the aneurysm group was occluded and otherwise there was no significant scaffold stenosis. Positive arterial remodeling, almost in the form of a fusiform aneurysm, was demonstrated in one patient. In 2 patients treated for stenosis, transient intraarterial filling defects resembling BVS struts (“stent silhouette”) was demonstrated on early follow-up angiograms. This finding later disappeared. In the patient with incidentally found parent artery occlusion who was judged to have devalued her internal carotid bifurcation and in the patient with positive remodeling, we were able to discontinue all antiplatelet medications at long term without any consequence. In one patient who discontinued Prasugrel against medical advice after 1 year, the scaffold remained patent.

Conclusion: Absorbable device technology has prospective applications in interventional neuroradiology. BVS should be optimized for cerebral circulation to achieve acceptable technical success and clinical results.

Dural sinus malformation with associated dural arteriovenous fistula: Single centre experience of 11 cases

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Purpose: Dural sinus malformation (DSM) with associated dural arteriovenous fistula (DAVF) is a very rare, poorly understood and often highly morbid disease presenting in early life. We present our single centre experience of the management of 10 patients with this condition and review the rather confused and bleak literature on this subject.

Materials and Methods: Between 2006 and 2017, 11 children with DSM + DAVF presented to our service.
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**Safety and Outcome of combined Endovascular and Surgical Management of Low Grade Cerebral Arteriovenous Malformations in Children compared to Surgery Alone**

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**Purpose:** To evaluate the outcomes of combined preoperative embolization and subsequent surgical resection in comparison with the surgical resection as the current standard of care for low-grade cerebral arteriovenous malformations (AVM) in the pediatric population.

**Materials & Methods:** The current study represents a retrospective review of pediatric patients with Spetzler-Martin (S-M) grades I and II cerebral AVMs treated between January 2005 and September 2016. Patients were divided into two groups: surgery alone or embolization plus surgical resection of AVM. Outcomes were assessed using the modified Rankin Scale (mRS) before and after the treatment, at 3 months and at final follow up. The association of demographics, clinical presentation, and lesions' morphological characteristics with the complications was studied as well.

**Results:** A total of 41 patients with low grade cerebral AVMs were identified during the study period. Only 34 patients met the inclusion criteria of this study with a mean age 10.6 ± 3.4 years (Range, 3–16 years). Twenty Two patients were boys and 12 girls. Twenty patients (59%) presented with ruptured AVMs. Twenty-five patients underwent combined treatment with pre-operative embolization followed by microsurgical resection (73.5%), while the rest (26.5%) underwent microsurgical resection only. A total of 35 embolization procedures were performed for 25 patients (Mode, 1; Range, 1 to 7). The mean follow-up time was 35.7 months. Only 2 minor complications resulted from all the embolization procedures with no clinical sequelae, and no change in mRS Score. There was no significance difference in the overall complication rate between both treatment groups [OR:1.13; 95% CI:0.23–5.62; P-value:0.88]. Three new focal neurological deficits resulted from the combined treatment; none of them was disabling (mRS > 2). While in the surgical management group, 2 focal neurological deficits were observed; one of which was disabling. The final outcome was good with no patient > 2 mRS in the combined treatment group. There was no significant difference in the overall favorable outcome (no change or improved mRS score) between the two treatment groups [p-value 0.14], favorable outcome in patients who presented with ruptured AVMs vs. non-ruptured [p-value 0.49], or patients with poor mRS score pre-operatively (mRS > 2) vs. good score (mRS ≤ 2) [p-value 0.36] between both treatment groups. S-M Grade II and eloquent location were found to be significantly associated with treatment complications of low grade pediatric cerebral AVMs.

**Conclusion:** Our results suggest no significant difference in the treatment complications and outcomes between combined endovascular and surgical management of low grade cerebral AVMs in children compared to surgical management alone.

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**10 Year Experience of Paediatric Aneurysm Treatment in a National Paediatric Centre**

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**Aim:** Intracranial aneurysms are rare in children, with greater heterogeneity of aetiology, location, morphology and clinical presentation than adult aneurysms. We report our last 10 year experience in a paediatric national referral centre, in the modern era in light of recent endovascular technical advances to highlight differences from adult practice.

**Material and Methods:** Between 2005 and 2016, 31 children with 43 intracranial aneurysms were referred to our neurovascular service. Retrospective analysis of all pre- and post-operative imaging studies and clinical data was performed.

**Results:** There were 17 males (55%) with median age at presentation of 9.3 years (range 0.1–16.2 years). Common presentations were headache (62%), collapse (35%), seizure (25%) and ptosis (9%). 14% of diagnoses were made incidentally on imaging for unrelated symptoms.
58% of patients had evidence of subarachnoid haemorrhage on presentation imaging with an average Fisher grade of 3.7.

Associated pathologies included bacterial endocarditis, HIV, PHACE syndrome, Moya Moya, Sickle cell disease and Noonan’s syndrome.

33 aneurysms were treated in 26 patients. 22 aneurysms were saccular in morphology and 11 were fusiform. 21 patients underwent endovascular treatment (10 coilings, 2 stent assisted coilings, 3 flow diverting stents and 6 parent vessel occlusions). 4 patients underwent surgical treatment (2 clippings, 2 EC-IC bypasses), 1 patient had combined surgical and endovascular treatment and 5 patients were managed conservatively.

There were 5 aneurysm recurrences during follow-up requiring further treatment (3 flow diverting stents, 1 stent assisted coiling, 1 previously clipped aneurysm that was coiled).

The overall cohort mortality was 9.7% (3 patients) - 2 had a poor clinical grade subarachnoid haemorrhage, of whom one was not offered treatment and one had a fatal rebleed on the day following surgery. One unruptured patient with a giant serpentine ICA/ MCA aneurysm suffered a fatal rebleed from recurrence 2 years post initial endovascular treatment. All surviving patients (90%) had a good long-term outcome (mRs 2 or better).

**Conclusion:** Paediatric intracranial aneurysms are a heterogeneous and challenging patient group, but in the modern era have overall favourable clinical outcomes. An appreciation of underlying disease process is important in selecting appropriate treatment strategy from the range of constructive and deconstructive endovascular and neurosurgical techniques. Higher rates of recurrence and new aneurysm formation in this patient group requires more extended imaging follow up than in adults.

**Materials and Methods:** Retrospective review of diagnostic angiography and neurointerventional data base of our institution identified a cohort of 15 patients with non galenic PAVF from January 2008 to November 2014 out of 6750 patients who were included in the study. Fourteen patients were treated endovascularly with coils/ N-buty1 cyanacrylate (NBCA)/Onyx – alone or in combination and spontaneous closure of the PAVF was noted in one patient just prior to procedure. Onyx alone was used in seven patients, NBCA alone in one patient, coils in two patients. In two patients coils with onyx were used. Coiling followed by NBCA embolization was in 2 cases. Balloon assistance was taken in a case of NBCA embolization to reduce the flow while injecting NBCA. Patients were followed up for evaluation of prognosis at 3 months and one year. Clinical outcome was noted and compared with the initial clinical scoring system status.

**Results:** Age of the patients ranged from 3 to 37 years with mean of 14 years and median 11 years. Most patients were male and most common presentation was head ache followed by seizure. Most common location of fistula was frontal lobe and most common type was single artery-single hole fistula associated with venous varix. Cerebral angiograms showed that these PAVF were supplied by the MCA (n = 7), ACA (n = 4), PCA (n = 2), ICA (n = 1) and VA (n = 1). Venous drainage was into superficial venous system in 12 cases and deep venous system in 3 cases. Complete occlusion of the fistula was achieved in 85.7% patients and downgrading of the fistula was achieved in one patient. Satisfactory obliteration was seen in all cases. One patient developed intraparenchymal hematoma on first post procedural day and outcome was poor. Two patients had intra-procedural complication with good outcome. Rest of the patients had improvement in symptoms and deficits if any.

**Conclusion:** PAVF are rare intracranial vascular malformations which can effectively be managed endovascularly with liquid embolics, coils alone or in combination. Adequate treatment with flow disconnection is associated with good clinical outcome. Complete occlusion of the fistula can be achieved in most cases in a single sitting with a reasonable morbidity related to the procedure, compared with the natural history of this disease.

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**Intracranial pial arteriovenous fistulae: clinical characteristics, endovascular treatment and outcome**

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**Purpose:** Pial arteriovenous fistulas (PAVF) are rare intracranial vascular malformations, predominantly seen in the paediatric population and distinct from arteriovenous malformations and dural arteriovenous fistulae. PAVF leads to a high morbidity and mortality. Aim of our study was to describe the clinical features and endovascular management of PAVF at various intracranial locations; to analyze the use of liquid embolic agents & coils alone or in combination in treatment of PAVF and to analyze the outcome of embolization.

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**The technique of superselective ophtalmic artery chemotherapy (SOAC) for retinoblastoma: the Argentinian experience**

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**Purpose:** To describe our experience with the SOAC technique in Argentina.
Material and Methods: We retrospectively analyzed patients who underwent SOAC for retinoblastoma from November 2014 to April 2017. The data collected were age, gender, number of procedures, arteries approached (ophthalmic artery or middle meningeal artery) and bilaterality of the treatment and complications. The procedure is performed under general anesthesia with endotracheal intubation. The femoral artery is punctured and 50 IU/kg of heparin is administered. Alternatively right or left femoral artery (FMA) is punctured with a 21G needle and a 3F sheath is inserted. A microcatheter flow dependent Magic 1.5 (Balt Montmorency, France) supported by 0.008 microwire Hybrid (Balt Montmorency, France) is placed through the sheath and navigated from the FMA to the distal part of the supraclinoid internal carotid artery (ICA). The microwire is then removed and the microcatheter is pulled while injecting contrast media (CM) using a 1cc syringe with fluoroscopy until it remains anchored in the ostium of the ophthalmic artery (OA). Care must be taken in the injection in order to avoid the movement of the microcatheter away from the ostium of the OA. If the OA is too small for an appropriate selective infusion or it can not be approached, the anastomotic ramus (AR) coming from the middle meningeal artery to the OA is catheterized with the Magic 1.5 microcatheter and the hybrid microguidewire, the drugs are then injected. Drugs used for chemotherapy are melfalan, topotecan, and carboplatin.

Results: We treated 41 patients, performing 248 procedures in 45 eyes. Two hundred forty eight arteries were cannulated (205 OAs and 43 MMA). Four children received SOAC in both eyes. Only one patient had to be enucleated the eye which received the SOAC. The youngest patient was 6 months old and the oldest was 6 years old. Bronchospasm during the procedure was present in four cases. One patient had hypotension and bradycardia during the navigation of the microcatheter in the ICA. They responded very well to intravenous epinephrine bitartrate infusion. Femoral artery transient thrombosis was found after procedure in two patients. They were successfully managed with antplatelet therapy. One children had retinal hemorrhage. One patient suffered an anaphylactic shock for carboplatin. He fully recovered after receiving epinephrine and corticoids.

Conclusion: SOAC technique is fast and effective endovascular technique with low rate of complications, longer follow up is needed to evaluate more accurately our results. Specially regarding the late effects of the radiation exposure.

Paediatric supra-selective intra-arterial chemotherapy (SIAC): safety and efficacy as a salvage therapy in intraocular retinoblastoma

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Purpose: Intra-arterial chemotherapy for the treatment of paediatric intraocular retinoblastoma is a novel treatment regimen delivered as a primary therapy, as well as a salvage approach in eyes where conventional treatment (systemic chemotherapy) has failed. The study aims to assess the safety and efficacy of supra-selective intra-arterial chemotherapy as a salvage therapy in intraocular retinoblastoma in children.

Method: We present our tertiary centre experience of SIAC involving 330 treatments in 95 children (54% right eye; 46% left eye). 63% of children suffered from bilateral retinoblastomas.

Results: 48 male and 47 female children underwent SIAC at a mean age of 3 years (range 0.5 – 12.5). The median procedure time was 93 minutes (including the 30 minute chemotherapy infusion time). Treatments were with melphalan alone or melaphalan and topotecan. Depending on prevailing anatomy, the commonest microcatheter tip delivery positions were selectively into the ophthalmic artery (43%), at the ophthalmic artery ostium (22%) and in the ipsilateral middle meningeal artery (14%). Balloon occlusion approaches were not used. Chemotherapy was only infused after confirming antegrade ophthalmic artery flow with angiographic choroidal perfusion and was fully delivered in 91% of procedures. In the 9% of procedures where complete delivery failed, ophthalmic artery ostial spasm / stenosis was the predominant cause (62%), Full chemotherapy delivery was usually possible on subsequent treatment episode. We noted a (previously described) stereotyped physiological reaction comprising transient hypotension and respiratory compromise. This was severe enough to require epinephrine support in 15% of children, always on second or third treatment. Globe salvage data was available on 98 eyes, of which 51 were saved (52%). Ocular complications occurred in 16% of chemotherapy cycles, including transient oculomotor palsies, vitreous and retinal haemorrhages and retinal ischaemia. There were no extraocular complications, in particular no cerebral ischaemic complications.

Conclusions: Salvage therapy using SIAC in paediatric intraocular retinoblastoma is feasible even in very young children with good technical and chemotherapy delivery success rates. There is an encouraging rate of globe salvage with acceptable ocular complication profile. There is an ongoing need for randomised controlled trials to compare the efficacy of first line SIAC with systemic chemotherapy.
Outcomes in neonatal vein of Galen malformation

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Objective: To describe the long term impact of neonatal vein of galen malformation presentations with the aim of identifying early clinical and radiological predictors of later neurocognitive outcomes.

Methods: Neonates presenting to GOSH and Glasgow (two UK National vein of Galen referral centres) with a confirmed diagnosis of vein of Galen malformation within the first 28 days of life between January 2006 and January 2016. The presentation and follow up radiological imaging were reviewed, as were the initial angiograms. The intensive care records were also analysed. All children were >1 year of age at the time of the neurocognitive assessment.

Results: 87 neonates were identified. All of the initial imaging was assessed and will be presented. In addition the presentation angiography was assessed, with factors considered including the angioarchitecture, the rate of shunting, and the overall cerebral perfusion. Of the 54 survivors, 45 children underwent neurocognitive assessment during 2016 and 2017 (7 were abroad and 2 refused consent to involvement in the study). The results of this neurocognitive testing will be presented. Predictors of late outcome (both clinical and radiological) will be discussed.

Conclusions: The study presents the long term outcomes of neonatal vein of Galen malformation in a unique cohort of children presenting to two UK National referral centres.

Cerebral aneurysms in pediatric population: a multi-faceted entity

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The purpose of the presentation is the description of the clinical symptoms, modality and results of treatment of cerebral aneurysms in a tertiary pediatric center.

Material and Methods: We analyzed retrospectively the data (age, gender, clinical manifestations, type of aneurysms, associated diseases, treatment and outcome) of patients having cerebral aneurysms from April 2004 to April 2017 in our institution, a pediatric hospital collecting patients from all over the country and neighbor countries.

Results: 40 children with 43 aneurysms were managed, 24 were saccular, ten dissecting, four fusiform, four infectious and one affecting a lenticulostriate artery. The youngest patient was a 7 months old baby boy and the oldest a 17 years girl. 28 patients had intracranial hemorrhage (ICH), 28 were male. Twelve cases had an associated disease. Two aneurysms were conservatory managed, six were clipped, the remaining were endovascularly treated, with coils alone, stent and coils and flow diverters stents. Four patients died due to ICH without being related to the treatment. The rest had no deficit after therapy.

Conclusion: Aneurysms in children are different entities not only by etiology but also in morphology and clinical manifestations. Saccular aneurysma predominate in older children. Treatment has evolved from surgery to the endovascular therapy, this technique has the advantage of being minimally invasive in sacular aneurysms and allows a more effective and tailored treatment (reconstructive and deconstructive techniques) in non-saccular aneurysms comparatively common in children.

Onyx Embolization in Pediatric Neuro-interventional Procedures

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Introduction: Although AVMs are rare among pediatric population, nearly half of spontaneous intracranial hemorrhages in children are due to these malformations. Onyx, is an FDA approved embolizant for adults, has limited studies regarding its safety and efficacy among children. Here, we evaluate the safety and efficacy of Onyx embolization in pediatric neurointerventional procedures.

Methods: In this study, all pediatric patients who underwent Onyx embolization of intracranial AVMs were evaluated over a period of 10 years. Medical records and radiology imagings were reviewed for each patient regarding demographic data, clinical presentations, embolization procedure and related complications.

Results: Seventy-two patients (female = 26 (36%)) with intracranial AVMs underwent total of 122 embolization procedures. Age of patients ranged from 1 month to 17 years with the mean of 10.2 years. Forty-four patients underwent a single embolization procedure and staged embolization was required for the remaining 28 patients prior to definitive treatment. Onyx embolization resulted in complete occlusion of the AVM in 10 patients (14%). A total of 66 patients underwent subsequent surgical treatment.

Overall 13 complications were reported which resulted in 7 transient neurological deficits and 6 clinically silent complications (Table 1). None of the complications resulted in mortality or permanent morbidity. No significant demographic characteristic differences observed in patients with or without complications.
Conclusion: In this study, we propose the safe and effective utilization of Onyx for embolization of pediatric cerebral AVMs. The relatively low rate of complications (10.6%) along with no mortality or permanent morbidity, suggests the safe utilization of Onyx as a preoperative or primary embolization treatment of pediatric intracranial AVMs. However, specific attention should be considered for its indications and technical limitations according to the broad spectrum of complications.

Table 1: Onyx Embolization complications

<table>
<thead>
<tr>
<th>Type of Complication: Outcome</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwire vessel perforation</td>
<td>3</td>
</tr>
<tr>
<td>Nontarget embolization</td>
<td>2</td>
</tr>
<tr>
<td>Intraparenchymal hemorrhage</td>
<td>1</td>
</tr>
<tr>
<td>Contrast-induced bronchospasm</td>
<td>1</td>
</tr>
<tr>
<td>Pulmonary edema</td>
<td>1</td>
</tr>
</tbody>
</table>

Spinal epidural arteriovenous fistulas: Clinical features and long-term outcomes of 15 cases

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1Asan Medical Center, Seoul, South Korea

Purpose: Spinal epidural arteriovenous fistulas (EDAVFs) are very rare spinal vascular malformations in the epidural space. We reviewed our experience in 15 patients with spinal EDAVFs and discuss their clinical features, radiological findings, and long-term outcomes.

Materials and Methods: Among 111 patients with spinal vascular malformations, diagnosed at our institutions from January 1993 to September 2016, there were fifteen patients who were diagnosed with EDAVFs confirmed by spinal angiography. Twelve patients were treated by endovascular embolization with coil and/or glue, and one patient was treated with coagulation of draining vein via surgical approach. We investigated clinical and radiological data of these 15 patients retrospectively. Clinical outcome was assessed with the Aminoff & Logue's scale of disability (ALS) and modified Rankin Scale (mRS). The median follow-up was 14.8 months (0–56 months).

Results: There were 10 male and 5 female patients, with mean age of 44.9 years. The majority of patients presented with pain (n = 10, 66.6%) or weakness (n = 8, 53.3%), followed by sensory symptom (n = 10, 66.6%) and voiding difficulty (n = 5, 33.3%). Six cases were osseous EDAVFs and 9 cases were non-osseous type EDAVFs. The most common location was the cervical spine (n = 7) and lumbar spine (n = 5), followed by the thoracic spine (n = 2) and sacrum (n = 1). Two patients did not undergo any treatment and were lost to follow-up. Of the twelve patients who received treatment and follow-up, an angiographic cure was obtained in 7 patients, near complete occlusion in 4 patients, and partial occlusion in one patient. At the last radiological follow-up, eleven patients (83.3%) had improved mRS score, and two patients (16.7%) were stationary.

Conclusion: Spinal EDAVFs are rare, but those can cause progressive neurological deterioration. Based on our experience, endovascular treatment can reverse the symptoms and lead to angiographic obliteration successfully.

Case Series: Spinal Cord Infarction Due to the Diaphragmatic Crus Syndrome

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2Johns Hopkins Hospital, Department of Neurology, Baltimore, United States
3Johns Hopkins Hospital, Department of Neurosurgery, Baltimore, United States

Purpose: The authors report eight cases of patients with Diaphragmatic Crus Syndrome (Spinal cord ischemia due to compression of a lumbar intersegmental artery by components of the diaphragmatic crus, with the artery radialis magna (ARM) or Artery of Adamkiewicz supplied by the salient intersegmental artery). To our knowledge, this represents the largest series of this rare syndrome reported in the literature.

Materials and Methods: We present a series of eight patients with angiographically confirmed DCS. We provide a review of this uncommon cause of spinal cord stroke, including a discussion of clinical presentation, imaging findings, important anatomical and physiological considerations and potential therapeutic options.

Results: Unlike the few previously reported cases of DCS characterized by episodic, MRI-negative ischemic events, seven of our patients presented with persistent neurologic symptoms and corresponding ischemic changes on MRI. In four of these cases, the compressed lumbar artery directly supplied the ARM, highlighting a previously unreported anatomical variant found in DCS. In our case series, at least four individuals had ARMs that originated at levels lower than T12, directly from the compressed lumbar vessels. We propose that this anatomical arrangement predisposes to a more severe form of DCS. Unlike previous reports that describe DCS almost exclusively as a right-sided phenomenon, three of our eight patients demonstrated left-sided compression. Selective Spinal Angiography typically demonstrated three signs:

1) An anterior spinal dorsolumbar artery (artery of Adamkiewicz) that does not descend to the conus medullaris.
We retrospectively analysed patients of spinal cord vascular malformations in our long series of spinal vascular malformations. Here we analyze this subset of clinical and angiographic features and are best treated by interventional Neuroradiology, New Delhi, India.

**Methods:** We retrospectively analysed patients of spinal cord macrofistulas (Giant Perimedullary Fistulas) have distinct demographic, genetic, and clinical features and are best treated by embolization. Findings from this series suggests that DCS is characterized by the coexistence of:

1. Existence of a prominent radicular artery arising from a first or second intersegmental lumbar artery.
2. Postural, hemodynamic, or comorbid factor that aggravates this stenosis leading to further occlusion and spinal ischemia.
3) Postural, hemodynamic, or comorbid factor that aggravates this stenosis leading to further occlusion and spinal ischemia.

**Results:**

- **Material and Methods:** Retrospective analysis of the clinical and angiographic data of 15 patients with symptomatic Spinal dural arteriovenous fistulas (SDAVF), treated in our institution with intra-arterial embolization, from 1998–2016.
- **Results:** This series includes 15 patients (12 male), with ages ranging from 42 to 79 years old. The majority presented with progressive paraparesis (14/15) and sphincter dysfunction (11/15). All the patients showed the typical magnetic resonance imaging (MRI) study abnormalities – cord oedema and peri-medullary signal voids. The endovascular treatment was performed under general anaesthesia and anticoagulation. The embolization material included microparticles in 9 patients, cyanoacrylate/glue in 9 patients and multiple materials (coils, microparticles and glue) in one patient. Angiographic exclusion of the fistula was obtained in 13 patients and clinical improvement in 11. Reported complications were: one patient with radiodermatitis, other with phlebothrombosis and other with subarachnoid haemorrhage.

**Conclusions:** The intra-arterial embolization of SDAVF is, in the present day, the first line therapy. The material of choice should be cyanoacrylate/glue; however other materials may also be considered if the angiographic characteristics of the lesion prove needed. The long term angiographic and clinical outcome is this series was very good with few complications.
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Novel augmented reality navigation technology with intraoperative 3D cone beam CT imaging in a hybrid operating room: Experience in open and minimally invasive spine surgery

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2Karolinska University Hospital, Department of Neuroradiology, Stockholm, Sweden
3Cincinnati Children's Hospital, Department of Radiology and Medical Imaging, Cincinnati, United States
4Philips Healthcare, Department of Image Guided Therapy Systems, Best, Netherlands

Background context: Several studies have shown that the use of a combination of intraoperative CT images and navigation significantly improves pedicle screw placement accuracy. A new concept of surgical navigation system combining augmented reality (AR) with intraoperative 3D cone beam CT (3DCBCT) was developed specifically for spine surgery.

Purpose: To evaluate the feasibility of using this surgical navigation system without fluoroscopic assistance for thoracic pedicle screw placement, and to assess the accuracy in open and minimally invasive (MI) setups.

Study design/setting: Cadaveric laboratory study.

Outcome measures: Pedicle screw placement accuracy.

Methods: Pedicle screws were placed in the open and MI setup by two neurosurgeons using this new surgical navigation system. The system was installed into a conventional hybrid operating room, where the operating table was integrated with a motorized high-end C-arm enabling intraoperative 3DCBCT imaging. In this concept, 3DCBCT images were automatically merged with live video data, obtained from four optical video cameras integrated into the frame of a flat panel detector of the C-arm, thereby enabling augmentation of the live video stream with superimposed fluoroscopic assistance for thoracic pedicle screw placement, and to assess the accuracy in open and minimally invasive (MI) setups.

Results:

- In the open setup, another 47 thoracic pedicle screws were placed on the contra lateral side using free hand technique, serving as controls.
- The accuracy in the open setup was 85% (compared to free hand technique 64%, P < 0.05) and in MI 89%.

Conclusions: Augmented reality surgical navigation with 3D CBCT imaging is feasible, and enables accurate thoracic pedicle screw placement without any use of perioperative fluoroscopy in both open and MI surgical setups. Preliminary data from the first clinical study are promising.

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Estimation of the number of feeding arteries of Spinal arteriovenous malformations by using three dimensional-digital subtraction angiography

Takamiya Soichiro1, Osanai Toshiya1, Seki Toshitaka1, Fujima Noriyuki2, Sasamori Toru3, Hida Kazutoshi3, Asano Tsuyoshi4, Kawabori Masahito1, Hamauchi Shuji3, Terasaka Syunsuke1 and Houkin Kiyohiro1

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2Hokkaido University Hospital, Department of Radiology, Sapporo, Japan
3Sapporo Azabu Neurosurgical Hospital, Department of Neurosurgery, Sapporo, Japan
4Chiba medical center, Department of Neurosurgery, Chiba, Japan

Purpose: Spinal angiography is a gold standard for evaluations or diagnoses of spinal arteriovenous malformations (AVMs). However, there is a possibility of overlooking some feeding arteries when multiple feeders exist. We here reviewed retrospectively cases of spinal intra-dural AVMs which had been performed three dimensional-digital subtraction angiography (3D-DSA), and attempted to estimate the number of feeding artery.

Materials and Methods: We reviewed our cohorts of patients with spinal intra-dural AVMs who had underwent 3D-DSA at Hokkaido University Hospital from January 2005 to December 2016 retrospectively, and selected nine patients who could obtain the date of multi-planar reconstruction of 3D-DSA from. We measured the CT values of feeding arteries and draining veins severally. The CT values represented the averages of maximum CT values of consecutive 5 axial slices. The ratio of the CT value of drainer to that of feeder (D/F ratio) was calculated, and a correlation between D/F ratio and the number of feeder was examined with the Pearson’s correlation coefficient.

Results:

- The average of the number of feeder was 2.3 (1-4), and the number of feeder shows significant negative correlation with the D/F ratio ($r = -0.77$).
Conclusions: By using D/F ratio obtained from 3D-DSA, the number of feeding artery of spinal intra-dural AVMs could be estimated.

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Pre-vertebrectomy arterial supply glue embolisation: relatively easy procedure to wide neurosurgical indications

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1S. Giovanni Bosco Emergency Hospital ASL TO2, Neuroradiology Department, Torino, Italy
2S. Giovanni Bosco Emergency Hospital - ASL Città’ di Torino, Neurosurgery, Torino, Italy
3S. Giovanni Bosco Emergency Hospital - ASL Città’ di Torino, Radiology Department, Torino, Italy

Purpose: Incidence of vertebral and paraspinal metastases has recently increased, partly for a longer oncological patients survival due to advanced medical and interventional therapies. Higher risks related to the primitive tumor and complications following its dissemination then consequently arise. Surgery of vertebral metastases has always been considered mostly as a palliation act to improve patient’s quality of life (QOL), whereas the oncological control is still very difficult to achieve.

Multidisciplinary teamwork (Neurosurgeon, Interventional Neuroradiologist and Oncologist) have recently demonstrated how different therapies interaction in oncological patients could result in a better outcome.

When possible, just a single session pre-vertebrectomy arterial supply glue embolisation helps neurosurgeons to faster increase feasibility, safety and accuracy of aggressive demolitive debulking.

Methods and Materials: Between June 2011 and February 2017, 56 patients suffering for vertebral metastases and different grade of epidural space invasion were surgically treated (stabilization with or without decompression, partial or complete somectomy and vertebrectomy), 27/56, after a collegial clinical and radiological evaluation, previously underwent a single session pre-vertebrectomy arterial supply glue embolisation under controlled conscious sedation.

Afterwards a QOL test has been administrated with a questionnaire SF 12 or ODI.

Results: All 27 pre-vertebrectomy arterial supply study and then embolisation were successfully performed (100% technical success). After first cases, endovascular embolisation, as the following somectomy or vertebrectomy, were always more accurate and complete.

The interventional procedure time, always anticipated by an updated CT-angiography (CTA) and stadiation study or MR-angiography (MRA), differed depending on lesion/s extension, volume and histological tumor type and vascularization but never lasted more than 100 minutes. The procedure itself, performed by superselective microcatheterization of intercostal or lumbar arteries, is usually safe, accurate, easy and not too much time-consuming after an accurate diagnostic angiography (DSA).

Dilution of Lipiodol and Glubran mixture was decided right after the diagnostic part of the endovascular procedure depending on metastatic vascularization and in-lesion artery-venous shunts.

Conclusion: Pre-vertebrectomy arterial supply glue embolisation is usually an easy and quite fast procedure for skilled Neurointerventionalist. Technical success is very high and a high-to “mostly completed” devascularisation of the metastatic lesions achievable by just a single session embolisation.

Usually the procedure is well tolerated under conscious sedation.

In few high vascularized aggressive lesions, pain-control was challenging.

Pre-operative embolisation helped Neurosurgeons to safely and faster work on a well devascularized surgery field.

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Predictive factors of the management of Spinal cord Arterio-venous fistulas; center experience with literature review

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1Alexandria University Hospital, Stroke and Neuroendovascular unit, Alexandria, Egypt

Background: spinal cord arterio-venous fistulas are rare case of progressive myelopathy. The predictive factors of their outcome after endovascular or surgical treatment are still controversial.

Materials and Methods: Twenty patients were diagnosed with spinal artery-venous fistulas; 13 of them had dural and 7 had perimedullary fistulas (1 Dorsal and 6 Ventral). Surgery, endovascular or both treatment were used.

Results: Ten of the 13 patients in the dural group were surgically treated, while 2 were managed by embolization and one combined. Seven patients improved, while 6 patients showed stationary clinical course after intervention. Five patients in the perimedullary group were embolized with clinical improvement, 1 patient refused intervention, and 1 patient had surgery. Clinical improvement was significantly correlated to the duration of symptoms before intervention (P < 0.012), and preoperative neurological status (P 0.001). No significant correlation was found with age, anatomic level of the fistula, fistula type, and type of intervention.

Conclusion: Microsurgery was preferred for dural and dorsally located perimedullary fistula, while embolization was preferred for ventrally located ones. Clinical improvement was significantly correlated to early intervention and preoperative neurological status. Age of the patient, fistula type,
This preliminary study demonstrates that percutaneous vertebroplasty utilizing OST-HMDs for imaging guidance is feasible. This novel visualisation approach may serve as a valuable tool for performing vertebroplasty and other minimally invasive percutaneous procedures in clinical practice.

106 Technical Note: Image Guidance for Percutaneous Vertebroplasty using an Optical see-through head-mounted display (OST-HMD)
Deib Gerard1, Johnson Alex2, Osgood Gregory2, Navab Nassir2, Qian Long2, Yu Kevin3, Andress Sebastian2, Unberath Mathias4, Hui Ferdinand4 and Gailloud Philippe5
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2Johns Hopkins Hospital, Orthopaedic Surgery, Baltimore, United States
3Johns Hopkins Hospital, Whiting School of Engineering, Baltimore, United States

Purpose: Optical see-through head-mounted displays (OST-HMD) can enable a mixed reality (MR) experience for interventionists during procedures encompassing both high resolution radiographic imaging and an unhindered view of the procedural site. The authors present a technical note detailing an approach to percutaneous vertebroplasty utilizing an OST-HMD as an alternative to a traditional angiography suite display monitor.

Materials and Methods: Mixed reality visualization was achieved using the Microsoft hololens OST-HMD system. A lumbar spine phantom was employed to perform the procedure. A commercially available vertebroplasty (Stryker) kit was utilized to perform a unipedicular vertebroplasty procedure at L2 in the spine phantom. The head mounted display created a real-time mixed reality environment by superimposing the virtual PA and lateral views onto the interventionist’s field of view. The procedure was filmed through the point of view of the operator who used a combination of world-anchored and body-anchored visualization modes. Following the intervention, the video was used to assess whether key anatomic landmarks could be consistently and reliably visualized. Dosimetry and time of procedure were recorded. The operator completed a questionnaire following the procedure detailing benefits and limitations of the procedure as well as visualization mode preferences.

Results: A unipedicular L2 percutaneous vertebroplasty was successfully performed using OST-HMD imaging guidance on a lumbar spine phantom. Dosimetry and procedural time compared favorably to typical clinical vertebroplasty procedural times. World-anchored and body-anchored visualization modes were equally effective in providing imaging guidance. Key anatomic landmarks were consistently and reliably visualized using both settings.

Conclusion: This preliminary study demonstrates that percutaneous vertebroplasty utilizing OST-HMDs for imaging guidance is feasible. This novel visualisation approach...
Percutaneous ozone nucleolysis for lumbar disc herniation

Mohamed Mohamed Ezeldin Amin1, Cirillo Luigi2, Dall’olio Massimo1, Princiotta Ciro2 and Leonardi Marco2
1IRCCS Institute of Neurological Sciences; Bologna, Italy & Faculty of Medicine, Sohag university, Egypt., Neuroradiology Unit, Bologna, Italy
2IRCCS Institute of Neurological Sciences; Bologna, Italy & DIMES, Department of Specialty, Diagnostic and Experimental Medicine, University of Bologna; Bologna, Italy, Neuroradiology Unit, Bologna, Italy

Background and Purpose: Oxygen-Ozone (O2-O3) nucleolysis with periganglionic infiltration is a minimally invasive treatment for patients of lumbar disc herniation. We assess the therapeutic outcome of ozone nucleolysis for these patients.

Patients and Methods: All patients were treated at the Neuroradiology Unit of Bellaria Hospital, Bologna, Italy. Although there were a lot of patients treated by ozone nucleolysis between December 2016 until March 2017, Only 92 patients answered and sent their follow-up questionnaires, 52 patients of them who met the following inclusion criteria were included. The patients presented with a clinical history of lumbosciatica/crualgia and failure of conservative treatment with CT and/or MR evidence of disc herniation either protruded or extruded with non-migrated nor sequestrated disc fragments. Post-operative patients with recurrent or persistent herniated disc were also included. Patients with cauda equina syndrome, Major neurological deficit, Spinal stenosis, uncontrolled spinal instability, Severe disc collapse, Spinal tumors or infections were excluded. Patients were treated under fluoroscopic guidance with a single session of intradiscal (5 ml) injection of (O2-O3) mixture at an ozone concentration of 27 g/ml followed by periganglionic (10) injection of (O2-O3) mixture, corticosteroid and a local anesthetic to enhance the anti-inflammatory and analgesic effect. Outcome is assessed for the pain intensity and its disability at two and six months after treatment using Oswestry disability index (ODI) and compared with the status before the intervention, defining the success in pain relief as an improvement of one level or more in the verbal pain intensity grades of ODI and an improvement of pain disability of equal or more than 30% reduction of the baseline ODI as a successful outcome based on the minimum detectable change.

Results: These results are preliminary and confined to early follow-up (Two months) questionnaires. Later six months questionnaires will be available and analyzed. According to the available data; Fifty two patients (28 females, 24 males) with age range of 37–87 years entered in this study. The pain disability of the patients according to ODI, showed a significant improvement. The mean SD of ODI was 17.05 ± 7.76 before the intervention. There was 40.36 % reduction in ODI after two months of treatment (the mean was of 10.17 ± 6.46 SD). Clinical success was observed in 39 (75 %) of the patients with good to excellent outcome in 20 patients (51.2 %) Of them and fair improvement in the remaining 19 patients. Also, a significant reduction in the pain intensity was observed in 34(65.3%) of the patients with partial pain relief in 23(67.6%) of them and complete pain relief in 11(32.3%) of them. No complications were recorded.

Conclusion: Ozone nucleolysis is a useful minimally invasive, safe and effective treatment in relieving pain as well as its disability for patients with lumbar disc hernia

ORAL PRESENTATIONS

TUESDAY

Tuesday, 17th of October – Pleanary Room – 07:15 – 08:00 – Back to the basics: Spine: pain and percutaneous treatment

Pathomechamisms of spinal pain
Kieran Murphy
University Health Network, Canada

Percutaneous spinal procedures
Giuseppe Bonaldi
Hospital of Bergamo, Italy

Tuesday, 17th of October – Pleanary Room – 07:15 – 08:00 – Plenary session 3. - Stroke care organization

INV09
Drip & ship or Mother ship
Abilleira Sónia1
1Health Department of Catalonia, Stroke Programme, Barcelona, Spain

Demonstration of mechanical thrombectomy (MT) efficacy in acute ischaemic stroke (AIS) patients with anterior circulation strokes due to large artery occlusions (LAO) is putting pressure on stroke systems of care. Existing stroke systems of care were developed under the thrombolysis era and are now being required to also guarantee urgent access to neurorinterventional procedures that require highly specialised skills, which are only available at tertiary stroke centres. The “time is brain” motto, on the one hand, and the uneven territorial distribution of tertiary hospitals on the other, which concentrate in densely populated areas, jeopardise the principle of equity that guides implementation of services in public health systems. MT trials have compared best medical treatment, including intravenous rtPA, +/- MT, and no randomised controlled
A different method is required for country/remote regions. The Stroke Team at Monash Health has developed a computational model to generate ECR service boundary lines for the four ECR capable hospitals in Melbourne, Australia. **Materials and Methods**: Melbourne has a population of about 4 million. The number of stroke cases for each postcode and the hospitals catchment areas were estimated by merging population census with published stroke data. Using Google Map API, for each simulated stroke incidence, traveling time at various times of the day from randomly generated addresses to the four ECR hub hospitals were estimated, forming the basis of the model. The model was simulated based on 2 and 3 hospitals hub models.

**Results**: In the 2-hub model, the catchment area was best distributed when Hospital A was paired with Hospital B (1a) or Hospital A paired with Hospital D (1c) without significant difference ($p = 0.2$). Catchment was poorly distributed when Hospital A was paired with Hospital C (1b), significantly different from the first two models ($p < 0.05$). Model 1a had the greatest proportion of patients arriving within 30 minutes ($p < 0.001$). At 1715, peak hour, 82% and 90% of cases were able to reach Hospital A and B respectively (model 1a) within 30 minutes, whereas in model 1b, only 71% and 69% of cases were able to reach Hospitals A and C.

In the 3-hub model, the combination of Hospitals A, B and D (2b) had a greater percentage of cases reaching the hospitals within 30 minutes compared to the combination of Hospitals A, B and C (2a), ($p < 0.001$).

**Discussion**: This method can evaluate and design services for metropolitan cities, and compare different strategies to shorten the treatment time, and also model the number of patients arriving at each ECR hub, to avoid overwhelming any one ECR hospital with stroke patients; which is likely extrapolatable to other metropolitan cities in the world. Finally, validation of the adopted models can be performed by comparison with actual ambulance times and location of stroke cases.

In Australia, in 2011, 35% of the population or about 8 million people live outside of the capital cities where all ECR hospitals are situated. Hence, a different approach will need to be adopted to enable equitable access for regional patients to access ECR taking into account the availability of stroke interventionists in country areas and the time delay in transferring these patients to capital cities.

**Conclusion**: A computational model based on travelling times to ECR hub hospitals can assist in the design of the most efficient and equitable access to ECR in major cities. A different method is required for country/remote regions.
INV11

Acute Stroke Treatment in Europe: a 44 country survey
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Background: Endovascular thrombectomy (EVT) has recently become part of standard practice for selected patients with ischemic stroke. Together with admission in stroke units, reperfusion strategies are associated with marked improvements in the outcome of patients with acute ischemic stroke. However, little is known about the current status of stroke care across Europe. We assessed the characteristics of national systems of stroke care in Europe.

Methods: Cross-sectional survey of European stroke professionals, endorsed by the major European stroke associations. Stroke experts of national stroke/neurology associations in all ESO, EAN and ESMINT member countries were identified through the databases of European organizations. A 64-item questionnaire was developed by the task force. Questionnaires were administrated via encoded e-mail or fax. Data were analysed using appropriate descriptive methods. Rates per million inhabitants were calculated using the United Nations population estimates for each country.

Findings: We obtained data for 44 European countries. Thirty-seven countries (84%) countries reported having an official national strategy to address stroke care recommendations. Eleven countries had less than 1 stroke unit per 1,000,000 inhabitants. Intravenous thrombolysis (IVT) was available in 42 out of 44 countries. The annual number of IVT per million population was less than 50 in 12 countries, while 4 countries had rates above 350. EVT was available in 40 out of 44 countries. Forty-three countries provided recent estimates for the annual number of EVT for acute ischemic stroke patients. In 2016, the reported number of procedures was less than 10 per million population in 14 countries. Two countries reported rates per million above 100. Fifteen out of 43 participating countries considered that the available centres covered the country overall needs for EVT.

Interpretation: Stroke care varies greatly among European countries. The heterogeneity in the use of reperfusion therapies does not match epidemiological burden. Substantial improvements in stroke care are urgently needed.

Funding: None

INV12

Current acute stroke management and nationwide prospective multicenter registry in Japan
Sakai Nobuyuki1, Yoshimura Shinichi2, Uchida Kazutaka3, Yamagami Hiroshi4, Imamura Hirotoshi5 and Sakai Chiaki6

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2Hyogo College of Medicine, Neurosurgery, Nishinomiya, Japan
3National Cerebral and Cardiovascular Center, Cerebrovascular Medicine, Suita, Japan

Background: To show the current medical management of acute ischemic stroke (AIS) treatment in Japan, and present ongoing multicenter prospective registry of acute cerebral large vessel occlusion (RESCUE-Japan Registry 2). Here we report the initial analysis of the registered patients of this study.

Methods: 1) At the approval of landmark device, Japanese government recommend to medical societies to establish guideline (GL) for new treatment. 2) RESCUE registry covered all the patients with acute large vessel occlusion, admitted to the participating hospitals within 24-hours after onset. Factors related to treatment selection and the methods and clinical outcome were analyzed. RESCUE2 have been conducted after stent retrievers approved in Japan.

Results: 1) Japanese Society of Neuroendovascular Therapy established GL for mechanical thrombectomy device in 2010, revised 2014 and 2015 with Japanese Neurosurgical Society and Japanese Stroke Society. In this GL, mechanical thrombectomy should be done board certified or same experienced physician involved stroke management. 2) A total of 2,433 patients registered, 1,003 patients were treated by endovascular treatment (EVT). Among them, only 247 patients (24.6%) matched AHA recommendation. In the low ASPECTS (<6) group, EVT was performed in 166/430 (39%) and favorable outcome (mRS 0-2) was obtained in 24%. In low NIHSS (<6) group, EVT was performed in 46/224 (20%), and favorable outcome was in 76% of EVT group. EVT was performed in 157/424 (37%) of the patients who arrived over 6 hours after onset and favorable outcome was obtained in 38%.

Discussion and Conclusions: EVT for AIS have been done by neuro-interventionist in Japan and rapidly growing. EVT was aggressively performed for outside of clinical evidence. Further analysis is necessary with the larger data of nation wide registry.

INV13

Acute Stroke care in North America
Raul Nogueira

Neuroendovascular Service, Marcus Stroke & Neuroscience Center, Grady Memorial Hospital, USA

Acute stroke care systems in Southeast Asia countries are at various stages of development, and therefore exhibit heterogeneity and diversity in terms of treatment availability and
practices for both intravenous thrombolysis and endovascular therapy. With the establishment of successful endovascular therapy trials over the past few years, the pressure for acute stroke care in Southeast Asia countries to meet this demand has become greatly magnified. There are unique features of stroke in Southeast Asia regions including susceptibility to intracranial atherosclerosis and high prevalence of intracerebral haemorrhage, these being modified by differing vascular risk factors from the effects of dietary and lifestyle habits. Clearly, the practice of acute endovascular stroke intervention needs to take into account these considerations. Acute stroke care in Southeast Asia also faces unique challenges on a background of an ageing population, differing political and healthcare systems in these countries. Base on existing published data and some of the multinational interactions and collaboration efforts over the past years, the challenges facing acute stroke care strategies in this region will be discussed.

Acute Stroke care in China

Ling Feng
Department of Neurosurgery, Xuanwu Hospital, China

Acute Stroke care in South America

Lautaro Badilla
Clinica Santa Maria, Chile

INV14

Stroke care in Africa

Taylor Allan¹
¹University of Cape Town, Neurosurgery, Cape Town, South Africa

Stroke has its largest impact in low and middle income countries with 87% of stroke related deaths and disability adjusted life years occurring in these countries. As opposed to high income countries the incidence of stroke is also increasing in low income countries. Treating stroke patients in Africa is hampered by uncertainty regarding aetiology, appropriate guidelines and poor implementation of existing guidelines. Regarding aetiology there is a much higher incidence of haemorrhagic stroke (34%) in low income countries compared to high income countries (9%), age also appears to be younger in low income settings. This lack of information coupled with a lack of tools essential to treating stroke, like CT scanners, means that appropriate guidelines for low income countries are lacking. It could be argued that applying existing guidelines for stroke unit care, thrombolysis and thrombectomy are still appropriate. Implementation is however poor. According to data collected by the WHO in 2015, out of 49 African countries only 1 (Seychelles), answered yes to the availability of acute stroke care for public patients. Progress is being made in some countries however and in South Africa there is now an effort to set up acute stroke care units. In 2013 there were only 5 stroke units in South Africa and this has increased to 17 currently. There has also been an increase in trained neurointerventionists and other specialists performing mechanical thrombectomy.

Acute Stroke care in Australia

Peter Mitchell
The Royal Melbourne Hospital, University of Melbourne Radiology, Parkville, Australia

Do you need help? Train the cardiologist

Adnan Siddiqui
Neurosurgical Stroke Service, Kaleida Health, USA

Do you need help? Train more neurointerventionists

Shelley Renowden
North Bristol NHS Trust, Southmead Hospital, UK Neuroradiology, Bristol, United Kingdom


Intracranial stenting in EU

René Chapot
Alfried Krupp Hospital in Essen-Ruettenscheid, Department of Radiology and Neuroradiology, Germany

Intracranial stenting in Asia

Jiao Liqun
China

Sinus thrombosis: the role of endovascular treatment

Jan Gralla
Inselspital, University Hospital, Berne, University Institute of Diagnostic and Interventional Neuroradiology, Bern, Switzerland
**INV15**

**Sinus stenosis: should it be treated endovascularly?**

Robertson Fergus J

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Venous sinus stenting has emerged as a promising treatment in the management of patients with refractory idiopathic intracranial hypertension, but optimal patient selection strategies, long term efficacy and safety outcomes remain unclear. A rigorous single centre approach to this disease is presented in the context of recent consensus statements for IIH.

**Tuesday, 17th of October – Pleanary Room – 14:00 – 15:40 – Parallel abstract session: AVM: Development and pathology**

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**Developmental considerations in Brain AVM**

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**Purpose:** Morphological studies on the vascular embryological development help in understanding arteriovenous disposition and can give some orientations in understanding vascular abnormalities. New approaches are focused in cellular- and extracellular-environmental processes affecting cell differentiation, and distribution. The aim of this work is to apply those combined observations in the discussion about possible mechanisms leading to the genesis of Brain Arteriovenous Malformations (BAVM).

**Material and Methods:** Our study material consists in 35 embryos and fetuses between 8 mm and 120 mm Crown-Rump length. Venous and arterial anatomy has been determined by following the trajectory of vessels with the aid of the microscope. The evaluation of angiographic and imaging data of supra- and infratentorial AVM from our everyday clinical practice brings us a review material for determining main pathological features to compare.

**Results and Conclusions:** Review of embryology shows that, mainly for veins, a process of heavy plexual expansion initiates before having the venous tree set, but along with the processes of growth is also possible to follow the later destruction of part of these plexual vessels, keeping only the main definite veins patent. Besides the proposed origins like wrong molecular environment (related, for example, to VEGF), and dural venous impairment as in Vein of Galen AVM, it could be hypothesized that occlusion of wrong pial and or dural connections could set the basis for higher venous pressure in an alternative venous structure. Maintenance of this conditions, probably besides other factors as angiogenic molecules could be related to the development of an AVM.

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**Embryological consideration of dural arteriovenous fistulas**

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**Purpose:** The topographical distribution of dural arteriovenous fistulas (DAVFs) was analyzed based on the embryological anatomy of the dural membrane.

**Material & Methods:** Seventy-five consecutive cases of intracranial and spinal DAVFs were analyzed based on the angiography, and each shunt point was identified according to the embryological bony structures. The area of dural membranes was categorized into three different groups based on the embryological origin whether it is from neural crest or mesoderm origin. The first area derived from paraxial mesoderm with endochondral bone, this was categorized as a ventral endochondral group (VE group). The second area derived from dorsal mesoderm on the membranous bone, it was categorized as a dorsal membranous group (DM group). The third one was a falco-tentorial group (FT group) located in the falx cerebri, tentorium cerebelli, falx cerebelli and diaphragm sellae. This FT group is derived from neural crest and was designated when the dural membrane was formed only with the dura propria (meningeal layer of the dura mater) and not from the endosteal layer of the dura mater.

**Results:** Cavernous sinus, sigmoid sinus and anterior condylar confluence was categorized to VE group, which had a female predominance, more benign clinical presentations, and a lower rate of cortical and spinal venous reflux. Transverse sinus, confluence and superior sagittal sinus belonged to the DM group. Olfactory groove, falx, tent of the cerebellum and nerve sleeve of spinal cord were categorized to the FT group, which presented later in life and which had a male predominance, more aggressive clinical presentations, and significant cortical and spinal venous reflux.

**Conclusion:** These three groups associated with the embryological domain showed the characteristics of population, sex differences and clinical feature of DAVFs. The FT group is derived from neural crest cell and this group was formed only with the dura propria as an independent risk factor for aggressive clinical course and hemorrhage of DAVFs.
Angioarchitecture of arteriovenous fistulas at the craniocervical junction: a multicenter cohort study of 54 patients

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Object: The aim of the present study was to assess the details of the angioarchitecture of arteriovenous fistulas at the craniocervical junction (CCJ AVFs) based on a retrospective multicenter cohort study, and to determine the associations between the angiographic characteristics and clinical presentations and outcomes.

Methods: Angiographic and clinical data of patients with CCJ AVFs from 20 centers that are member of the Japanese Society for Neuroendovascular Therapy (JSNET) were analyzed. Angiographic findings (feeding artery, location of arteriovenous [AV] shunt, draining vein), and patient data (age, sex, presentations, treatment modality, outcome) were tabulated and stratified based on the angiographic types of the lesions as diagnosed by a member of the CCJ AVF study group, which consisted of a panel of six neurointerventionalists and one spine neurosurgeon.

Results: The study included 54 patients (median age, 65 years; interquartile range [IQR], 61–75 years) with a total of 59 lesions. Five angiographic types were found among the 59 lesions: type 1: dural AVF (22/59; 37%); type 2, radicular AVF (17/59; 29%); type 3, epidural AVF with pial feeders (14/59; 24%); type 4, epidural AVF (6/59; 10%); and type 5, perimedullary AVF (6/59; 10%). In almost all lesions (98%), AV shunts were fed by radiculomeningeal arteries from the vertebral artery that drained into intradural or epidural veins through AV shunts on the dura mater, on the spinal nerves, in the epidural space, or on the spinal cord. In more than half of the lesions (63%), the AV shunts were also fed by a spinal pial artery from the anterior spinal artery (ASA) and/or lateral spinal artery. This study also demonstrated that the angiographic characteristics associated with hemorrhagic presentations, the most common presentation of the lesions (73%), were the inclusion of the ASA as a feeder, the presence of aneurysmal dilatation on the feeder and CCJ AVF type 2 (radicular AVF). Treatment outcomes differed among the angiographic types of the lesions.

Conclusions: CCJ AVFs commonly present with hemorrhage and are frequently fed by both radiculomeningeal and spinal pial arteries. The AV shunt develops along the C1 or C2 nerve roots and can be located on the spinal cord, on the spinal nerves, and/or on the inner or outer surface of the dura mater.

Microvascular anatomy of spinal dural arteriovenous fistulas: arteriovenous connections and their relationships with the dura mater

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Object: The microvascular anatomy of spinal dural arteriovenous fistulas (AVFs), especially the relationships of the vessels with the dura mater, has yet to be angiographically demonstrated in detail and proven histologically.

Materials & Methods: From April 2009 through December 2016, a total of 15 patients with spinal dural AVFs in the thoracic region underwent open microsurgical obliteration at Tokyo Metropolitan Neurological Hospital (n = 10) and the University of Tokyo Hospital (n = 5). The microvascular anatomy of spinal dural AVFs was comprehensively assessed by using advanced microangiography, including 3D computer graphics (n = 14) and intraoperative indocyanine green video angiography (n = 10), and by histological findings (n = 7).

Results: The 2 microangiography techniques revealed the spatial course and in vivo blood flow of the meningeal vessels and their relationships with the dura mater in sufficient detail. The meningeal branch of the intercostal artery split into multiple meningeal vessels on the outer dural surface of the spinal root sleeve. In 14 of 15 patients, these meningeal vessels ran in a longitudinal direction along the thecal sac and crossed the dura mater of the thecal sac to the inner dural surface. In the other 1 patient, meningeal vessels crossed the dura mater of the spinal nerve root. After crossing the dura mater, these vessels gathered and joined a single intradural draining vessel. On the inner dural surface of the thecal sac, the single draining vessel was fed by the surrounding multiple meningeal vessels, which appeared to be caput medusae. Histological findings revealed that the structure of the meningeal branch of the intercostal artery corresponded to that of a normal artery. The structure of intradural draining vessels corresponded to that of a vein modified by retrograde arterial reflux. On the inner dural surface, more than 1 meningeal artery gathered and joined with the proximal bridging vein.
Conclusions: Spinal dural AVFs were commonly located on the inner dural surface of the thecal sac, where multiple direct AV connections between more than 1 meningeal feeding artery and a single proximal bridging vein. Our results differed from the widely accepted concept that the arteriovenous shunt is commonly located on the dural mater of the spinal nerve root sleeve and drains into the radiculomedullary vein.

A Multi-Institutional Analysis of the Untreated Course of Cerebral Dural Arteriovenous Fistulas

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Object: The rarity of cerebral dural arteriovenous fistulas (dAVFs) has precluded analyses of their natural history across large cohorts. A considerable proportion of the few reports that exist have evaluated heterogeneous groups of untreated and partially treated lesions.

Methods: A multi-institutional database of dAVFs was queried for demographic, angiographic data and untreated natural course. Stratified by Djindjian type, annual nonhemorrhagic neurologic deficit (NHND) and hemorrhage rates were derived along with risk factors for each. Multivariable Cox proportional hazards regression model were used to calculate hazard ratios.

Results: 295 dAVFs had at least one month of untreated follow-up. For 126 type I dAVFs, there were no episodes of NHND or hemorrhage over 177 lesion-years. Annualized NHND and hemorrhage rates were 4.5% and 3.4% for type II, 6.0% and 4.0% for type III, and 4.5% and 9.1% for type IV dAVFs, respectively. Annualized NHND and hemorrhage rates were 2.3% and 2.9% for type II-IV dAVFs that did not present with NHND or hemorrhage, 23.1% and 3.3% for dAVFs presenting with NHND and 0% and 46.2% for those presenting with hemorrhage, respectively. On multivariate analysis, NHND presentation (HR 5.03, 95% CI 0.42–694) were significant risk factors for hemorrhage and 46.2% for those presenting with hemorrhage, respectively.

Conclusion: All type II-IV dAVFs should be considered for treatment; given the high risk of rebleeding, those presenting with NHND/hemorrhage should be treated expeditiously.

Modified classification of spinal dural arteriovenous fistula new concept of subtype based on the location of shunt point

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Purpose: Spinal dural arteriovenous fistula (SDAVF) is defined as the clinical entity with AV shunt on the dura at the root sleeve and reflux to the spinal vein. However the difference of angioarchitecture has been pointed out by its location. The purpose of this study is to review and sort the characteristics of SDAVF that has been mixed together and to propose the new classification.

Material and Method: We reviewed 20 patients diagnosed and treated as SDAVF between 2005 and 2016, in the age of 49–82 years old (mean age 65.7 years) including 4 females. All of them presented congestive myelopathy due to the reflux except for two patients manifesting subarachnoid hemorrhage (SAH).

Result: There were 10 patients (all males) with “typical” SDAVF with single channel and reflux to the spinal vein. The level of the shunt was located at T6 to L2. While eight patients showed different aspect of shunt at the level of L1 to sacral portion. Their AVF shunted to the vertebral epidural venous pouch, and flowed upward through a subdural vein then connected to the spinal vein at the lower thoracic level. Both two female patients with the AVF at the upper cervical portion manifested SAH. The lesion was located at C1 -2 portion (V1-2 level of vertebral artery) and drained into the epidural venous plexus. This angioarchitecture was completely different from that of three cases of DAVF at cranio-cervical junction similar to SDAVF. Both cases were associated with a ruptured aneurysm fed by anterior spinal artery (ASA) and were diagnosed as radicular AVF.

Conclusion: This study revealed that SDAVF has a different feature by the location. Typical (classical) SDAVF is male dominant and is located at lower thoracic to upper lumbar region, which is single fistula type draining into the dorsal spinal veins similar pattern to intracranial non-sinus type DAVF. While, other subtype located at lower lumen to sacral region shows a ventral epidural venous pouch and the drainage to the spinal veins through an ascending subdural vein. This type of SDAVF is called as spinal epidural AVF. Third type of SDAVF is radicular AVF located at the upper cervical region. There is a quite different aspect from thoraco-lumbar SDAVF because it has the contribution of ASA with the highly associated ruptured aneurysm, and mainly drains extradurally. These three types (SDAVF, spinal epidural AVF, radicular AVF) should be differentiated as the independent clinical entity based...
Demographic and Angioarchitectural features predictive of Brain Arteriovenous Malformations Seizures in KwaZulu-Natal, South Africa

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Background: Brain arteriovenous malformations (AVMs) often present with epileptic seizure which carries standard mortality rate two to three folds higher than in the general population. Epileptic seizures account for 20-40% of all clinical presentations of patients with brain AVMs, rendering it the second most common form of Brain AVM presentation. Brain AVM-related epilepsy may be disabling and can adversely impact on patient’s health related quality of life.

Methods: We conducted a retrospective chart review of all consecutive patients who presented with brain AVMs to three interventional neuroradiology hospitals with brain AVMs in KwaZulu-Natal, South Africa, over a period of 10 years. Diagnosis of brain AVM was made using Computerized Topography (CT-scan), Magnetic Resonance Imaging (MRI) and Digital Subtraction Angiography (DSA) or a combination of these methods. The demographic and clinical presentations were derived from patient’s electronic medical record (Sorian⁵). Radiological features were determined using axial CT or MRI Scan. Angioarchitectural features were determined from DSA.

Statistical analysis: Univariate logistic regression analysis was performed to identify factors associated with seizures presentation. Factors with a p-value <0.2 in the univariate analysis were entered into multiple logistic regression analysis to determine predictors of seizures presentation.

Results: A total of 157 patients were evaluated. Univariate logistic regression analysis indeed shows that male gender was a risk factor for the development of seizures in patients with brain AVMs when compared to female (OR = 2.1; 95%CI: 1.03–4.18). African-black patients were found to harbour 4-folds increased risks of presenting with seizures compared to White patients (OR = 4.1; 95% CI: 1.3–12.8). There was significant association between brain AVMs-related seizures and; cortical lobar location (OR = 16.2; 95%CI: 3.7–70.1) and AVMs nidus measuring >3 cm (OR = 4.6; 95%CI 2.2–9.8). Multivariate logistic regression analysis indicated that male gender (OR = 2.8; 95%CI: 1.16–6.74), brain AVM nidus size ≥3 cm in maximal diameter (OR = 3.9; 95%CI: 1.25–12.50) and cortical lobar location (OR = 11.1; 95%CI: 2.32–52.80), are significant predictors of seizure presentation.

Conclusion: Brain AVM-related epilepsy should not be overlooked as a benign condition, as epilepsy is associated with increased premature death and carries mortality rate of 2.3–5.1 times compared to general population. Brain AVM inflicts young patients at the prime of their economically productive life. The more definitive/targeted management options may be preferable than anti-epileptic drugs alone. In order to identify potential targets we need to first understand the risk factors associated brain AVMs-related seizures in our population.

Demographic and Angioarchitectural features predictive of Brain Arteriovenous Malformations hemorrhage in KwaZulu-Natal, South Africa

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Background: Arteriovenous malformations of the brain are associated with one of the most devastating complications affecting the central nervous system such as hemorrhagic stroke. Intracerebral hemorrhage (ICH) represents 10% of all strokes, and 2% of spontaneous ICH are due to ruptured brain arteriovenous Malformations (BAVMs). The morbidity and mortality associated with AVM hemorrhage is as high as 35%–50% and 10%, respectively.

Aims: This study aimed to investigate the association between specific angioarchitectural features, demographic variables and hemorrhagic presentation of BAVMs.

Methods: We conducted a retrospective chart review of all consecutive patients who presented to three interventional neuroradiology hospitals with brain AVMs in KwaZulu-Natal, South Africa, over a period of 10 years. Diagnosis of brain AVM was made using Computerized Topography (CT-scan), Magnetic Resonance Imaging (MRI) and Digital Subtraction Angiography (DSA) or a combination of these methods. The demographic and clinical presentations were derived from patient’s electronic medical record (Sorian⁵). Radiological features were determined using axial CT or MRI Scan. Angioarchitectural features were determined from DSA.

Univariate logistic regression analysis was performed to identify factors associated with hemorrhagic presentation. Factors with a p-value <0.2 in the univariate analysis were entered into multiple logistic regression analysis to determine predictors of seizures presentation.
Results: This study identified 157 patients with brain AVMs. Seventy one (45%) patients presented with hemorrhage. The median age was 31(IQR: 22–44) years. The univariate analysis using unadjusted logistic regression found a significant association between brain AVM hemorrhage and deep location (OR = 5.6; 95%CI: 2.4–10.9), AVM size ≤ 3 cm in maximal diameter (OR = 2.01; 95%CI: 1.06–3.08), exclusive deep venous drainage (OR = 3.9; 95%CI: 1.68–9.12), and the presence of associated arterial aneurysms (OR = 3.2; 95%CI: 1.50–6.67). Multiple logistic regressions analysis found deep AVM location (OR = 3.3; 95%CI: 1.43–7.71), exclusive deep venous drainage (OR = 3.3; 95%CI: 1.09–9.90) and presence of aneurysms (OR = 3.4; 95%CI: 1.44–7.88) to be significant predictors of brain AVM hemorrhage.

Conclusion: The morbidity and mortality associated with brain AVM hemorrhage is devastating even among the developed countries where human expertise and technological advancements for care are easily accessible. The implications are more severe in the developing world where resources for care and rehabilitation are scarce. Identification of the risk factors that predispose an individual patient with brain AVM to the high risk of hemorrhage could be useful in timely selection of patients to whom interventional therapies are warranted, and directing the choice of appropriate therapies.

Venous analysis in posterior Fossa AVM presenting with hemorrhage

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Purpose: Arteriovenous malformations (AVMs) are constituted by a tangle of fistulous vascular connections draining in one or more venous dilatations. The goal of this study is to evaluate the venous drainage of twenty posterior fossa AVMs presenting haemorrhage with special emphasis in understanding eventual features as distal venous occlusions, absence of a normal confluence drainage, or abnormal embryological dispositions, that could explain their behaviour.

Material and Methods: This a retrospective review consisting of 12 females and 8 males, with a median age of 41 yo. Location of the AVM was cisternal in 3 cases, restricted to the vermis (culmen - declive) in four cases, and in different locations of the hemispheres with vermician or cisternal involvement in the rest of cases.

Results and Conclusions: In 11 cases only one vein was draining the AVM, most frequently the superior vermian vein. Venous stenosis, fistulous component or venous / intranidal dilatation was seen in 9 cases. One of both superior petrosal sinus was not seen in two cases, in one case the superior vermian vein was not draining in its normal position, and in another case one of both tentorial sinuses draining the AVM showed a very long intradural segment. In one case, a vein of the lateral recess of the fourth ventricle was part of the AVM drainage.

A novel method determining the annual risk for hemorrhage in unruptured brain arteriovenous malformations

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Background: The magnitude of the annual risk for hemorrhage in earlier unruptured brain arteriovenous malformations (AVMs) vary over a wide range in the literature. There is a strong clinical need to determine the risk accurately.

Methods: The risk for hemorrhage of AVMs is assessed by a novel methodology. The traditional approach, in which individual patients have been followed over time is replaced by an analysis of the age distribution of the first AVM hemorrhage. The shape of this age distribution becomes universal for a large enough number of patients. We collected data from 3396 patients in whom the age of the first hemorrhage was known.

Results: The character of this distribution strongly indicates that AVMs are not congenital but instead develop over the early part of life. The annual risk for hemorrhage in earlier unruptured AVMs was concluded to be around 3.1% with an uncertainty of ±0.2%. The risk for hemorrhage was found to be unrelated to AVM volume but influenced by it’s location, with the highest risk for AVMs located centrally.
Tuesday, 17th of October – Pleanary Room – 14:00 – 15:40 – Parallel Plenary session 5/A - Minimally invasive spine treatment

Vertebroplasty versus vertebral augmentation in porotic disease: pro vertebroplasty

Mary Lee Jensen
University of Virginia School of Medicine, USA

Vertebroplasty versus vertebral augmentation in porotic disease: pro augmentation

Mario Muto
AORN Cardarelli Hospital, Naples, Italy

Image guided spinal surgery

Luigi Manfre
AOE Cannizzaro Hospital, Catania, Italy

Percutaneous treatment of spine metastasis

Allan Brook
Interventional Neuroradiology, Montefiore Medical Center, USA

Percutaneous pain procedures

Kieran Murphy
University Health Network, Canada

Tuesday, 17th of October – Session room 1. – 07:15 – 08:00 – Back to the basics: Non-atherosclerotic cerebral vascular disease - adults and children

INV16

Vasculitis: pathology and imaging

Mikulis David¹
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The purpose of this presentation is to demonstrate the imaging features of the major forms of cerebral vasculitis and to discuss these features in light of underlying pathology. In doing so, the following elements will be addressed:

- Vessel wall anatomy and function
- Pathophysiology and remodeling mechanisms of blood vessels
- Direct (bacterial and viral) and indirect (autoimmune, immune complex) causes of vasculitis

- Insights from the pathogenesis of giant cell arteritis
- Imaging: Luminal angiographic findings (DSA, MRA, CTA) and MRI vessel wall imaging findings

Emphasis will be placed on the recent development of MRI imaging methods that enable direct imaging of the walls of blood vessels. These methods have shown the ability to distinguish pathologies that produce similar luminal defects seen on conventional angiographic methods.

Childhood stroke

Gabrielle DeVeber
Division of Neurology, Hospital for Sick Children, Toronto, Canada

Tuesday, 17th of October – Session room 1. – 14:00 – 15:40 – Parallel abstract session - AVM: Embolization techniques

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Cortical venous reflux in arteriovenous malformations

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Purpose: Cortical venous reflux is not limited to dural arteriovenous fistulas. We will describe the clinical symptoms, angiographic characteristics and treatment of three patients with cortical venous reflux due to pial arteriovenous malformations (AVMs).

Material and Methods: Three patients with cerebral pial AVM and cortical venous reflux were found in the database of our institution. Clinical history and imaging data were analyzed.

Results: Patient 1, a 63-year-old female with an unbled AVM in the right parietal lobe, suffered from progressive cognitive decline. Neuropsychological tests revealed memory impairment and mental slowness. MRI and subsequent DSA showed an occlusion of the superior sagittal sinus with secondary venous rerouting in multiple dilated cortical and parenchymal veins. She was treated by embolization of multiple pial and dural feeding branches. After this her dementia resolved. A small rest of the AVM will be treated by radiosurgery.

Patient 2, a 51-year-old female, presented with left-sided hemianopia. An AVM was found on CT and MRI in the genu of the corpus callosum with vasogenic edema in the left occipital lobe. Subsequent DSA showed pinpoint stenosis of the large intraventricular draining vein and cortical venous rerouting. Two weeks later, after an acute hemorrhagic event, the AVM was surgically resected.

Patient 3, a 7 year old girl presented with a right-sided hemiparesis caused by a bleeding in the left thalamus. CT angiography showed increased vascularization in the left...
thalamus, in concordance with an AVM. DSA however showed a small right sided AVM, draining to the contralateral thalamic veins, due to an occlusion of the straight sinus, causing reflux through the vein of Galen to the contralateral left side. The hemorrhage was related to the venous congestion.

Conclusion: Cortical venous reflux is a rare but clinically significant occurrence in pial AVMs, often due to stenosis or occlusion of the primary draining vein. Our cases stress a relation with progression of clinical symptoms such as dementia and most likely also with increased hemorrhagic risk.

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Curative and adjunctive AVM Onyx embolization of AVMs through the choroidal arteries
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Objective: The anterior or posterior choroidal artery is often recruited to supply deep location arteriovenous malformations (AVMs). This study is to report curative and adjunctive AVM Onyx embolization through these arteries.

Methods: This study retrospectively reviewed six patients with cerebral AVMs who underwent endovascular embolization through the choroidal arteries between October 2015 and October 2016. Embolization was performed as a curative procedure in five patients and adjunctive procedure in one patient.

Results: Four patients underwent embolization through the anterior choroidal artery (AchA), and two patients underwent embolization through the lateral posterior choroidal artery (LPchA). One of the four patients in whom embolization was from the AchA (distal to the plexal point) developed transient hemiparesis. Complete obliteration was confirmed by angiography at the last follow-up in five patients.

Conclusions: Onyx embolization of cerebral AVMs through the choroidal arteries is possible as a curative or adjunctive procedure.

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Contribution of preradiosurgical embolization for AVM may depend on its quality – Japanese registry of Radiosurgery following Embolization for AVM
Miyachi Shigeru1, Hiramatsu Ryo1, Matsubara Noriaki2, Ohnishi Hiroyuki3, Izumi Takashi4 and J-REAL study investigators5
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4Nagoya University Graduate School of Medicine, Neurosurgery, Nagoya, Japan
5J-REAL office, Takatsuki, Japan

Purpose: Recent reports have posed the doubt to the effect of pre-radiosurgical embolization because it makes the planning of stereotactic radiosurgery (SRS) difficult and has the risk of recanalization out of the target. We investigated whether the performance and quality of embolization may influence the success of SRS based on the retrospective case cohort study.

Material and Method: Seventy-three patients who underwent embolization followed by radiosurgery (Gamma knife) during 2003 and 2012 in eight institutes having skillful neurointerventionists were nominated. They were divided in two groups at 3 years follow up after final SRS; “successful occlusion group (S group)” with radiologically complete occlusion of AVM, and “non-successful occlusion group (N group)”.

Conclusion: The cause of the unsuccessful result of post-embolization SRS might be the larger and diffuse angioarchitecture, but the proper embolization with high rate of nidus penetration to avoid recanalization is more important. Effective embolization is essential to contribute and promote the occlusion following radiosurgery.

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Squid Brain Arteriovenous Embolization using the Eclipse Balloon: About 15 patients
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Purpose: The usefulness Squid as embolization agent for the management of vascular malformation is well established. We report our initial experience with the Eclipse double lumen Balloon

Methods and Technique: Between December 2016 and May 2017, 15 patients aged between 15 to 70 years were
endovascularly treated with the Eclipse (Balt) doble balloon combined with Squid liquid brain embolization material, in patients presenting high grade brain arteriovenous malformation (AVM). A total number of 28 balloons were used in the patient cohort. The balloon showed good distal navigability and also a stable capacity to built a “plug” to obtain better Squid penetration. During injection, the balloon remained stable in all (except 2 cases) without spontaneous deflation or rupture. The retrieval of the catheter in most cases took less than a minute (19/28) while in 9, it took less than five minutes. Total exclusion of the brain AVM was obtained in 85% of the cases, finishing treatment of the 15% of the patients by stereotaxic radiosurgery.

**Conclusion:** Eclipse Dual-lumen balloon catheter Squid embolization is a safe and effective technique. With the experience his technique and balloon can be applied to new pathological brain vascular anomalies.

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**Cerebral AVM: Preliminary Experience with Phil Embolic Material in a Single Center**

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**Purpose:** To describe our early experience in treating cerebral Arteriovenous Malformations (AVMs) with the Precipitating Hydrophobic Injectable Liquid (PHIL; MicroVention, Tustin, California) while it was available to use.

**Materials and Methods:** Between September 2015 and March 2016 a total of 22 patients with pial AVMs were treated with PHIL as the exclusive embolic agent. Clinical presentation, location of AVM, type, fluoroscopic time, radiation dose, procedural time, microcatheter used, volume of PHIL injected, complications, immediate angiographic data, adverse events, and any neurologic deficits were included in the analysis.

**Results:** 16 patients with un-ruptured AVM but most symptomatic were treated. Eight cases established by hemorrhage. 12 patients with Spetzler-Martin grade II AVMs, six grade III, and four grade IV. 9/12 (75%) grade II and 3/6 (50%) grade III AVMs were complete occluded. A Headway Duo Microcatheter (MicroVention, Tustin, California) was used in 16 procedures and a dual lumen Scepter Balloon (MicroVention, Tustin, California) used in six. A median of 0.7 cc (range 0.22 – 5.5 cc) of Phil was injected. Embolization duration was less than 5 minutes in 68% of times. Material visibility was graded as optimal in all cases. There were no procedural complications.

**Conclusion:** PHIL liquid embolic agent appears to be an excellent alternative embolic material with certain advantages compared with other available liquid embolic agents. Further studies are required to fully evaluate its safety and efficacy.

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**Preliminary in-vivo experience with the new PHIL LV 25% (Precipitating Hydrophobic Injectable Liquid – Low Viscosity) in a swine model**

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3Microvention, Research and Development, Tustin, United States

**Background and Purpose:** The purpose of this first in-vivo experience in a swine model was to determine the effectiveness, penetration, radiopacity and safety of PHIL LV 25% in the swine rete as compared to the other embolic material of similar density: Squid 12.

**Methods:** 6 Yucatan swine underwent intravascular superselective embolization with the new PHIL LV 25% (viscosity of approximately 12 centistokes) of a single rete. Two of these swine underwent additional embolization of the opposite rete with Squid 12 and were sacrificed for histological analysis. In all animals, a Headway Duo microcatheter was advanced into the ascending pharyngeal artery and wedged into the proximal compartment of the specific rete and controlled embolization was performed. Reflux, plug building, penetration and ease of microcatheter retraction was scored after each injection. Each rete was partially embolized to preserve patency of the outflow intracranial circulation and to not cross the midline.

**Results:** The four swine that were not immediately sacrificed did not experience any neurological or physiological changes on follow-up. PHIL LV 25% demonstrated similar and in one rete better penetration than Squid 12. Plug formation and ease of microcatheter retraction were optimal with PHIL LV 25% despite prolonged injection times (10–30 minutes). Histology did not demonstrate any inflammatory response in the rete or surrounding tissues.

**Conclusion:** Although this is a very small pre-clinical study utilizing the new PHIL LV 25%, it demonstrated similar or better penetration of the device into the rete than the Squid 12. PHIL LV 25% is less radiopaque than Squid 12 but it was easy to visualize during a controlled injection due to its uniform radiopacity. PHIL LV 25% demonstrated excellent distal penetration, ease of plug formation, ease of microcatheter retraction and no evidence of any adverse reaction in the swine-rete model.
Results: After 2 years.

3 months. The cases combined with SRS repeated angiography. The embolized cases were evaluated clinically after unexpected ruptured complication during or after embolization. The embolized cases were evaluated clinically after 3 months. The cases combined with SRS repeated angiography after 2 years.

Results: 796 procedures of embolization were performed in 465 cases. 158 cases were followed with stereotactic radiosurgery (SRS). 5 cases were obliged to have the surgical removal of AVMs because of unexpected ruptured complication during or after embolization. The embolized cases were evaluated clinically after 3 months. The cases combined with SRS repeated angiography after 2 years.

Purpose: To compare the safety and efficacy of two BAVM embolization

Methods: with Glubran or Onyx.

Material and Methods: We reviewed the consecutive series of 465 cases of BAVMs, treated in our institute from 2011 to 2015. All the treatments were started with embolization. The embolic material was Glubran and onyx. There is no mixture of these two materials in single patient. Among those, 158 cases followed with stereotactic radiosurgery (SRS). 5 cases were obliged to have the surgical removal of AVMs because of unexpected ruptured complication during or after embolization. The embolized cases were evaluated clinically after 3 months. The cases combined with SRS repeated angiography after 2 years.

Conclusion:

The safety and efficacy of two BAVM embolization Methods: with Glubran or Onyx

He Xuying

Zhuijiang Hospital of Southern medical university, Guangzhou, China

Purpose: To compare the safety and efficacy of two BAVM embolization

Methods: with Glubran or Onyx.

Material and Methods: We reviewed the consecutive series of 465 cases of BAVMs, treated in our institute from 2011 to 2015. All the treatments were started with embolization. The embolic material was Glubran and onyx. There is no mixture of these two materials in single patient. Among those, 158 cases followed with stereotactic radiosurgery (SRS). 5 cases were obliged to have the surgical removal of AVMs because of unexpected ruptured complication during or after embolization. The embolized cases were evaluated clinically after 3 months. The cases combined with SRS repeated angiography after 2 years.

Results: 796 procedures of embolization were performed in 465 cases. 158 cases were followed with stereotactic radiosurgery. AVM occlusion rate of embolization is 21.08% (98/465). Total occlusion of nidus was achieved in 207 cases (44.51%). The overall complication was 4.09% (19/465), morbidity was 1.07% (5/465) and mortality was 0.21% (1/465). Glubran was used in 765 procedures in 440 cases, one procedure in 187 cases and twice or more in 253 cases. AVM occlusion rate of embolization only is 20.91% (92/440). With the combination of SRS, the total occlusion was achieved in 201/440 (45.68%). Procedure related rupture occurred in 13 cases, with permanent neurological deficits in 3 cases and 1 death. Ischemia events happened in 4 cases, with permanent neurological deficits in 2 cases. The complication with Glubran embolization was 3.86% (17/440), morbidity 1.14%, mortality 0.22%. Onyx was used in 25 cases with 31 procedures. No additional SRS was used in this group. Total occlusion was achieved in 6 cases (24%), rupture happened in 2 cases (8%) without permanent deficits. There was no ischemic complication or death. The stratification and matching analysis according to the BAVM size, location and history has been performing in this data bank.

Conclusion: Attempts to achieve higher occlusion rate with the method of embolization only could bring more complications. Embolization with Glubran could achieve lower occlusion rate, compared to that with Onyx. Glubran embolization combined with SRS could be helpful to achieve higher obliteration rate of BAVM.

Endovascular AVM embolization using double lumen DMSO-compatible balloon-catheter

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Purpose: we started applying the method of embolization of AVM with onyx through DMSO-compatible balloons from 2014.

25 operations were performed in 18 patients aged from 14 to 56 years 9 male, 9 female. 2 patients were presented with dural AVM, 14 patients (185 cases) brain AVM, 3 patients (5 operations) facial AVM.

24 operations were performed through the ECA and 1 through the ICA (fronto-basal artery) in the case of the high flow fistula.

50% Ascent (Codman)
50% Scepter (microvenion)

The using of balloons provides the most rapid pressure cooking effect. Lid lock occurs immediately after inflation of the balloon, however, this fact has a number of limitations: 1 - high risk of damage of the brain vessels by balloon-catheter or guide during distal catheterization. 2 - the higher the risk of rupture of the afferent of brain vessel 3 - more significant traction while detaching the tip of the balloon from the onyx bung at the end of embolization. This is why using of DMSO-compatible balloon-catheter in intracranial vessels is associated with higher risks.

The external carotid artery is the most suitable field of application for this technique.

Rupture of the balloon in the external carotid artery does not have fatal consequences.

Results: In all cases embolization with onyx was performed.

The goals and objectives of each stage of embolization were achieved in the amount prescribed by the preoperative planning. In cases of dural AVM it was possible to achieve a total of embolization. In cases of facial AVM, in one case there was total embolization and in one - subtotal, followed by surgical removal of the AVM and defect plastic. In cases of cerebral AVM it was possible to increase the efficacy of each stage and the amount of onyx inserted in each stage.

Conclusion: ONXY embolization through a balloon catheter is an effective, convenient and quite safe method of treatment. The distal distribution of ONXY in AVM improves, the volume of injected embolisate increases, the operation time reduces. The ECA is the most suitable region for the application of the DMSO compatible balloon-catheter due to the anatomical features of the vessels. In cases of AVM SM IV-V it is possible to use this type of embolization through ECA several times, correctly planning stages and keeping the afferents. Embolization through DMSO-compatible balloon is more physiological because there is no reflux and vessels not participating in blood supply of AVM, are saved. Manipulations in the brain vessels have significant differences comparing to ECA.
There were no cases of embolic complications or intracranial hemorrhage. In case of perforation of the vessel of the external carotid artery (n 1) we performed total embolization of AVM covering the area of perforation by inflated balloon. After performing the embolization, the balloon was deflated, lowered to the level of the perforation, inflated again and the damaged area was sealed.

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Endovascular Treatment of Brain AVMs with the SQUID®

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Purpose: To evaluate the angiographic and clinical results following endovascular treatment of brain AVMs, with a recently developed, non-adhesive liquid embolic agent. Materials and Methods: SQUID® is a modified Ethylene-Vinyl Alcohol copolymer dissolved in DMSO and mixed with micronized Tantalum powder. The smaller size of tantalum particles is supposed to result in decreased viscosity, improved penetration and better radiographic visualization of the embolic agent when compared to Onyx®. Between December 2011 and May 2016, 61 patients with 62 brain AVMs, age 6–77 years, underwent endovascular treatment at the Odense University Hospital using transarterial and in one case transvenous injections of SQUID®. There were 32 males and 29 females. 22 AVMs were ruptured, the rest elective. According to the Spetzler-Martin classification, 3 AVMs were grade 1, 31 grade 2, 16 grade 3, 11 grade 4, and one grade 5. Superselective catheterization of the feeding branches were performed with Sonic detachable microcatheters, achieving intranidal position of the tip of the microcatheter. The injection of the SQUID was performed in high grade fluoroscopy in 9 cases, the endovascular therapy was combined with surgery, of which 3 were elective, the rest surgical evacuation of the hematoma directly after the embolization, while in two cases with radiation therapy.

Results: Total occlusion with embolization alone was achieved in 32 patients, confirmed by follow-up angiographies. Additionally 7 AVMs were eliminated with the combination embolization & surgery, and two with embolization & radiation. In 7 cases, subtotal occlusion was achieved. 4 patients were lost for follow up, due to death, the rest is ongoing. 7 patients bled within one month following the treatment.

Conclusion: Endovascular treatment of brain AVMS with SQUID® is feasible and safe. In the authors’ experience, SQUID® offers promising advantages when compared to Onyx®.

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Double catheters technique for disconnecting very high flow intracranial arterial venous fistulas

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Purpose: The purpose of this report is to review our experience for treatment of direct and very high flow intracranial AV fistulas by disconnecting at the AV junction.

Materials and Methods: From 2006 to 2016 among the 200 cerebral AVMs there are 10 cases with direct and very high flow intracranial AV fistulas. There are four males and 6 females. The mean of age is 27. The main symptoms of these patients were seizures and fainting and cerebral bleeding. The direct AV shunt was located in posterior cerebral artery in 4 cases the others 5 in anterior circulation: 3 from ACA, 2 from MCA, one case from dural branch of occipital artery. The draining vein was connected to the vein of Galen in 3 and draining to the superficial cerebral vein in 5 and 2 to traverse sinus. The first case was treated in 2006 by injection pure glue but failed to stop the AV shunt because of enlargement of the feeder artery and very high flow AV shunt. Then the AV junction was approached with 2 microcatheters and deployed two coils to work together against coil migration to the huge venous pouch. The first coil is play a role of prevention the following coils fly to the venous pouch. When the second deployed coil was stable; it was detached. And then, we continue with next coils using the second microcatheter until we can low down or stop the AV shunt. If coiling alone cannot control the AV shunt; we will inject diluted glue to fix the coils mass and finally the first distal coil was detached.

Results: 10 cases of direct and very high flow intracranial AV fistulas were treated successfully by using the double coils technique without any related procedure complication. Clinical symptoms after the procedure had improved dramatically. Follow up clinical is no more seizures and fainting. Follow up angiograms reveal the AV fistulas were cured in all 10 cases and draining venous pouches shrunk themselves.

Conclusions: In our experience, double catheters technique can be performed safely to disconnect the very high flow intracranial AV fistulas. The benefit of this technique is to reduce the amount number of coils and eliminate the risks of mass effect or recanalization because we don’t coiling the venous pouch.
Endovascular intervention for acute large vessel occlusion in children poses many challenges, ranging from (i) initial diagnosis to (ii) imaging to (iii) judgment as to natural history to (iv) detailed treatment protocols to (v) systems challenges in providing care rapidly but appropriately. This brief introductory talk will frame the various problems through the use of an illustrative case, and set the stage for the speakers in the session to outline approaches to these issues.

Cerebral ischemic stroke is clearly accepted as a medical emergency with many possibilities for recanalization and repercussion. While these techniques are now well-established it has become more and more important to perform a work-up of the acute stroke patient with so-called advanced imaging techniques. Whether one uses CT or MR: one must ascertain that we are in the presence of a stroke: first of all a hemorrhagic cause or a non-ischemic cause must be excluded. Then one has to assess if the cerebral tissue itself has suffered any damage: this can be seen either on diffuse-weighted imaging or on the unenhanced CT images where sometimes hypo density may appear very early and sign a severe ischemic event. Then we will assess if the vessel can be opened and if there is any tissue at risk to be saved (penumbra). This we can do with both CT and MR techniques. CT has the advantage of being slightly faster and to provide a luminographic effect on angio-CT that corresponds more closely to conventional angiography. This will help to define the recanalization that can be done. The use of perfusion techniques with CT or MR is also well established and one can obtain with both techniques reliable maps of relative cerebral blood flow and volume that allow us to calculate some kind of penumbral model. This will help in order to assess the efficacy of recanalization. In the follow-up we prefer to use MRI ignored to assess exactly lesion size as well as to diminish radiation exposure.
**Tuesday, 17th of October – Session room 2. – 13:15 – 13:45 – Poster session**

**PP309**

**Patient Radiation Dose from Neuroangiography: Effect of Serial Application of Dose Reduction Protocols**

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**Purpose:** The purpose of this study was to quantify the reduction in patient radiation dose by serial application of dose reduction protocols including low dose angiography, roadmap save for femoral puncture site, reduced cranio-caudal Field-of-view (FOV) in acquisition of 3D rotational angiography, and low dose 3D rotational angiography.

**Materials and Methods:** Retrospective review of the prospectively collected database were analysed. Radiation dose data from 506 neuroangiographies performed were collected for the period January 2012 – February 2013 (phase 1). In phase 2, the system was configured with low dose angiographic protocol (from 3.6 mGy/f to 1.8 mGy/f) for cerebral angiography and roadmap image was saved for the evaluation of femoral arterial puncture site instead of femoral angiography. Radiation dose data from 504 neuroangiographies were collected for the period March 2013 – June 2014. In phase 3, decreased cranio-caudal FOV was applied for the acquisition of dual-rotational 3-dimensional (3D)-DSA. Radiation dose data from 79 neuroangiographies were collected for the period October – December 2015. In phase 4, standard manufacturer setting (5 s 0.36 mGy/f) for dual-rotational 3D-DSA has been modified to create lower dose single-rotational 3D-DSA protocols by lowering dose per frame (5 s 0.10 mGy/f). Radiation dose data from 67 neuroangiographies were collected for the period June – August 2016. Patient radiation exposure was quantified using cumulative dose area product (DAP) and cumulative air kerma (AK).

**Results:** The Serial application of dose reduction protocols provided significant reduction in DAP and AK: from 140.8 Gy cm² and 1.02 Gy in phase 1, to 82.0 and 0.61 in phase 2, 59.2 and 0.51 in phase 3, and 46.1 and 0.42 in phase 4.

**Conclusion:** Dose reduction protocols (including low dose angiography, roadmap save for femoral puncture, reduced cranio-caudal FOV for 3D-DSA and low dose single-rotational 3D-DSA) provided significant dose reduction (67.3% for DAP and 58.3% for AK) in clinical setting.

**PP310**

**Long-term Results of Angioplasty using Stent-retrievers for Cerebral Vasospasm in SAH**

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**Purpose:** To report our long-term results of mechanical angioplasty using stent-retrievers for recurred symptomatic cerebral vasospasm in SAH patients.

**Materials and Methods:** We retrospectively reviewed medical records and radiological images of 7 patients who developed delayed vasospasm following subarachnoid hemorrhage and showed recurrence after initial angioplasty using intra-arterial vasodilator infusion from 2014 to 2017 at our institution. For those patients, we temporarily deployed a stentriever in the spastic branches for 3 minutes for mechanical vasodilation under general anesthesia and full heparinization. Three available stentreivers (Solitaire, Trevo, Revive) were used. We evaluated the clinical and radiological outcomes including recurrence rates and feasibility.

**Results:** A total of 39 stentriever-angioplasties were attempted for proximal or distal vessels. Deliveries and deployments of the stentreivers to the targeted spastic segments were feasible in all of the procedures before the intra-arterial infusion of vasodilator. Instant angiographical vasodilations were acquired in 33 (85%) vessels after retrieval of stentreivers. Follow-up images showed no significant recurrence of vasospasm in the vessels dilated by the stentreivers. Neurological improvements were noted in 6 (86%) patients after the procedures which include subsequent intra-arterial vasodilator infusion. One thrombotic occlusion of branch was recanalized with intra-arterial Tirofiban infusion. Temporary aggravation of vasospasm in the supraclinoid ICA which was thought to be caused by microwire irritation was relieved with the same procedure. One case of wire-induced distal vessel injury was trapped with detachable coils without further neurological detriment of the patient. No angiographical abnormality was found in the stentriever-deployed spastic vessels (12/39, 31%) at long-term follow-up angiograms (3 patients, mean 18.6 months).

**Conclusion:** Mechanical angioplasty using stent-retrievers for the delayed symptomatic vasospasm in the subarachnoid hemorrhage patients can be a feasible option especially for the recurred cases after chemical only angioplasty.
PP311
Safety of nonprotected carotid artery stenting - a single centre experience

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Introduction: With careful patient selection and multidisciplinary approach, carotid artery stenting (CAS) showed similar risks and benefits as carotid artery endarterectomy (CEA). Angioplasty of atherosclerotic plaque is the most important step during the CAS because it bears the risk of releasing plaque debris into the intracranial circulation. Distal embolic protection devices were developed to prevent stroke as one of the major complications during the procedure. Due to non-conclusive results of their efficiency in some of major trials and other complications that can theoretically occur during employment of such devices there are large differences in frequency of their use among operators.

Objectives: Objective of this study was to compare incidence of clinical evident stroke in early postprocedural period in patients who had CAS with distal embolic protection with patients who had the same procedure without distal embolic protection.

Methods: We retrospectively analyzed data of patients that were endovascularly treated for carotid artery stenosis in our department from 2006 to 2016, and searched for clinical evidence of stroke that could be attributed to the procedure. During that period there was 335 CAS procedures for atherosclerotic stenosis, with 94 procedures with and 241 without distal embolic protection.

Results: We found no significant difference in peri-procedural stroke incidence in two groups of our patients.

Conclusion: Although our study is retrospective case-control study we displayed safety of our current CAS protocol which does not include distal embolic protection for all patients.

PP312
Anterior choroidal artery: anatomical-angio-graphic analysis

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Purpose: The anterior choroidal artery (AChA) presents anatomical variations in its path, size, number of branches and irrigated brain region. The purpose of this work is showing the anatomy of the anterior choroidal artery compared to angiographic studies.

Materials and Methods: This work is descriptive retrospective. We studied 300 digital subtraction angiographies DSA (Phillips Allura and Allura Clarity angiographers), both internal carotid arteries of the choroid segment in early and late arterial phases consecutively. We registered the diameter of vessel and the variations in its origin and branches. We compared these images with the ones from Instituto de Morfología J J Naón, Medical School, University of Buenos Aires.

Results: The anterior choroidal artery (AChA) was born as a single artery from carotid C4 segment, close to the origin of the posterior communicating artery (PComA). A double origin, an artery that after a short path is branched, or an origin from the middle cerebral or posterior communicating artery is infrequent. The artery is divided into a cisternal segment and a choroidal or intra-choroidal one. In this work we found AChA hyperplasia at 2%; hypoplasia at 3% and hypoplasia of the distal segment (only case), AChA PComA transposition, origin from PComA and origin from the middle brain artery ACM ≤1%, associated with one brain vascular malformation.

Conclusion: It is of vital importance to recognize the anatomy and the irrigated territories of the artery due to clinical manifestations arising from its engagement. Noteworthy is the role of the brain angiography as an analytical method when studying the anatomy and solving pathologies that involve this artery.

Key words: Anterior choroidal artery, anatomy, digital subtraction angiography

PP313
Pure N-butyl-cyanoacrylate Treatment for Pediatric Intracranial Nongalenic Pial Arteriovenous Fistulas

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Background and Purpose: Nongalenic pial arteriovenous fistulas (NGAVFs) are rare vascular disease. It is challenging in treatment because it has a high flow rate and usually present in infant or children. We reported angiographic and clinical outcome of treatment by pure N-butyl-cyanoacrylate (NBCA).

Materials and Methods: From 2006 to 2017, a total of 7 consecutive cases of pediatric (NGAVFs) were reviewed. One patient was excluded because of loss of data. The age of onset, clinical presentation, embolization technique and angiographic and clinical outcome were analyzed.

Results: All cases of pediatric NGAVFs were treated by endovascular method using pure NBCA in the first session
Intra-arterial chemotherapy for retinoblastoma: Initial experiences in Hungary

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Purpose: To report our preliminary experience regarding eye salvage rates, patients survival and complications following intra-arterial chemotherapy (IAC) for retinoblastoma in our centre

Materials and Methods: Our retrospective analysis included 6 children (1 girl, 5 boys) with International Intraocular Retinoblastoma Classification (IIRC) Group D eyes (right: 3, left: 3) after first-line systemic chemotherapy failures or recurrent diseases from February 2015.

Results: Superselective trans-ophthalmic intra-arterial chemotherapy was performed via the femoral route under general anaesthesia. Mean number of IAC sessions/eye was 2.33 (1–3). All 6 eyes received two agents (melphalan and topotecan), but the first eye in the first session received melphalan alone. Enucleation was avoided in 5 eyes. Intravitreal chemotherapy was applied in one eye. All children are alive without systemic side effects. The residual vision of one eye was lost immediately following the procedure. No other complication was encountered.

Conclusion: Our preliminary experience in a small patient group proved intra-arterial chemotherapy for IIRC Group D retinoblastoma an effective and safe method in treatment of this tumour.

Dural sinus malformation in newborns: A report of an extremely rare congenital cerebrovascular malformation with favorable endovascular treatment outcome

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Dural sinus malformation (DSM) is an extremely rare congenital cerebrovascular malformation characterized by arteriovenous shunts within large malformed dural lake. The huge dural lake is usually located at the transverse sinus, superior sagittal sinus, or torcular hemophili. This condition may be diagnosed prenatally. We report 2 cases of successful endovascular treatment of DSM in term newborns.

Case 1: A 47-day-old boy, weighing 4,970 grams presented with congestive heart failure, macrocrania and seizure. CT angiography revealed multiple arteriovenous shunts with large venous lake at superior sagittal sinus involving torcular herophili. Transarterial glue embolization was performed with N-butylcyanoacrylate (NBCA) achieved the dramatic improvement of congestive heart failure at 2 months of age. Macrocrania, seizure and development milestone were significantly improved during the follow up period after 2 sessions of transarterial glue embolization at 5 and 10 months of age respectively.

Case 2: A 34-day-old boy, weighing 2,630 grams presented with congestive heart failure and macrocrania. CT angiography revealed multiple arteriovenous shunts at right transverse-sigmoid junction and jugular bulb with large venous lake at right tentorial sinus. Urgency transarterial glue embolization was set at 1.5 month of age with significant improvement of congestive heart failure. Three sessions of staged transarterial embolization were scheduled with NBCA at 3.9 and 10 months of age respectively, result in the improvement of presenting symptom and subsequently his development milestone.
Conclusion: Early diagnosis and treatment of DSM is important to prevent irreversible brain injury and improve heart failure. CT or MR angiography is valuable tool for diagnosis and preoperative planning. Staged transarterial embolization with NBCA is proven to be effective treatment of choice in this rare complex congenital neurovascular pathology with favorable outcome.

Tuesday, 17th of October – Session room 2 – 14:00 – 15:40 – Parallel abstract session - AVM: arterial and venous embolization

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Comparison of Predictive Grading Systems for Procedural Risk in Endovascular Treatment of Brain Arteriovenous Malformations – Analysis of 104 Consecutive Patients

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Background: Endovascular embolization of brain arteriovenous malformations (AVMs) is widely utilized, often used in conjunction with micro- and/or radiosurgery. Grading systems to assess procedural risks of endovascular embolization have been proposed, but none has been independently validated. We sought to validate and compare these grading systems in 104 consecutive patients with brain AVMs who underwent endovascular embolization between 2003 and 2016 at our tertiary academic referral center in the US.

Methods: Clinical and demographic data were obtained from the medical records. Cerebral angiograms were reviewed and Buffalo[1], AVM Neuroendovascular (AVMN)[2], and Spetzler-Martin (SM) grades determined. Clinical outcomes and complications were collected. Receiver operating characteristics (ROC) curve analysis was performed.

Results: Forty-five (43.3%) patients were females, with an average age at presentation of 43.2 ± 16.2 years. Forty-nine patients (47.1%) presented with hemorrhage. Fifty-five (52.9%) AVMs were located on the left side, 40 (38.5%) were in an eloquent brain region, and mean AVM size was 3.4 ± 1.4 cm. There were 10 major and 17 minor complications in 25 patients (rupture of a vessel: 9; retained/fractured microcatheter: 5; off-target embolization: 4; extension of embolic cast into venous outflow: 2; artery dissection: 1; ischemic stroke presumed to be related to embolization: 6). Arterial pedicle size (p = 0.002) and number of arterial pedicles (p = 0.04) were predictors of complications, while AVM side, location in/near an eloquent brain region, patient age, AVM size, or venous drainage pattern were not. The Buffalo score was predictive of complications (p = 0.004), but AVMN (p = 0.23) and SM grades (p = 0.35) were not. ROC curve analysis revealed an area under the curve (AUC) of 0.68 ± 0.05 for the Buffalo score, significantly better than AVMN (AUC 0.58 ± 0.06, p = 0.04) and SM grades (AUC 0.56 ± 0.06, p = 0.05).

Conclusions: Our independent analysis of 104 patients with brain AVMs treated with endovascular embolization validates the predictive capacity of the Buffalo score, but not AVMN or SM grades, for endovascular embolization procedural risk.

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Transvenous embolization of cavernous dural arteriovenous fistula via alternative routes instead of the inferior petrosal sinus

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Purpose: Transvenous embolization through the inferior petrosal sinus (IPS) is a standard treatment for cavernous sinus dural arteriovenous fistula (CSdAVF). However, it may be difficult to approach when the IPS is occluded. We reviewed the cases treated via alternative routes to the IPS.

Materials and Methods: The author treated 39 CSdAVF patients from April 2003 to March 2017, reviewed 50 transvenous procedures for these patients, and analyzed the treatment records and angiographic data of the cases treated by routes other than the IPS.

Results: Transvenous embolization through alternative routes to the IPS was performed in 4 of 39 cases and 5 of 50 procedures (10%). Two cases were treated via the facial vein (FV), 2 cases via the pterygoid plexus (PP), and 1 case via the superficial temporal vein (STV). In one case, the shunt remained incompletely occluded via the FV, and the residual shunt was completely occluded via the PP. In the remaining 3 cases, the shunt was completely occluded with one treatment. One patient failed to reach the CS via the STV and the FV because of the tortuosity of these veins, and eventually could be treated via the PP. In recent 3 cases, the intermediate catheter was useful for passing through the tortuous mobile veins.

Conclusion: Because the shunted pouch of CSdAVF is often located the posterior portion of the CS, the backward approach from the anterior draining vein, the superior ophthalmic vein, through the FV or the STV may have an advantage to reach the intended part. It is considered that transvenous embolization via alternative routes to the IPS is useful when the IPS is occluded and the approach to the target site in the CS is difficult.
Advantages and limits of transvenous embolization of brain arteriovenous malformations

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Purpose: Transvenous embolization of brain AVMs has been recently reported as a feasible technique to achieve partial or complete occlusion of complex AVMs. This technique consists in catheterization of the root of the draining vein and retrograde filling of the nidus after venous occlusion. We report our single center experience in transvenous Onyx (Medtronic) embolization of brain AVMs in order to evaluate the advantages and limits of this approach.

Material and Methods: From April 2011 to April 2017 we attempted transvenous embolization in 17 patients with brain AVM (age range 7 to 65 years). In 5 cases the patient was a child (7–16 years old). The AVM had a deep localization in 7 cases. In 8 cases a previous partial embolization had already been performed. Two patients were asymptomatic and the others had history of haemorrhage or seizures. In all cases, transvenous Onyx was injected through a 3-mm detachable tip Apollo microcatheter (Medtronic).

Results: The transvenous Onyx embolization was successfully performed in 14 cases. In 3 patients we had a technical failure because of impossible drainage vein catheterization: in 2 cases the intervention was continued by arterial embolization and in 1 case it was aborted. The acute angle orientation of a cortical targeted vein was the common cause of catheterization failure. In 7 patients combined transvenous and transarterial Onyx injection was performed. In the 14 patients successfully transvenously treated, complete occlusion was achieved in 10 patients (in all these cases the venous drainage was single) and the remaining 4 patients (all with multiple draining veins) were treated by radiosurgery. No clinically relevant intraprocedural complications occurred. In one patient with a mesencephalic AVM bleeding occurred 24 hours subtotal transvenous occlusion.

Conclusion: Transvenous embolization of brain AVMs is feasible in highly selected patients, however more standard approaches should be evaluated before considering transvenous embolization. The more common indications for transvenous embolization are the deep location and the presence of symptoms. The main advantage is chance of treating AVMs in deep locations, otherwise difficulty manageable. The disadvantages are technical complexity and increased haemorrhagic risk if the occlusion is not complete but the vein is occluded (patent residual nidus).

The combination of transarterial and transvenous approach in endovascular treatment of cerebral AVM

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Purpose: to increase the rate of complete obliteration and to reduce the frequency of hemorrhagic complications in the postoperative period by using a combination of approaches in the treatment of cerebral AVMs.

Materials and methods: In the department of vascular neurosurgery using combined access were operated 12 patients with cerebral AVM. Male 3 (25%), female 9 (75%). Spetzler & Martin scale: grade II - 4 (33,3%), grade III - 6 (50%), grade IV - 2 (16,7%) patient. Most patients (10) have previously been operated by endovascular technics. By the time of the last stage of surgery 5 patients had subtotal embolization (>90%), other 7 had partial embolization (≤90%). The hemispheric localization of AVM - 9 (75%), within subcortical structures - 2 (16,7%), the posterior cranial fossa AVM - 1 (8,3%) patient. In all cases, we performed operations through arterial and venous femoral accesses. Evaluation of AVM occlusion grade was based on control angiograms immediately after the intervention and 3 months later. A modified Rankin outcome scale was used to assess the functional result.

Results: Total embolization was obtained in all patients. Technically, we began to embolize AVM with transarterial injection and continued until complete cessation of malformation filling and only after this proceeded to transvenous embolization to the residual part of the malformation. Control 3 months DSA was performed for 10 (83,3%) patients, that showed the absence of AVMs recanalization. There was no increase in neurological deficit in the postoperative period. Functional outcomes were favorable (mRs-0-2) -12 patients. There were no hemorrhagic complications, what was confirmed by CT results.

Conclusions: Using of combine (transarterial and transvenous) approach as the final stage of embolization of the cerebral AVMs appears to be a promising direction. Primary results show its high efficiency in prevention of hemorrhagic complications and decrease the rate of recanalization after total occlusion. At the same time, further clarification of the indications for the selection of patients for this method is required.
Outcomes Associated with Treatment of Unruptured Cerebral Arteriovenous Malformations

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Purpose: In early 2013, patient enrollment in a randomized trial of unruptured brain arteriovenous malformations (ARUBA) was discontinued earlier than planned after interim analysis revealed statistically significant outcome differences between the treatment groups. At 33 months, it was reported that the incidence of stroke and death was more than three times higher in the intervention group (30.7%) than the nonintervention group (10.1%). In light of the preliminary findings of ARUBA, a retrospective analysis was performed to determine the rates of stroke and death in the population of patients that underwent treatment for unruptured arteriovenous malformations (AVMs) at Indiana University since 2001.

Materials and Methods: A multi-institutional, retrospective search of radiology reports from Indiana University and its affiliated institutions generated between 2001 and 2016 was performed to identify all patients with arteriovenous malformations. The following data were collected: initial clinical symptoms, presence of hemorrhage at presentation, location, size, drainage pattern (superficial versus deep), treatment (medical management only versus endovascular therapy, surgical excision, radiotherapy, or a combination of these interventions), and subsequent stroke/death. For cases in which these data were not available in the dedicated radiology reports, the corresponding images were referenced to collect any excluded information. An analysis was performed to determine the rates of stroke and death in the population of patients that underwent treatment for unruptured arteriovenous malformations.

Results: Four hundred seventy-three AVMs were identified, 169 (36%) of which were unruptured at diagnosis. Of the unruptured AVMs, 59% presented with headache and 20% presented with seizure. Six percent of AVMs were discovered incidentally and 13% presented with nonspecific symptoms such as altered mental status and dizziness. By the Spetzler-Martin Grading Score, 17% of cases were classified as grade I, 33% grade II, 30% grade III, 16.5% grade IV, and 3.5% grade V. One hundred twenty-nine of the initially untreated AVMs underwent intervention shortly after diagnosis and 40 were treated with conservative medical management alone. Only four of the medically managed AVMs later ruptured. Of the unruptured AVMs that underwent intervention, 14% were embolized, 16% were treated with radiosurgery, and 13% were surgically resected. The remainder were treated with a combination of the above therapies. Following intervention 12.4% experienced subsequent stroke. No deaths were reported.

Conclusions: The results of this study demonstrate a much lower rate of stroke or death following intervention compared to the results of the ARUBA trial (12.4% versus 30.7%). Complication rates for patients treated with intervention in this study were similar to those treated with medical management alone.

A comparison of clinical outcomes between interventional management and observation in a 7-year review of unruptured brain arteriovenous malformations

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Objective: To compare the long term outcomes between the non-treatment or observation group and the interventional treatment group of patients with unruptured brain arteriovenous malformations (AVM).

Methods: All patients who presented with unruptured brain AVM between Jan, 2007 and Sep, 2013 at Siriraj Hospital were retrospectively reviewed. There were 82 patients who met the inclusion criteria, of which, 21 patients were in the observation group and 61 patients were in the interventional treatment group. The patient characteristics and AVM architectures in each group were recorded. Statistical analysis was used to demonstrate an association of clinical, imaging and complication outcomes between the observation group and the interventional treatment group. The details of the patients who had complications were also identified.

Results: Clinical improvement was found in 69 patients (84.2%), 13 (18.8%) were in the observation group and 56 (81.2%) were in the embolization group. The multivariate analysis revealed that the treatment was the only independent factor associated with clinical outcomes (adjusted odds ratio 7.14, 95%CI 1.66–30.70, P = 0.008). There were 14 patients with complications, only one was in the observation group, who died from ruptured flow related aneurysm. Among 13 patients in the interventional treatment group, the complications occurred immediately after procedure in 8 patients and delayed in 5 patients, varying from 2 days to 5.5 years. Eight had hemorrhage, 4 had ischemic insults, and one had secondary change of glioblastoma multiforme at the site of AVM. This last patient had received radiosurgery after embolization. The final patient outcomes of treatment group were 1 mortality, 7 morbidity (3/7 subsequent full recovery) and 5 without clinical change. In the treatment group, the patients who had complications were outnumbered than those without complications (92.9% vs 70.6%, P = 0.102), which had a clinically significant difference.
Methods: The retrospective analysis of an IRB-approved spinal vascular database disclosed 38 patients with the angiographic diagnosis of PmAVF seen in our service between January 2000 and March 2017. Full angiographic documentation was only available in 33 patients. Clinical features were recorded. SpDSA was analyzed for the following: Merland classification, flow pattern (high-flow vs. low-flow), arterial feeder side, number of feeding arteries, level of arteriovenous shunt, location on the surface of the spinal cord and spinal venous hypertension. MRI was examined for T2 SI abnormalities, T2 flow voids, cord parenchymal enhancement and SAH.

Results: We reviewed SpDSA in 33 patients with an average age of 38.8 years (SD 24, range 0.2–80), 19 (58%) males and 14 (42%) females. Fourteen (14/30, 47%) patients presented with chronic symptoms, 12/30 (39%) patients presented subacutely (5 patients had SAH) and 4/30 (14%) were asymptomatic. Three (9%) patients had a total of 4 PmAVF lesions at the cranio cervical junction. Clinical presentation with sphincter disorder was often observed in Type I (80%) than Type II (43%) and Type III (11%).

Conclusions: Our study demonstrated that the interventional treatment group has a higher rate of better clinical outcomes, however, also has a higher rate of complications. Hence, the potential risks and benefits of treatment should be weighed against the angioarchitecture and the natural history for an individual unruptured AVM.

Perimedullary arteriovenous fistulas: Clinical presentation and imaging findings in regard to flow pattern in 33 patients
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Introduction: Perimedullary arteriovenous fistulas (PmAVF) consist of direct arteriovenous connections between spinal arteries and perimedullary veins. PmAVFs were identified as a distinct entity by Djindjian et al in 1977 and further characterized by J.J. Merland et al in 1980, who divided them into Types I, II, and III (i.e. Merland Classification) based on the number and prominence of their feeding and draining branches. It is often assumed that the three types of PmAVFs represent a pathological continuum and characterize identical lesions seen at various stages of evolution, but differences in presentation seem to indicate otherwise. In our experience, Type I lesions tend to manifest with a progressive myelopathy in elderly patients, while Type II and II appear more common in younger patients. In this retrospective analysis of PmAVFs diagnosed at our institution we aim to examine the hypothesis that Type I lesions represent a separate group from Type II and III, with distinctive demographic, modes of presentation and etiology.

Methods: The retrospective analysis of an IRB-approved spinal vascular database disclosed 38 patients with the angiographic diagnosis of PmAVF seen in our service between January 2000 and March 2017. Full angiographic documentation was only available in 33 patients. Clinical features were recorded. SpDSA was analyzed for the following: Merland classification, flow pattern (high-flow vs. low-flow), arterial feeder side, number of feeding arteries, level of feeding artery origin, level of arteriovenous shunt, location on the surface of the spinal cord and spinal venous hypertension. MRI was examined for T2 SI abnormalities, T2 flow voids, cord parenchymal enhancement and SAH.

Results: We reviewed SpDSA in 33 patients with an average age of 38.8 years (SD 24, range 0.2–80), 19 (58%) males and 14 (42%) females. Fourteen (14/30, 47%) patients presented with chronic symptoms, 12/30 (39%) patients presented subacutely (5 patients had SAH) and 4/30 (14%) were asymptomatic. Three (9%) patients had a total of 4 PmAVF lesions at the cranio cervical junction. Clinical presentation with sphincter disorder was often observed in Type I (80%) than Type II (43%) and Type III (11%).

Conclusions: Our study demonstrated that the interventional treatment group has a higher rate of better clinical outcomes, however, also has a higher rate of complications. Hence, the potential risks and benefits of treatment should be weighed against the angioarchitecture and the natural history for an individual unruptured AVM.

Locating the target for embolization of hemorrhagic spinal arteriovenous malformations using 3D-DSA and MRI fusion
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Purpose: The treatment of spinal cord arteriovenous malformation (SCAVM) is challenging. This presentation is to demonstrate how we define the embolization target by using the fusion image of rotational digital subtracted angiography (DSA) and MRI.

Material and Method: The natural history of the SCAVMs is not well defined and the treatment can be challenging. We experienced two cases of intramedullary SCAVM presented with intramedullary hemorrhage which the image fusion technique was useful in locating the treatment target. The first case was a 34-year-old man who had previous hemorrhage 10 years ago. He presented with severe tetraparesis caused by a hematomyelia. The initial angiogram showed a venous pouch which was at the hematoma site but as the hematomyelia extended over a length we could not be sure if this was the bleeding site. The patient was observed conservatively and scheduled to undergo embolization two months later. The venous pouch enlarged over time and the embolization was aimed to decrease the flow to this vein. The patient’s motor function improved immediately after the embolization and the venous pouch disappeared at the follow-up angiogram. In the second case, a 24-year-old woman, the initial angiogram did not show any findings specific to the rupture point. But at the time of treatment, a venous pouch was detected and after the fusion with MRI, was highly suspected to be the bleeding point and considered unstable. After embolization targeted to the nidus draining into this vein, the pouch disappeared. In both cases, the fusion of MRI images to the 3D DSA was useful in locating the exact target of the treatment.

Result, Conclusion: In certain cases, the technique of the fusion of the rotational DSA with the MRI can help in defining the exact target of treatment in SCAVMs.
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**Combined endovascular and surgical treatment of spinal dural arteriovenous fistulas**

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**Purpose:** To present single centre experience and results in combined endovascular and surgical treatment of type I spinal dural arteriovenous fistulas (SDAVFs). SDAVFs are rare but most common form of spinal vascular malformations. They are low-flow vascular shunts fed by radicular arteries in patients who most often present with myelopathy.

**Materials and Methods:** We conducted a retrospective review of 27 adult patients with a diagnosis of SDAVF who underwent treatment at University Hospital Centre Zagreb from January 2013 to April 2017. We compared complication rates, recurrence rates, and data on clinical and imaging follow-up in these patients.

**Results:** Out of 28 patients in the study, 12 patients underwent endovascular embolization (Onyx was used in 1 patient and NBCA in 11 patients) as the first line therapy. 15 patients underwent surgical ligation as initial therapeutic modality. 6 patients in embolization group had recurrence of fistula during the course of follow-up requiring surgical ligation. Patients in both groups showed significant improvement in clinical status after successful treatment.

**Conclusion:** Although significant number of the fistulas are amenable to endovascular embolization, microsurgical obliteration is the first option in specific anatomic situations and usually the only solution in recurrent cases. Combined approach offers best results after careful selection of patients based on DSA imaging.

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**The analysis of the anatomic route of hypoglossal nerve within the hypoglossal canal using multi-detector CT in case with anterior condylar confluence dural arteriovenous fistula**

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**Purpose:** The anterior condylar confluence dural arteriovenous fistula (ACCDAVF) is relatively rare dural arteriovenous fistula affecting vasculatures close to the anterior condylar confluence. The drainage vein of the ACCDAVF often empties into anterior condylar vein. Accordingly, hypoglossal nerve palsy sometimes develops after the transvenous embolization for the ACCDAVF. Although the anatomic route of hypoglossal nerve within the hypoglossal canal is important issue to prevent the complication, none of literature has been performed such an anatomical analysis. The aim of the current study was to elucidate its route within the hypoglossal canal and to facilitate the safe transvenous embolization for ACCDAVF.

**Methods and Materials:** We experienced the seven cases with ACCDAVF from 2011 to 2016. 4D-CTA was performed in all the cases. In six of them, the anterior condylar vein was well-developed and was well-visualized by 4D-CTA. In these cases, we recognized the hypoglossal nerve as a filling defect within the hypoglossal canal and then analyzed the nerve route within the canal. We also analyzed the exact location of the fistula in these cases by digital subtraction angiography.

**Results:** In all the analyzed six case, the filling defect of hypoglossal nerve ran caudal to anterior condylar vein. The fistulas were located on the superior wall of the hypoglossal canal in the five out of seven cases. We performed transvenous embolization in four cases and neither of them had posttherapeutic hypoglossal nerve palsy.

**Conclusion:** The shunt pouch was usually located superior wall within the canal, opposite to the hypoglossal nerve. Therefore, the selective transvenous embolization of shunt pouch within the superior wall of hypoglossal canal can contribute to avoiding posttherapeutic hypoglossal nerve palsy. 4D-CTA is useful to detect the route of hypoglossal nerve in the canal and such a knowledge is crucial for the treatment of ACCDAVF.

**Tuesday, 17th of October – Session room 3. – 14:00 – 15:40 – Parallel abstract session – DAVF**

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**Everything its Possible in a Single Session:** 

**Improving Endovascular Treatment of Complex Intracranial Dural Arteriovenous Fistulas (dAVFs) Using a Dual Lumen Balloon Augmentation Technique**

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**Purpose:** Using a Dual Lumen Balloon Augmentation Technique
Purpose: Endovascular embolization of intracranial Dural Arterio-Venous Fistulas (dAVF) remains a challenge. We describe the advantages of utilizing a dual lumen Scepter balloon catheter (MicroVention Inc, Tustin, California, USA) in combination with embolic agents: ethylene vinyl alcohol copolymer, also known as Onyx (ev3, Irvine, California, USA), and Precipitating Hydrophobic Injectable Liquid (PHIL; MicroVention, Tustin, California) for the treatment of complex dAVFs in a single session.

Methods: Since 2014 we decided to treat intracranial dAVFs with Balloon Augmentation Technique (BAT) trying to obtain a complete obliteration in a single session. A retrospective review of all cases where we used BAT was analyzed. A total of 76 patients with intracranial dAVF were treated with this approach. Clinical symptoms, location, type and angiographic images were reviewed.

Results: Most patients were symptomatic (60%). 28 dAVFs were located in transverse-sigmoid sinus, 19 cases in cavernous sinuses, 8 torcular lesions, 6 in anterior and orbital fossa, 5 in tentorium, 6 in middle temporal fossa and 4 in superior sagittal sinus. History of major trauma was present in 22 cases. Embolization procedure was performed in a single session in 70 patients (92%) two sessions in three and >2 times in three cases. Transarterial approach was performed in 51 patients (67%), exclusively transvenous approach in 11, direct percutaneous in 6 and the rest were treated by combined A-V approach. Onix was used in 62 dAVFs and Phil in 14. Complementary coiling was used in 13 cases. Complete obliteration of fistulas was achieved in 73/76 (96%). There were one intracranial symptomatic hemorrhage procedure related, three undesired onix migration without clinical significance, one case of monoclonal visual loss due to orbital syndrome and two patients presented cutaneous radiation-related lesions after procedure.

Conclusion: Endovascular treatment of dAVFs was feasible and safe. The dual lumen balloon augmentation technique has several advantages for use with Onyx and Phil thinking in a single session to achieve a complete obliteration without multiple catheterizations and injections. Large series are underway to confirm this approach.

140 Intracranial Dural AVF: A Single Centre Experience

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Purpose: Cranial Dural AVFs (CDAVF) is rare, complex neurovascular disorders yet to be well understood. A comprehensive classification which can explain the pathophysiology, clinical spectrum & natural history of these rather heterogeneous lesions and guide management is elusive. We present our experience on managing these CDAVF cases based on a retrospective analysis from our archives.

Materials and Method: We retrospectively analyzed CDAVF patients treated in Dept. of Neuroimaging and Interventional neuroradiology, AIIMS from January 2005 and August 2016 period. Clinical presentation, angioarchitecture, management and follow up were critically analyzed. Clinical presentation was grouped as: Aggressive - intracranial hemorrhage, progressive neurological deficit, progressive dementia; Intermediate - TIA, seizure, cranial nerve deficits, vision loss, papilloedema or glaucoma; Benign - tinnitus, atypical headaches, and features of orbital venous congestion. Based on angioarchitecture as: Topographical location of shunt - Sinus or extrasinus; Venous drainage pattern - Sinus stenosis, occlusion or isolation; Cortical venous reflux (CVR) - present or absent; Parenchymal venous strain (PVS) - tortuous, engorged pial/medullary veins around the shunt. Management was individualized according to the clinical presentation & angioarchitecture. Treatment approach included endovascular, surgery, radiosurgery, combined methods.

Results: A total of 59 patients (mean age - 42.8yrs, M: F = 44:15) were included. Aggressive presentation was seen in 24 pts, intermediate in 13 pts and benign in 22 pts. According to angioarchitecture - dural sinus shunts (DSS) accounted for 33 pts while extra sinus shunt in 26 patients. CVR was present in 10 patients; PVS was seen in 22 patients, while both were noted in 10 patients. Presence of CVR and PVS are significantly associated with aggressive presentation, p < 0.05 and p < 0.01 respectively. Total number of patients treated was 42, of whom endovascular - 33, Gama knife - 2, Surgery - 4, combined surgery + embolization - 2. 85% of patients treated in the endovascular group showed clinical improvement on follow-up. Complication was observed in 3 patients - 1 case with thromboembolic occlusion of left MCA, which was reanalyzed with intraarterial Abciximab infusion, another patient had onyx migration which was retrieved with Solitaire stent and finally one patient developed SAH during transvenous access, hence procedure was abandoned.

Conclusion: Endovascular embolisation is the mainstay of treatment which may require multiple novel strategies. Interval improvement in parenchymal venous strain may be a reassuring angiographic sign in the follow-up of partially treated patients.

141 Treatment of Cavernous Sinus Dural Arteriovenous Fistula with Onyx Embolization via Venous Pathway: A Case Series

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Purpose: Cavernous sinus (CS) dural arteriovenous fistula (CSdAVF) is defined as an abnormal arteriovenous connection involving dura mater, within or near the walls of the CS. Treatment of CSdAVF has recently improved, but because of its rare prevalence, there is no standardized endovascular treatment. Coil embolization is most popular method. Recently, transvenous onyx embolization is also used to cavernous treatment but there is a little experience. This paper focuses on our experience of embolization of CSdAVF using Onyx with coils, via venous approaches.

Materials and Methods: We retrospectively collected 21 patients who diagnosed with CSdAVFs and underwent endovascular treatment between January 2015 and December 2016 at Samsung Medical Center in Korea. Onyx embolization with coils via venous and double micro-catheters were used in procedure. First step of procedure was coil inserts in fistula space and onyx injection was done for filling out remnant space of fistula. Clinical and radiologic data were retrospectively reviewed.

Results: 9 patients (mean age: 68.3 years; 7 females and 2 males) had treated with Onyx embolization via venous pathway. Ocular symptoms and signs were the most frequent clinical findings. Middle meningeal artery is most frequent feeding artery. Cognard classification showed Type III in 2, Type IIa + b in 1, Type IIb in 5, and Type I in 1. All patients had treated using double micro-catheters except one patient. Inferior petrosal sinus is most preferred approaching vein. Total occlusion in immediate angiography was achieved in 7 cases (77.8%) and partial occlusion was in 2 cases (22.2%). 7 patients (77.8%) showed improvement of their symptoms and 2 patients (22.2%) have no significant change of their symptoms. Two patients had cranial nerve palsy post-operatively, which completely recovered 1 month. All patients had over 1 year follow-up and there is no recurrence.

Conclusion: Our experience suggested treatment of using onyx embolization via venous is safe, feasible and effective, as 77.8% (7/9) of cases were totally occluded without any significant clinical sequelae.

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Endovascular Treatment of Intracranial Dural Arteriovenous Fistulas Involving Large Sinuses under Intrasinus Balloon Protection

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Object: To evaluate the safety and efficacy of the intrasinus balloon protection technique in dural arteriovenous fistula (DAVF) with large sinuses.

Methods: Twelve patients (3 female and 9 male) with DAVFs involving large sinuses, who underwent endovascular treatment with intrasinus balloon protection at our center from 2012 to 2016, were retrospectively reviewed. We collected all clinical presenting symptoms, imaging findings, and follow-up outcomes to evaluate the effect of the intrasinus balloon protection technique.

Results: Five patients had Cognard A fistulas, while 7 patients had Cognard B fistulas. The location of DAVFs included the sigmoid sinus (n = 3), transverse sinus (n = 4), transverse-sigmoid sinus (n = 1), and superior sagittal sinus (n = 1). Three patients had multiple fistula orifices (n = 3). The initial balloon protection technique was used in all cases to preserve sinus drainage function. Complete fistula occlusion was demonstrated in 8 patients and partial fistula occlusion in 4 patients. Immediate symptoms improved in all patients. The mean angiogram follow-up period of 10 patients was 6.5 months, the finding were fistula obliteration (n = 5), fistula stability (n = 2), fistula recurrence (n = 2), and de novo fistula (n = 1). Balloon-protected sinus was occluded in the patient with de novo fistula.

Conclusion: The intrasinus balloon protection technique can ensure sinus patency to maintain normal drainage function and stability of embolic effects.
ultra-low concentration has high permeability into the lesion and low adhesive property. In selected situations, it is possible to perform “plug and push”-like embolization as non-adhesive liquid embolization materials. It is crucial to warm NBCA-lipiodol mixture before injection and employ intermediate guiding catheter. Appropriate case selection and anatomical consideration for dangerous Anastomosis are indispensable prerequisite for the safe treatment.

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Direct percutaneous sclerotherapy for venous malformations of the face
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Purpose: Venous malformations of the face are a group of lesions responsible for aesthetic problems, pain and functional limitation of the affected area, and are identified at birth in 90% of the cases. These venous malformations usually present bluish coloration on the skin and mucosa and involve fascia and muscles of the affected region. Treatment consist of surgical resection and/or sclerotherapy (with sclerosis agents). Absolute alcohol and bleomycin are two effective substances with excellent results.

Materials and Methods: A retrospective analysis of 55 cases submitted to percutaneous embolization at the Neurosurgery service, from April 2006 to December 2015. The observed variables were age, sex, presentation symptoms, type of lesion, location, number of lesions and the material used.

Results: Performed sixty-four procedures, analyzed 40 patients in the total, and 24 required new approaches. Of the total number of patients, 30 were female (75%) and 10 were male (25%), mean age was 24.98 years (1–73). The lesions involved the malar region in 19 cases, the lip in 10, only the face without involvement of the mucosa in 15, eyelid in 3, and sclera eyelid in 1. Aesthetic discomfort in all patients, pain and functional limitation in four patients. Of the procedures, 16 patients required a second approach with an average of 2.5 therapeutic sessions per patient reopened and the volume of ethanol and bleomycin varied according to the size of the lesion.

Conclusion: the percutaneous treatment with sclerotherapy of these facial lesions is an efficient and safe technique for cure or eventual reduction of the preoperative lesion and the combination of ethanol and bleomycin presents with better results.

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The usefulness of 3D venography in the treatment of dural arteriovenous fistulae
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Purpose: The standard treatment of cavernous sinus dural arteriovenous fistula (CSdAVF) and hypoglossal canal dural arteriovenous fistula (HCdAVF) is transvenous embolization (TVE). Catheterization to the shunt point from the internal jugular vein (IJV) is sometimes difficult because the route can be anatomically complicated. In CSdAVF, because of the variations of the connection between IPS and IJV, we sometimes cannot navigate the catheter to the inferior petrosal sinus (IPS) easily in a conventional way, especially when the IPS is occluded. We report the efficacy of the 3D venography in demonstrating the route from the IJV to the shunt point.

Methods: We experienced 11 dAVF cases treated using 3D venography. (nine cases of CSdAVF and two cases of HCdAVF) We put a 6Fr guiding catheter into the IJV and perform 3D venography while slightly compressing on the IJV.

Results: We were able to demonstrate the entrance to the occluded IPS in eight cases with CSDAVF and the connection between the shunt point and IJV in two cases with HCdAVF, and the catheterization was done successfully with the help of the 3D venography roadmap guide. In one case with CSdAVF, the IPS was not clearly shown because she had also a HCdAVF so the venous blood coming from HCdAVF diluted the contrast injected from the IJV. In this case, the entrance was demonstrated by the fusion of the injection to the external carotid artery with the venogram.

Conclusion: The 3D venography with manual compression of the IJV is useful to make the connection of the IPS to the IJV clear. We recommend using 3D venography in treating certain types of dAVF.

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Dural arteriovenous fistulas of the anterior and posterior condylar vein: anatomy and treatment
Hellstern Victoria1, Aguilar-Perez Marta1, AlMatter Mohammad1, Bhogal Paul1, Serna-Wandel Carmen1 and Henkes Hans1
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Dural arteriovenous fistulas of the anterior or posterior condylar vein are a rare, however important disease. DAVFs of the anterior or posterior condylar vein are associated with pulse-synchronous tinnitus, ophthalmological symptoms or in case of cortical venous drainage there is the risk of intracranial hemorrhage. Therefore arises the need to treat this fistulas. To perform efficient endovascular therapy god knowledge of the anatomy of the veins at the skull base is mandatory. The anatomy of the veins at the skull base as
well as treatment strategies for dAVFs of the anterior and posterior condylar vein will be demonstrated.

Tuesday, 17th of October  – Session room 4.  – 14:00 – 15:40 – Parallel abstract session - Aneurysm research

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Hemodynamic Changes Caused by Multiple Stenting in Vertebral Artery Fusiform Aneurysms: A Patient-specific Computational Fluid Dynamics Study

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2National Scientific and Technical Research Council of Argentina, Buenos Aires, Argentina

Purpose: Multiple stenting technique has largely improved the long-term outcomes of intracranial fusiform aneurysms and the hemodynamic mechanism remains unclear. In this study, we analyzed the hemodynamic changes caused by different stenting strategies in patient-specific models using computational fluid dynamics (CFD) technique, aiming to provide evidence for clinical decision-making.

Materials and Methods: Ten vertebral artery fusiform aneurysms (VAFAs) were enrolled and their patient-specific CFD models were reconstructed. Then Fast Virtual Stenting technique was applied to simulate sequential multiple stent placement (from single stent to triple stents) in the VAFA models. Hemodynamic parameters, including wall shear stress (WSS), pressure, oscillatory shear index (OSI), relative residence time (RRT) and flow pattern, were calculated and compared between groups with different number of stents.

Results: Virtual stents were deployed in all ten cases successfully and consistent to the real stent configuration. WSS decreased progressively by 7.2%, 20.6% and 25.8% as the number of stents increased. Meanwhile, RRT and pressure revealed to increase by 11.3%, 15.4%, 45.0% and by 15.7%, 21.5%, 28.2%. OSI showed no stable variation trend. Flow vortexes and displacing the vortex center from the aneurysmal wall.

Conclusion: Stenting could modify hemodynamic pattern of VAFAs, which might favor thrombosis formation in aneurysmal sac. This effect could be enhanced as the number of stents increased. However, the potential risk of rupture or recanalization existed and should be considered when planning to use multiple stenting technique in VAFAs.

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Emerging secondary flow patterns at the initiation site of sidewall aneurysms

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2National Institute of Clinical Neurosciences, Department of Neurointerventions, Budapest, Hungary

Purpose: The evaluation of hemodynamic parameters is well established in the literature to investigate the initiation process of intracranial aneurysms based on numerical flow simulations. However, one can find disagreements on which hemodynamic parameters induce the process that leads to aneurysmal growth. A doubt might arise as a result of various subjective decisions throughout the construction of numerical geometries from the medical images. Due to these uncertainties wall shear stress (WSS) as a parameter might be misleading. In order avoid this controversy our evaluation method focuses on the emerging flow patterns in the digitally reconstructed pre-aneurysmal vessel geometries.

Materials and Methods: The medical images were retrieved at the National Institute of Clinical Neurosciences of Hungary by 3D DSA-angiography. The segmentation was created using the open source software VMTK. For further corrections and final surface smoothing another open source software was used for which the Taubin filter was utilized. To reconstruct the geometries virtually, an algorithm based on the Voronoi representation of the lumen surface was adopted where the aneurysm sac and the associated parent vessel is removed then remodeled using a cubic-spline interpolation. Subsequent to the surface generation the geometry is exported to ANSYS 17.0 for the numerical flow simulation. In this investigation six aneurysms were considered and two control cases for validation.

Results: Our argument is that uncertainties in the geometry influence the WSS computations. Hence, to demonstrate our concern, the same geometry after the same segmentation was evaluated with a small difference in the final smoothing. Comparing the two calculations, it can be seen that qualitatively different WSS distributions can arise as a result of a small change during the surface smoothing procedure. Instead of the WSS distributions we investigated the flow field itself. According to the computations a strong secondary flow motion can be identified at the site of the future aneurysm. To characterize the phenomenon, we formulated a parameter called secondary flow ratio (SFR) which can quantify the relative importance of secondary currents to the bulk flow, defined by local the centerline direction. The result of all geometries show that a higher SFR accompanied by elevated in-plane velocities can be recognized at the future site of the aneurysm.

Conclusion: The evaluation of the flow field and its derived quantities are numerically more robust than those defined...
Impact of vessel geometry on flow diverter mesh density in curved arteries

Purpose: The effective mesh density and resulting Metal Surface Area (MSA = percentage of the metal covered area) has been thought to have a significant impact on the actual flow diverting capacity of woven Flow Diverters (FD). We studied the impact of vessel geometry on MSA in a typical aneurysm bearing curved vessel section.

Materials and Methods: Parophthalmic ICA aneurysms were selected as a characteristic location for aneurysms on a curved vessel. The vessel diameter, pitch and radius of the curvature were measured on 3D DSA models of 10 such curved vessel. The vessel diameter, pitch and radius of the curvature ranged from 4–6 mm. In the corresponding tubular models, the absolute value of MSAc ranged between 39.5–42.8% for the Ø5 × 20 mm FD, 39.2–42.8% for the Ø4 × 20 mm device and 24.9–31.5% for the Ø4.5 × 20 mm PED. In each case, MSAc exceeded both MSAP and MSAD by 1–9%. The radius of curvature influenced MSAc by 1.8–6.6%.

Conclusion: In our model, vessel geometry of curved arteries (including the pitch and curvature radius, characteristic for human parophthalmic aneurysms) does not significantly influence effective mesh density of FD-s measured as MSA. This study was supported by grant No KTIA_NAP_13-1-2013-0001 from the Hungarian National Brain Research Program.
corresponds to the expectations. The trends are different for the different manufacturers but these can be well explained by the different stent structure.

**Conclusion:** Hydraulic resistance results of various stents under various deployment conditions are presented. This study was supported by grant No KTIA_NAP_13-1-2013-0001 from the Hungarian National Brain Research Program.

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**Comparing the flow diverting effects between double LVIS and single PIPELINE using CFD simulation**

Shojima Masaaki¹, Hoshi Takeharu² and Yagi Takanobu²

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²EBM corporation, Tokyo, Japan

**Purpose:** Now, endovascular treatments of aneurysms are frequently supported by neck bridging stents or flow diverters. However, the flow diverters cost about three times of the neck bridging stents. The Low-profile Visualized Intraluminal Support (LVIS) stent, which belongs to the neck bridging stent, has a braided structure with a small-sized cell similar to the flow diverter and this stent could be ranked between a neck bridging stent and a flow diverter. There are some observations that the double layered LVIS stents could reduce the aneurysm flow more than the flow diverter. To validate these findings, we compared the flow diverting effects of double layered LVIS stents and a flow diverter (Pipeline).

**Materials and Methods:** An 8 mm sized internal carotid ophthalmic artery aneurysm (8 mm) was subjected to this study. Micro-CT was used to construct virtual stents for LVIS and Pipeline. CFD simulations were performed for the four virtual model (Control, single layered LVIS (SL), double layered LVIS (DL), Pipeline(FD)). The intra-aneurysmal velocity, the aneurysm wall shear stress and the aneurysm inflow volume were compared.

**Results:** The metal coverage ratios for the virtual models were 16.9 % for SL, 27.1% for DL and 33.2% for FD. The aneurysm wall shear stress decreased by 42.5 % for SL, 54.7% for DL and 70.1% for FD. The intra-aneurysmal velocity decreased by 30.2 % for SL, 44.9% for DL and 74.3% for FD. The aneurysm inflow volume decreased by 19.5 % for SL, 35.0% for DL and 47.8% for FD.

**Conclusion:** Although the metal coverage ratio of DL was similar to that of FD, the flow diverting effects of DL was not comparable to that of FD in our study.

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**Particle residence time for prediction of intracranial aneurysm rupture risk**

Leemans Eva¹,², Cornelissen Bart MW²,³,¹, Rosalini Giorgia²,⁴, Majoe Charles BL.M², van Bavel Ed T.² and Marquering Henk A.²,¹

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⁴University of Pavia, Department of industrial engineering and information, Pavia, Italy

**Purpose:** A continuous need exists to accurately determine the aneurysmal rupture risk to decide which patient is eligible for treatment. Aneurysm hemodynamics play an important role in growth and subsequent rupture. Within the available hemodynamic parameters, particle residence time (PRT) is relatively unexplored. As this parameter is related to thrombus formation and monocyte adhesion, it likely also influences the rupture risk. The goal of this study is to evaluate the association between PRT and rupture.

**Materials and Methods:** We determined the PRT for 97 aneurysms (52 ruptured, 45 unruptured) based on computational fluid dynamic models. Particles were injected in the parent vessel and were followed over at least one cardiac cycle. The PRT was defined as the time needed for 75% of the particles that entered the aneurysm to leave the aneurysm.

**Results:** In all cases, 75% of the particles left the aneurysm within five cardiac cycles. A significantly higher PRT was seen in ruptured aneurysms (P = 0.046). The median PRT was 0.11 (IQR 0.05–0.30) seconds and 0.08 (IQR 0.03–0.17) seconds for the ruptured and unruptured cases respectively.

**Conclusion:** This study determined the PRT in a large cohort of intracranial aneurysms. PRT showed to be associated with aneurysmal rupture and may be considered a risk factor. Larger residence times may be related to intense biological activity such as inflammation. Additional studies are needed before this measure can be used in clinical practice.

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**Fast patient-specific flow diverter deployment simulation**

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²Budapest University of Technology and Economics, Department of Hydrodynamic Systems, Budapest, Hungary
³National Institute of Clinical Neurosciences, Department of Neurointerventions, Budapest, Hungary

**Purpose:** Now, endovascular treatments of aneurysms are frequently supported by neck bridging stents or flow diverters. However, the flow diverters cost about three times of the neck bridging stents. The Low-profile Visualized Intraluminal Support (LVIS) stent, which belongs to the neck bridging stent, has a braided structure with a small-sized cell similar to the flow diverter and this stent could be ranked between a neck bridging stent and a flow diverter. There are some observations that the double layered LVIS stents could reduce the aneurysm flow more than the flow diverter. To validate these findings, we compared the flow diverting effects of double layered LVIS stents and a flow diverter (Pipeline).

**Materials and Methods:** An 8 mm sized internal carotid ophthalmic artery aneurysm (8 mm) was subjected to this study. Micro-CT was used to construct virtual stents for LVIS and Pipeline. CFD simulations were performed for the four virtual model (Control, single layered LVIS (SL), double layered LVIS (DL), Pipeline(FD)). The intra-aneurysmal velocity, the aneurysm wall shear stress and the aneurysm inflow volume were compared.

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**Conclusion:** Although the metal coverage ratio of DL was similar to that of FD, the flow diverting effects of DL was not comparable to that of FD in our study.
Purpose: In order to optimise the treatments of IAs, it is extremely useful to have a virtual stenting method to approximate the effects of the FD (flow diverter) deployment before the actual implantation. Although there are several methods present in the literature covering this topic, we present a novel method here which is more comprehensive regarding the details of the deployment procedure. It is computationally highly efficient allowing for “virtual deployment - evaluation - change of FD parameters - virtual redeployment” loops. The primary aim is to provide a general method for different FD types that can reproduce the deployed surface shape accurately together with the occasional less than optimal vessel wall fits and strut density changes.

Materials and Methods: The FD is represented as a network of MSDs (mass-spring-dampers) consisting of a series of interconnected MSD rings. The mechanical properties of these springs are fine tuned to match two mechanical responses of each FD: the radial and the axial compression response. We use a patient-specific geometry aided initialisation. The virtual FD is initially positioned along a segment of the centreline of the vessel in a compressed state. Its rings follow the Frenet-frame to incorporate additional effects, such as rotation, due to the vessel curvature. The rings are then expanded one after another according to the MSD mechanics starting from the distal end towards the proximal one to simulate the real process of the deployment. The motion of the structural points of the virtual FD structure is computed using the velocity Verlet algorithm. The intersection of their trajectory with the vessel wall is calculated by building an oriented bounding box (OBB) tree from the vessel surface.

Results: Deployment runs were executed on a set of 11 PCom aneurysms. The mean run-time was 4.5 s on an average notebook together with the 3D visualisation of the stent expansion. The results yield the surfaces of the deployed stents. Even though their actual woven structure is not represented, the virtual structure shows the local relative density changes which can easily be mapped to the real stent structure if necessary. Since the local radius is not used (as opposed to several existing techniques), non-tight wall fits, for instance due to very high vessel curvature, may also appear showing the necessity of a different FD, e.g. one with higher flexibility. Further useful information resulting from the computation is the force exerted on the vessel wall by the deployed FD.

Conclusion: The presented technique is both fast and stable allowing for the evaluation of several possible FD deployments in a few minutes. Due to the nature of the numerical method, it is easy to extend it with additional effects, such as the clinical push-pull technique with different delivery wire advancements.

Acknowledgement: This study was supported by grant No KTIA_NAP_13-1-2013-0001 from the Hungarian National Brain Research Program.

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Location specific inflow profiles for intracranial aneurysms
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Purpose: Size and location of intracranial aneurysms are frequently used to identify aneurysms with a high risk of rupture. In addition, hemodynamic characteristics are expected to play an important role in aneurysm growth and rupture. Therefore, differences in flow characteristics between ruptured and unruptured cohorts have been studied using computational fluid dynamics. Many of these studies simulated blood flow in patient specific vascular models using generalized flow profiles of healthy volunteers. However, large inflow variations between subjects have been observed. The purpose of this study is to analyze aneurysmal inflow variations for different locations, anatomical variations in the Circle of Willis (CoW), and patient age, and to present location specific velocity profiles.

Materials and Methods: From our database of treated intracranial aneurysms in the period between 2009 and 2011, patients with phase contrast MR imaging were included. Velocity measurements were performed for the vertebral artery, basilar artery, internal carotid artery, middle cerebral artery, and the A1 and A2 segments of the anterior cerebral artery. Mean and peak systole velocity magnitudes, flow rates, and group averaged flow profiles were calculated for each location and CoW configuration. The CoW configuration was determined by inspecting the 3D TOF MR imaging data for hypoplastic and absent arterial segments. The Wilcoxon rank sum test was used to check for differences in flow between complete and incomplete CoW configurations. The Pearson correlation coefficient was used to analyze the association between velocity magnitudes and patient age.

Results: This study included 96 patients with 103 aneurysms. Higher A1 flow rates were observed for incomplete anterior configurations (1.9 ml/s) compared to complete anterior configurations (1.4 ml/s), p < 0.001. Lower basilar artery flow rates were observed for cases with one or two hypoplastic/absent P1 segments (0.9 ml/s) compared to complete posterior configurations (2.5 ml/s), p = 0.024. Furthermore, higher patient age was associated with lower mean velocity magnitudes (r = −0.37, p < 0.001).

Conclusion: Flow rates of the basilar artery and A1 segment are significantly different in cases with hypoplastic or absent arterial segments in the CoW, when compared to cases with complete configurations. Location specific flow profiles for aneurysmal parent arteries in different CoW configurations...
can be used in future CFD studies when no patient specific inflow profiles are available.

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Newtonian viscosity model for CFD studies in cerebral aneurysms

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Computational fluid dynamics has become a popular clinical tool for studying cerebral aneurysms and predicting the cause of initiation, the growth rate and the rupture risk of aneurysms. The CFD simulations in cerebral aneurysm adopt different assumptions to simplify the simulation. One of these assumptions is the Newtonian blood viscosity model. In this work, a numerical study is constructed to inspect whether the Newtonian blood viscosity model assumption is appropriate or not and how such model is compared to a realistic non-Newtonian viscosity model. A comparison is done between the Newtonian model and the Carreau model for three different patients for maximum wall shear stress, area average of wall shear and velocity profiles. Results represented a relatively similar wall shear stress and velocity profile values for high velocity regions such as the parent artery. As for the aneurysm dome, there is a noticeable difference between the two viscosity models due to low velocity in this region. It is concluded that the Newtonian assumption is valid for high velocity regions due to the equal coefficient of viscosity for both Newtonian and non-Newtonian models. The Newtonian fluid assumption presents error of around 45% in WSS when compared to Carreau non-Newtonian model in regions of stasis or slowly recirculating secondary vortices mainly inside the aneurysm dome. Overall, the Newtonian assumption is deemed an invalid assumption when considering the pulsatile velocity of blood.

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Hemodynamic effect of parent artery occlusion for giant intracranial aneurysm on surrounding arteries and aneurysm based on magnetic resonance fluid dynamics and computational fluid dynamics

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Purpose: Giant intracranial aneurysms are rare and treatment is complex and challenging. Endovascular parent artery occlusion (PAO) techniques have been established as one of the treatment modalities for patient with ischemic tolerance assessed with balloon occlusion test (BOT). However, the hemodynamic changes after PAO and the impact on surrounding arteries barring additional aneurysms remain unclear. Our aim was to retrospectively analyze the hemodynamic changes of the contralateral side of the giant internal carotid artery aneurysm before and after PAO using magnetic resonance fluid dynamics (MRFD) and computational fluid dynamics (CFD).

Material and Method: Case 1 with an additional small aneurysm at right ICA and Case 2 with an additional basilar artery aneurysm (BA-SCA) underwent treatment for giant left-sided ICA aneurysm with PAO. We used pre- and post-treatment 3D TOF MRA and 3D cine PC MR images to perform a patient-specific MRFD. Pulsatile flow was simulated using CFD. Visualization of flow activity, including flow volume, streamline, and wall shear stress (WSS) profiles on contralateral side to PAO were performed and quantitatively analyzed.

Result: All flow activity parameters were increased, especially around the remaining aneurysms without changes in aneurysm size. Specifically, flow volume increased in contralateral side to PAO, without changing the total sum of inlet volume. Streamline velocity increased without significant changes in direction inside contralateral ICA, though there is inflow pattern change inside BA-SCA aneurysm in case 2. WSS in case 1 was increased inside ICA aneurysm and in case 2 the highest peak WSS was around the basilar tip adjacent to the BA aneurysm.

Additionally, vessel remodeling was observed in both cases with a four-time increase in right A1 region of ACA after 10 month (1.1 mm to 5.6 mm), and a two-time increase in left Pcom artery (0.7 mm to 1.4 mm) after 2 month in case 1 and case 2 respectively with a resulting decrease in WSS in that area.

Conclusion: The application of MRFD and CFD to the management of giant intracranial aneurysm helps to assess hemodynamic changes after PAO, especially for evaluating additional intracranial aneurysms affected by such treatments. PAO causes initial increase in flow volume and WSS on remaining blood vessels, without influencing aneurysm size in initial follow up phase. However, previous studies show a link between increased WSS to aneurysm growth. Therefore, we recommend long time follow up to observe any changes in shape and size of remaining aneurysm.
ORAL PRESENTATIONS

WEDNESDAY

Wednesday, 18th of October, Plenary room – 07:15 – 08:00 – Back to the basics: AVM – evolution and elimination

Evolution of AVM
Hong Qi Zhang
Hong Kong Baptist University, China

Principles of AVM surgery
Robert Reisch
Hirslanden Private Hospital Group, Switzerland

Wednesday, 18th of October, Plenary room – 08:00 – 08:35 – Plenary Session 6. - AVM research

INV19
Latest results in AVM pathogenesis research, Brain AVM: animal models, pathogenesis and new therapeutic options
Su Hua
1University of California, San Francisco, Department of Anesthesia and Perioperative Care, San Francisco, United States

Patients harboring brain arteriovenous malformation (bAVM) are at life-threatening risk of rupture and intracranial hemorrhage (ICH). The pathogenesis of bAVM has not been completely understood. Current treatment options for bAVM are invasive and risky. Treatment of unruptured bAVMs has become increasingly controversial because the natural history for these patients may be less morbid than invasive therapies. There is currently no specific medical therapy available to bAVM patients.

More than 95% of bAVMs are sporadic. The genesis of bAVMs has been enigmatic. Although recent studies found somatic mutations in AVM endothelia cells, the causative effect of these mutations needs to be proven. About 5% of bAVM are due to hereditary hemorrhagic telangiectasia (HHT), a familial disease characterized by AVMs in multiple organs and mucocutaneous telangiectasias. The two main subtypes of HHT (HHT 1 & 2) are caused by mutations in two genes implicated in transforming growth factor-β (TGF-β)/bone morphogenic protein (BMP) signaling pathways: Endoglin (ENG), and Activin-like kinase 1 (ALK1; ACVLR1). An important conceptual advance in the field is that HHT can serve as a familial form of the more common sporadic bAVM.

Animal models are important for study disease mechanisms and test new therapies. Historically, “AVM” models have been largely based on extradural arteriovenous (A-V) fistulas to study hemodynamic changes or develop platforms for technology development. With few exceptions, they are extradural in nature; none displays the clinical syndrome of recurrent hemorrhage into the brain parenchyma or cerebrospinal fluid (CSF) spaces. Through manipulate HHT causative genes; we have developed several bAVM models in adult mice, which have bAVM lesion in the brain parenchyma.

Using mouse models, we have identified several key factors that are crucial for bAVM formation and progression: (1) angiogenesis, (2) gene mutation in endothelial cells, (3) inflammation, and (4) participation of bone marrow-derived cells. We found that bAVM vessels have less mural cell coverage, which is associated with vessel leakage and micro-hemorrhage in both HHT bAVMs in mouse models and in human sporadic bAVMs. Evidence suggests this phenotype is caused by decreased expression of platelet derived growth factor B (PDGFB) opening up new therapeutic options.

We have tested several novel therapeutic strategies based on the mechanisms we have identified. We showed that inhibition of vascular endothelial growth factor (VEGF) signaling through bevacizumab (an anti-VEGF antibody) treatment or intravenous injection of an adeno-associated viral vector (AAV) expressing soluble FMS-related tyrosine kinase 1 (sFLT1) containing the extracellular domain of VEGF receptor-1 inhibits bAVM formation and progression. Thalidomide and its less toxic analogue, lenalidomide treatment reduces the number of abnormal vessels and micro-hemorrhage.

INV20
Latest results in DAVF pathogenesis research
Bhogal Pervinder
1Klinikum Stuttgart, London, United Kingdom

Dural arteriovenous fistulas are complicated lesions that can present with a wide variety of clinical syndromes ranging from pulsatile tinnitus, rapidly deteriorating dementia and even haemorrhage. Although these lesions are frequently encountered the pathogenesis of these lesions is yet to be elucidated. Whilst considerable research has been performed recent advances regarding the role of hypoxia and angiogenic factors may provide a greater understanding of the development of these lesions.

In this talk we will review the potential underlying mechanisms of formation of dAVF including recent evidence from advanced neuroimaging and animal studies as well as the role of hypoxia and angiogenic factors.
Embolization should aim complete occlusion by using transarterial-transvenous approach

Hudak

University of Pécs, Department of Neurosurgery, Pécs, Hungary

Purpose: The aim of our study was to present the possibilities and advantages of the combined transarterial-transvenous approach (CAVA) in embolization of deep arteriovenous malformations.

Materials and Methods: Between 2003 and 2016, 102 consecutive patients underwent embolization of deep brain AVMs with CAVA-technique. Spetzler-Martin grade II were 10,6%, III - 34,8%, IV - 38,0% and V - 16,6%. The clinical presentations were: hemorrhage - 73pt., intractable epilepsy - 12pt., focal steal syndrome - 12pt. and intractable headache - 9pt. The number of procedures were 224. Catheterization of both the feeding arteries and the AVM draining vein performed simultaneously. The first step is transarterial embolization of the fistulous part of the nidus and the shunt of the AVM. Then transvenous retrograde embolization was performed to occlude the nidus and the AVM draining vein.

Results: With the introduction of this novel combined transarterial-transvenous technique a significant improvement has been achieved in the efficacy of the endovascular treatment of the deep brain AVMs. Curative effect (complete permanent occlusion) was achieved in 89%, subtotal occlusion (≥90%) was 3% and partial occlusion (≥60%) was 8% of the patients, with the complication rate comparable to those of the conventional treatment options. The mean session number was reduced to 224/102. The outcome according to GOS was V in 71,2%, IV in - 13,6%, III - 6%, II - 1,6% and I - 7,6%. We have changed the level of understanding about the pathological nature of AVMs. The analysis of the venous structures is extremely important in AVM embolization. After embolization of the shunt, part of the nidus and the venous drainage of the AVM, we observed normalization of the visually pathologic vessels of the AVM.

Conclusion: Combined transarterial-transvenous approach is the method of choice in management of deep brain AVMs. It offers a significantly higher occlusion rate with a low complications rate. It is not necessary to embolize all the feeding arteries transarterially, as blood flow within the malformation may stop after the embolization of the pathological vessels only. It has been proved that the angiographic definition of the nidus of the AVM may be misleading! Nidal vessels originally visualized as anomalous must not be always occluded, resected or irradiated because they are able to regenerate.

Embolization should aim complete occlusion by using transarterial approach**

Kocer Naci

Neuroradiology, Istanbul, Turkey

Due to complex features of AVMS, ongoing scientific discussions still did not reach a consensus to achieve a standard of treatment.

Brain arteriovenous malformations (bAVMs) are usually managed by combining multi-staged endovascular embolization and microsurgical resection especially if avms are sgm grade 3–5. However there are no guidelines that determine the extent and goals of embolization at each stage and the time interval between the different embolization stages and surgery.

During the lecture I will try to describe our strategies on the transarterial embolization; selection of cases, extention of treatment, limitation of transarterial approach and our mentality to combine with other treatment options on the brain AVMs.

Embolization should be used as a complementary method to surgery

Boccardi Edoardo

Niguarda Hospital, Milano, Italy

The endovascular treatment (embolization) of brain AVMs has seen a lot of major improvements in the last 30 years. With the advent of EVOH around the year 2000 we thought we had found the final solution for the mini-invasive complete cure of brain AVMs. However after several cases and worldwide experience we discontinued this approach for two main reasons: 1. the final complete cure of an AVM was too rarely achieved (40–50% of the times in the best series, 10–20% in the average series) and 2. the rate of complications, especially hemorrhagic events, was too high (15–20% of serious morbidity/mortality). The comparison with the surgical approach, especially in low grade AVMs (cure rate above 95%, and complication rate below 5%), pushed us to change directions. In the meanwhile surgery also had experienced many technical improvements: non-stick bipolar forceps, laser, ICG, intraoperative Doppler, and more.

Today the role of embolization in our center is twofold: - in hemorrhagic AVMs, the rupture point when recognized is endovascularly occluded, while the complete cure of the AVM is postponed after the expected clinical improvement - in unruptured AVMs it is used as a pre-surgical modality: the goal is not an intranidal diffusion of the liquid embolic material, but rather the occlusion of the arterial feeders that are the most difficult or annoying for the surgeon, in a simpler but less risky and more effective way.
We believe that this approach has greatly improved our overall outcomes in the treatment of brain AVMs.

Most AVM-s should be treated by microsurgery

Peter Vajkoczy
Department of Neurosurgery, Charite Universita¨tsmedizin Berlin, Germany

INV24
Non-Surgical AVM’s should be treated by radiosurgery without embolisation

Radatz Matthias¹
¹Royal Hallamshire Hospital, Neurosurgery/Radiosurgery, Sheffield, United Kingdom

The National Centre for Stereotactic Radiosurgery in Sheffield/ UK has treated in excess of over 7000 AVM’s over a period of over 30 years. Careful analysis of this significant group of patients has shown evidence of a negative effect of previous partial embolisation of AVM’s on the cure rates after Stereotactic Radiosurgery.
To optimise patients cure rates following stereotactic radiosurgery non-surgical AVM’s should therefore be treated by radio surgery without embolisation.
The National Centres data and outcome will be presented to underpin this statement.

The European AVM treatment consensus proposal

Marco Cenzato
Ospedale Niguarda, Milan, Italy

Wednesday, 18th of October, Plenary room – 10:45 – 11:15 – Plenary session 8. - The Pierre Lasjaunias Memorial Lecture
Low magnetic field MRI imaging of cerebral vascular disease

Gary Green
The University of York, United Kingdom


Mental health in the angiography suit

György Purebl
Semmelweis University, Budapest, Hungary

Partners or customers: physician – industry interaction

INV25
Industry

Fitz Matt¹
¹MicroVention, R&D and Operations, Tustin, United States

Many patient injuries and deaths can be attributed to failure of medical technologies such as coils, stents, and access products. The purpose of this lecture is to propose a new model for physician-industry partnership to improve the quality and reliability of medical devices.
This lecture will focus on how devices returned to the manufacturer after an incident can be used in the same was as the airline industry uses “black boxes” to understand what caused a failure and how the design and manufacturing of a product can be improved with this information. Specifically, how industry and physicians can partner to understand the circumstances of a device issue, return the device to the manufacturer in good condition, and receive a report on how and why the device failed. The ultimate goal is to create a virtuous circle of cooperation in which devices are continuously improved using data from failures to enhance patient safety.
By working together, physicians and the medical technology industry can take a page from the air transport industry to improve patient safety by constantly analyzing and understanding device failures and continuously updating and improving the manufacture and design of life-saving devices.

Medicine

Patrick Brouwer
Karolinska University Hospital, Sweden

Wednesday, 18th of October, Plenary room – 14:15 – 16:15 – Parallel abstract session - Aneurysm research

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Stromal cell-derived factor 1a facilitates aneurysm remodeling in elastase-induced rabbit saccular aneurysm

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Purpose: Inflammation plays a crucial role in aneurysm wall remodeling, which could lead to the rupture of intracranial aneurysms. Stromal cell-derived factor 1a (SDF-1a), a vital
inflammation cytokine, is also related to aneurysm pathogenesis. However, the characteristics of SDF-1α expression and its role in aneurysm remodeling remain largely unknown. In this study, we aimed to investigate the expression dynamics of SDF-1α and its correlation with aneurysm remodeling.

**Materials and Methods:** Saccular aneurysms were induced by porcine pancreatic elastase in New Zealand White rabbits. Aneurysm size was measured by digital subtraction angiography. Endothelial-like cells on the aneurysm wall were assessed on postoperative days 1, 3, 7, 14, 21, and 30. SDF-1α levels in the aneurysmal wall and serum were examined at several follow-up time points. Adherent molecule expression was examined, and migration assays were performed in vitro. After SDF-1α stimulation, the mobilization of endothelial-lineage cells and its role in the reendothelialization of the aneurysm wall were investigated in a saccular aneurysm rabbit model.

**Results:** After the creation of saccular aneurysms in rabbits, the aneurysm sacs were filled with a thrombosis within 3 days, followed by a significant enlargement on day 14 and maturation on day 21. Serum SDF-1α levels increased in a bimodal fashion on day 1 and day 14, whereas SDF-1α expression in the aneurysm wall reached its maximum on day 14. VE-cadherin was up-regulated after SDF-1α stimulation and down-regulated by the SDF-1α ligand blocker AMD3100. Endothelial progenitor cell migration was enhanced by SDF-1α and blocked by AMD3100. The in vivo administration of SDF-1α to rabbits with saccular aneurysms promoted endothelial-lineage cell mobilization into the peripheral blood and reendothelialization of the aneurysm wall.

**Conclusions:** The SDF-1α expression level in the peripheral blood and local aneurysm wall correlated with the aneurysm remodeling process in rabbits with elastase-induced saccular aneurysms. We conclude that SDF-1α may facilitate aneurysm wall remodeling by up-regulating VE-cadherin expression and mobilizing endothelial-lineage cells.

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Recombinant human SDF-1α administration accelerates aneurysm neck reendothelialization in rabbit saccular aneurysm after flow diverter treatment

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**Background:** Reendothelialization in the aneurysm neck is pivotal to vascular repair for intracranial aneurysm after flow diverter (FD) implantation. SDF-1 is a vital chemotacticant to stem cells. Recombinant human SDF-1α (rhSDF-1α) is proved to facilitate reendothelialization after drug-eluting stent implantation in aorta abdominales. Here we sought to investigate the therapeutic effects of intravenous administration of recombinant human SDF-1α (rhSDF-1α) and uncover its potential mechanisms for promoting aneurysm neck reendothelialization in saccular aneurysm after FD.

**Methods:** Recombinant pET32a-186 plasmid was transformed into E.coli to produce the rhSDF-1α protein. The biological activity of rhSDF-1α was analyzed by migration assay. Saccular aneurysm was induced by elastase in New Zealand White male rabbits (n = 20). FD were implanted into the elastase-induced saccular aneurysm. rhSDF-1α (50 μg/kg/day) was intravenously administered for consecutive seven days after FD implantation. After these procedures, aneurysms were harvested for two or four weeks respectively. Scanning electron microscopy was used to measure the neointima thickness and count endothelial-like cells at aneurysm neck. Four weeks later, RNA levels of endothelial makers in the neointima at aneurysm neck were detected by real-time PCR.

**Results:** Migration assay showed that rhSDF-1α induced migration of endothelial progenitor cells in dose-dependent manner. FD was successfully implanted in 20 saccular aneurysm rabbits. Two weeks after stent implantation, follow-up angiography showed partial aneurysm occlusion in all groups and total aneurysm occlusion in seventeen models (9 of rhSDF-1α group; 8 of control group). No significant change of neointima thickness at aneurysm neck (P < 0.05) was observed. Importantly, more endothelial-like cells were observed at aneurysm neck in rhSDF-1α group at two weeks (55 vs 13 per high power field, P < 0.01) and four weeks (104 vs 60 per high power field, P < 0.01). The RNA levels of endothelial markers including Tie2, VE-cadherin and KDR were significantly enhanced compared to those of control group (P < 0.05).

**Conclusions:** Intravenous administration of rhSDF-1α can accelerate reendothelialization in the aneurysm neck after FD implantation in elastase-induced saccular aneurysm rabbits. The safety and efficacy of rhSDF-1α in reendothelialization needs further investigation. Our study not only uncover an important role of rhSDF-1α in inducing aneurysm occlusion, but also suggests that it achieves this function through modulating the reendothelialization.

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Development of Statin eluting coils to enhance neck endothelialization and thrombus organization in the aneurysm cavity

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**Purpose:** Endovascular coil embolization of intracranial aneurysms has been accepted widely. However, recurrence
of aneurysms especially in large cases after coil embolization is a serious problem which remains to be solved. Problems of coil compaction, recanalization and rare endothelialization at the aneurysm orifice are not yet solved. Some data suggest that systemic statin administration does not improve aneurysm healing in coiled aneurysms. We investigated the efficacy of local administration of atorvastatin, which accelerate thrombus organization in the cavity in a rat model of aneurysm and improve the endothelialization of rabbit elastase aneurysm model.

**Material and Methods:** Twenty one metal coils coated with atorvastatin and fifteen bare coils were inserted into the ligated external carotid arterial (ECA) sacs of rats. The ECA sacs were removed 2 or 4 weeks after the coils were implanted and examined by histology and immunohistochemical assay. Sixteen aneurysms were created in rabbits and were embozized with platinum coils. Eight rabbits served as controls and eight rabbits embozized with atorvastatin eluting coils. Digital subtraction angiography was used to evaluate stability after embolization. Subjects were euthanized 4 weeks after coil embolization. Histologic samples were examined.

**Results:** The organized areas in the ECA sacs in the atorvastatin group (63.4 ± 21.4%, 2 wk; 82.7 ± 19.3%, 4 wk) was significantly higher than the bare metal group at 2 and 4 weeks (25.7 ± 16.2%, 2 wk; 41.5 ± 22.9%, 4 wk). Organized tissues that formed around the coils coated with atorvastatin were characterized by an accumulation of cells positive for αSMA and collagen connective matrix. Tissues also were accompanied by marked formation of endothelium at the orifice of the ECA sac. In the rabbit elastase aneurysms, we found the local atorvastatin administration can improve aneurysm neck endothelialization.

**Conclusion:** We suggest 4 points. First improving endothelial function, second decreasing oxidative stress, third decreasing the vascular inflammation. And fourth statin suppresses the excretion of MMP and inhibits the destruction of ECM. Coils and local administration of atorvastatin effectively accelerated intra-aneurysmal organization and endothelialization over the coils at the orifice of aneurysms in a rat and rabbit model. Atorvastatin is widely used to lower cholesterol, so its safety is already established. We developed drug-eluting coils to optimize the local concentration of atorvastatin and its duration of efficacy.

**Development and evaluation of a statin-carrying embolization coils**

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The treatment of intracranial aneurysms with detachable coils is now widely accepted as a safe, efficient, and minimally invasive technique. Rates of rebleeding after coil embolization are not so high, however, postoperative coil compaction and recanalization are still persistent problems. Our group previously demonstrated that coils coated with statins, 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase inhibitor, can accelerated intra-aneurysmal organization and endothelialization in a rat model of aneurysm (Kodama T et al. J Biomed Mater Res Part B 101B:656–662, 2013). In this presentation, we constructed some prototype statin-carrying embolization coils and evaluated release profiles of statins and their efficacy in external carotid artery (ECA) aneurysm models created in dogs and rabbits. A statin-carrying coil was developed by a modification of ED Coil system (Kaneka Medix Corp.). In-vitro released amounts of statin from developed coils were measured by a LC/MS/MS system (LCMS-8040, Shimadzu Corp.). External carotid artery (ECA) aneurysm models were created with the technique reported previously (Ohyama T et al. Neurol Med Chir (Tokyo) 44: 279–287, 2004; Ohyama T et al. J Neurosurg 102:109–115, 2005; Kodama T et al. ibid). A developed coil was inserted externally through a small arteriotomy in the dog experiment, and delivered intravascularly in a rabbit experiment. A volume embolization ratio of each experiment was calculated with an angiogram pictured with an X-ray angiographic imaging system (BRANSIST alexa F12, Shimadzu Corp.). Created and emboziled model aneurysms were observed by X-ray angiographic method at extirpation and extracted specimens were observed micrographically under a microscope.

We have developed a method to carrying and controlled releasing of statins from embolization coils and achieved to control a profile of release of statins from a developed coil. In animal experiments, X-ray angiographic observations showed formation of white-collar band at neck position of model aneurysms embolized with statin-carrying coils and formation of thick organization were observed micrographically at neck of model aneurysms embolized with statin-carrying coils. Our statin-carrying embolization coils by a modification of ED Coil system are still under development, but our observation suggests that statin-carrying coil can promote the formation of sufficient covering organization at the neck of embolized aneurysms and is become a promising device to treat intracranial aneurysms.
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Autologous Adipose-Derived Mesenchymal Stem Cells Improve Healing Of Coiled Experimental Saccular Aneurysms: An Angiographic and Histopathological Study

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Purpose: Long-term occlusion of coiled aneurysms frequently fails, likely due to poor intrasaccular healing and inadequate endothelialization across the aneurysm neck. The purpose of this study was to determine if attachment of autologous MSC on platinum coils could improve healing response in an elastase-induced aneurysm model in rabbits.

Material and Methods: With institutional animal care and use committee approval, aneurysms were created in rabbits and embolized with control platinum coils (Axium, Medtronic) (n=6) or coils seeded ex vivo with autologous adipose-tissue mesenchymal stem cells (MSC) (n=7).

Aneurysmal occlusion after embolization was evaluated at one month with angiography. Histological samples were analyzed with gross imaging and graded based on neck and dome healing on hematoxylin-eosin staining. Fibrosis was evaluated using a ratio of the total area presenting collagen. Endothelialization of the neck was quantitatively analyzed using CD31 immunohistochemistry. Chi-squared and student’s t-test were used to compare groups.

Results: Healing score (11.5 versus 8.0, p = .019), fibrosis ratio (10.3 versus 0.13, p = .0061), and endothelialization (902.262 μm2 versus 14,106 μm2, p = 0.04113) were significantly greater in the MSC group. The MSC group showed marked cellular proliferation and thrombus organization, with a continuous membrane bridging the neck of the aneurysm. Angiographic stable or progressive occlusion rate was significantly lower in the MSC group (0.00, 95%CI: 0.00-0.41) compared to controls (0.67, 95%CI: 0.22-0.96) (p = .02).

Conclusions: Autologous mesenchymal stem cells attached to platinum coils significantly improve histological healing as they result in improved neck endothelialization and collagen matrix formation within the aneurysm sac.

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Vessel Wall MRI in Intracranial Aneurysms with High Rupture Risk Based on PHASES Score

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Purpose: Arterial wall enhancement (AWE) on vessel wall MRI (VW-MRI) might be an indirect imaging marker for inflammation of intracranial aneurysm wall. This study aimed to investigate the potential value of VW-MRI in rupture risk assessment of unruptured intracranial aneurysms.

Materials and Methods: Clinical data and VW-MRI images were retrospectively reviewed in patients with unruptured intracranial aneurysms. PHASES score was calculated for each aneurysm to assess the rupture risk.

Results: 110 patients (40 males and 70 females; mean age of 57.2 ± 10.7) harboring 160 unruptured aneurysms were included in the study. AWEs were present in 62 (58.6%) lesions. Aneurysms with AWE were revealed to be of significantly higher PHASES score (p = 0.001), more irregular shape (p = 0.003) and different distribution of sites (p = 0.023) comparing with aneurysms without AWE. The size and site were independently related with presence of AWE in multivariate analysis. The median PHASES score of AWE group was significantly higher than Non-AWE group (p < 0.001). And as the rising of PHASES score, the proportion of aneurysm with AWE were increased progressively.

Conclusions: AWE was more frequently observed in unreptured intracranial aneurysms with high rupture risk based on PHASES score. Aneurysmal size and site were independently related with the presence of AWE. VW-MRI might be a feasible in vivo method for aneurysmal risk assessment in clinical decision-making.

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Vessel Wall MR (VW-MR) Evaluation of the Aneurysm Wall Enhancement in Unruptured, Untreated Intracranial Brain Aneurysms

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Purpose: The study of intracranial aneurysms has traditionally been done based on their morphologic characteristics using conventional techniques. There is an ongoing interest in being able to better characterize the aneurysms walls and parenting vessels using Vessel Wall MR technique (VW-MR). This technique is used as a complement to conventional techniques in the study of diverse vascular pathologies, from unruptured and ruptured aneurysms to assessing site of vessel biopsy. Our team modified the VW-MR technique to obtain two T1 weighted volumes for reducing the time for screening patients with unruptured brain aneurysms. We present the partial results and characteristics of our ongoing research on Vessel Wall Enhancement in Intracranial Unruptured and Untreated Aneurysms using VW-MR technique.

Materials and Methods: Patients: During the period of February through April 2017, we have recruited 18 patients who underwent aVW-MR as part of a routine study for unruptured and untreated intracranial aneurysms. IMAGING ACQUISITION
CT, AngioCT, DSA were performed on the patient during routine workup, with special attention on the VW-MR using a 3.0 Tesla MR Siemens and a 32 Channels Head Coil. A Multislab sequence is done (3D-TOF-MRA), at the Willis Circle with spot sequences. T2 Turbo Spin Echo (TSE) sequences are done in the axial, coronal and sagittal plane at the site of the aneurysm. Sequence is repeated in the 3 orthogonal planes doing a T1 spin-echo sequence with blood suppression. A T1 3D TSE-SPACE sequence is also obtained. The T1 sequences, 2D and 3D are repeated posterior to the administration of contrast media.

Partial Results: In this preliminary series, 18 patients who underwent VW-MR for unruptured brain aneurysms were recruited (62.1% male), with an age range between 27–71y (x = 54 y). A total of 29 aneurysms were studied. The localization of the aneurysms was mainly of the anterior circulation, with the most common places being Ophthalmic (20.7%) and PCom (17.2%) segments of the ACI, and Sylvian Bifurcation (13.8%). The most common type of aneurysm was the Sacular type (69%). One fourth (24.1%) of the aneurysms studied had a nipple. Aneurysmal wall enhancement was seen in 58.6%. Of these, the ones without nipples were the majority (76.5%), presenting with a complete enhancement. In contrast, 75% of the nippleted ones presented with partial/irregular enhancement wall suggesting differences in wall stability. Significant reduction in time for the acquisition of 3D VW-MR was achieved (<13 minutes compared to 1 hour/artery segment) without any complications.

Conclusion: In this series, the aneurysms with nipple had the most irregular/partial enhancement of their wall, suggesting wall instability in concordance to the known high risk of rupture described in the literature for irregular shaped aneurysms.

The modified 3D VW-MR described in this study is a plausible and safe technique for screening patients with aneurysms.

New hydrophilic stent coating inhibits platelet adhesion in vitro and in vivo

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Purpose: Platelets react to foreign body surfaces and induce blood coagulation. Therefore, during neurovascular interventions with implantation of stents and flow diverters the standard of care includes the dual antiplatelet therapy (DAPT) with ASA and clopidogrel, followed by antiplatelet monotherapy with ASA forever. Although the risk for stent thrombosis is reduced, the risk for hemorrhagic complications increases and there are patients, for which DAPT is not suitable at all. A potential solution for this dilemma is the application of an antithrombogenic coating on the device surface. Such a coating should reduce the thrombogenicity of the implant itself, hence making dual antiplatelet therapy obsolete. This would solve the problem of bleeding and reduce device induced thrombosis as well. The purpose of this study was to develop and evaluate a new hydrophilic stent coating (HPC).

Materials and Methods: NiTi test plates and regular devices were coated with two different hydrophilic polymers (I+II). Coating efficiency was analyzed using the wilhelmy plate method. Platelet adhesion and reaction to the different coatings was examined during whole blood contact (from different donors) in vitro in a chandler loop (devices; n = 5) and in cell culture dishes (NiTi test plates; n = 10). Uncoated NiTi test plates and devices served as controls. In detail, SEM analyses, CD61 immunofluorescence microscopy and platelet function were studied. In order to analyze tissue and healing response in vivo, coated and uncoated devices were implanted in 4 dogs for 3 weeks. Cross sections of the vessels and devices were analyzed histologically. One coating was identified as superior to the other and was used for the coating of pCONUs.

Results: NiTi test plates and devices were coated with different polymers efficiently. Incubation with whole blood revealed a strong inhibition of platelet adhesion for one of the coatings in vitro. After incubation with whole blood in vitro, plates with coating type I (HPC-I) and without coating were completely covered with activated platelets, whereas platelet adhesion on coating type II (HPC-II) was reduced significantly. Both coatings did not evoke adverse effects on the blood itself (red blood cell count, complement activation). Histology revealed no differences between coated and uncoated devices concerning tissue and healing response. Implantation of coated (HPC-II) pCONUs was then performed in 5 selected patients under ASA only without thrombus formation.

Conclusion: A new hydrophilic polymer coating was evaluated, which inhibits platelet adhesion in vitro. Preliminary clinical experience confirms its efficiency when applied on pCONUs and implanted in patients under ASA only.

STAT: Stenting in the Treatment of Aneurysm Trial

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Background and Purpose: The best Endovascular Treatment Technique for Unruptured Intracranial Aneurysms (UIAs) remains controversial. The aim of the presentation is to present the study design of the Stenting in the Treatment of Aneurysm Trial (STAT).

Study Design Overview: The STAT trial is a randomized, multicentre, prospective, controlled trial comparing stenting and coiling using any approved coil, to coiling alone with or
without balloon assistance. The study is currently conducted in 4 centers. Eligible are patients with UIAs with large necks (≥ 10 mm) (STAT1) or with an aspect ratio < 1.5 (STAT2) or with a major recurrence after previous coiling (STAT3). Excluded are patients with recurring, previously stented aneurysms. The entire study aims to enrol 600 patients over a period of 5 years. A minimisation algorithm will be used to ensure balance between treatment arms. Patients will be followed clinically with the modified Rankin Scale at discharge, at 1 month and at 12 months. Follow-up CT-scan or MRI will be performed at discharge. Angiographic follow-up will be performed at 12 months. Adverse events will be recorded as they occur during the 12-month follow-up period. The primary outcome is the recurrence rate and will be assessed by a Core Lab adjudication committee on standardised angiographic projections. Adverse events, morbidity and mortality will be considered as secondary endpoints as well the incidence of in-stent stenosis defined as a reduction of the luminal diameter of ≥ 50%.

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The low profile LVIS Jr Stent in treatment with coiling of intracranial aneurysms.

Initial 21 devices and follow up in a Brazilian single center experience

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Purpose: We presente our experience with low profile stent LVIS Jr in remodeling or jailing technique of unruptured intracranial aneurysms, periprocedural results and follow up. Materials and Methods: We analyzed 21 consecutive devices implanted in 17 patients in the treatment of a total of 22 aneurysms, of the anterior and posterior circulation with technique assisted by coils. Sex, age, location and size of the aneurysm, device type, associated technique, technical difficulty, complication and clinical and angiographic follow up.

Results: Seventeen patients, three male and fourteen female, with a total of twenty-two (22) saccular aneurysms, with twenty-one (21) unbroken and (01) recanalized were recorded. Minimum age of 28 to 82 years, with average of 56 years. All patients were on a double antiplatelet regimen (Aspirin 200 mg and clopidogrel 75 mg). Aneurysms were located in A.com (31.8%), MCA (27.3%), BA (13.6%), A.Ch.A (13.6%) Op.A (4.5%) With diameters ranging from 2.5 to 10.5 mm and a mean of 5.4 mm. In all cases, the LVIS Jr device (Microvention, Tustin, CA) was used, 17 stents with a diameter of 2.5 mm and 3 with a diameter of 3.5 mm. The association of the complementary technique occurred in 100% of cases, Remodeling with single or double Scepter C balloon and / or XC (Microvention, Tustin, CA) occurred in 18 (90%), as well as the jailing technique in 2 (10%). There was no difficulty in navigating, releasing and implanting, with difficulty in conformation (partial opening) of the device and a case of A.Com an (4.7%). In one case (Op.A an) there was a need to implant a second device to contain coils inside the aneurysm sac. The perioperative complication rate was 10%, a device thrombosis at MCA 4 h after the procedure, with re intervention and total recanalization using fibrinolytic and partial thrombosis due to the difficulty of opening the device in A. com with frontal hemorrhage and morbidity (4.5%). All 22 aneurysms in the 17 patients were monitored with DSA between 6 months and 1 year with a 100% occlusion rate of the aneurysms, without stenosis or stent occlusion.

Conclusion: The endovascular treatment of small and large saccular aneurysms using the LVIS Jr Stent device, associated with a complementary remodeling or jailing technique, in our experience represents a safe and effective procedure with a high rate of aneurysmal occlusion in the medium and long term and Low morbidity and mortality rate.

References:

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The influence of stent stiffness on vascular morphology and accompanying hemodynamic changes in intracranial sidewall aneurysms

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Purpose: For wide-necked intracranial aneurysms, stent assisted coiling is a frequently used treatment method. Mechanical properties of stents may have substantial effects on the vascular geometry and therefore on the intra-aneurysmal hemodynamics. A decreased aneurysmal inflow could promote thrombus formation in the aneurysm sac and reduce recurrence rates. The purpose of this study is to quantify morphological changes of parent arteries and accompanying hemodynamic changes in intracranial sidewall aneurysms after stent placement.

Materials and Methods: For 6 patients harboring 6 sidewall aneurysms, 3D rotational angiography (n = 11) and MRA...
Materials & Methods:
A 45-yr-old man presented with symptoms treated in our institution and their outcome. The purpose of this study was to report a case of giant cavernous ICA aneurysm treated with stent graft placement. The intervention was performed at the Department of Interventional Neuroradiology, New Delhi, India.

We retrospectively analyzed DSA records in our Department for 25 patients with giant cavernous aneurysms: Giant Problem – Smart Solution. All patients had treatment records. 5 patients (20%) were treated with surgical techniques. Parent vessel sacrifice with detachable balloons or coils was done primarily for 5 patients (20%). Endosaccular coiling was done in 4 patients (16%), 1 without balloon or stent assistance, 1 with balloon assistance and 2 with stent assistance. In 1 patient where coiling was tried, procedure was converted into parent vessel sacrifice with coils. In 5 patients (20%), flow diverter was deployed. In 6 patients (24%), stent graft was deployed. One of those patients presented with massive epistaxis whom was taken up for procedure with inadequate antiplatelet priming. Due to in-stent thrombosis, procedure was converted to parent vessel sacrifice.

Results: For 2 cases with stents located partially in the extradural space, tortuosity and flow patterns remained unchanged. In the 4 intradural cases, tortuosity decreased with a mean of 56% and flow characteristics changed in 3 cases.

Conclusion: Vessel straightening of the aneurysmal parent artery occurs after stent placement in intradural arteries, and results in differences in aneurysmal flow characteristics in some cases. However, hemodynamic changes vary and the changes in the morphology of the parent artery are hard to predict. A larger population is needed to confirm these findings and to relate induced changes with recurrence rates.

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Endovascular management of intracavernous ICA aneurysms: Giant Problem – Smart Solution
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Purpose:
1. To report a case of giant cavernous ICA aneurysm treated with stent graft deployment.
2. To retrospectively analyze the giant cavernous ICA aneurysms treated in our institution and their outcome.

Materials & Methods: A 45-yr-old man presented with headache & diplopia for 1 year. Imaging revealed partially thrombosed giant cavernous ICA aneurysm in the right side. With the patient not affording, and with an intent to preserve the parent vessel, it was planned to deploy stent graft across the aneurysm. He had a type IB right cavernous carotid artery with relatively less tortuosity favoring the use of stent graft. Post deployment of balloon mounted stent graft, check angiogram showed no filling of the aneurysm, good apposition of the stent graft and no in-stent thrombosis. 4 days post procedure, patient showed complete resolution of his symptoms. Follow up MRI after 2 months showed complete thrombosis of the aneurysm with shrinkage and patent parent vessel.

We retrospectively analyzed DSA records in our Department from January 2011 to April 2017 for all giant cavernous ICA aneurysms which had treatment records. Patients were analyzed for location & size of the aneurysms, mode of treatment, peri-procedural complications, outcome and follow up.

Results: 25 patients with giant cavernous aneurysms had treatment records. 5 patients (20%) were treated with surgical techniques. Parent vessel sacrifice with detachable balloons or coils was done primarily for 5 patients (20%). Endosaccular coiling was done in 4 patients (16%), 1 without balloon or stent assistance, 1 with balloon assistance and 2 with stent assistance. In 1 patient where coiling was tried, procedure was converted into parent vessel sacrifice with coils. In 5 patients (20%), flow diverter was deployed. In 6 patients (24%), stent graft was deployed. One of those patients presented with massive epistaxis whom was taken up for procedure with inadequate antiplatelet priming. Due to in-stent thrombosis, procedure was converted to parent vessel sacrifice. All the patients showed improvement in symptoms, at 4 weeks follow up.

All the patients in the endovascular group had follow up with CTA or DSA. One patient who underwent coiling had recurrence, whom on subsequent follow up showed spontaneous parent vessel occlusion. 5 patients who underwent stent graft deployment (eliminating 1 patient who was subsequently treated with parent vessel sacrifice), had mean follow up of 12 months, with none of them showing recurrence or stent graft occlusion. 5 patients who underwent flow diverter deployment for 6 aneurysms, had mean follow up of 9 months, with all of them showing shrinkage of aneurysm size and normal flow through the flow diverter.

Conclusion: In our experience, relatively cheaper technique of stent graft deployment in selected cases with favorable anatomy has proven to be equally effective as flow diverter deployment with good clinical outcome in long term follow up.

Wednesday, 18th of October, Plenary room – 16:45 – 17:05 – Plenary session 10. – Best paper session

AWARD1
Collateral status set the onset-to-recanalization time window for good outcome
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Objective: We tested whether the probability of good outcome (modified Rankin scale, 0–2) by onset-to-recanalization time (ORT) would differ between good and poor collateral groups.

Methods: We identified all patients who had recanalization success by endovascular thrombectomy for anterior circulation large artery occlusion from the prospectively maintained registries of 16 comprehensive stroke centers between September 2010 and December 2015. Prognostic factors were evaluated. The patients were dichotomized into good and poor collateral groups based on computed tomographic angiography (CTA). We tested whether the probability of good outcome by ORT would be different between 2 groups.
Results: Five hundred fifty-four patients fulfilled enrollment criteria. Age (OR, 0.946; 95%CI, 0.919–0.970; p < 0.001), diabetes mellitus (OR, 0.358; 95%CI, 0.192–0.669; p < 0.001), previous infarction (OR, 0.376; 95%CI, 0.191–0.738; p = 0.004), National Institute of Health Stroke Scale (OR, 0.914; 95%CI, 0.865–0.96; p < 0.004), and previous infarction (OR, 0.914; 95%CI, 0.113–0.822) than in good collateral group (adjusted OR, 0.926 for every 30 minutes; 95%CI, 0.875–0.980).

Conclusion: The likelihood of good outcome by ORT showed significantly faster drop in poor (adjusted OR, 0.944; 95%CI, 0.919–0.970; p < 0.001), and poor collateral (p = 0.0019) groups. The probability of good outcome by ORT showed significantly faster drop in poor (adjusted OR, 0.305 for every 30 minutes; 95%CI, 0.113–0.822) than in good collateral group (adjusted OR, 0.926 for every 30 minutes; 95%CI, 0.875–0.980).

Conclusion: The safety and efficacy of FRED in treating cerebral aneurysms is comparable and not inferior to that of other flow diverters. Anti-platelet regimens are an important component of successful treatment and it is essential to tailor the regimen according to individuals' response to P2Y12 inhibitors. FRED can be navigated and deployed by a single operator which is an essential technical aspect pertaining to its use.
Intra-arterial treatment of brain tumors is different from other tumors in the body, due to the presence of the blood brain barrier, high flow arteries and the risk of stroke. Intra-arterial chemotherapy treatment of glioblastoma has been first attempted in the 1950s, and since then no substantial therapeutic advances have been made. Although there is preclinical and clinical evidence showing increased delivery with intra-arterial drug administration, effective drugs need to be developed to take advantage of this improved delivery method. Central nervous system lymphomas are on the other end of the spectrum, where methotrexate is an effective drug, which may be administered intra-arterially after osmotic blood brain barrier disruption. This technique has been shown to be a viable alternative of higher doses of intravenous methotrexate. The safety of interventional procedures has improved greatly in the past decades, and intra-arterial chemotherapy of brain tumors with or without blood brain barrier disruption can be performed safely. With the introduction of new therapeutics, such as antibody drug conjugates, intra-arterial administration of these large molecules may be beneficial in the future. This presentation is reviewing the literature as well as discussing emerging potentials of intra-arterial anti-tumor drug delivery in the brain.

Wednesday, 18th of October, Plenary room – 17:45 – 18:45 – Aneurysm research

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Minor communicating malapposition has a major impact on aneurysm occlusion after flow diverter implant

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Purpose: Malapposition identified on digital subtraction angiography (DSA) after flow diverter (FD) implant may have a negative correlation to aneurysm healing. Minor malapposition, not visible on DSA, which communicate into the aneurysm can further delay the aneurysm healing. We assessed the impact of communicating malapposition (CM) seen on optical coherence tomography (OCT) and we evaluated the effect of balloon angioplasty (BA) on reversal of communicating malapposition.

Materials and Methods: Elastase-induced aneurysms were created in 50 New Zealand White rabbits. The animals were randomly allocated into 3 treatment groups as follows: Classic Pipeline Embolization Device (cPED, n = 20); Pipeline Embolization Device with Shield technology (sPEDn = 20); or, Flow Reduction Endoluminal Device (FRED, n = 10). Ten animals from cPED and sPED groups and all animals in FRED group were began dual antiplatelet therapy (DAPT; aspirin and clopidogrel 10 mg/kg each), which was continued daily until the terminal endpoint. All animals received post implant OCT, followed by BA and repeat OCT to assess device/vessel apposition. At 30 days, DSA and OCT were acquired to assess aneurysm occlusion and healing. The incidence of CM was assessed on a binary scoring system: 0– CM present; 1–CM absent. Aneurysm occlusion on DSA was measured using a 5-point scale. A score of 3 or 4 (minimal neck remnant or complete occlusion) was considered a positive outcome.

Results: Overall positive aneurysm outcome at 30 days was seen in 50% of cases (n = 25), with no CM seen in 80% of those cases (n = 20). Significant interaction between no CM and positive outcome was confirmed by a Fisher exact test, p = 0.0014. Balloon angioplasty showed improvement in CM status in 9 out of 35 cases of CM, and in 89% of the improved cases showed positive outcome, confirmed by a Fisher exact test, p = 0.0019.

Conclusion: Our preliminary study showed that minor communicating malapposition confirmed by OCT could have a significant negative impact on aneurysm occlusion and would delay the healing process. Ballon angioplasty improved the FD apposition and resulted in a higher aneurysm occlusion rate.

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The Flow Redirection Endoluminal Device (FRED) in treatment of intracranial aneurysms. Initial 28 devices and follow up in a single center Brazilian experience

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Purpose: The use of flow diverter has expanded in its indications with promising results. We present our experience with FRED (Microvention, Tustin, CA) in an initial series with several types of aneurysmal lesions, technical difficulties, results and complications in short follow-up.

Materials and Methods: We analyzed 26 consecutive patients, with saccular, fusiform, Blister and ICA injury, with a total of 28 implanted devices in the anterior and posterior circulation. Sex, age, location, type of lesion, aneurysm size, technical difficulty, associated technique, acute and late complications and clinical and angiographic follow up.
Results: Twenty-six patients, 22 females and 4 males. Saccular aneurysms were 20 (77%), BBLA 3 (11.5%), reco-
nalized aneurysm 1 (3.8%), fusiform 1 (3.8%) and ICA injury 1 (3.8%). Minimum age of 25 to 74 years, with a mean age of 55 years. All the elective cases were on a double platelet antiplatelet regimen (Aspirin 200 mg and clopidogrel 75 mg), except one of the BBLA hyperacute cases and one case of ICA injury. The lesions were located in the anterior circulation in 96.2% and vertebral basilar in 3.8%, ranging in size from 3.5 to 26 mm in diameter. The technique asso-
ciated with coils was used in 2 cases (7.6%) of partially thrombosed aneurysms, as well as the need for angioplasty using the Scepter C balloon (Microvention, Tustin, CA) in 3 cases (11.5%). Acute complications were 2 cases (7.6%) of stent thrombosis, with recanalization after fibrinolytic use. A case of shortening of the device and need for retreatment (3.8%), two cases of occlusion of the device (7.6%) but with no clinical repercussion were found. We also observed inti-
mal hyperplasia <50% in DSA control in 3 cases (11.5%). There was one case of death (3.8%) due to severe cerebral ischemia after device thrombosis.

Conclusion: This initial series showed the possibility of using FRED in several types of aneurysms. The FRED system was technically easy to deploy. The ability of the to be recaptured after partial deployment and to maintain its internal shape in tortuous vessels was demonstrated well. In cases with large differences in pre and post aneurysm arterial diameter, there is difficulty in choosing the size of the device. Index of late aneurysmal occlusion compatible with other FD, but with an apparent increase of cases of intimal hyper-
plasia in this series.

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Innovations in Endovascular Treatment Strategies for Large Carotid Cavernous Aneurysms – The Safety and Efficacy of a Flow Diverter

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Purpose: Conventional coil embolization for large carotid cavernous aneurysms (CCAs) has a limit because of the insufficient results for the prevention of recurrence and for the reduction of mass effect. Although trapping of parent artery may be the most radical treatment, it also has a risk of ischemic complications due to the intracranial perforation disorders associated with external–internal arterial bypass. We successfully treated 20 patients with large CCAs using flow diverter (PipelineTM embolic device: PED) and discuss about its safety and efficacy.

Clinical Material and Methods: Twenty patients including 19 female, mean age 71.3 years old, with large CCAs sized in more than 10 mm of maximum diameter including 4 giant ones, were treated with PED over three years. Under the sufficient dual antiplatelet management PED was deployed over the orifice of the aneurysm, and post-
dilatation with micro-balloon for the good stent apposition was performed in all cases. Two patients required multiple, telescoping stents. Clinical and radiological states with MRI were checked in 1, 3 and 6 months, respectively. Angiographic follow-up was performed at 6 months.

Results: In all patients PED was appropriately deployed. Post-angiogram showed the stagnation of contrast with eclipse sign in 17 cases. One patient with difficult giant aneurysm requiring 5 telescoping stents encountered temporary ischemic symptoms due to the complicated pro-
cedure. Of 15 patients with ocular motor impairment defi-
ciency improvement of symptoms are seen in 11 patients including 6 patients with cure in 3 to 6 months follow-up. However, 4 patients demonstrated temporary worsening at 2 weeks after the treatment, which recovered within 3 months. Angiogram of 6 months follow-up showed com-
plete occlusion in 64% (7/11) of patients, and MRI showed reduction of aneurysm volume in 82% (9/11).

Conclusion: Flow diverter for large CCAs promised clinical and radiological efficacy in our case series. It can shrink the aneurysm and improve the symptoms due to mass effect without sacrificing the parent artery. It will be necessary to summate the cases and to verify the long-term results.

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Wall apposition is more important than mesh density in flow diverters

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Purpose: Computational and experimental studies dem-
strate improved efficacy of flow diverters (FDs) with higher implant mesh density (number of pores per mm2). Animal studies are less conclusive as some show a beneficial effect, while others show no effect of mesh density at all. Recently, implant malapposition was strongly associated with incomplete occlusion after FD therapy. We therefore
set two goals in the current study: 1) whether there is a relationship between FD mesh density and aneurysm occlusion, 2) whether there is a relationship between FD wall apposition and aneurysm occlusion.

**Materials and Methods:** A decellularized aneurysm was microsurgically created in the abdominal aorta of 36 Wistar rats. Of these 36 animals, 12 received a low mesh density FD (24 wires, porosity 80%, mesh density of 10 pores / mm²), 12 rats received a high mesh density FD (36 wires, porosity 70%, mesh density of 23 pores / mm²) and 12 control rats did not receive a FD. Six animals from each group were sacrificed at two different time points: 1 month and 3 months after surgery.

Tissues from control rats were embedded in paraffin and sectioned with a microtome. All tissues were subsequently subjected to haematoxylin and eosin staining. Through histology we determined the following parameters: aneurysm occlusion, aneurysm filling (%), strut apposition, and average distance from malapposed struts to artery wall. All statistical analyses were performed using GraphPad Prism. Statistical significance was set to p < 0.05.

**Results:** After 1 month of follow-up, total aneurysm occlusion was seen in 0/6 animals in the control group, 2/6 animals in the low mesh density group and 1/5 animals in the high mesh density group. After 3 months of follow-up was seen in 0/6 animals in the control group, 2/6 animals in the low mesh density group and 1/5 animals in the high mesh density group.

The average aneurysm filling at 1 and 3 months combined was 49.7% (SD ± 19.8%), 96.4% (SD ± 6.0%) and 96.8% (SD ± 6.1%) for the control group, the low mesh density implant group and the high mesh density implant group, respectively. Both the low mesh density and high mesh density implant groups statistically differed from the control group (Dunn’s multiple comparison test, p < 0.05), but not from each other.

The average number of malapposed struts at 1 and 3 months combined was significantly higher in the non-occluded aneurysms (7.7 ± 2.6, n = 12) than in the occluded aneurysms (4.4 ± 1.9, n = 11) (Unpaired t-test, p = 0.0023). The average distance between the malapposed struts and artery wall was also larger in the non-occluded aneurysms (48.7 µm ± 18.8 µm) than in the occluded aneurysms (33.9 µm ± 11.5 µm) (Unpaired t-test, p = 0.0352).

**Conclusion:** In this animal study, FD wall apposition was more important than mesh density for achieving full aneurysm occlusion.

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**Retreatment of residual aneurysms after flow-diversion: An experimental study**

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**Background:** Flow diverters (FDs) are increasingly used to treat aneurysms. The management of aneurysms that fail to occlude following FD is problematic. We aimed to reproduce FD failures in an animal model to explore various management strategies.

**Methods:** Twenty wide-necked aneurysms were created at the carotid-lingual bifurcation in 10 canines, and treated with FDs 4–6 weeks later. Follow-up angiography was performed at 3 months. Suitable residual aneurysms were randomly allocated: retreatment with FDs (n = 6), injection of liquid embolic between two layers of FDs (n = 4), or no retreatment (n = 2). Angiography was repeated 3 months later, followed by euthanasia, stereophotography and pathology.

**Results:** Patent wide-necked aneurysms were produced in 17/20 attempts (85%); 3 months after initial FD treatment there were 15/17 (88%) residual aneurysms. In 3 cases, the device had prolapsed into the aneurysm, leaving 12 aneurysms for the retreatment study. The two untreated residual aneurysms remained unchanged at 6 months. Retreated aneurysms (3/6 with FD and 3/4 with FD + PHIL) showed improved angiographic results at 6 months (median score of 2; P = 0.03), but residual aneurysms were still present in all cases. Parent artery occlusion occurred in 2 aneurysms treated with FD + PHIL. At pathology, aneurysms were empty or partially filled with thrombus; leaks were found in the neointima covering FDs, connecting the arterial lumen to residual aneurysms.

**Conclusion:** Failure of flow diversion can be reproduced in canine models. Retreatment of residual flow-diverted experimental aneurysms with additional FDs, even when supplemented with liquid embolic agents did not lead to aneurysm occlusion.

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**AMD3100 accelerates reendothelialization of neointima formation in rabbit saccular aneurysm after flow diverter treatment**

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**Purpose:** To investigate the role of AMD3100 that acts as an antagonist of SDF-1/CXCR4 in the neointima repair in rabbit saccular aneurysm after flow diverter (FD) treatment.
Materials and Methods: Saccular aneurysm models of New Zealand White Rabbits were established by using porcine pancreatic elastase. Three weeks later, FDS of Tubridge were implanted into the saccular aneurysm models. All the treated models were divided into two groups: AMD3100 group was subcutaneously injected with AMD3100 5 mg/kg per day, while control group was injected with saline. Two and four weeks after FD treatment, morphology and thickness of the neointima were investigated by using hard tissue section and masson trichrome staining. Simultaneously, scanning electron microscope (SEM) was used to detect the number of endothelial-like cells and fluorescence quantitative PCR was used to determine mRNA expression level of molecular biomarkers of the neointima, such as KDR, VE-cadherin, CD34, Tie2.

Results: At two and four weeks after FD treatment, SEM results showed that AMD3100 group had more endothelial-like cells than that in control group in the neointima. Masson trichrome staining showed that the intima in the AMD3100 group was more intact than that in the control group. Furthermore, the PCR results demonstrated the increased mRNA expression level of KDR, VE-cadherin, Tie2 in the neointima in AMD3100 group compared with control group.

Conclusion: Interval use of AMD3100 promotes the neointima repair of rabbit saccular aneurysm and facilitates the endothelialization of the neointima after FD treatment.

Wednesday, 18th of October, Session room 1. – 07:15 – 08:00 – Back to the basics: DAVF – evolution and occlusion

Evolution of DAVF

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Endovascular treatment of DAVF

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Can blister-like aneurysm disappear?
Spontaneous occlusion of a side wall basilar aneurysm. Case report and review of the literature

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Purpose: Blister-like aneurysms (BLA) are rare lesions with high morbidity and mortality. Among them those located at the basilar artery are unusual and the reports scarce. Irrespective from the site of origin these kind of lesions have a common appearance: they can be saccular or resemble a shallow bulge from the arterial surface, usually have broad neck and small dimensions at the moment of diagnosis but can rapidly grow. They also have very high risk of recurrence after treatment and very high risk of rebleeding. These lesions that usually grow in time and very often rebleed but we couldn’t find any report describing regression and spontaneous healing. We describe a case of a basilar artery BLA that spontaneously regressed and disappeared on follow up. We couldn’t find the lesion anymore and the basilar artery wall reshape, with short-term changes or enlargement of the sac. We found an enlargement of the lesion at first but then the aneurysm disappeared on follow up.

Conclusions: To our knowledge there haven’t been previous reports of a decrease in size or spontaneous regression of such a lesion. Maybe these lesions are not a single subtype of aneurysms but a spectrum of different histological entities some of which have a benign course. We think that vessel wall imaging may help to stratify the relative risk and tailor the treatment strategy.

Treatment of ruptured blister and blister-like aneurysms with flow-diverters: a dual centre experience

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Purpose: Treatment of ruptured blister and blister-like aneurysms is difficult with coiling or surgery and result in frequent regrowth, rebleeding and high fatality rate. Due to the pure endoluminal arterial reconstruction, flow-diverters (FDs) may represent a promising treatment option. Due to double anti-aggregation therapy combined with time needed for aneurysmal occlusion, it is controversial how safe FDs are in acute subarachnoid haemorrhage (SAH). We analysed safety and effectiveness of FD in acute phase of ruptured blister and blister-like aneurysms.

Materials and Methods: All patients (pts) with ruptured blister and blister-like aneurysms treated with FD from 04/2008 to 02/2016 at the University Hospital of Heidelberg and of Cologne were retrospectively analysed. Aneurysmal occlusion rate (Raymond grading scale), flow-diversion rate (O’Kelly Marotta grading scale - OKM), SAH Hunt & Hess (H&H) grade, complications and clinical outcome (mRS) at discharge and follow-ups were analysed.

Results: 15 pts were identified (f/m:9/6; mean age: 49 ± 14y; SAH H&H-grade: I: 7 pts, II: 3 pts, III: 3 pts, IV: 2 pts; in 11 pts the aneurysm was located in the anterior circulation) with 2,5 ± 0,9 mm mean maximal aneurysmal diameter, 2,3 ± 0,9 mm mean neck diameter and follow-up with DSA, Flat-Panel CT and/or MRI until complete aneurysmal occlusion. 1 pt died due to hydrocephalus during the acute phase. Pontine ischemia with complete recovery occurred in 1 pt with FD in basilar artery. At 6 months 13 pts had mRS = 0. Complete occlusion of the aneurysm (Raymond 1; OKM D) occurred in all pts: 3 immediately after FD implantation, 10 in ≤ 6 months, 1 in ≤ 12 months, 1 ≤ 32 months). Implantation of a second FD was necessary in 3 pts, due to subacute growing aneurysm (2 pts) and failed occlusion after 24 months (1 pt). No rebleeding occurred.
Conclusion: Implantation of FD acutely in ruptured blister and blister-like aneurysms seems to be safe and effective. Multicenter-studies with larger patient cohorts are necessary to confirm and validate these results.

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Short-segment Internal Trapping for A Symptomatic Thrombosed Large Fusiform Vertebra Artery Aneurysm: Vermicelle technique

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Purpose: Internal trapping with coil for symptomatic large vertebral aneurysms is already established as treatment of the first choice. However, when perforators arise nearby neck of aneurysm, parent artery occlusion has high risk, and some kind of solution is necessary. In those cases, we tried treatment by performing watertight trapping of short segment using NBCA and coil.

Material and Methods: At the beginning, peri-aneurysmal ASA or perforators are detected by high-resolution 3DRA and MPR. Double micro catheters are advanced to the distal part of the aneurysm through 7F balloon guiding catheter. Some quantity of coils are placed in distal part and then 25–33% NBCA is injected in that coil mass with preserving of those branches. Same maneuver is repeated in proximal part. In the aneurysm, Coil should not be inserted or even if coil is inserted into aneurysm we keep it in small quantities to avoid mass effect worsen.

Results: Case 1 is a 53-years-old male, a right VA thrombosed aneurysm about 25 mm including thrombosis which onset was Wallenberg syndrome. ASA and perforators were originated from the peripheral parent artery. Case 2 is a 51-year-old male, right VA thrombotic aneurysm of about 11 mm that developed with lower limb paralysis. Similarly ASA and perforators were arisen. In both cases, short distance internal trapping was necessary; we performed with NBCA and coils. Both symptoms improved after treatment, and MRI after six months confirmed size reduction.

Conclusions: In the case of symptomatic large vertebral aneurysm, when the distance from the lesion to the important perforator is extremely short, it was considered that the mother vessel occlusion combined with coil and NBCA is useful.

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Clinical and Angiographic Follow-Up Results of Endovascular Coiling using Triple Microcatheters for patients with relatively Wide-necked Aneurysm in Parent Artery Less than 1.5 mm in diameter

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Purpose: To evaluate the usefulness of endovascular coiling with triple microcatheters (Triple microcatheter technique) to treat relatively wide-necked and overriding aneurysm in parent artery less than 1.5 mm in diameter

Materials and Methods: Triple microcatheter technique was performed in 25 patients (M:F = 10:15, mean age: 60 years, range: 28–82) in our institution between Jan.2013 and April 2017. Clinical presentations were acute subarachnoid hemorrhage in seven patients and unruptured aneurysm in 18. Lesion locations were as follows, eight in M1 segment, six in M2 segment, seven in anterior communicating artery, one in A2 segment, two in PICA, and one in posterior communicating artery.

Triple microcatheters were deployed for coil delivery in all 25 patients.

Results: Immediate angiographic results consisted of total occlusion in seven patients, near-total occlusion in 12, and subtotal occlusion in six.

There was one complication related to thrombi in petrous ICA during procedure, resulting in hemiparesis. There was no procedure-related morbidity or mortality in the other patients. Angiographic follow-up (mean: 9 months, range: 1–40) was achieved in 18 patients. Follow-up angiograms showed total or near-total occlusion in 14 patients and partial recanalization in four patients. Additional endovascular treatment was performed in two patients (1 stent-assisted coiling and 1 triple microcatheter technique, respectively). Clinical follow-up was available in all patients (mean: 16.6 months, range: 1–44). There was no newly developed neurologic event or rebleeding in all patients.

Conclusion: Endovascular coiling with triple microcatheter technique could be an effective and safe treatment option of the relatively wide-necked small aneurysm in small parent artery less than 1.5 mm in diameter.

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Features and results of endovascular treatment of ophthalmic segment aneurysms

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Purpose: to select the optimal tactic for endovascular treatment of patients with aneurysms of the ophthalmic segment of the internal carotid artery (ICA).

Materials and Methods: in the department of vascular neurosurgery from 07/2014 to 05/2017, 96 patients with aneurysms of the ophthalmic segment of the ICA were treated by endovascular method. Male were 14 (14.5%), female is 82 (85.5%). The size of an aneurysm less than 5 mm was 38 (39.6%), from 6 mm to 14 mm - 48 (50%), from 15 mm to 24 mm - 7 (7.3%), ≥25 mm - 3 (3.1%). 25 (26%) patients had tandem aneurysms located on this segment of the artery. According to the Wang Y classification (2013), the type I was in 59 (61.5%) patients, the type II was in 37 (48.5%).

Results: 111 operations were performed. Of these, 8 (7.2%) operations by using only coiling, 38 (34.2%) interventions by coiling with assistant techniques, and 56 (50.6%) operations using flow-diverter stents. The outcome was following: mRS-0-1 in 89 (92.7%), mRS-2 is 5 (5.3%) and mRS-4 is 1 (1%) patient. 1 patient died, mortality rate is 1%. In the group of coiling or assisted coiling techniques in the long-term period the total occlusion of aneurysm (Raymond I) was achieved in 29 (88%) and subtotal (Raymond II) in 4 (12%) cases. After 6 months follow-up in FD group, total occlusion was achieved in 32 (72.8%), subtotal aneurysm thrombosis in 4 (9%), partial thrombosis in 8 (18.2%) cases. In 34 (30.6%) patients, long-term results are not available at the moment. One postoperative complication (0.9%) associated with asymptomatic in-stent thrombosis of the FD stent, 2 (1.8%) cases of intraoperative thromboembolic complications, 1 (0.9%) case of parenchymal hemorrhage unrelated with aneurysm which led to fatal outcome.

Conclusions: the choice of the optimal method of endovascular intervention based on the geometric characteristics of the aneurysm of the ophthalmic segment of the ICA allows to improve the efficiency of treatment of this group of patients by increasing the rate of aneurysm occlusion without worsening the clinical outcome of the treatment.

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Low dose 3D rotational angiography for intracranial aneurysm: analysis of image quality and patient radiation dose

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Purpose: The purpose of this study was to evaluate image quality of low radiation dose rotational 3D rotational angiography (RA) and effectiveness of clinical implementation of low radiation dose 3D RA in diagnostic procedures for intracranial aneurysms.

Materials and Methods: Retrospective review of the prospectively collected database of the 146 patients (45 male, 101 female, median age, 60 years; range, 20–82 years) from October to December 2015 (group 1) and from June to August 2016 (group 2) was performed. For group 1, standard manufacturer setting (5 s 0.36 μGy/f) for dual-rotational 3D-DSA has been used for 3D RA. For group 2, 3D RA was performed using single-rotational 3D-DSA protocols by lowering dose per frame (5 s 0.10 μGy/f). Subjective image quality assessment of 79 standard and 68 lower radiation dose 3D RA was performed in a randomized, blinded evaluation of volume rendered (VR) reconstruction images, using a 5 point scale. Between two groups, subjective image quality scores of 3D RA were analyzed using noninferiority statistics. Patient radiation exposure was quantified using cumulative dose area product (DAP) in Gy-cm2 and cumulative air kerma (AK) in Gy, and these were statistically compared in two groups.

Result: Image quality of the low radiation dose 3D RA was not inferior, as demonstrated by the 95% confidence interval of the difference, which did not cross the pre-defined non-inferiority margin of -0.1. For the evaluation of single vessel by 3D RA, mean DAP and AK were 5.76 Gy-cm2 and 0.056 Gy in group1 and 1.16 Gy-cm2 and 0.013 Gy in group2 (80% and 77.2% reduction for DAP and AK, respectively). Total patient radiation doses (DAP and AK) during cerebral angiography including 3D RA were also decreased from 59.15 Gy-cm2 to 46.07 Gy-cm2 for DAP (22.2% reduction), and from 0.510 Gy to 0.425 Gy for AK (16.7% reduction).

Conclusion: Low radiation dose 3D RA maintained image quality, and implementation of low dose 3D RA significantly contributed to the reduced radiation doses of patients with diagnostic procedures for intracranial aneurysm.

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Correlation of Vessel Wall MR Features of Intracranial Vertebral Artery Dissection to Intravascular Ultrasound Findings

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Purpose: To correlate several features of vessel wall MR imaging of intracranial vertebral artery dissection (VAD) to intravascular ultrasound (IVUS) findings

Materials and Methods: Vessel wall MR study (3D variable refocusing flip-angle volume isotropic turbo-spin-echo acquisition, VISTA TI and PD using 3.0T) was performed in 243 patients with fusiform and/or stenodilation on CT angiography between May 2015 and January 2017. Among these patients, stent deployment for dissection was performed in 26 patients and poststen vessel wall MR images were also obtained in 16 of 26 patients.
Post-embolization Dual Energy CT (DECT) of brain: frequently noted contrast enhancing areas after endovascular treatment of unruptured intracranial aneurysm

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Purpose: The usefulness of dual energy CT (DECT) of brain has been reported, because of its ability to differentiate contrast from hemorrhage through three-material decomposition. In our institution, DECT has been adapted to our routine practice, and every CT exam after endovascular procedure (regardless of procedure type; aneurysm treatment, arteriovenous malformation treatment, or carotid stenting) is being performed in dual-source, dual-energy CT system (Definition FLASH & Force, Siemens, Forchheim, Germany).

The purpose of this study is to share our institutions experience on dual energy CT (DECT) of brain specifically after endovascular treatment of unruptured intracranial aneurysms, and to explore variables affecting transient BBB disruption noted as contrast enhancing areas on post-procedure DECT.

Materials and Methods: Between June of 2016 and April of 2017, all post-endovascular procedure brain CT (regardless of type of procedure) images were obtained with DECT scan. Among 83 cases of unruptured intracranial aneurysms treated with endovascular treatment, 6 cases were excluded for time interval exceeding one hour between the last angiography time and the post-procedure DECT acquisition. By reviewing virtual non-contrast (VNC) images and iodine map images, presence, degree, and location of contrast enhancing areas were determined. Variables that might influence BBB disruption are tested to see if they are correlated with the presence of contrast enhancement.

Results: In 61% of the cases (47/77), at least subtle (to global) gyral/sulcal contrast enhancement was seen in the corresponding territory of the treated aneurysm. Number of 2D angiography (contrast injections) acquired during the procedure, and the patient's age were significantly correlated with presence of contrast enhancing areas after procedure.

Conclusion: Contrast enhancing area – considered as transient BBB disruption – is a frequently encountered CT finding after endovascular treatment of unruptured intracranial aneurysms. It can be easily identified in DECT images immediately after the procedure, and is correlated with number of angiography run (contrast injection amount) during the embolization.
after treatment. We also selected patients with a known residual IA after FD treatment. These patients were included at their regular follow-up moment. Patients receiving FD treatment for an earlier coiled aneurysm were excluded from this study.

Full brain sCTA was performed on a wide detector CT system (320-row detector CT scanner, Aquilion One Vision; Toshiba Medical Systems). A low dose non-enhanced volume acquisition was followed by a contrast enhanced volume CTA using 50 mL contrast agent. Iterative and noise reduction filters, single energy metal artifact reduction (SEMAR) and SUREstoration algorithms were applied.

DSA was performed on a flat-panel C-arm angiography system (Allura Xper FD20; Philips Healthcare). Standard posteroanterior, lateral, 3D and detailed 2D acquisitions were made. An average of 50 mL of contrast agent was used.

sCTA and DSA studies were performed within one day. Imaging was independently scored by two clinicians. Aneurysm occlusion (Raymond scale) was our primary parameter. Sensitivity and specificity of sCTA compared to the DSA was assessed using McNemar’s test for paired binomial data.

Results: A total of 13 patients (8 women and 5 men) were enrolled in this study. Six patients were newly treated and received early follow-up imaging 1 month after treatment. The remaining patients (n = 7) had a known aneurysm remnant and were included at their regular follow-up moment. All patients were treated with a Surpass FD (Surpass FD; Stryker Neurovascular). In all cases (n = 13), sCTA and DSA provided adequate diagnostic image quality. A total of 9 aneurysm remnants (7 residual aneurysms and 2 neck remnants) were demonstrated by both sCTA and DSA.

The sensitivity and specificity of sCTA for the detection of aneurysm occlusion was 100% (95% CI = 63.06%–100%), 100% (95% CI = 81.47%–100%) for the first and the second reader, respectively. Agreement between readers was perfect (Kappa = 1.0). The smallest neck remnant detected on sCTA was 1.3 mm.

Conclusions: The diagnostic accuracy of sCTA proved to be comparable to angiography for the evaluation of aneurysm occlusion after FD treatment in this prospective case-cohort study.

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MRA for follow up of aneurysms after treatment with flow diverter stents

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Purpose: To evaluate the accuracy of MRA follow-up in patient with cerebral aneurysms treated with flow-diverter stents

Materials and Methods: 16 patients with lateral or bifurcation aneurysms treated with flow-diverter stents (with and without coils) underwent 1.5T MRA with Gadolinium after endovascular treatment. DSA at time of treatment and MRA at 6 months were used as baseline. Follow up at 1 year included MRA and DSA. Two independent experienced interventional neuroradiologists compared DSA and MRA at 1 year to baseline and to each other. Evaluation included evaluation of aneurysm occlusion as well as of the parent artery for patency and stenosis.

Results: 12 ICA, 1 MCA bifurcation and 3 posterior circulation aneurysms were included. 9 of the aneurysms were treated by FD stents alone and 7 by stent and coils. On MRA 13/16 aneurysms were completely occluded, 2/16 partially occluded and 1/16 unchanged from baseline. On DSA, 11/16 aneurysms occluded, 4/16 were reduced in size and 1/16 was unchanged. Comparison of MRA to DSA showed no significant differences (p > .05). Concerning the patency of the stented parent artery, there was not discrepancy of findings between the MRA and the DSA. Both modalities detected stent occlusion in 1 case, mild in stent stenosis in 1 cases and complete patency in 14/16 patients.

Conclusion: MRA with Gadolinium is accurate in evaluating the occlusion rate of cerebral aneurysms treated with flow-diverter stents (with or without additional coils). It is also accurate in evaluation of the stented parent artery. The clear advantage of MRA is its non-invasive nature.

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Mechanical recanalization using Solitaire AB device for severe thromboembolic events in endovascular treatment of intracranial aneurysms

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Introduction: Severe thromboembolism with complete occlusion of the proximal arteries during or after coil embolization can cause serious neurological deficits. The study aimed to assess the effectiveness and safety of Solitaire AB device as a rescue therapy for severe thromboembolic complications in the endovascular treatment of intracranial aneurysms.

Materials and Methods: Between February 2013 and April 2016, 1047 intracranial aneurysms treated with endovascular procedures were retrospectively reviewed in our center. Severe thromboembolisms occurred in 10 patients and were treated by Solitaire AB device including clot retriever and permanent stent deployment.

Results: The location of arterial occlusion was distal to the aneurysm rather than the coil/parent artery interface or in-stent area. Four patients had distal thromboembolic events before coil embolization, and six patients had it after coiling. The complete arterial recanalization (TICI 3) was achieved in all patients and no cerebral hemorrhage was related to the procedure after the rescue therapy. Among these patients with the aforementioned neurovascular procedures, the mean Glasgow outcome scale (GOS) score was 4.5
Wednesday, 18th of October, Session room 1 – 17:45 – 18:45 – Parallel abstract session - Aneurysm clinical: Imaging, Outcomes, Miscellaneous

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Angiographic and clinical long-term follow-up in patients with acutely ruptured aneurysm undergoing web treatment

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**Background:** Wowen EndoBridge (WEB) is a novel device for the treatment of ruptured and unruptured aneurysm. Long and short-term follow up has evaluated the safety and feasibility of the WEB device in unruptured aneurysm. To our knowledge only short-term follow-up of the WEB device has been evaluated in patients with ruptured aneurysm. In the present study we present for the first time long-term follow data for patients treated with WEB in ruptured aneurysm.

**Material & Methods:** From September 2013 to October 2016 39 patients presented with an acute ruptured aneurysm and was treated with a WEB device. 5 males and 35 females with a mean age of 59 years (range 30–88 years). 5 patients died before follow-up. Three patients did not have follow-up due to cognitive impairment. 6 patients are waiting long-term follow-up. One patient was retreated 7 months after initial treatment with coils due to a large neck remnant. Follow-up modality was either MRA or DSA with a 3D-DSA (or both). Mean follow-up time was 13 months (range 8.3–26.0 months). The majority of the aneurysms were located in the ACOM (9 patients), PCOM (7 patients) and basilar artery (3 patient). 24 patients had long-term follow-up.

**Results:** The mean neck size of the aneurysm was 4.2 mm (range 2.0–7.0 mm). Mean treatment time was 63 min (23–127 min). In four patients a remodeling device (balloon in three aneurysms and stent in one) had to be used. Two patients had deficits probably related to the WEB treatment. 6 patients had deficits not related to the procedure and the rest did not have any deficits. 14 patients did not have any neck remnant (100% occlusion), on the follow-up 9 had a small a neck remnant (>90% occlusion) and one patient had a growing neck remnant and were treated successfully with a flow diverter.

**Conclusions:** These results demonstrate that mechanical recanalization using Solitaire AB device seems to be effective and safe as a rescue therapy for severe thromboembolic events during cerebral aneurysm embolization.

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Development and Validation of the Procedure-Related Neurologic Complications Risk Score for Elderly Patients with Ruptured Intracranial Aneurysm Undergoing Endovascular Treatment

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**Purpose:** Our aim was to develop and validate a procedure-related neurologic complications (PNC) risk score for individual elderly patients with ruptured intracranial aneurysms undergoing endovascular treatment (EVT).

**Materials and Methods:** Preoperatively collected data, including clinical, lesion, and procedure characteristics of consecutive elderly patients (≥60 years), were used to develop a PNC risk predictive score based on the coefficients (β) of a multivariable logistic regression analysis. The PNC included intraprocedural rupture, thromboembolic events, and rebleeding within 30 day after EVT.

**Results:** Overall, 519 eligible patients who underwent EVT were enrolled. At 30 days, the PNC rate was 13.08%. Six risk factors were independently associated with PNC and comprised the PNC score (PNC score, 0–16 points): hypertension (2 points), Hunt-Hess grade ≥3 (3 points), Fisher grade ≥3 (2 points), wide-necked aneurysm (2 points), with a bleb on the aneurysm sac (3 points), and aneurysm-size (3–10 mm, 1 point; <3 mm, 4 points). The PNC score model predicted the risk of PNC at a sensitivity of 63.22% and specificity of 84.79%. Moreover, the PNC score demonstrated significant discrimination (area under curve, 0.799; P < 0.001) and calibration (Hosmer-Lemeshow test, P = 0.319). Excellent prediction, discrimination, and calibration properties were reproduced by the internal validation group with bootstrapping techniques.

**Conclusions:** The PNC score can be an easily applicable tool for predicting the risk of PNC for individual elderly patients with ruptured intracranial aneurysms undergoing EVT. Our study provides large case-based evidence supporting the integration of individual clinical, lesion, and procedure characteristics to predict PNC risk.
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Long-term outcomes of coiled unruptured intracranial aneurysms: followed for up to 20 years

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Object: Long-term follow-up results of coiled unruptured intracranial aneurysms (UIAs) remain unclear. We aimed to analyze the frequency of rupture, re-treatment, stroke, and mortality of patients with coiled UIAs followed for up to 20 years at multiple stroke centers.

Methods: We retrospectively analyzed patients who underwent coil embolization between 1995 and 2004 at 4 stroke centers. To collect the late (≥1 year) follow-up data, postal questionnaires were used to assess whether patients had experienced rupture or re-treatment of a coiled aneurysm, any strokes, or death.

Results: Overall, 184 patients with 188 UIAs were included. The median follow-up period was 12 years (interquartile range, 11–13), and the maximum was 20 years. A total of 152 UIAs (81%) were followed for more than 10 years. The incidence of rupture was 2 in 2122 aneurysm-years (annual rupture rate was 0.09%). Nine of the 188 subjects with coiled UIAs (4.8%) underwent additional treatment. In 5 of the 9 re-treatments, the first re-treatment was performed more than 5 years after the initial treatment. Large aneurysms were statistically more likely to require re-treatment. Nine strokes occurred over the 2122 aneurysm-years. Seventeen patients died in this cohort.

Conclusions: Our study demonstrates low risk of rupture of coiled UIAs with long-term follow-up periods of up to 20 years. This suggests that coiling of UIAs could prevent rupture for a long period of time. However, large aneurysms might need to be followed for a longer time.

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Clinical outcome of Ruptured Aneurysm Treatment in the US: National Inpatient Sample Data (NIS) analysis

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Purpose: After ISAT publication in 2002, coiling has been an alternative option to clipping for ruptured cerebral aneurysm treatment. However, clinical outcome study regarding ruptured intracranial aneurysm treatment across the US with multi-institutional, non-trial based large scale is rare. We compared clinical outcome measures (COMs) between coiling and clipping as well as COMs trend over time.

Materials and Methods: NIS data from 2007 to 2013 in the US were queried to extract ruptured cerebral aneurysms that were treated with either coiling or clipping. Clinical outcome measures (COMs) included in-hospital mortality (IM), postoperative stroke (pS), combined mortality and stroke (cMS), all in-hospital complications (aIC) and home discharge rates (HD). Multivariable logistic regression and propensity score matching (PSM) adjusted for demographic, clinical, and disease severity measures were used to compare COMs between coiling and clipping. The volume-outcome relationships on COMs and annual trend of COMs were also assessed.

Results: Adjusting for case mix, coiling was associated with significantly lower rates of pS and cMS and a higher rate of HD (p < 0.05). Clipping had lower aIC than coiling which was statistically significant (p < 0.05). Clipping had lower IM (10.8%) than coiling (12.2%) without adjustment, however, the difference was reversed after PSM (estimated 1.2% higher rate of mortality for clipping), although not statistically significant (p = 0.20). Increasing case volume correlated with decreasing IM, cMS and increasing HD in the clipping group (p < 0.05) but no significant differences in the coiling group. Coiling showed improvement in IM and cMS during the observed time period (p < 0.05) but clipping did not. HD rates in the clipping group decreased and aIC rate increased over time in both cohorts (p < 0.05).

Conclusion: Coiling demonstrated better or equivalent COMs comparing to clipping in ruptured cerebral aneurysm patients in our study. Limitations of the study include the observational nature of the data and the potential for unobserved confounders and selection bias.
Preliminary Results from the ISAT-2 Trial

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Background: The International Subarachnoid Aneurysm Trial (ISAT) demonstrated improved one-year clinical outcomes for patients with ruptured intracranial aneurysms treated with endovascular coiling compared to surgical clipping. Patients included in ISAT were mostly good grade subarachnoid hemorrhage (SAH) patients with small anterior circulation aneurysms. The purported superiority of coiling is commonly extrapolated to patients not studied in the original trial or to those treated using new devices not available at the time. Conversely, many patients are treated by clipping despite ISAT, because they are thought either to be better candidates for surgery, or to offer more durable protection from aneurysm recurrences. These practices have never been formally validated. Thus, for many ruptured aneurysm patients the question of which treatment modality leads to a superior clinical outcome remains unclear.

Methods: ISAT II is a pragmatic, multicenter, randomized trial comparing clinical outcomes for non-ISAT patients with subarachnoid hemorrhage allocated to coiling or clipping. Inclusion criteria are broad. The primary end-point is the incidence of poor clinical outcome (defined as mRS > 2) at one year. Secondary end-points include measures of treatment safety for a number of pre-specified subgroups, with efficacy end-points including the presence of a major recurrence at one year.

Results: 96 patients have been recruited to date. Preliminary results will be presented at the conference.

Comparison of procedure-related complications between stent-assisted coil placement and coiling without stent for the treatment of acutely ruptured intracranial aneurysms

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Purpose: To compare the perioperative procedure-related complications of stent-assisted coil placement (SACP) and coiling without stent in acutely ruptured intracranial aneurysms.

Materials and Methods: According to an institutional review board-approved protocol, 133 patients treated with SACP and 289 patients treated with non-stent assisted coiling from January 2012 to December 2014 were reviewed retrospectively. Baseline characteristics, procedure-related complications and mortality were compared between the two groups.

Results: The SACP group and coiling without stent group were statistically comparable with respect to all baseline characteristics except for aneurysm location (P < 0.001) and parent artery configuration (P = 0.021). The procedure-related intraoperative rupture and thrombosis, and postoperative early rebleeding and thrombosis occurred in 3.0% (4 of 133), 2.3% (3 of 133), 1.5% (2 of 133), 0.7% (1 of 133) of the SACP group vs. 1.0% (3 of 289), 1.4% (4 of 289), 1.4% (4 of 289) and 0.0% of the coiling without stent group, respectively (P = 0.289, P = 0.810, P = 1.000, P = 0.315, respectively). One patient presented with coil escape in the group of coiling without stent. The procedure-related mortality was 1.5% (2 of 133) in SACP group and 0.7% in coiling without stent group (P = 0.796). Multivariable analysis showed no significant predictors for the total perioperative procedure-related complications, hemorrhagic complications or ischemic complications.

Conclusion: The perioperative procedure-related complications and mortality did not differ significantly between SACP and coiling without stent in patients with acutely ruptured aneurysms. SACP might be a feasible and reasonable option for treatment in the acute phase of ruptured intracranial aneurysms.

Wednesday, 18th of October, Session room 2. – 07:15 – 08:00 – Back to the basics: The invisible factor: aneurysm wall

INV27
Biology and histology of the intracranial aneurysm wall
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Background: Unruptured intracranial aneurysm (IAs) is a common (3% prevalence past middle age), often asymptomatic disease that is increasingly often detected as an incidental finding. Due to the risks associated with endovascular or microsurgical treatment of IAs, treatment of unruptured IAs should be focused to those which indeed are likely to rupture, especially since many IAs never rupture. However, because of the devastating consequences of IA rupture, unruptured IAs may cause invalidizing anxiety among those who carry them despite low risk of rupture. Especially these patients, as well as others with low risk unruptured IAs, would benefit from drug therapy that would reduce the risk of their IA progressing into a rupture-prone one. Our aim has been to elucidate the biology of the IA wall, in order to identify cellular and molecular...
mechanisms to be exploited by later translational research that develops novel diagnostic tools for the detection of rupture-prone IAs as well as drug therapy that reduces the risk of IA rupture.

**Methods:** We collected and studied during the last 15 years tissue samples from the fundus of intracranial aneurysms that were treated with microsurgical clipping. These tissue samples were studied with histological stainings, immunohistochemistry, and with methods of molecular biology at the protein and RNA level. The results were compared with clinical and radiological presentation of the IAs, and more recently, with flow conditions determined with computational fluid dynamics.

**Results:** Unruptured IA walls are characterized by proliferation of mural smooth muscle cells and synthesis of new collagen by these cells, both of which are key features of adaptive remodeling with which the IA wall adapts to mechanical load. In contrast, ruptured IA wall is characterized by loss of the mural smooth muscle cells, inflammation, and luminal thrombosis – features of degenerative remodeling. IA wall remodeling translates to IA growth, which changes the geometry and subsequently flow conditions that in turn modulates the remodeling. The molecular mechanisms of flow driven IA wall remodeling are discussed further in the presentation, as well as their translation to clinical practice.

**Conclusions:** Aneurysm wall is dynamic structure that models in order to adapt to mechanical stress. Rupture is caused by loss of adaptive remodeling and subsequent degenerative remodeling. Knowledge of IA wall remodeling can be translated into novel diagnostic tools and promoting targets for drug therapy that stabilizes the unruptured IA wall have already been identified.

**Imaging of the aneurysm wall**

**Timo Krings**

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**Wednesday, 18th of October, Session room 2. – 13:15 – 13:45 – Poster session**

**PP316**

**Dural Arteriovenous Fistulas as a Reversible Cause of Dementia: An analysis of Radiographic Features and Treatment Outcome**

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**Purpose:** Intracranial dural arteriovenous fistula (dAVF) is a treatable cause of dementia, which may be underdiagnosed. The purpose of this study is to analyze radiographic features and treatment outcome in the patients with dAVF who presenting with dementia and to compare angiographic characteristics between patients with dementia and non-dementia.

**Methods:** The patients with aggressive type of dAVFs between March 2001 and February 2016 at Siriraj Hospital were retrospectively reviewed. Dementia was defined as significant cognitive decline in one or more cognitive domains. The analysis of demographic baseline, characteristics of dAVFs, treatment, and outcomes were performed.

**Results:** There were 189 patients with 264 fistulas. Of these, 26 patients (13.7%) with 37 fistulas presented with dementia. No difference in age and sex between groups (median age, 55.5 years in dementia and 54.0 years in non-dementia). In dementia group, median symptom onset was 4 weeks (range, 1 day to 156 weeks). Memory (69.2%), language (57.7%), and attention deficit (46.2%) were the most common cognitive domains affected. Other associated symptoms were psychomotor retardation (50%), headache (46.1%), seizure (30.8%), bruit (26.9%), ataxia (26.9%), impaired vision (26.9%), weakness (23.1%), and parkinsonism (7.7%). Radiographic findings showed white matter edema (73.1%), gyral calcification (29.2%), parenchymal hemorrhage (19.2%) and hydrocephalus (19.2%). The fistula’s locations were: 20 transverse-sigmoid sinus, 8 superior sagittal sinus, 6 torcular herophili, 3 cortical vein. Fistulas were found significantly greater in transverse-sigmoid sinus (dementia 54.1% and non-dementia 29.8%, p = 0.004), superior sagittal sinus (dementia 21.6% and non-dementia 8.8%, p = 0.018) and torcular herophili (dementia 16.2% and non-dementia 5.7%, p = 0.021). We observed 53.8% and 26.5% of patient with and without dementia had fistula’s drainage into superior sagittal sinus and/or straight sinus. All dAVFs patients with dementia had undergone endovascular treatments (median session = 1), 73.1% had completely obliteration. In 2 patients, embolization was followed by surgery. At the follow up (median, 42 weeks), all patients showed the clinical improvement within 4 weeks after treatment. Of these, 14 patients were fully recovery, 2 patients died due to refractory epilepsy and stroke. A nonsignificant trend toward fully recovery was noted in patients with younger than 60 years, shorter symptom onset, prior independent status, and non-seizure at presentation. Intraparenchymal hemorrhage had significant negative effect on recovery.

**Conclusion:** Dementia is not uncommon presentation of aggressive dAVFs (13.7%). The location at transverse-sigmoid sinus and superior sagittal sinus is greater than those in non-dementia group. Dementia is reversible, after curative treatment, especially without intraparenchymal hemorrhage. Endovascular treatment was effective in improving clinical symptoms.
PP317
Angiographic and clinical characteristics of thoracolumbar spinal epidural and dural arteriovenous fistulas

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Background: To compare the angiographic and clinical characteristics of spinal epidural arteriovenous fistulas (SEAVFs) and spinal dural arteriovenous fistulas (SDAVFs) of the thoracolumbar spine.

Methods: A total of 168 cases diagnosed as spinal dural or extradural AVFs of the thoracolumbar spine were collected from 31 centers. Spinal angiography and clinical findings, including symptoms, gender, and history of spinal surgery/trauma, were retrospectively reviewed. Angiographic images were evaluated, with a special interest in spinal levels, feeders, shunt points, a shunted epidural pouch and its location, and drainage pattern, by six readers to reach a consensus.

Results: The consensus diagnoses by the 6 readers were SDAVFs in 108 cases, SEAVFs in 59 cases, and paravertebral AVFs in one case. Twenty nine of 59 cases (49%) of SEAVFs were incorrectly diagnosed as SDAVFs at the individual centers. The thoracic spine was involved in SDAVFs (87%) more often than in SEAVFs (77%). Both types of AVF were predominant in males (82% and 73%) and frequently showed progressive myelopathy (97% and 92%). A history of spinal injury/surgery was more frequently found in SDAVFs (36%) than in SEAVFs (12%) (p = 0.001). The shunt points of SDAVFs were medial to the medial interpedicile line in 77%, suggesting that SDAVFs commonly shunt to the bridging vein. All SEAVFs formed an epidural shunted pouch, which was frequently located in the ventral epidural space (88%) and drained into the perimedullary vein (75%), the paravertebral veins (10%), or both (15%).

Conclusion: SDAVFs and SEAVFs showed similar symptoms and male predominance. SDAVFs frequently involve the thoracic spine and shunt into the bridging vein. SEAVFs frequently involve the lumbar spine and form a shunted pouch in the ventral epidural space draining into the perimedullary vein.

PP318
Factors affecting the reachability of NBCA-lipiodol mixture to the arteriovenous shunt during transarterial embolization: a clinical study in intracranial dural arteriovenous fistulas

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Background and Purpose: Although n-butyl 2 cyanoacrylate (NBCA) must reach the venous side beyond the fistulous point for successful embolization of dural arteriovenous fistulas (DAVFs), the reachability is affected by various factors and is different in each case. The purpose of this study is to review cases of DAVFs treated by transarterial embolization with NBCA-lipiodol mixture (NBCA-Lip) and to clarify several factors associated with the reachability of NBCA.

Methods: Ninety-six embolization procedure in 26 consecutive patients with DAVFs treated by transarterial embolization with NBCA-Lip in our institution from May 2009 to November 2016 were retrospectively reviewed. DSA images before, after and during injection of NBCA-Lip, and procedural records were reviewed with particular interest in reachability of NBCA-Lip (feeder occlusion or arteriovenous shunt occlusion) and factors potentially associated with the reachability including volume rates of NBCA-Lip, injected artery, types of the feeding artery injected (proper feeder or proximal feeder), status of injection (wedged or not wedged), position of a microcatheter in relation to the acute curvature of the feeding artery, and use of additional techniques. Correlation of the reachability of NBCA-Lip with those factors were statistically analyzed using XLSTAT software.

Results: Among 96 injections of NBCA-Lip, AVS occlusion was obtained in 48 injections, and was associated with injection from proper feeder (p = 0.001), wedge injection (p < 0.0001), and injection at non-precurved portion (p < 0.0001) with statistical significance. Injections using additional technique showed higher rates of AVS occlusion than the other (68% vs 45%), but the difference is not significant (p = 0.05). Volume rates of NBCA-Lip was not associated with the reachability.

Conclusion: The reachability of NBCA-Lip is significantly affected by position and status of microcatheter tip. Wedge injection from proper feeder promises AVS occlusion, while no wedge injection from precurved portion of the proximal feeder must result in suboptimal embolization.
PP319

The Effectiveness of Dural Venous Sinus Sacrifice as A Treatment of Aggressive Type Cranial Dural Arteriovenous Fistulas

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Objective: To evaluate the effectiveness of dural venous sinus sacrifice as a treatment of aggressive type cranial dural arteriovenous fistulas (dAVFs) in terms of both clinical and angiographic outcome.

Materials and Methods: One hundred and twenty-eight patients with 163 aggressive type cranial dAVFs who were treated with dural sinus sacrifice endovascularly and/or surgically at Siriraj Hospital, Bangkok, Thailand were retrospectively reviewed. Clinical outcome and angiographic outcome were categorized and recorded. Procedural complications were also recorded. Only 103 patients (80.5%) who had been following up for at least 90 days were analyzed for clinical outcome.

Results: There were 53 males and 75 females with age ranging from 20 years to 93 years (mean age 55.44 years). The overall angiographic cure rate of dural venous sinus sacrifice as a part of the treatment of aggressive dAVFs was 81.6%. In the analysis of clinical outcome (duration of follow up average at 2 years and 6 months), 75 patients (72.8%) had clinical improvement and 21 (20.4%) were clinically stable. Worsening of the presenting symptoms was observed in 7 patients (6.8%). Procedural complications were found in 5 patients (3.9%).

Conclusion: With proper patient selection, dural venous sinus sacrifice is a safe and effective treatment strategy with high angiographic cure rate, good clinical outcome and low incidence of procedural-related complication.

PP320

The “GROUTING TECHNIQUE” in high-grade Intracranial Dural Arteriovenous Fistulae Embolization

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Background: Intracranial dural arteriovenous fistulae (dAVFs) are abnormal vascular connections between meningeal arteries and dural sinuses or cortical veins. dAVFs account for 10 to 15% of intracranial vascular formations, and mostly affect middle-aged population. The clinical manifestations are quiet variable, depending on the locations, vascular complexities, and hemodynamic properties of dAVFs. In patients with low-grade dAVFs, there may be no symptom; on the other hand, patients with complex dAVFs may suffer from severe neurological symptoms and intracranial hemorrhage. There are many grading systems for dAVF classification. Overall, the higher the grade, the more aggressive behavior it will be. Meanwhile, there are a lot of treatment options for dAVFs, including conservative treatment, surgery, radiosurgery, endovascular treatment and combination of above.

Objective: In dealing with high-grade dAVF, it is always challenging for interventional neuroradiologist due to its complexity of fistula. However, high-grade dAVFs should be treated as early as possible to prevent hemorrhage. Thanks to the advance development of materials for endovascular intervention, it offers interventional neuroradiologists an opportunity for dAVF treatment in an effective and minimal invasive way. We introduce an innovated and integrated procedure, the “Grouting Technique”, which is composed of using detachable coils and liquid embolizer to extirpate the dAVF in a single procedure.

Method: 10 patients, who were diagnosed as dAVF, were included in the study. All patients underwent cerebral MRI and diagnostic DSA for pre-treatment planning. All patients were treated under general anesthesia in bi-plane angi-suite. Retrograde catheterization of the involved dural sinus or cortical vein was performed via transverse approach. Two microcatheters were navigated into target site for coiling and liquid embolization. After adequate framing and nesting of target site with detachable coils via one microcatheter, the liquid embolizer was injected to obliterate the fistula via another microcatheter, so named “Grouting Technique”.

Result: We successfully treated 10 dAVFs patients with “Grouting Technique”. All patients recovered well without obvious neurological deficit. The symptoms resulting from dAVFs relieved after treatment. No procedure-related complications occurred.

Conclusion: The “Grouting Technique” is a feasible option for endovascular treatment of complex dAVFs. It provides angiographic elimination of dAVF and contributed to symptom relieving, without significant complication.

PP321

Increase of fluoroscopic radiation dose rate during multi-stage Onyx embolization of brain AVMs

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Purpose: Multi-stage of embolization is one of the treatment options of brain arterio-venous malformations (AVMs). Recently Onyx (Medtronic) has become the most popular
embolic materials for this purpose. Different from the first embolization procedure, the successive procedures usually are suffering from presence of radiodense Onyx cast in the nidus, which could hamper the successive procedures. In this study we focused on the influence of the Onyx cast in the fluoroscopic radiation dose since presence of the any radiopaque material in the field could increase the exposure setting due to automatic exposure control system of the angiographic machine.

**Materials and Methods:** During last 3 years, there were 18 patients who underwent multi-stage Onyx embolization (more than twice) for brain AVM. From the radiation dose chart of each procedure, total fluoroscopic duration (min), dose-area product (DAP, μGy.m2) of both frontal and lateral planes were obtained. For the simplification of the dose comparison, we compared the frontal and lateral fluoroscopic dose (DAP)/time (min) (dose rate, μGy.m2/min) of initial and lateral stages of the embolization (paired t-test).

**Results:** Three sets of data were analyzed including a pair of total fluoroscopic dose per minute on A/B plane separately, a pair of DAP dose per minute on A/B plane separately and a pair of air kerma (AK) Dose per minute on A/B plane separately. All of them indicating a significant difference between the doses per minute in the initial and the last session except for the total fluoroscopic dose on the A plane.

**Conclusion:** Due to the function of automatic exposure control during fluoroscopy, successive Onyx embolization procedures could increase the fluoroscopic radiation doses for multi-stage brain AVM embolization. Active use of collimation with less magnificent may help prevent inadvertent radiation exposure burden.

**PP322**

**Correlation between angioarchitecture and obliteration rate of the brain arteriovenous malformation (BAVM) after hypofractionated stereotactic radiotherapy (HSRT)**

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**Purpose:** To determine which angiographic features could affect on obliteration rate of the BAVM after hypofractionated radiotherapy (HSRT).

**Materials and Methods:** This was a retrospective study of 99 BAVM patients underwent HSRT at Ramathibodi hospital between 1997–2012. Medical charts were reviewed for clinical data. Multiple angiographic features on digital subtraction angiogram (DSA) were assessed in both groups (non-obliteration VS obliteration of BAVM) i.e. flow velocity (high/ moderate/low), dilated arterial feeder (no/mid, moderate/ severe), presence of associated aneurysm, type of perinidal angiogenesis (sprouting, no-sprouting), presence of fistulous component, type of nidus (compact, diffuse), presence of deep venous drainage, number of draining vein, presence of venous stenosis, presence of venous ectasis and presence of dural supply. Obliteration of the BAVM was evidenced by MRI/MRA or DSA. Statistical analysis was performed to assess whether which angiographic features associated with obliteration of the BAVM.

**Results:** 99 BAVM consisted of 58.6% of male. Mean age was 32.1 years. Mean BAVM size was 5.5 cm and Median BAVM volume was 29.9 ml. BAVM predominantly located in the eloquent area. Most of BAVM was treated by embolization (77.8%) and combined embolization and surgery (1.0) although 21.2% did not received any treatment before HSRT. Complete obliteration of BAVM following HSRT was achieved in 19 cases (19.2%). None of the investigated angiographic features showed statistically significant association with the obliteration of the BAVM after HSRT.

**Conclusion:** None of the angiographic features in our study predict the obliteration rate of the BAVM underwent HSRT.

**PP323**

**Determination of the natural history of neck remnants of cerebral aneurysms treated with detachable coils assessed with Magnetic Resonance Angiography**

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**Purpose:** Most intracranial aneurysms are now treated with detachable coils however there is an increased incidence of recurrence compared with clipping. Following coiling, the degree of aneurysm occlusion has been shown to predict long-term outcomes. The Raymond-Roy Occlusion Classification (RROC) is the most widely accepted system used to assess the status of treated aneurysms. Given that the majority of aneurysms demonstrate residual neck filling, the specific aim of this study was to evaluate the long-term outcome of class II aneurysms using magnetic resonance angiography (MRA).

**Material and Methods:** A retrospective study of all aneurysms treated with coils from 2006 to 2016 was performed. A senior radiology trainee reviewed all imaging under the supervision of two Interventional Neuroradiologists. Statistical analysis and class differences were determined using a Pearson Chi2, calculations were performed using Stata version 13.

Inclusion criteria included: age at least 18 years, first treatment of an aneurysm, treatment with coils, RROC class II occlusion and a minimum of 36 months follow up. Exclusion criteria included: age less than 18 years, aneurysm retreatment, complex aneurysms, RROC class I or III and less than 36 months follow up. Mycotic, dissecting, fusiform and giant aneurysms were considered complex.

At the time of coiling, the degree of aneurysm occlusion was assigned a RROC class I, II or III. On subsequent MRA
studies, the aneurysm was reassigned a further MRRC class. The time and date of aneurysms requiring retreatment was also recorded.

**Results:** During the 11-year period, 466 aneurysms underwent coiling, of which 131 cases were included in the study accounting for 72.80% of all treated aneurysms. Aneurysms arose from the anterior circulation in 83.12% of cases and posterior circulation in 21.11%.

Aneurysm recurrence occurred in 19.08% of aneurysms on average 1.65 years post coiling (s = 1.69 years). Recurrence occurred as soon as 0.13 years and as late as 5.69 years. Aneurysm recurrence requiring retreatment occurred in 10.69% of all class II aneurysms on average 2.10 years post coiling (s = 2.00 years). Retreatment was required as late as 6.10 years.

**Conclusion:** The majority of cerebral aneurysms treated with detachable coils demonstrate residual neck filling upon conclusion of the procedure. Neck recurrence is not uncommon occurring in 19.08% of all class II aneurysms. However, only 10.69% of all class II patients will require retreatment.

**PP324**

**Factors Related to Retreatment after Coil Embolization of Basilar Tip Aneurysm -Effect of Morphological Change Induced by Stent Placement**

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**Background and Purpose:** Coil embolization is now a common treatment option for basilar tip aneurysm (BTA). However, the rate of recanalization and retreatment is higher compared with intracranial aneurysm in other sites. This study investigated the factors related to retreatment after coil embolization of BTA, especially about morphological factors, and then procedures to reduce retreatment was considered.

**Materials and Methods:** A retrospective study of all aneurysms treated with detachable coils however there is an increased incidence of recurrence compared with clipping. Following coiling, the degree of aneurysm occlusion has been shown to predict long-term outcomes. This study aims to determine the natural history of coiled aneurysms according to the Raymond-Roy Occlusion Classification (RROC) system using magnetic resonance angiography (MRA).

**Results:** At the follow-up, 8 patients showed recanalization and 7 (30.4%) required retreatment. In morphological factors, posterior cerebral artery (PCA) arising from the aneurysmal dome was significantly frequent in R group (85.7% vs. 37.5%, p = 0.022). Angle between basilar artery and PCA (BA-P1 angle; 54.4 vs. 74.4 degrees, p = 0.033) and angle between each PCA (P1-P1 angle; 144.7 vs. 184.7 degrees, p = 0.013) were significantly smaller in R group.

**Conclusion:** It was suggested that morphological factors of aneurysm are related to retreatment of BTA after coil embolization, and complete occlusion at first treatment may decreases retreatment. In addition, angular remodeling as “side-wallization” induced by stent placement may hardly causes retreatment. Therefore, more aggressive treatment including stent assist intended for complete occlusion should be provided to BTA that is expected to require retreatment.

**PP325**

**Determination of the natural history of cerebral aneurysms treated with detachable coils according to the Raymond-Roy Occlusion Classification assessed with Magnetic Resonance Angiography**

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2Princess Alexandra Hospital, Radiology, Brisbane, Australia

**Purpose:** Most intracranial aneurysms are now treated with detachable coils however there is an increased incidence of recurrence compared with clipping. Following coiling, the degree of aneurysm occlusion has been shown to predict long-term outcomes. This study aims to determine the natural history of coiled aneurysms according to the Raymond-Roy Occlusion Classification (RROC) system using magnetic resonance angiography (MRA).

**Material and Methods:** A retrospective study of all aneurysms treated with coils from 2006 to 2016 was performed. A senior radiology trainee reviewed all imaging under the supervision of two Interventional Neuroradiologists. Statistical analysis and class differences were determined using a Pearson Chi2, calculations were performed using Stata version 13.

Inclusion criteria included: age at least 18 years, first treatment of an aneurysm, treatment with detachable coils and a minimum of 36 months follow up. Exclusion criteria included: age less than 18 years, aneurysm retreatment, complex aneurysms and less than 36 months follow up. At the time of coiling, the degree of aneurysm occlusion was assigned a RROC class I, II or III. On subsequent MRA studies, the aneurysm was reassigned a further RROC class. The time and date of aneurysms requiring retreatment was also recorded.

**Results:** During the 11-year period, 466 aneurysms underwent coiling, of which 180 met inclusion criteria. Aneurysms
arose from the anterior circulation in 78.89% cases and posterior circulation in 21.11%.

Aneurysm recurrence occurred in 14.29% of class I aneurysms, 19.08% of class II aneurysms and 26.19% of class III aneurysms. While there was a trend towards higher recurrence rates in class III, a statistically significant difference was not demonstrated (p-value 0.056). The mean time to recurrence was 1.65 years for class II and 1.31 years for class III. Overall, aneurysm recurrence occurred in 20.56% of cases, on average 1.46 years following the original coiling. Aneurysms recurrence requiring retreatment occurred in 0.00% of class I aneurysms, 10.69% of class II aneurysms and 26.19% of class III aneurysms. This confirmed a statistically significant difference for retreatment rates between all RROC classes (p-vale 0.023). The mean time to retreatment was 2.38 years for class II and 1.34 years for class III. Overall, retreatment was required in 13.88% of cases, on average 1.92 years following the original coiling.

Conclusion: The natural history of coiled cerebral aneurysms can be determined according to the RROC system using MRA. Recurrence rates are similar between class II and III aneurysms however class III aneurysms are almost twice as likely to require retreatment. Therefore, all efforts should be made to achieve class II aneurysm occlusion as it has been shown to drastically reduce retreatment rates.

Wednesday, 18th of October, Session room 2. – 14:15 – 16:15 – Parallel abstract session:
Aneurysm clinical: Outcomes

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Complex endovascular treatment of brain aneurysms in the acute period of subarachnoid hemorrhage
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Purpose: Assessment of endovascular treatment in the acute period of intracranial bleed as a result of ruptured brain aneurysms

Material and Methods: In the period from 1997 to 2016, 129 patients (133 aneurysms) in the acute stage of SAH (21 days) were treated at the Acad N. N. Burdenko Institute of Neurosurgery. Age of the patients from 2 to 79 years. Anterior circulation aneurysms – 84 (61, 3%), posterior circulation aneurysms – 49 (38, 7%). Intra-arterial injection of verapamil for prevention and treatment of cerebral spasm was performed in 12 patients (28 procedures total) after closing the ruptured aneurysm in the acute stage of subarachnoid hemorrhage.

Results: Thromboembolic complications - 4 patients (3.25%); rupture - 7 patients (5.7%); increasing spasm - 10 (8.2%); coil and stent migration - 4 patients (3.25%); endovascular access to aneurysm failed due to severe spasm - 5 patients (4.06%); mortality - 4 patients (3.25%). Intraoperative use of heparin and washout systems in order to decrease thromboembolic events, and intraarterial use of verapamil for prevention and treatment of a cerebral vasospasm were very effective additions in the last 3 years. Using general anesthesia, minimally traumatic manipulation in the lumen and maximally shortened duration of operation were important factors in achieving good outcomes.

Conclusion: Endovascular approach is a safe and effective treatment method in the acute period of intracranial bleed as a result of a ruptured brain aneurysm.

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Endovascular treatment of aneurysm in elderly patients
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Purpose: There is currently a worldwide growth of the elderly population, with exponential prospects for the coming decades. Brain aneurysms are lesions that are difficult to treat with conventional surgery and have great potential mortality and morbidity, particularly in elderly patients or in poor clinical - neurological conditions. In elderly individuals, the chance of an aneurysm occurring is significantly greater when compared to younger age groups and the endovascular technique has demonstrated efficacy and safety. This study aims to report the experience and follow-up of endovascular treatment of cerebral aneurysms in patients aged 75 years or older in reference service in Blumenau – SC, Brazil.

Materials and Methods: Retrospective analysis of medical records of patients with aneurysm treated by an endovascular procedure in the neurosurgery department of Blumenau-SC, Brazil, between October 2005 and April 2017, and aged 75 years older.

Results: The total number of patients aged 75 years and over was 78 patients. Their mean age was 78.99 years (75–91 years), with a predominance of females, 82.05% females (n = 64). A frequent risk factor was hypertension in 75.64% (n = 59), followed by 53.85% with dyslipidemia (n = 42) and 15.38% with diabetes mellitus (n = 12). The most common sites of aneurysms were in the posterior communicating artery, 26.92% of the cases (n = 21), the anterior communicant, 15.38% (n = 12), the middle cerebral artery bifurcation and the cavernous segment of the internal carotid artery, both 6.41% of cases (n = 5). The majority of aneurysms were incidental, 65.38% (n = 51). Among the 34.62% of patients with subarachnoid hemorrhage (n = 27), 6.67% (n = 5) had Fisher III and 18.67% (n = 14),
Fisher IV; In the Hunt-Hess scale, 14.67% (n = 11) patients were in grade III and 2.67% (n = 2) in grade IV. The saccular type of aneurysm predominated in 96.10% (n = 74) and small in 55.13% (n = 43). Large aneurysms were found in 33.33% (n = 26) and giants in 10.26% (n = 8). The aneurysm was single in 76.62% (n = 59). Endovascular treatment did not include stents in 81.82% of the cases, in which only coils were used. There was failure in 1.30% (n = 1). Clinical and angiographic vasospasm occurred in 3.85% (n = 3) of them. The complication rate corresponded to 4.62% and mortality, to 4.92% of the total number of patients with embolized aneurysms; Among the victims of subarachnoid hemorrhage, respectively, 1.49% and 11.11%.

Conclusions: The statistical parameters confirmed that the endovascular technique is an appropriate and safe therapeutic alternative for the treatment of cerebral aneurysms in elderly individuals. The patients treated had complications expected for the age group.

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Follow-up outcome of re-embolization in recanalized aneurysms after coiling: further recurrence rate and related risk factors
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Purpose: It is well known that coiled aneurysms may recanalize over time, making follow-up evaluation mandatory. However, midterm and long-term outcome of re-embolization in recurred aneurysms after coil embolization has not been adequately investigated. We generated estimates of the re-treatment outcomes during follow-up monitoring, analyzing risk factors related to the further recanalization.

Materials and Methods: A total of 133 aneurysms in 129 patients were retrospectively reviewed, each subjected to re-embolization for major recanalization after initial coil embolization, and to midterm and extended monitoring after the re-treatment. Cumulative medical records and radiologic data were assessed. Further recurrence rates and related risk factors were assessed using binary logistic regression analysis.

Results: A total of 47 aneurysms (35.3%) displayed recanalization at 6 months postembolization, with 17 and 30 instances of minor and major recanalization, respectively. Multivariate analysis indicated that posterior circulation (HR = 6.129; p = 0.010), incomplete occlusion at time of second coiling (HR = 9.975; p = 0.001) and large-sized aneurysm (>7 mm) at time of first coiling (HR = 13.598; p < 0.001) were predictors of re-recanalization. In 86 aneurysms showing complete occlusion at mid-term, 76 were further evaluated (>12 months), displaying 18 aneurysms (23.7%) of delayed recanalization (minor, 14; major, 4) during a follow-up of 230.1 aneurysm-year (annual delayed recanalization rate: 7.8% aneurysm-year). Out of 15 aneurysms with minor recanalization at 6-month and with extended follow-up (12 months), progression to major recanalization was observed in 6 aneurysms (40.0%) during a follow-up period of 44.0 aneurysm-year (annual progression rate: 13.6% aneurysm-year).

Conclusions: Majority of re-coiled aneurysms (64.7%) displayed complete occlusion at 6-month follow-up. However, posterior circulation, incomplete occlusion at time of second coiling, and large aneurysm size before the treatment were predisposed to further recanalization. Mid-term recanalization rate in the re-embolized aneurysms seems to be higher than initial aneurysm.

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Endovascular coil embolization of internal carotid artery anterior wall aneurysms
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Purpose: Aneurysms arising from the non-branching sites in the internal carotid artery (ICA), or so-called anterior wall (AW) aneurysms, have been reported. The surgical management of these aneurysms poses technical challenges, and such patients are frequently referred for endovascular coil embolization (CE). The purpose of this study was to report the clinical presentation, endovascular treatment and outcome of ICA AW aneurysms.

Material and Methods: From 2003 to 2016, we treated 65 patients (M:F = 15:50, age, 37–72 years, mean 62.6) with ICA AW aneurysms. Eight patients presented with subarachnoid haemorrhage, nine patients presented with visual disturbance and the remaining 48 patients were asymptomatic.

Results: Although 63 of the 65 patients were treated with an adjunctive (Balloon remodelling; BR, Double catheter: DC, Stent assist: SA) technique, all aneurysms could be treated with aneurismal CE. Combination of adjunctive techniques are BR: 39, SA + DC: 9, SA in 4, DC + BR in 4, SA + BR:3, DC: 3 and DC + BR + SA: 1 patient. Angiographic results were complete occlusion in 35, small neck remnant in 25 and dome filling in 5 patients. We experienced neurological deterioration in 2 patients. One patient with a large aneurysm developed an embolic cerebral infarction within 24 h. Another patient with a large symptomatic aneurysm showed deterioration of ipsilateral visual acuity 2 days after CE. Although none of the patients showed rupture or re-rupture of the treated aneurysm in the follow-up period, 4 patient with a ruptured ICA AW aneurysm who showed aneurysmal recanalization underwent re-CE.
Conclusion: The results of this study indicate that endovascular CE is a safe and effective therapeutic alternative for ruptured and unruptured ICA AW aneurysms.

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Endovascular treatment of 338 middle cerebral artery aneurysms: A single center 10-year experience

Zhou Yu

Objective: Endovascular treatment has been widely used for the treatment of intracranial aneurysms. However, endovascular treatment of middle cerebral artery (MCA) aneurysms remain controversial. This study was aimed at assessing the safety and effectiveness of endovascular treatment in unruptured and unruptured MCA aneurysms.

Materials and Methods: 320 consecutive patients with MCA aneurysms were treated via endovascular approach in our institution between 2006 and 2016, with 155 male patients and 165 female patients and an average age of 55.3 ± 10.7 years. The retrospectively collected data including clinical features, angiographic results and follow-up outcome were analyzed.

Results: 320 patients with 191 ruptured MCA aneurysms and 147 unruptured MCA aneurysms were enrolled in this study. The treatment strategy included coiling (n = 161), stent-assisted coiling (n = 152), stent alone (n = 12), other-assisted coiling (n = 4), occlusion of parent vessel (n = 9). In-hospital mortality occurred in 18 patients and peri-procedural complications occurred in 22 patients (6.5%). mRS ≤ 2 at discharge were obtained in 278 patients. Angiographic follow-ups were collected in 194 patients (64.2%), with an average of 257.2 follow-up days. The angiographic follow-up outcomes were as follows: complete occlusion in 138 aneurysms, improved in 17, stable in 36 and recurrence in 18 aneurysms. Rupture status of aneurysm was significantly correlated with complication rate, mRS at discharge and immediate complete occlusion rate (P < 0.001). Complications were decreased in the recent two years (0) compared with that in previous eight years (8.4%) (P = 0.04).

Conclusion: Endovascular treatment for ruptured and unruptured MCA aneurysms were effective and safe, and could treated as first-choice option. With modification of antiplatelet protocol and application of new devices, complication was decreased in recent two years.
neurologic symptoms (3 GOS score) was observed in 1.4% of patients. After the microsurgical operations there were no lethal outcomes.

The outcomes of surgical treatment, depending on the method (endovascular or microsurgical), did not differ statistically significantly ($p > 0.05$).

**Conclusion:** Surgical treatment of patients with unruptured asymptomatic cerebral aneurysms of intradural part of ICA up to 15 mm in size is associated with low levels of morbidity and mortality.

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The experience of endovascular treatment of unruptured intracranial aneurysms: a single-center study

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**Purpose:** The purpose of this study is to explore the efficacy and safety of endovascular treatment of unruptured intracranial aneurysms (UIA).

**Materials and Methods:** We retrospectively analyzed the clinical outcomes, complications, or follow-up outcomes of UIA treated by endovascular treatment which were enrolled in our hospital within five years recently, and further evaluated the clinical prognosis. The mean follow-up time is $18.6 \pm 1.5$ months (ranged 3–49 months).

**Results:** The total of 333 aneurysms (AN) in 256 patients, the percentage of AN occlusion after endovascular procedures is 88.7% (227/256. But 24 (9.4%) patients occurred poor clinical outcome: transient complications associated with embolization during operation occurred in 9 cases (3.5%), in which 3 (1.2%) showed hemorrhage, after treatment aiming to symptom and rehabilitation exercise, only 1 (0.4%) was left with permanent neurological deficit; following follow-up, stent stenosis occurred in 6 patients (2.3%), and there were 10 patients (3.9%) had recurrent AN, and no case suffered death. Associated headache following endovascular treatment occurred in 86 patients (33.6%), and inclined to show after stent assisted embolization of UIA. Finally, good clinical prognosis (mRS < 2) were achieved in 95.3% patients. UIA patients who had giant AN ($P = 0.032$) inclined to achieve poor outcomes, and the diameter of UIA over 10 mm ($P = 0.004$) may increase the possibility of AN recurrence after endovascular treatment.

**Conclusion:** Endovascular procedure is efficacious and safe way to treat UIA, this therapy aiming to treat selected UIA cases is helpful to decrease the risk of bleeding, and to achieve favorable prognosis.

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Ruptured middle cerebral artery aneurysms with a concomitant intraparenchymal hematoma: the role of hematoma volume

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**Background:** A new recommendation in the AHA/ASA guidelines for the management of aneurysmal subarachnoid hemorrhage states that microsurgical clipping may receive increased consideration in patients with ruptured middle cerebral artery (MCA) aneurysms and large (>50 mL) intraparenchymal hematomas. However, clinical outcome data supporting this recommendation are sparse. We wanted to study whether this statement was applicable to our patient cohort.

**Methods:** We reviewed the clinical and radiological data of 81 consecutive patients with MCA aneurysms and concomitant hematomas admitted between January 2006 and December 2015. The relation between (semi-automatically quantified) hematoma volume (< or >50 ml), neurological condition on admission (poor: GCS < 8 or non-reactive pupils), treatment strategies (no treatment, coiling or clipping with or without decompression and/ or clot removal), and outcome (favorable: mRS score 0–3) was evaluated.

**Results:** Clinical outcome data were available for 76 patients. A significant difference in favorable outcome (17% versus 68%) was seen when comparing patients with poor and good neurological condition on admission ($p < 0.01$). Patients with hematomas >50 ml had similar outcomes for coiling and clipping, all underwent decompression. Patients with hematomas <50 ml did not show differences in favorable outcome when comparing coiling and clipping with (33% and 31%) or without decompression (90 and 88%).

**Conclusion:** Poor neurological condition on admission, and not large intraparenchymal hematoma volume, was associated with poor outcome. Therefore, even in patients with large hematomas, the neurological condition on admission and the aneurysm configuration seem to be equally important factors to determine the most appropriate treatment strategy.

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Long-term result of endovascular treatment with preservation of the vertebral artery in isolated dissecting aneurysms of the posterior inferior cerebellar artery

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Endovascular management of distal anterior cerebral artery (DACA) aneurysms: A Retrospective Review Study

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Introduction: Distal anterior cerebral artery (DACA) aneurysms are rare and their treatment by both surgical clipping or endovascular treatment poses technical difficulties. Earlier studies have reported higher complication rates in DACA aneurysms compared with other aneurysms in the circle of Willis. Therefore, endovascular management of DACA aneurysms still remains as a challenge in their management.

Aims: To review clinical presentation, angiographic presentation of DACA aneurysms, complication and outcome of their endovascular treatment in our institutional experience.

Methods: Retrospective review study among 185 patients with intracranial aneurysms treated with endovascular management from September 2009 to December 2013 in Max Superspecialty Hospital, New Delhi, India, 11 patients (5.9%) with 12 DACA aneurysms were studied retrospectively. We reported clinical presentations, cerebral angiographic findings, endovascular treatment, complications and outcomes. The clinical and angiographic outcomes were assessed using modified Rankin scales and Raymond scale, respectively.

Results: Of 11 patients, 54.5% were female and 45.5% were male with mean age was 48.4 years (33–65 years). All patients had subarachnoid hemorrhage that indicated ruptured DACA aneurysm. All of DACA aneurysms were small size. Post-coiling angiograms showed complete occlusion in all patients. Two patients had intra-procedural aneurysm rupture but without any clinical sequelae and 1 patient had thrombus formation which was thrombolysed at the end of coiling. All patients had good outcome.

Conclusion: Our experience with 11 patients showed endovascular management of small DACA aneurysms is safe with good outcome.

Keywords: Distal anterior cerebral artery, endo-vascular management, coiling, Rankin scale, Raymond score.
Surgical Clipping or Endovascular Coiling for Unruptured Intracranial Aneurysms: A Pragmatic Randomized Trial

**Material and Methods:** 34 AChA aneurysms were treated by coil embolization between April 2005 and April 2017. Of the 34 aneurysms, 14 had transcranial MEP (TC-MEP) recorded during embolization. Average aneurysms size was 5.0 (3.0–7.0) mm. Two aneurysms had ruptured and 12 were unruptured. To stimulate TC-MEP, corkscrew electrodes were placed at C3 and C4, and electromyograms were obtained for the contralateral thenar muscle. All patients were treated under general anesthesia and TC-MEP was used to record every coil insertion from framing to finishing.

**Results:** Two of the 14 aneurysms exhibited MEP change. One MEP change appeared after framing of coil insertion. The other one appeared after finishing of coil insertion. MEP recovered after coil extraction in both aneurysms. During MEP change, DSA showed blood flow in the AChA. No patient experienced neurological deficit and no new infarction of the AChA was observed on MR images obtained after embolization.

**Conclusion:** TC-MEP can evaluate the blood flow in the AChA including undetectable AChA branches on DSA, and might reduce the risk of potential ischemic complications during coil embolization of AChA aneurysms.

**Background:** Unruptured intracranial aneurysms (UIAs) are increasingly diagnosed and are commonly treated using endovascular treatment or microsurgical clipping. The safety and efficacy of treatments have not been compared in a randomized trial. How to treat patients with UIAs suitable for both options remains unknown.

**Methods:** We randomly allocated clipping or coiling to patients with one or more 3–25 mm UIAs judged treatable both ways. The primary outcome was treatment failure, defined as: initial failure of aneurysm treatment, intracranial hemorrhage or residual aneurysm on one year imaging. Secondary outcomes included neurological deficits following treatment, hospitalization > 5 days, overall morbidity and mortality and angiographic results at one year.

**Results:** The trial was designed to include 260 patients. An analysis was performed for slow accrual: 136 patients were enrolled from 2010 through 2016 and 134 patients were treated. The one-year primary outcome, available for 104 patients, was reached in 5/48 (10.4% (4.5%–22.2%)) patients allocated surgical clipping, and 10/56 (17.9% (10.0%–29.8%)) patients allocated endovascular coiling (OR: 0.54 (0.13, 1.90), P = 0.40). Morbidity and mortality (mRS > 2) at one year occurred in 2/48 (4.2% (1.2%–14.0%)) and 2/56 (3.6% (1.0%–12.1%)) patients allocated clipping and coiling respectively. New neurological deficits (15/65 vs 6/69; OR: 3.12 (1.05, 10.57), P = 0.031), and hospitalizations beyond 5 days (30/65 vs 6/69; OR: 8.85 (3.22, 28.59), P = 0.0001) were more frequent after clipping.

**Conclusion:** Surgical clipping or endovascular coiling of UIAs did not show differences in morbidity at one year. Trial continuation and additional randomized evidence will be necessary to establish the supposed superior efficacy of clipping.

(Funding: Canadian Institutes of Health Research (CIHR) MOP1195554; Trial registration: ClinicalTrials.gov NCT01139892).

**Hybrid surgical and endovascular treatment of a giant cervical carotid aneurysm in a child**

**Oral Presentations**

**Oral Presentations**

**Wednesday, 18th of October, Session room 2. – 17:45 – 18:45 – Parallel abstract session – Aneurysm clinical: Outcomes**

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**Surgical Clipping or Endovascular Coiling for Unruptured Intracranial Aneurysms: A Pragmatic Randomized Trial**

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**Background:** Unruptured intracranial aneurysms (UIAs) are increasingly diagnosed and are commonly treated using endovascular treatment or microsurgical clipping. The safety and efficacy of treatments have not been compared in a randomized trial. How to treat patients with UIAs suitable for both options remains unknown.

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(Funding: Canadian Institutes of Health Research (CIHR) MOP1195554; Trial registration: ClinicalTrials.gov NCT01139892).

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**Hybrid surgical and endovascular treatment of a giant cervical carotid aneurysm in a child**

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We present a rare case of an isolated true aneurysm of the cervical internal carotid artery (ICA) in a child and discuss the treatment options.
A 7-year-old girl presents with progressive airway compression and dysphagia. Secondary to a giant fusiform extracranial ICA aneurysm extending from the carotid bifurcation to the petrous segment. On DSA, there was significant tortuosity of the ICA with two 180-degree kinks. The patient was treated by a staged approach, first by surgical correction of loop and 3 weeks later by placement of two self expanding stent grafts (Viabahn) together with a bridging nitinol stent. The child tolerated the procedures well without adverse events. CT angiographies at 2 days and 5 months postoperatively demonstrated patency of the stents without restenosis and serial decrease in the size of the aneurysm with cessation of the mass effect. At 14 months follow up CTA, stent was noted to be occluded asymptotically due to interim cessation of antiplatelet therapy against medical advice.

With only 10 cases reported in the literature, pediatric cervical ICA aneurysms are extremely rare and case-by-case planning of treatment may be needed because of associated vascular tortuosity. Since there is no standard regimen for antiplatelet treatment in the pediatric age group, such treatment also needs to be individualized. Close monitoring of adherence to antiplatelet therapy is recommended if stents are placed in children.

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**Long-term Results of Endovascular Treatment for Ugly Aneurysms using Sandwich Technique**

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**Purpose:** To report mid-term results of endovascular treatment for ugly aneurysms with Sandwich technique.

**Methods:** Between Dec 2009 and Nov 2016 endovascular treatment with sandwich technique (stent/coils/stent) was performed in 12 patients (M:F = 5:7, mean age: 56.5 years) with aneurysm surgically difficult or difficult with conventional endovascular treatment. Lesion characteristics were as follows: unruptured aneurysm in eleven and ruptured in one, 7 saccular dissecting aneurysms: 6 in supraclinoid ICA and one in P1 segment 4 fusiform dissecting aneurysm in intracranial vertebral artery 1 P-com aneurysm (rupture during stent-assisted coiling)

**Results:** Technical success was achieved in all patients (total occlusion in seven and subtotal occlusion in six). There was no procedure-related morbidity or mortality. Serial angiographic follow-up was available in seven patients (mean: 22.4 months, range: 2–48 month). Two patients with subtotal occlusion showed near-total occlusion on 3 month follow-up angiogram and there was no recanalization or regrowth of aneurysm in remaining six patients.

**Conclusion:** Endovascular treatment with Sandwich technique was technically feasible and safe for treatment of ugly aneurysm which was surgically difficult or difficult with conventional endovascular treatment. It could be another treatment option for aneurysms difficult to deploy Pipeline embolization device.

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**Endovascular treatment of tiny intracranial aneurysms: sixteen-year experience with 113 cases at a single institution**

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²Sanbo Brain Hospital Capital Medical University, Department of Interventional Neuroradiology, Beijing, China

**Purpose:** To report a single institution’s long-term experience of endovascular treatment of tiny intracranial aneurysms.

**Materials and Methods:** From January 2001 to December 2016, 113 tiny intracranial aneurysms (≤3 mm in diameter, 53 were ruptured and 60 were unruptured) in 103 patients (48 men; mean age, 54.9 years) were treated by endovascular therapy. Their clinical and angiographic outcome were assessed.

**Results:** Technical successful rate were 98.2% (111/113). Endovascular procedures for two unruptured tiny aneurysms in two patients failed because of unsuccessful micro-catheterization. Among the 88 tiny aneurysms coil embolized (Coiling Group), 36 underwent simple coiling, 20 received balloon-assisted coiling, 26 received stent-assisted coiling, 6 received balloon-in-stent assisted coiling. Twenty-three tiny aneurysms received sole stenting ("non-flow diverter" stents) in the parent artery (Sole-stenting Group). Intra-procedural rupture occurred in 3.5% (4/113) of the endovascular procedures, while thromboembolic complications occurred in 2.7% (3/113). Procedure-related mortality rate was 0.9% (1/113). For 88 aneurysms of Coiling Group, post-operative total and subtotal occlusion were achieved in 35.2% and 42.0% respectively. Forty-four of them received angiographic follow-up, total and subtotal occlusion was achieved in 59.5% and 31.4% respectively. Recanalization occurred in 9.1% (4/44) and retreatment occurred in 6.8% (3/44). Among 23 aneurysms of Sole-stenting Group, 18 underwent angiographic follow-up, 10 remained unchanged in size, 6 became smaller and 2 disappeared. No rebleeding occurred during clinic follow-up for the two-group aneurysms.

**Conclusion:** Endovascular treatment of tiny intracranial aneurysms can be performed safely and effectively. Recanalization and retreatment rate are both relatively low for the coiled tiny aneurysms. Short-term effect of aneurysm occlusion for sole stenting with “non-flow diverter” stent is not optimal yet.

**Keywords:** Intracranial aneurysm; Tiny; Endovascular therapy
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Factors of Aneurysmal Rebleeding Differ Depending on Clipping and Coiling after Subarachnoid Hemorrhage  
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2Clinical Research Center, Nagasaki, Japan  

Background and Purpose: Perioperative aneurysmal rebleeding is a major cause of death and morbidity in subarachnoid hemorrhage (SAH). Recognizing risk factors for rebleeding might help to identify the aneurysms that benefit from acute treatment. The aim of this study was to determine predictors for an aneurysmal rebleeding in pre-, intra- and postoperative period comparing between clipping and coiling.

Methods: The incidence of rebleeding, demographic data, and clinical data from 4933 patients with aneurysmal SAH were retrospectively collected from Nagasaki SAH registry. All clinical variables were examined by multivariate analysis, and a binary logistic regression analysis was performed to identify the risk factors related to rebleeding.

Results: Preoperative rebleeding occurred in 10.3 ± 0.5% of the 4933 aneurysm during the in-hospital stay. In the preoperative period, aneurysm size (OR 2.56, 95% CI: 1.91–3.43), cardiac disease (OR 1.65, 95% CI: 1.07–2.54) were significantly associated with rebleeding. On the other hand, intraoperative rebleeding occurred in 8.8%. Aneurysm location (Anterior communicating artery (Acom): OR 1.47, 95% CI: 1.06–2.00), aneurysm size (OR 1.71, 95% CI: 1.22–2.39), family history (OR 1.71, 95% CI: 1.10–2.64), preoperative rebleeding (OR 1.68, 95% CI: 1.03–2.77), clipping (OR 2.51, 95% CI: 1.61–3.80) were significantly associated with intraoperative rebleeding. Interaction analysis showed Acom vs others at clipping was significantly affected intraoperative rebleeding. Aneurysm location (OR 1.57, 95% CI: 1.18 to 2.07) affected the final outcome. There was no difference in the postoperative rebleeding between clipping and coiling.

Conclusions: Aneurysmal rebleeding after SAH has a characterististics in the pre-, intra-, and postoperative period. Acom could be a good candidate for endovascular coiling after SAH.

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Prognostic factor for recurrence of coiled small intracranial aneurysms  
Yoon Seokmann1, Oh Jae-Sang1, Shim Jae-Hyun1, Oh Hyuk-Jin1 and Bae Hack-Gun1  
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Objectives: The aim of this study was to retrospectively evaluate the changes of angiographic result after endovascular treatment and factors associated with further obliteration, or recanalization in patients with small intracranial aneurysms.

Methods: Five hundred and thirty seven saccular aneurysms were embolized during 10 year period between 2007 and 2016. Of these, small aneurysms (<10 mm) with more than 3 months angiographic follow up were included. We assessed the aneurysm characteristics, immediate and follow-up angiographic results according to Raymond-Roy classification (RROC) and retreatment rate.

Results: Two hundred and fifty aneurysms in were included. Mean age was 55.7 ± 12.3 and ruptured aneurysm was 127 (50.8%). Conventional coil embolization, balloon assisted coiling (BAC) and stent assisted coiling (SAC) were employed in 124, 48, and 78 cases, respectively. Immediate postoperatively, RROC of I, II, and III were 63.6%, 22.4%, and 14.0%, retrospectively. Mean follow-up duration was 29.1 ± 23.0 months. At last follow-up, RROC of I, II, and III were 72.4%, 23.2%, and 4.4%, respectively. SAC showed higher progressive obliteration rate during follow up (from 57.7% to 91.0% in RROC I). Overall retreatment rate was 6.8% and ruptured aneurysm was associated with significantly higher retreatment rate (2.4% vs. 11.0%, p = 0.015). SAC group showed significantly higher progressive obliteration and lower recurrence rates (37.2%, p = 0.001, 5.1%, p < 0.001). Logistic regression analysis revealed that ruptured aneurysm and SAC were identified as the independent factors for further obliteration (OR, 95% CI: 0.467, 0.228 to 0.956 and 2.8896, 1.335 to 6.285, respectively), and recurrence (OR, 95% CI: 2.345, 1.109 to 4.959 and 0.229, 0.074 to 0.705, respectively).

Conclusions: Use of stent seems to prevent recurrence and facilitate further occlusion of coiled aneurysm, possibly due to the flow diversion effect. Long term angiographic outcome of stent assisted coiling could be comparable to that of microsurgical clipping in patient with small sized aneurysms.

Key word: small aneurysm, stent assisted coiling, recanali- zation, retreatment

Wednesday, 18th of October, Session room 3. – 07:15 – 08:00 – Back to the basics: The slinky enemy: vasospasm

Pathophysiology and non-endovascular treatment of vasospasm  
Péter Vajkóczy  
Department of Neurosurgery, Charite Universitätsmedizin Berlin, Germany

Endovascular Treatment options  
Thomas Liebig  
University of Cologne, Germany
Wednesday, 18th of October, Session room 3. – 14:15 – 16:15 – Parallel abstract session -
Aneurysm clinical: Coil and assisted coil

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Aneurysm coil embolization using ED coil® and 1.5F Marathon® catheter

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Purpose: Marathon® catheter (Covidien, CA, USA) is a flow-directed microcatheter designed in order to deliver liquid embolic agent for brain AVMs and dural AVFs. The authors report their clinical experience of aneurysmal embolization using Marathon® catheter and assess the usefulness of this method.

Materials and Methods: 10 patients with intracranial aneurysms underwent coil embolization using Marathon catheter in our institutions. In all cases, ED extra-soft® coils (Kaneka, Osaka, Japan) were used as embolic agents.

Results: All embolization procedures were successfully accomplished in all cases and satisfactory occlusion was achieved without causing any new neurological symptom. Marathon® catheter showed superior navigability and operability during treatment of distally located small aneurysms. Moreover, it showed minimum reluctance in crossing the struts of neck-bridging stent.

Conclusion: Aneurysm coil embolization using Marathon® catheter has a certain role in treating small aneurysms which are located distally, beyond tortuous vessels, or need trans-cell access.

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Initial Institutional Experience with the Axium Prime Extra Soft Coil for Treatment of Intracranial Aneurysms

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Purpose: This study’s goal is to evaluate the safety and efficacy of the Axium Prime Extra Soft (ES) coil for treatment of intracranial aneurysms.

Methods: We conducted a retrospective review of all consecutive patients with intracranial aneurysms treated with Axium Prime ES coils at a single center between January 26th, 2016 and March 28th, 2017. Baseline patient and aneurysm characteristics, procedural variables and complications were recorded. Aneurysm occlusion at angiographic follow-up was determined using the Roy-Raymond scale. Aneurysm retreatment was recorded.

Results: 45 patients with 48 intracranial aneurysms were included, 36 women (80%). Mean age was 58.2 years (median 58 years, 36–92 years). 47 aneurysms were treated successfully with coils (98%). 17 aneurysms were ruptured (35%), 8 recurrent (17%) and 3 symptomatic (6%). Mean maximum aneurysm size was 5.7 mm (median 5.2 mm, 2.2–26.2 mm), mean neck 2.8 mm (median 2.6 mm, 1–6.2 mm), mean dome to neck ratio 1.7 (median 1.4, 0.9–11.5). Aneurysm locations were: 13 anterior communicating artery, 11 middle cerebral artery, 10 internal carotid artery, 5 anterior cerebral artery, 4 posterior communicating artery, 1 basilar tip, and 1 each posterior inferior cerebellar, superior cerebellar, posterior cerebral and persistent hypoglossal arteries. Aneurysm embolization techniques were: 23 balloon-assisted coiling (48%), 11 stent-assisted coiling (23%), 10 simple coiling (21%), 3 Pipeline/coiling (6%), and 1 aneurysm was treated with flow diversion after attempted coiling (2%). Mean total number of coils deployed per aneurysm was 3.5 (median 3, 1–14). Mean number of Axium Prime ES coils deployed per aneurysm was 2.1 (median 2, 1–7). Mean Axium Prime ES coil length as total coil length percentage was 55.1% (median 42%, 11.1–100%). Mean packing density was 35.2% (median 35.7%, 1.6–63%). There were 6 peri-procedural complications: 3 coil herniations during balloon-assisted coiling requiring stenting (6%), 1 intra-operative aneurysm re-rupture controlled with balloon inflation (2%), 1 small peripheral subarachnoid hemorrhage on post-operative day 1 (2%), and 1 subacutestent thrombosis on post-operative day 4 (2%). The subacute stent thrombosis resulted in the patient’s death (2.2%). No other treatment-related complication resulted in a permanent neurological deficit or death. Angiographic follow-up was performed in 19 aneurysms (42%, 26 aneurysms currently pending follow-up). Mean time to follow-up was 6.3 months (median 6.1 months, 5.9–7.6 months). At follow-up, 14 aneurysms were completely occluded (74%, Raymond 1) and 5 showed residual neck (26%, Raymond 2). There were no residual aneurysms at follow-up (Raymond 3).

Conclusion: The Axium Prime ES coil is safe and effective for the treatment of intracranial aneurysms, achieving high packing densities, low risk of major treatment-related complications, high medium-term complete/near-complete aneurysm occlusion rates, and low re-treatment rates.
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Second-generation Hydrogel-coated Coils for the Endovascular Treatment of Intracranial Aneurysms: A Randomised Controlled Trial

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Background: Endovascular embolisation of intracranial aneurysms with hydrogel-coated coils lowers the risk of major recurrence, but technical limitations (coil stiffness, time restriction for placement) have prevented their wider clinical use. We aimed to assess the efficacy of softer, second-generation hydrogel coils.

Methods: A randomised controlled trial was conducted at 22 centres in France and Germany. Patients 18–75 years old with untreated ruptured or unruptured intracranial aneurysms measuring 4–12 mm in diameter were eligible and randomised (1:1 using a web-based system, stratified by rupture status) to coiling with either second-generation hydrogel coils or bare platinum coils. Assist devices were allowed as clinically required. Independent imaging core lab was masked to allocation. Primary endpoint was an adverse composite outcome of angiographic and clinical outcomes at 18 months. Analyses were done using a modified intention-to-treat approach. This study is registered in the German Clinical Trials Register, DRKS-ID: DRKS00003132, and has been completed.

Findings: Randomisation began on October 15, 2009, and stopped on January 31, 2014, after 513 patients (hydrogel n = 256, bare platinum n = 257); 20 patients were excluded for missing informed consent and nine for treatment-related criteria. 484 patients (hydrogel n = 243, bare platinum n = 241) were included in the analysis; 208 (43%) were treated for ruptured aneurysms. Final endpoint data were available for 456 patients. 45/226 (19.9%) patients in the hydrogel group and 66/230 (28.7%) in the control group had adverse composite primary outcomes, giving a statistically significant reduction in the proportion of adverse composite primary outcomes with hydrogel coils—adjusted for rupture status—of 8.4% (95% CI 0.5–16.2, p = 0.036). Adverse and serious adverse events were evenly distributed between groups.

Interpretation: Endovascular coil embolisation with second-generation hydrogel coils reduces the rate of adverse outcomes in patients with medium-sized intracranial aneurysms.

Funding — MicroVention, Inc.

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A prospective, multicenter study assessing the embolization of neurovascular lesions using the Penumbra SMART COIL® System: Initial results from the SMART Registry

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Purpose: Conventionally, platinum coils used in intracranial embolization possess a constant softness level along an individual coil's entire length. Penumbra SMART COILS, which transition in softness throughout their length, were recently developed. Reported herein are initial baseline characteristics and results from the multicenter SMART Registry.

Materials and Methods: The SMART Registry is a prospective post-market registry of subjects with cerebral aneurysms and other malformations treated with SMART COILS. This initial analysis evaluated data collected from the 175 subjects with aneurysms out of the first 200 consecutive subjects enrolled at 18 centers. Registry endpoints include procedural device-related serious adverse events, ability to achieve adequate occlusion immediately post procedure, number of times re-access with a guidewire was required due to catheter kickout, and retreatment through follow up. Data are collected through one-year follow up.

Results: The 200 subjects received treatment for aneurysms (87.9%), arteriovenous malformations (1.0%), fistulae (6.0%), and other lesions (5.0%). This analysis presents data from the 175 aneurysm subjects. The mean age was 60.0 ± 13.5 years; 70.9% (124/175) were female. Aneurysm sizes were 89.1% small, 10.3% large, and 0.6% giant; 62.5% were wide-neck aneurysms. Aneurysms were located
in the internal carotid artery (39.6%), anterior cerebral artery (26.9%), middle cerebral artery (17.1%), posterior circulation (13.7%), and other locations (2.9%). Median total fluoroscopic time was 37.0 min (IQR 23.0–57.0, range 3.0–210.0), and time from first coil deployment to last coil detachment was 13.5 min (IQR 7.0–31.5, range 0.0–107.0). Around one-third (37.8%) of subjects underwent stent-assisted coiling, and 23.4% underwent balloon-assisted coiling. Median packing density was 30.0% (IQR 21.0–32.0). Based on the investigator’s adjudication, adequate occlusion immediately post-procedure was achieved in 98.8% (171/173) of cases. Eighty (80) percent of cases did not require re-access with a guidewire due to catheter kick-out, with 15% reporting 1 attempt and 5% reporting 2 or more attempts. There were 7 (4.0%) procedural device-related serious adverse events. The three reported deaths (1.7%) occurred >24 hours post-procedure and were not device-related. Data collection for one-year subject follow up is ongoing.

Conclusion: Initial results of the SMART Registry suggest the SMART COIL is effective in achieving adequate occlusion in embolization of a variety of neurovascular lesions and locations.

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Extra-soft SMART (PENUMBRA) coils in the endovascular treatment of very small (≤3 mm) intracranial aneurysms

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Purpose: Coiling of very small (≤3 mm) aneurysms is technically difficult with a high intra-procedural rupture rate. This is related to catheter stability and small aneurysm size with inherent increased pressure on the aneurysm walls during coil delivery.

Recently, a new range of extra-soft platinum coils SMART coil [PENUMBRA] have been introduced, which are supposedly extremely soft, cause less catheter displacement and conform better to the shapes of the very small aneurysms. We report the intra-procedural complication rates, angiographic results and clinical outcomes of 13 consecutive patients harbouring very small intracranial aneurysms (≤3 mm) treated with extra soft SMART (PENUMBRA) coils in a single neurosciences centre in NE England from Feb 2016 to Feb 2017.

Materials and Methods: Retrospective analysis of the neurovascular database from 19 Feb 2016 - 7 Feb 2017 identified 13 patients (with 13 very small aneurysms) treated with the extra-soft SMART (PENUMBRA) coil system. The relevant case notes, angiography, cross-sectional imaging and follow up clinic data was reviewed. In this group of patients we looked at the incidence of intra-procedural complications, the use of adjunctive devices, clinical outcomes, angiographic recurrences.

Results: 13 patients (8 Female and 5 male) harbouring very small intracranial aneurysms were treated with extra soft SMART (PENUMBRA) coils.

Age range was from 43–71 years (median 54 years). There were 7 acutely ruptured and 6 unruptured aneurysms (3 neck remnants) comprising of 5 ACOM, 1 A1, 2 M1, 3 MCA and 2 Basilar aneurysms. 7 aneurysms measured 3 mm, 5 aneurysms measured 2 mm and 1 aneurysm measured 2.5 mm in size respectively. 22 extra soft SMART (PENUMBRA), 3 soft SMART (PENUMBRA) and 1 Axium Prime (MEDTRONIC) coils were used for the treatment, 10 aneurysms were treated purely with the extra soft coil range, the other three aneurysms were treated with either the soft SMART or the Axium PRIME coils in addition to the extra soft coils. The average number of coils used per case was 2 coils.

Adjunctive devices were used in 9 cases (6 balloons and 3 stents).

Coils were delivered into these small aneurysms from the neck of the aneurysm. There was no microcatheter displacement during coil delivery. No re-sheathing or redeployment was needed in these cases. No intra-procedural rupture, coil migration, coil stretching, failure of coil detachment or intra-procedural thrombosis was noted. All coils were detached. There was no mortality or procedure related morbidity in these patients with no change in the baseline mRs after the procedure.

6 month FU MRA/catheter angiogram is available in 7/13 patients which revealed complete aneurysm occlusion with no remnants in 6 patients and a tiny neck remnant in 1 patient which is under observation. There were no rebleeds on FU.

Conclusion: The extra soft SMART (PENUMBRA) coils are safe and effective in the treatment of otherwise difficult to treat very small aneurysms.

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Long-term follow-up results of the Penumbra SMART coil in the endovascular treatment of intracranial aneurysms

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Background: The Penumbra SMART coil is a novel next-generation device that becomes progressively softer from its distal to proximal end and has a tight loop configuration that renders each coil true to its intended size. We previously reported on the safety and efficacy of this device in a cohort of 17 patients who underwent endovascular coil embolization of 17 intracranial aneurysms (IAs).

Objective/Methods: To follow-up our initial investigation, we analyzed the records of 48 consecutive patients,
including the 17 patients from our initial study, with 50 IAs treated with SMART coils between March 2015 and September 2016.

**Results:** Thirty-five female and 13 male patients were identified, harboring 50 total aneurysms. Twenty-three patients presented with subarachnoid hemorrhage, seven had recurrent aneurysms, and three had an additional aneurysm treated concurrently. Thirty aneurysms (six of which were recurrent) were treated with stand-alone coiling, thirteen (one of which was recurrent) were treated with stent-assisted coiling, and seven were treated with flow diversion with adjuvant coiling. An initial post-treatment Raymond-Roy Occlusion Classification (RROC) I or II closure was achieved in 37 (74%) aneurysms, including 25 (83%) aneurysms undergoing primary stand-alone coiling. Thirteen (26%) aneurysms were classified as RROC III, and all but four aneurysms in this category were either stent-assisted, flow diverted with adjuvant coiling, or recurrent aneurysms. The average length of long-term follow-up was 223 days. Of the 36 (75%) patients with long-term follow-up (four patients from the initial population deceased and eight were lost to follow-up or have not yet returned for follow-up), 31 (86%) patients had IAs with RROC I or II closures while seven (14%) patients had RROC III occlusions. Four (11%) aneurysms required retreatment (of which three had undergone primary stand-alone coiling and one had underwent stent-assisted coiling), for which all except the prior stent-assisted coiling underwent flow diversion with adjuvant coiling. Two patients had minor intraprocedural ruptures, and remained neurological stable without further clinical sequelae.

**Conclusions:** The Penumbra SMART coil is a safe and effective device for the endovascular treatment of IAs. Additional studies comparing its safety and efficacy profile over long-term periods to other mainstream coils are necessary.

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**Does stent type impact coil embolization outcomes in extended follow-up of small-sized aneurysms (<10 mm)?**

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**Purpose:** Self-expandable stents have enabled endovascular treatment of wide-necked aneurysms (ordinarily viewed as technically prohibitive), with favorable outcomes. However, the impact of stent type on occlusive stability has not been adequately investigated. In small-sized saccular aneurysms, we generated estimates of stent-assisted coil embolization outcomes during follow-up monitoring. Stent type and other risk factors linked to recanalization were analyzed.

**Methods:** A cohort of 289 patients harboring 315 small-sized aneurysms (<10 mm) was subjected to mid-term and extended follow-up monitoring after stent-assisted coiling. Three types of stents (Enterprise, 195; Neuroform, 27; LVIS, 93) were deployed in this population, all medical records and radiologic data of which were reviewed. Mid-term recanalization rates and related risk factors were assessed using binary logistic regression analysis.

**Results:** A total of 49 aneurysms (15.6%) displayed recanalization at 6 months postembolization, with 34 and 15 instances of minor and major recanalization, respectively. Multivariate analysis indicated that wide-necked aneurysms (>4 mm) (HR = 2.309; p = 0.020), incomplete occlusion at time of coiling (HR = 2.688; p = 0.004), and stent type (p = 0.045) were significant factors in mid-term recanalization; whereas hypertension (p = 0.123) and packing density ≤30% (p = 0.167) fell short of statistical significance. Compared with Enterprise (HR = 2.735) or Neuroform (HR = 4.410) stents, outcomes proved more favorable with use of LVIS.

**Conclusions:** Above findings demonstrate that in addition to occlusive status at time of coil embolization and neck size, stent type may affect follow-up outcomes of stent-assisted coil embolization in small-sized aneurysms. LVIS (vs Enterprise or Neuroform stents) performed best during follow-up monitoring in terms of limiting recanalization.

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**Long-term angiographic outcome of stent-assisted coiling compared to non-assisted coiling of intracranial saccular aneurysms**

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**Purpose:** To compare angiographic result at long-term follow-up, and rates of progressive occlusion, recurrence, and retreatment of stent-assisted coiled (SAC) and non-assisted coiled (NAC) intracranial saccular aneurysms.

**Materials and Methods:** Retrospective evaluation of department records identified 260 patients with 283 saccular intracranial aneurysms who had long-term angiographic follow-up (more than 12 months) and were successfully treated with SAC (89 aneurysms) or NAC (194 aneurysms) at the University Hospital Center Zagreb from June 2005 to July 2012. Initial and control angiographic results in both groups were graded using Roy/Raymond scale, converted to descriptive terms, and the differences between them were evaluated for statistical significance. A multivariate analysis was performed to identify factors related to progression of aneurysm occlusion and recurrence at follow-up, and those related to aneurysm retreatment.

**Results:** There were more progressively occluded aneurysms in SAC group (38 of 89 aneurysms, 42.7%) than in NAC group (46 of 194, 23.7%) (P = 0.002), but there were no
significant differences in the rates of recanalization, regrowth, and stable result. Multivariate logistic regression identified the use of stent as the most important factor associated with progressive occlusion (P = 0.015, odds ratio 2.22, 95% confidence interval 1.17–4.21), and large aneurysm size and posterior circulation location as most predictive of aneurysm recurrence and retreatment.

Conclusion: The use of stent is associated with delayed occlusion of initially incompletely coiled aneurysms during follow-up, but does not reduce the rate of recurrence and retreatment compared to coiling alone. Long-term angiographic follow-up is needed for both SAC and NAC aneurysms.

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Atlas stent-assisted coiling of unruptured middle cerebral artery aneurysms

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Purpose: to evaluate stent assistant coiling of unruptured middle cerebral artery aneurysms (with wide neck and branches incorporation) with Atlas stent usage.

Method: procedure related complication of consecutive patients undergoing Atlas stent-assisted coiling from October 2015 to March 2017 and MRI occlusion of aneurysm sac 3-months later were evaluated prospectively. Y-stent technique was used in 9/12 (75%) cases and single stent was used in 3/12 (25%) cases. Patients were tested for antiplatelet drug resistance.

Results: Treatment was successful in all cases (12 cases). Median age was 58 years (36–75 years) and 9/12 (75%) were women. Average maximal aneurysm diameter was 6.0 (3.5–8 mm). Six aneurysms were located on the left side and six aneurysms on the right side. There was no periprocedural complication. MRA follow-up was available in 9/12 (75%) patients. Aneurysm occlusion was complete in 8/9 (88.9%) and neck remnant was present in 1/9 (11.1%). No subarachnoid hemorrhages and no ischemic events related to the procedure were observed during follow-up.

Conclusion: High technical and clinical success was achieved. Preliminary results are very promising, long-term follow-up is necessary.

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NeuroForm Atlas stent-assisted coiling of intracranial aneurysms: preliminary results

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Background and Objective: Stent-assisted coiling is increasingly performed as intervention for wide-neck intracranial aneurysms. The NeuroForm Atlas stent (CE-marked) is relatively new. This is the first study in which the effectiveness and safety of NeuroForm Atlas stent-assisted coiling for intracranial aneurysms are evaluated.

Methods: We retrospectively analyzed data from all patients treated with NeuroForm Atlas stent-assisted coiling of an intracranial aneurysm, both ruptured and unruptured, between June 2015 and December 2016 in our center. Primary end-points were favorable clinical outcome (modified ranking scale score 0–2) and successful aneurysm occlusion (Raymond-Berndt class I/II), both at 6 months follow-up. Secondary end-points were among others occurrence of intervention-related complications leading to permanent neurological deficit and immediate aneurysm occlusion and recanalization. Fisher’s exact tests were performed to analyze significance of differences in occlusion and clinical outcome rates for several subgroups (α = .05).

Results: Twenty-seven (10 for subarachnoid hemorrhage, 17 electively) consecutive patients were treated with NeuroForm Atlas stent-assisted coiling. At 6 months follow-up 18/26 (69.2%) survivors had successful aneurysm occlusion and 22/26 (84.6%) favorable clinical outcome. Mortality rate was 3.7% (1/27). However, cause of death was not associated with treatment. No intervention-related complications leading to permanent neurological deficit occurred. However, intra-procedural thromboembolic complications were experienced in 4/27 (14.8%) patients and ischemic stroke related to treatment occurred in 4/26 (15.4%). No hemorrhagic complications were observed.

Conclusion: NeuroForm Atlas stent-assisted coiling is a feasible, safe and effective option for treatment of both unruptured and acutely ruptured aneurysms.

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Initial experience with the ATLAS microstent for the treatment of wide-necked aneurysms

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Introduction: This study was aimed to assess clinical safety and efficacy of the ATLAS microstent in stent-assisted coil embolization of wide-neck intracranial aneurysms.

Methods: Single-center interventional clinical study in 14 patients (6 females, 7 males, mean age 58, age range
47–73 years) for the endovascular treatment of wide-neck aneurysms. After obtaining informed consent, patients were included according to the following criteria: aneurysm fundus-to-neck ratio <2 or neck diameter >4 mm, and a parent vessel diameter of ≤4.5 mm. Primary end point for clinical safety was absence of death, absence of major or minor stroke, and absence of transient ischemic attack. Primary end point for treatment efficacy was complete angiographic occlusion according to the Raymond-Roy Occlusion Classification (RROC) immediately after the procedure.

Results: In 12/13 (92 %) of patients, the primary end point of safety was reached, one patient showed a transitory ischemic attack which completely resolved until discharge. In 12/13 (92 %), efficient occlusion (RROC1) was reached, and in 1/13 (8 %), a residual neck remained (RROC2). A sequential approach (first stent then coiling through the same catheter) was used in 3 cases, the other 10 were treated with the standard jailling technique. Deployment was technically successful in all cases.

Conclusions: Deployment of the ATLAS microstent is safe and effective to assist the treatment of intracranial wide-neck aneurysms.

Stent Assisted Coiling of Intracranial Aneurysms with the Low-Profile Neuroform Atlas Stent

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Objective: The smaller version of Neuroform, the open-cell intracranial stent, has been recently introduced as the Atlas stent. We would like to report the angiographic and clinical results of stent-assisted coiling with Atlas stent in the treatment of intracranial aneurysms in a single hospital.

Methods: We retrospectively evaluated all intracranial aneurysms treated by coiling and placement of a single Atlas stent in our hospital. Patients were excluded if the stent was used secondarily and placed in an effort to aid or salvage aneurysm embolization using another device (eg balloon or flow diverter) or if dual stenting was performed. Variables related to the patients, aneurysms, stented arteries and clinical/angiographic follow-up results were analyzed.

Results: There were 50 consecutive aneurysms in 43 patients (25 female, mean age 51.7), 5 were ruptured. Aneurysms locations were as follows: 18 MCA bifurcation, 12 Acom, 5 Pcom, 4 Basilar Tip, 2 Supraclinoid ICA, 3 ACA, 1 MCA M1 segment, 1 SCA, 1 PCA P1 segment, 1 distal cervical ICA, 1 PICA, 1 V4 segment. Mean sizes of aneurysm dome, aneurysm neck, proximal parent artery and distal parent artery were, in respective order, 6.9 mm (range 2–17), 3.8 mm, 2.63 mm (range 1.5–4.4) and 1.79 mm (range 0.9–3.5). One patient who never used Clopidogrel after the procedure had a focal visual field deficit secondary to a small occipital stroke 2 months after the procedure. Otherwise in patients who adhered to their antiplatelet therapy, there were no permanent neurologic complications or mortality perioperatively and during follow-up. No failures were encountered secondary to navigation-related problems. At a mean follow-up of 7 months (range 1–19), 90 % of the aneurysms had satisfactory (RR1 and RR2) angiographic results. Although the preoperative and postoperative measurements of the angles between the parent artery and stented branch in working projection showed a statistically significant difference (p = 0.01), the absolute difference between the mean values of these angles (preoperative 86.63 °/–30.98, postoperative 90.4+/–30.4 degrees) was only 3.8 degrees and is clinically not relevant.

Conclusion: Open-cell intracranial stents have advantages that are well-documented in the literature. In addition, Atlas stent was associated with better navigability and minimal distortion of vascular geometry in this series. It is possible that the better clinical and angiographic result obtained in this series is a consequence of the constellation of all of these properties.

Wednesday, 18th of October, Session room 3. – 17:45 – 18:45 – Parallel abstract session - Aneurysm clinical: Coil and assisted coil

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T-configuration stenting technique with Low-profile Visualized Intraluminal Support Junior (LVIS Jr) device in wide-necked and complex bifurcation intracranial aneurysms

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Purpose: To describe and study the feasibility, efficacy, and safety of the T-configuration stent-assisted coiling technique with Low-profile Visualized Intraluminal Support Junior (LVIS Jr) device in the treatment of wide-necked and complex bifurcation intracranial aneurysms.

Methods: Retrospectively identified patients with wide-necked bifurcation intracranial aneurysms treated using T-configuration stenting technique with LVIS Jr device.

Results: Eight patient with 8 bifurcation intracranial aneurysms (5 ruptured and 3 unruptured) and a mean age of 60.4 ± 10.6 years (44–70 years) were identified. The aneurysms locations were the anterior communicating artery (4/8), middle cerebral artery bifurcation (3/8) and basilar artery tip (1/8). T stentings were performed using LVIS Jr devices. The procedures were performed with a technical success rate of 100%, and an immediate total occlusion rate of 62.5% was achieved. We observed a delayed thromboembolic event in 1 patient (12.5%). No patients remained permanent morbidity and no deaths occurred. Angiographic follow-up evaluations were performed in 5 patients (62.5%) as of the time of submission of the paper. The mean length
of follow-up was 6.6 ± 2.5 months (range 3–9 months). The total occlusion rate at the last follow-up was 80.0% (4/5). The recanalization rate was 20.0% (1/5). In-stent stenosis was present in 1 patient (20.0%). In-stent stenosis was morphologically mild (<50%) and asymptomatic in this case. Modified Rankin Scale scores of all patients at the last clinical follow-ups were 0 and 1.

Conclusion: T-stent-assisted coiling with LVIS Jr device is a feasible, effective, and relatively safe endovascular technique used to treat wide-necked and complex bifurcation intracranial aneurysms. The midterm angiographic and clinical outcomes are outstanding.

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Endovascular Treatment of Cerebral Aneurysms Using LVIS Jr Stent: Mid-term Clinical and Angiographic Results

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Purpose: This report details our experience with the LVIS Jr. device for intracranial aneurysms. The midterm angiographic and clinical outcomes are outstanding.

Clinical outcomes are outstanding.

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Endovascular treatment of unruptured aneurysm with LVIS and LVIS Jr. stent

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Purpose: Unruptured intracranial aneurysms are defined as those without current or previous history of bleeding, or any symptoms that may be related or previous bleeding. With the advent of modern and precise neuroimaging techniques, the number of incidentally diagnosed aneurysms has been increased exponentially. Because of that, it has been too much discussed about therapeutic modality to be used to solve the problem. In the present study we describe our experience related to the embolization of unruptured or incidental aneurysms using the new LVIS (Microvention, Terumo) and LVIS Jr (Microvention, Terumo) stent.

Materials and Methods: A retrospective study was performed with the medical records of patients submitted to endovascular treatment for unruptured aneurysms using the LVIS and LVIS Jr. stent (Microvention, Terumo) during the period from February 2015 to April 2017.

Results: The sample had a total of 88 patients, with a mean age of 55.54 years (30–83) and female majority (88.6%). About risk factors, it was possible identify 10.2% of patients with diabetes mellitus, 52.2% with systemic arterial hypertension, 12.5% smokers and 40.9% dyslipidemic. The most common location of the aneurysms was the bifurcation of the middle cerebral artery with 15 cases (17%), followed by the carotid-ophthalmic artery with 13 cases (14.7%), the anterior communicating artery with 9 cases (10.2%), of the cavernous carotid artery with 8 cases (9%). There was a predominance of small aneurysms with 81 cases (92%) and large cases in 7 cases (7.9%). Saccular aneurysms, in 84 cases (95.4%), Fusiform in 4 cases (4.5%). The stent was used in association with coils in 82 cases (93.1%). The LVIS stent was used in 64 cases (72.7%) and LVIS Jr. in 24 cases (27.2%).

Conclusion: Despite the controversy in treating or not treating the incidental aneurysms; we conclude based on our data that the endovascular treatment of aneurysms with the LVIS and LVIS Jr. stent is a technique with low morbidity and mortality, with minimal risk of complications.
Reconstructive endovascular treatment of vertebral artery dissecting aneurysms with the Low-profile Visualized Intraluminal Support (LVIS) device

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Purpose: The low profile visualized intraluminal support (LVIS) stent, a new device offered as an option between conventional neurovascular stents and flow diverters, was designed to avoid the long term efficacy of endovascular treatment while avoiding impact on side branches. The aim of our study is to evaluate the feasibility, safety, and efficacy of the LVIS device in reconstructive treatment of vertebral artery dissecting aneurysms (VADAs).

Materials and Methods: We retrospectively reviewed the neurointerventional database of our institution from June 2014 to May 2016. Patients who underwent endovascular treatment of VADAs with LVIS stents were included in this study. Patients demographics and presenting symptoms, vascular risk factors, aneurysm characteristics, technical feasibility, procedural complications, and angiographic and clinical follow-up results were evaluated.

Results: 38 patients with VADAs who underwent treatment with LVIS stent were identified, including 3 ruptured VADAs. All VADAs were successfully treated with reconstructive techniques including the stent-assisted coiling (n = 34) and stenting only (n = 4). Seventeen cases were reconstructed with a single LVIS stent including four patients using another Enterprise stent simultaneously. Double LVIS stents were used in 21 patients including one patient with Enterprise stent used simultaneously. Post-procedural complications developed in 3 patients (7.9%) including two small brainstem infarctions and one delayed thromboembolic event. Complications resulted in one case of minor permanent morbidity (2.6%). There was no procedure-related mortality. The follow-up angiogram was available in 30 patients at an average of 8.3 months (range, 2 to 30 months), which revealed complete occlusion in 23 patients (76.7%), residual neck in five patients (16.7%), and residual sac in two patients (6.7%). The follow-up of 22 aneurysms with incomplete immediate occlusion revealed 22 aneurysms (88%) with incomplete occlusion. In the result of embolization. One aneurysm (6.3%) showed recanalization and required retreatment. None of these patients with follow-up angiography demonstrated the evidence of in-stent stenosis. Eighteen dissections with PICA involved underwent angiographic follow-up and none of them showed impaired flow of PICAs except one occlusion because of delayed thromboembolic event. Clinical follow-up at 5–28 months (mean 14.1 months) was achieved in 36 patients because two patients died of pancreatic cancer and basal ganglia hemorrhage, respectively. No new neurologic deterioration or aneurysm (re)bleeding was observed.

Conclusions: Our preliminary experience with reconstruction of VADAs with the LVIS device demonstrates that this treatment approach is feasible with good short-term angiographic and clinical outcomes. Long-term and larger cohort studies are necessary to determine long-term outcomes of this therapy.

Preliminary experience with stent-assisted coiling of aneurysms arising from small (<2.5 mm) cerebral vessels using Low-profile Visualized Intraluminal Support (LVIS) device

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Purpose: Stent-assisted coiling of wide-necked aneurysms in small parent vessels measuring <2.5 mm in diameter is a technically challenging procedure. Some studies had detailed the use of LVIS stents for the treatment of wide-necked intracranial aneurysms with small vessels and reported relatively high rates of peri-procedural thromboembolic event and in-stent stenosis. The low-profile visualized intraluminal support (LVIS) stent is a new device recently introduced for the treatment of wide-neck intracranial aneurysms. We conducted this retrospective study to examine the LVIS device safety, deployment feasibility and treatment effectiveness in intracranial aneurysms with parent vessels measuring <2.5 mm in diameter.

Materials and Methods: Aneurysms with a LVIS stent deployment in a small parent vessel (<2.5 mm in diameter) between October 2014 and April 2016 were included. Procedure-related complications, angiographic results, clinical outcomes, and midterm follow-up data were analyzed retrospectively. Particular attention was given to vessel patency, aneurysm occlusion, and the incidence of thromboembolic events.

Results: A total of 22 patients (9 women and 13 men) was studied, including 5 ruptured and 17 unruptured aneurysms. Their mean age was 51.6 years (range: 33–65 years). Most of the aneurysms were located in the anterior circulation (90.9%), with 14 middle cerebral artery aneurysms (63.6%), 5 anterior communicating artery aneurysms (22.7%), and 1 anterior cerebral artery aneurysm (4.5%). Two aneurysms were located at the basilar artery tip. The parent vessel sizes varied from 1.7 to 2.4 mm (mean 2.1 mm). The maximum sizes of aneurysms varied from 1.7 to 10.8 mm (mean 4.8 mm). The technical success rate of stenting was 90.9%, in the case, there was no failure to navigate or deploy the stent. Immediate post-procedural angiograms showed complete occlusion in 8 aneurysms (36.4%), neck residual in 8 (36.4%), and residual aneurysm in 6 (27.3%), respectively. Procedure-related complication developed in one patient (4.5%) presenting with aneurysm rupture. No thromboembolic event was observed in our series and there was no permanent morbidity or mortality. All patients underwent angiographic follow-up at a mean of 8.3 months which revealed complete occlusion in...
18 (81.8%) patients, neck remnant in three (13.6%) and residual sac in one (4.5%). No recanalization of the target aneurysm was observed. There was one case (4.5%) with asymptomatic in-stent stenosis. Clinical follow-up at 6–23 months (mean 16.1 months) was achieved in all patients and no new neurologic deterioration or death was observed.

**Conclusion:** Our preliminary results show that the LVIS stent is a safe and effective device for endovascular treatment of intracranial aneurysms with small parent vessels. Periprocedural thromboembolic complications and in-stent stenosis are uncommon. Larger studies with long-term follow-up are needed to validate our promising results.

The safety and efficacy of low profile visualized intraluminal support (LVIS) stents in assisting coil embolization of small (>3 mm, ≤10 mm) intracranial aneurysms

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**Purpose:** The low profile visualized intraluminal support (LVIS) device is a new generation of self-expanding braided stents for stent assisted coiling of intracranial aneurysms. This study assessed the clinical safety and efficacy of the LVIS stent for embolization of small (>3 mm, ≤10 mm) intracranial aneurysms.

**Materials and Methods:** Patients with small intracranial saccular aneurysms treated using the LVIS device in our center between April 2014 and December 2016 were reviewed. The primary outcomes were procedural safety, target aneurysm recurrence, and long-term follow-up of clinical and angiographic outcomes.

**Results:** 580 patients with small intracranial saccular aneurysms were treated using the LVIS stent. 165 (28.4%) were ruptured ones. Procedure-related complications occurred in 39 patients (6.7%). Clinical outcome (median, 33 months) was good in 481 patients (82.9%) with a modified Rankin Scale score of up to 2. 464 (80.0%) patients underwent angiographic follow-up at a mean of 13.4 months, complete occlusion was achieved in 488 (84.2%) patients.

**Conclusions:** Our findings provide reliable evidence demonstrating that the LVIS stent may be a preferred treatment option for small intracranial saccular aneurysms with higher complete occlusion and less recurrence rate.

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**Leo baby stent-assisted coiling in the treatment of challenging aneurysms: experience in 30 consecutive cases**

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**Purpose:** Evaluate the safety and efficacy of this technique in complex, wide neck aneurysms with small parent artery (<2.5 mm).

**Materials and Methods:** A retrospective and descriptive analysis was performed in 30 consecutive cases during 26 months. Leo + Baby (Balt, Montmorency) 2.5/2.0 x 18 mm stent assisted coiling was used in wide neck, small parent vessel (<2.5 mm) aneurysms; both anterior and posterior circulation. Aneurysm occlusion grades (Raymond-Roy classification), procedure related complications and clinical outcome (Rankin modified scale) at six months follow up were analyzed.

**Results:** 29 patients (21 women) were treated between September 2014 and October 2016. 32 stents were placed (22 Leo 2.5 x 18 y 10 Leo 2.0 x 18). 34 aneurysms treated (25 unruptured). 27 anterior circulation aneurysms (14 AcoA and 13 MCA), 7 posterior circulation aneurysms (4 PCA and 3 PICA). Complete occlusion (Raymond I) was achieved in 88.2% (30 cases), residual neck (Raymond II) in 8.8% (3 cases), residual aneurysm (Raymond IIIa) in 3% (1 case). Procedure related complication (stent thrombosis) were observed in 3 cases, all resolved satisfactorily with the use of abciximab. All patients had a good clinical outcome (Modified Rankin scale 0 in 100% of the cases).

**Conclusions:** The use of this technique in the treatment of challenging aneurysms demonstrates to be safe and effective. With high rates of complete occlusion and a good clinical outcome.

**Key words:** Leo baby stent, stent assisted coiling, wide neck aneurysm, small vessels
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Long term follow up of widenecked and/or bifurcational aneurysms treated with the Leo Baby stent alone, or combined with loose coil packing

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Purpose: To review our long term results of endovascular treatment of non-ruptured aneurysms of the afore-mentioned type, with the Leo Baby braided stent.

Materials and Methods: Between 1 January – 31 December 2013, 15 patients with 19 aneurysms were treated with the Leo Baby stent as a standalone therapy - 2 aneurysms - or combined with loose packing with coils - 17 aneurysms. In the cases where coils were used, the coil delivery microcatheter was jailed in the sac. All of the aneurysms were winenecked or bifurcational, located on the ICA in 3, the ACom in 4, the MCA in 8, and the distal ACA in 4 cases. All patients were premedicated with double antiplatelet agents, the effect of adequate inhibition of the platelet activity was measured with VerifyNow. During the treatment, the patients were heparinized. There were no periprocedural complications. The double platelet inhibition was maintained for 3 months, and ASA was administered for additional three months.

Results: Follow up at 18-24 months showed total occlusion of 17 aneurysms, with intact flow in the branches arising from the sac, while the remaining two aneurysms were unchanged. In one of them, an additional stent was placed 24 months following the first one. The final result of this only aneurysm is still pending.

Conclusion: Endovascular occlusion of widenecked and/or bifurcational aneurysms with the Leo Baby stent alone or combined with loose coil packing with coils if feasible, with very limited risk of complications, and good long term results. In the authors’ experience, this braided stent has significant flow diverter effect, that facilitates the thrombosis of the aneurysmal sac even with loose coil packing.

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Collateral Circulation Status Predicts Rate of Occlusion and Risk of Clinical Deficit in Branch Vessel Coverage

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Purpose: Flow diversion often necessitates covering branch vessels adjacent to the aneurysm. Although historically branch vessel coverage was avoided because of the concern for occlusion, a number of recent studies observed a low rate of branch vessel occlusion and only rare clinical deficits from these occlusions. The hypothesis emerging from these studies is that, in most cases, branch vessel remain open and only occlude when there is robust collateral supply. If true, this paradigm would relax the restrictions on branch vessel coverage and allow for informed decisions about flow diversion device placement. In this abstract, we examine the relationship of collateral circulation and altered angiographic flow in branch vessels.

Methods: We studied a consecutive retrospective cohort of 84 patients from 2011–2016, who had branch vessel coverage associated with aneurysm flow diversion using the Pipeline Embolization Device (PED). Immediate post-treatment angiography and interval follow-up angiography and cross-sectional angiography (CTA or MRA) was evaluated for branch vessel filling. Branch vessels demonstrated either normal, slow, or absent contrast opacification. Collateral circulation was assessed for all branch vessels with slow or absent flow when selective angiography was available. Statistics were generated using the R statistics software platform.

Results: We identified 129 branch vessels covered by the PED construct in 84 patients. These were primarily anterior circulation branches (118 of 129) and of those, most were ophthalmic arteries (67 of 118). Slow flow was seen in 16 of 129 branches (12%), only 1 of which progressed on follow up to full occlusion. Angiographic occlusion was seen in 12 vessels (9%), one of which reversed from no flow to slow flow on follow up. Ten patients had new or worsening neurologic deficits, two of which were associated with stent thrombosis. Four patients had new visual deficits although the covered ophthalmic artery remained patent; three patients had deficits related to mass effect or peri-aneurysmal parenchymal inflammation from the adjacent aneurysm.

The majority of branch vessels with altered flow had angiographic evidence of collateral circulation (17 of 27, 63%). Altered branch vessel flow (slow or absent) was not associated with new or worsening neurologic deficit. In the subset of branch vessels with altered flow, lack of collateral circulation was associated with new or worsening neurologic deficit (p < 0.05, Fisher exact test), which in all cases occurred in the setting of PED construct thrombosis. Altered branch vessel flow was not associated with the use of adjunctive coils or the use of more than one PED construct.

Conclusion: Branch vessel occlusion is an known complication of flow diversion that rarely results in clinical deficits. It is believed that most patients can tolerate branch vessel occlusion without clinical deficits because of distal supply via collateral circulation.
Aneurysm expansion can cause clinical deterioration after flow diverter treatment: A retrospective series of 16 intracranial aneurysms

Purpose: Flow diverters (FD) are stent-like implants that can be used to treat large and giant intracranial aneurysms (IA). Although FD treatment is considered to be a safe and effective treatment for IAs, some patients develop transient mass effect related symptoms within the first 6 months after treatment. Post-operative IA expansion is thought to play a role in this transient neurological deterioration. The purpose of this study was to objectify post-operative aneurysm expansion and aneurysm deformation in a retrospective case series of FD treated patients.

Material and Methods: A total of 45 patients were treated with a FD for a large or giant IA in our institute between 2010 and 2016. Of these 45 patients, 15 patients with 16 treated IAs underwent early follow-up (FU) imaging within 6 months after treatment. Follow-up imaging was typically performed because of a change in neurological condition and FU moment therefore differed per patient (mean time interval to FU imaging: 2 months, range 0–6 months). Neurological deterioration was classified as mass-effect related or non-mass effect related. All treated IAs were segmented manually and IA volumes (cm3) were determined by using a dedicated segmentation tool (Horos, v.2.0.0.). Subsequently, 3D reconstructions were made to visualize IA expansion and changes IA orientation after FD treatment (3ds Max v.2016 & Matlab v2016a).

Results: All but one IA showed an increase in volume at FU imaging as compared to pre-operative imaging. Mean pre- and post-operative volumes for all IAs were 5.3 cm3 (SD 4.3 cm3) and 6.4 cm3 (SD 6.1 cm3), respectively and differed significantly from each other (paired T-test, p = 0.047). Eleven patients (11 IAs) presented with mass effect related symptoms, of which 7 were transient in nature. Every patient with mass effect related symptoms presented with IA expansion or changes in IA orientation. Mean increase (%) in IA volume in patients experiencing mass effect related symptoms was 28.1% (1.54 cm3). All non-mass effect related symptoms (5 patients, 5 IAs) were ischemic, of which two were transient in nature. All but one IA showed post-operative aneurysm expansion in this group of patients. Mean increase (%) in IA volume in these 5 patients was 9.0% (0.33 cm3), and did statistically differ from the IA volume increase seen in the other 11 patients (Welch T-test, p = 0.032). Although IA expansion was also seen patients presenting with non-mass effect related symptoms, it is unknown whether this plays a role in the clinical worsening of these patients.

Conclusions: Intracranial aneurysm expansion or change in IA orientation after FD treatment is a probable cause of transient clinical worsening after FD treatment. Key Words: intracranial aneurysm, flow-diverter, aneurysm growth, aneurysm rupture

The Silk Flow Diverter in the Endovascular Treatment of Intracranial Aneurysms: Results Diversion, a French multicenter, prospective registry

Purpose: To assess the safety and effectiveness of the silk flow-diverter in the endovascular treatment of intracranial aneurysms at one year follow up in routine clinical use in an unselected cohort.

Materials and Methods: DIVERSION is a prospective, consecutive, multicenter non-interventional study for evaluation of the treatment of intracranial aneurysms with flow diverters conducted by the French Society of Neuroradiology (SFNR) in collaboration with the French National regulatory Agency for the Safety of Medicines and Health Products. The study was organized by an independent CRO and safety data were monitored by an independent DSMB. Imaging data were reviewed by 2 interventional neuroradiologists independent to the study.

After providing informed consent, overall 377 patients (54 ± 13 years; 295 women [78%]) harboring 451 intracranial aneurysms (21 acute ruptured aneurysms) were enrolled in the study in 34 participating centers from October 2012 to February 2014. 118 aneurysms (25.6%) in 100 patients were treated with the silk FD. The primary endpoint was the morbi-mortality rate at 12 months.

Results: Mean aneurysm size was 7.3 ± 5.9 mm, and mean neck size was 5.1 ± 3.3 mm. Deployment of flow diverter was successful in 96% of cases, Coiling was associated in 24.6%, balloon remodeling technique in 6.8% and stenting in 11%. No neurological deaths and no permanent severe morbidity (defined as a 2 points increased in mRS) were observed post-operatively.
Total and sub total occlusion was observed in 82.2% at one year with Kamran scale Grade 3 and 4 respectively in 17.8 and 64.4%.

Conclusion: Endovascular treatment of unruptured intracranial aneurysms with the silk FD was feasible in a high percentage of case, very safe and associated with a high rate of total and subtotal occlusion.

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Mid-term Results of the DERIVO Flow Diverter Stent in the Treatment of Cerebral Aneurysms

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Purpose: The DERIVO embolization device (DED) is a new nitinol flow diverter stent manufactured for the treatment of intracranial aneurysms. In this study, we evaluated the safety and efficacy of the DED in the treatment of cerebral aneurysms and, present the periprocedural complications and mid-term results.

Materials and Methods: We treated 40 aneurysms using 30 devices in 27 patients with wide-necked, mostly medium-sized, and fusiform aneurysms. Sixteen of the patients included in the study were females and the other 11 were males. Headache was the most frequent symptom. While 37 (91.2%) aneurysms were in the anterior circulation, 3 (8.8%) were in the posterior. Intracranial stent medication was accomplished in all patients. All patients were evaluated one day later for any ischemic lesion with diffusion-weighted imaging. The first, second and third follow-up angiograms were planned to be performed after 3, 9 and 24 months.

Results: In all patients, the treatment was successful. No hemorrhagic complication was seen on CT performed immediately following the procedure. All patients were discharged without any neurological deficit. While 31 (77.5%) of 40 aneurysms in 27 patients were totally closed on the 3rd-month follow-up angiogram, 29 (82.9%) of 35 aneurysms in 23 patients were totally closed on the 9th-month follow-up. And 24th-month follow-up angiograms showed complete closure of nine aneurysms (75%) in seven patients with 12 aneurysms. General morbidity was 7.4% and mortality 3.7%.

Conclusion: The DED seems effective and safe in the treatment of different kinds of cerebral aneurysms.

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Single center experience with a new generation flow diverter device (DERIVO Acandis GbmH)

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Introduction: Use of flow-Diverter has become widely accepted for the treatment of several types of cerebral aneurysm.

The aim of this work is to evaluate the early and mid-term follow-up results of the latest version of the DERIVO Embolisation Device (Acandis GmbH & Co) as a new generation flow-diverter.

Method: DERIVO consists of 24 nitinol wires looped at the distal end, resulting in a braided net of 48 wires with an innovative electro polished surface. In its latest version, all wires contain a radiopaque core to improve visibility.

Between October 2015 and April 2017 we treated 36 patients with unruptured cerebral aneurysm with size between 6 mm and 32 mm.

Aneurysms were located in all cerebral territories: 1 in pericallosal artery, 6 in vertebrobasilar artery, 2 in middle cerebral artery bifurcation and 27 in different levels of internal carotid artery.

All stents were delivered using 2.7F Excelsior XT-27 Microcatheter (Stryker Neurovascular) navigated with the support of a microguidewire 0.014”, mainly Synchro 0.014” (Stryker Neurovascular) inside a Neuron (Penumbra Inc.) guiding catheter.

Follow-up was performed at 6 months (AngioCT) and 12 months (DSA).

After treatment, double antiplatelet therapy was administered in the first 90 days, followed by single antiplatelet therapy until 6 months.

Results: In all the cases stent delivery was easily achieved with fast opening and complete wall apposition even in tortuous anatomies. In spite of good delivery and expansion, in 2 cases we had a proximal end migration of the stent inside the aneurysmal sac which was issued with rescue treatment. In another case we had a mild distal migration when the flow diverter was navigated within the microcatheter after the deployment. In all these cases the procedures were concluded with technical success.

No periprocedural or post-procedural Clinical complications, including permanent neurological impairments, strokes, and bleedings were observed.

We have observed one case of intimal hyperplasia at 6 months, controlled with reintroducing double antiplatelet therapy and improved at 12 months.

Occlusion rate was 69% (9/13) at 6 months, 100% (11/11) at 12 months.

Conclusions: The DED seems effective and safe in the treatment of intracranial cerebral aneurysms, with complication rate not superior to other FD-stents.
Due to the increased visibility of the stent, the correct deployment has always been easy to be verified. Further studies are still necessary to confirm clinical data.

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First experience in Argentina with Derivo flow diverter device, midterm follow up

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Purpose: DERIVO embolization device (DED) is a new hybrid nitinol flow diverter endoluminal device manufactured for the treatment of intracranial complex aneurysms. In this first experience, we evaluated the safety and efficacy of this flow diverter in the treatment of intracranial wide neck aneurysms and present the midterm follow up.

Materials and Methods: We treated 16 unruptured aneurysms using 16 devices in 15 patients with wide-necked, big and giant sized aneurysms. Ten of the patients were women and the other were men. Headache was the most frequent symptom. All the aneurysms were located in the anterior circulation. Dual antiplateled medication were administered 5 days before the procedure. The first follow-up angiography were planned to be performed after 6 months.

Results: In all patients, the device was successfully implanted. One hemorrhagic complication was seen during microguidewire exchange. Fourteen of the patients were discharged without any neurologic deficit. Immediately total occlusion have been seen in 9 of 16 aneurysms, the other 6 were totally closed after 6 months follow-up angiography and 1 aneurysm remains open. General morbidity was 6%, and mortality was 0%.

Conclusions: The DERIVO device shows to be effective and safe in the treatment of wide neck intracranial aneurysms, long term follow up will be needed.

Key words: DERIVO flow diverter, wide neck aneurysm, big and giant aneurysm, new tools

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The DERIVO Trial: a prospective multicentre register study. Clinical and angiographic mid-term results in forty patients

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Background: The study objective is to examine the safety and efficacy of aneurysm treatment with the Derivo flow-diverter (FD, Acandis, Pforzheim, Germany).

Methods: Adult patients (≥18 years) with intracranial unruptured aneurysms are currently enrolled into this trial at 12 clinical sites in Germany and Poland. This trial has the following characteristics: prospective, multicentre, observational, unblinded, single arm, uncontrolled. All study patients will be treated with the Derivo FD within the intended use of the device. It is planned to recruit up to 100 patients.

Findings: Inclusion was started in July 2014. In 40 patients clinical and core lab assessed angiographic mid-term follow-up results will be available. The analysis for these mid-term study outcomes (3–6 months) in these patients include shift of modified Rankin Scale score at baseline, discharge, and mid-term; any adverse and serious adverse events. Analyses of angiographic data include baseline aneurysm characteristics, immediate angiographic result after implantation of the Derivo FD applying the Szikora classification, as well as mid-term angiographic results (Kamran classification).

Conclusion: Clinical and Core Lab-assessed angiographic mid-term results in forty patients will be available for presentation in October, 2017.

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Endovascular Treatment of Spontaneous Rupture Intracranial Aneurysms using the Derivo Embolization Device (DED)

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Purpose: To evaluate the safety, feasibility, efficacy and clinical applications of the Derivo Embolization Device (DED) in the treatment of hemorrhage associated intracranial aneurysms.

Material and Methods: Between January 2015 and May 2017, 18 patients (9 male - 9 female) presenting 18 wide-neck symptomatic aneurysm, were treated by the DED. Of them 5 were Hunt & Hess Grade I, 5 Grade II, 3 Grade III and 5 grade IV. No intracranial hematoma was observed in initial CT scan. 9 (50%) of them were localized in the internal intracranial distal carotid artery, 5 in the posterior circulation (27,7%) and 4 (22,2%) in the anterior circulation. Fast charge of anti-platelets agents was administered in all patients. A total number of 21 DED were used in the hole population. All patients were evaluated 7 days after by MRI searching for ischemic or flow related complications. Follow-up angiograms were performed at 3 and 9 months.

Results: In all patients, immediate signs of intra-sacural stasis were observed. Computed tomography scan performed immediately after the procedure showed no intracranial complications. All patients were discharged without any neurologic deficit, but 1 (5,55%) patient developed signs of intracerebral ischemia 7 days after the procedure, presenting occlusion of the internal carotid artery. During follow-up 14 (77,77%) aneurysms were totally excluded on the 3-month follow-up angiogram, and 3 (16,66%) aneurysms in on the 9-month follow-up.

Conclusions: The DED seems effective and safe in the treatment of hemorrhagic related intracranial aneurysms.

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Flow Diverters in Developing Countries: Endovascular Treatment of Intracranial Aneurysms with FRED. Mid-term Results

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Purpose: Clinical experience with Flow- Diverters (FD) has been widely described in the literature since 2007 for the endovascular treatment of difficult-to-treat or otherwise untreatable cerebral aneurysms (wide-neck, fusiform, dissecting, blisterlike, or giant). A new generation of FD is currently available: the Flow Re-direction Endoluminal Device (FRED; MicroVention, Tustin, California, USA). We report our experience and Mid-term results using this device.

Materials and Methods: Between March 2014 and April 2017 we conducted a retrospective review of all consecutive cases in which the FRED was used to treat intracranial aneurysms in Medellin Colombia by the same operators. Patient demographics, clinical presentation, aneurysm characteristics, technical aspects, immediate results post-treatment and mid-term outcomes were reviewed.

Results: A total of 152 patients with 174 intracranial aneurysms were treated with FRED. Most (75.2%) located in anterior circulation, 44 were giant, 60 large and 70 small lesions. History of SAH in 29 aneurysms (16.6%) of these: 14 blood blister-like aneurysms, and 15 complex lesions (i.e. Dissecting, fusiform or severe segmental defect). The technical success rate was 100%. A single device was implanted per aneurysm in all cases except in four cases where telescoping was necessary. FD alone strategy was performed in 84% of cases. In 27 aneurysms a combination of FD and coils was implemented. In six cases FRED was used to extend the construct of previous FD unsuccessfully implanted. Angiographic and clinical follow-up were available after 6 months in 55 aneurysms showing a total occlusion in 80% (O’Kelly Marotta D: 44/55). After 1yr, 76 patients with 82 aneurysms had radiological FU and total occlusion (Grade D) reached 92%. There were eleven complications of in-stent thrombosis immediately after FRED deployment (7.2%): seven patients solved without permanent deficit and four patients evolved with disable stroke. We identified two cases of symptomatic intra cerebral hemorrhage procedure-related and two cases with delayed hemorrhage during FU. No recanalization of a previously occluded aneurysm was observed.

Conclusion: In this study, the treatment of complex intracranial aneurysms with FRED was feasible, safe and effective. The unique dual-layer design of the device would suppose technical advantages over other FDs. The 6-12 months aneurysm occlusion rate and complication profile of FRED were similar to other FDs. Randomized trials with long-term follow-up are necessary to determine the optimal scenario for this technology.

Wednesday, 18th of October, Session room 4. – 17:45 – 18:45 – Parallel abstract session - Aneurysm clinical: Flow diversion 2

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Treatment of complex cerebral aneurysms using the FRED flow diverter: experience in a series of 25 aneurysms

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Purpose: Flow diverters have emerged as a crucial option for the treatment of complex aneurysms with good results.
The FRED is a unique double layer device that may provide potential advantages over other flow diverters. In this paper, we retrospectively analyze the results of the treatment with FRED of a series of 25 aneurysms, to assess its efficacy and safety. Angiographic and clinical results as well as follow-up angiograms were retrospectively reviewed. 

**Materials and Methods:** Between December 2014 and January 2017, 24 patients harboring 25 aneurysms were treated with the FRED flow diverter. Inclusion criteria were: wide neck aneurysms (aneurysm fundus-to-neck ratio < 2 or neck diameter > 4), fusiform, dissecting or giant aneurysm, dysplastic parent artery and neck remnant (recanalization after previous coiling). Twenty-one aneurysms were in the internal carotid artery, 2 in the basilar artery, 1 in the vertebral artery and 1 was vertebral-basilar. Four aneurysms were giant partially thrombosed, 9 were small (< 10 mm) without neck and 3 were neck remnants of ruptured aneurysms acutely treated with coils. Occlusion rate was evaluated following Okelly Marotta grading scale. 

**Results:** Adequate deployment of the FRED was successfully achieved in the 25 aneurysms. Two cases were embolized with coils in the acute stage of SAH and retreated with FRED afterwards. Sixteen aneurysms were treated only with FRED and in 7 cases adjunctive coiling was used. All patients were kept under dual antiplatelet therapy for 6 months and follow up angiogram was performed 7 months after treatment. Two clinical complications were seen: one was a bowel wall hematoma and the second was a retroperitoneal bleeding that were treated in a conservative way. No neurological complications were reported. All patients were followed clinically and follow-up angiograms were performed in 18 aneurysms showing: total occlusion (OKM D) in 13/18 (72.2%); small neck remnant (KM C 3) in 3/18 (16.6%) and aneurysm filling (OKM A) in 2/18 (11.1%). In one of these two last cases, a foreshortening of the distal part of the FRED herniating into the aneurysm was observed in the follow up angiogram. There was no device related complications. Mortality and morbidity rates were 0% 

**Conclusions:** The FRED flow diverter is a safe device for treating complex aneurysms resulting in a high occlusion rate. Although our data shows high occlusion rates with no neurological complications, larger series and prolonged follow-ups are required to prove its effectiveness. 

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**European Multicenter Study for Evaluation of a Dual layer Flowdiverting Stent for Treatment of wide neck Intracranial Aneurysms: The EuFRED-Study**

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**Background and Purpose:** Endoluminal reconstruction with flow diverting stents represents a widely accepted technique for the treatment of complex intracranial aneurysms. This European register study analyzed the initial experience of 16 neurovascular centers with the Flow Redirection Intraluminal Device (FRED) system used for the treatment of intracranial aneurysms.

**Materials and Methods:** We retrospectively evaluated the data of patients with intracranial aneurysms treated with FRED between February 2012 and March 2015 in 16 European centers. Each center provided the consecutive data of their initial experiences with this second-generation flow diverting stent. The data were collected with specific data sheets, retrospectively updated and pooled for analysis. Device related and procedural related complications, transient and permanent morbidity, mortality and occlusion rate over time were evaluated.

**Results:** During the defined study period, 579 aneurysms in 531 patients (27.2% men; 13–86 years of age; median 54 years) were treated with FRED in the respective neurointerventional centers. 12.8% of aneurysms were previously ruptured, only 7.6% were treated in the acute stage. Median aneurysm size was 7.6 mm (range 1 – 36.6 mm) and median neck size 5.3 mm. Successful stent deployment with a median number of 1 stent per patient occurred in 98% of cases. Additional coiling of the aneurysm was performed in 18.1% and PTA of the flow diverter after deployment was necessary in 3.9% of aneurysms. The overall complete occlusion rate was 69.2%, with a median follow-up at 8 months (range 3 - 45 month). Progressive occlusion was witnessed over time, with complete occlusion in 82% of aneurysms followed through 6 months. One year after treatment 96% of aneurysms showed complete occlusion. In 8.7% complications were reported, resulting in a transient morbidity of 5.5% and a permanent morbidity of 0.8%. 7% of complications occurred during the follow up period. The overall mortality rate was 1.5%.

**Conclusion:** Intracranial aneurysm treatment with only one FRED device results in a high safety profile. Treatment elicited a similar high rate of complete angiographic occlusion as with other flow diverting stents at 1 year followup in a “real world” population of cerebral aneurysms.

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**Aneurysm treatment with FRED and FRED Jr: Results of SAFE (Safety and Efficacy Analysis of Fred Embolic Device in Aneurysm Treatment) Study**

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**Purpose:** Flow diversion is now a well-established endovascular technique for the treatment of intracranial aneurysms. FRED and FRED Jr are dual-layer, self-expanding nickel titanium flow-diverters. SAFE is a prospective, multicenter
Intracranial Aneurysms with FRED stent: Experience in the Endovascular Treatment of Complex Aneurysms

Purpose: Flow-diverting stents, such as the Flow Re-direction Endoluminal Device (FRED; MicroVention, Tustin, California, USA), have emerged as a novel means of treating complex intracranial aneurysms. This observational analysis of the initial Colombian experience provides insight into patient selection, technical challenges, clinical and radiographic outcomes, and complication rates after the use of FRED device for intracranial aneurysms.

Materials and Methods: Cases were compiled from 5 Colombian centers between March 2014 and April 2017. We performed a multicenter study evaluating patients with intracranial aneurysms treated with FRED. Technical success, morbidity and mortality were registered. Regarding safety, a well-defined variables included: spontaneous rupture of the FRED-treated aneurysm; spontaneous non-aneurysmal or distal intracranial hemorrhage (ICH); thrombo-embolic stroke; parent artery stenosis, and permanent cranial neuropathy.

Results: During the defined study period, 252 patients with 268 aneurysms treated with FRED were included in this registry. Technical success, stent deployment observed in all cases with exception of two cases where the operators decided to pull back the device and treated the aneurysms with other strategy. The mean aneurysm size was 12.4 ± 5 mm, and the median angiographic follow-up was 6.5 months. 81 aneurysms (30.2%) were small, 132 (49.2%) were large and 55 (20.5%) were giant. The median clinical follow-up time was 8.2 months. The neurological morbidity rate was 7.5% (19/252), and the neurological mortality rate was 2.3% (6/252). The combined neurological morbidity/mortality rate was 9.8%. The most common adverse events were ischemic stroke (5.9%, 15/252) and spontaneous ICH (1.9%, 5/252). The complete occlusion rate at the last follow-up was 87.6% (92/105).

Conclusion: In the largest regional series on FRED for intracranial aneurysms to date, data suggest that treatment with the Flow Re-direction Endoluminal Device is safe and efficacious, with complication rates comparable with others FD available. Our local results are promising but larger series with long-term follow-up are required to determine its superiority.
Background and Purpose: Flow-diverters are emerging as an endovascular treatment alternative of proximally located intracranial aneurysms. However, treatment of aneurysms at and beyond the Circle of Willis is not well established. We assessed the clinical safety and efficacy of the Flow Re-Direction Endoluminal Device Jr. (FRED Jr.) dedicated for small vessel diameter between 2.0 and 3.0 mm.

Materials and Methods: This was an institutional review board-approved multicenter observational clinical study of 42 patients with 47 aneurysms treated by flow direction technique using FRED Jr. The primary endpoint for clinical safety was the absence of death, major or minor stroke, and TIA. The primary endpoint for treatment efficacy was complete and near-complete occlusion according to the O’Kelly Marotta grading scale at follow-up after 1–3, 6 and 12 months.

Results: The FRED Jr. deployment was technically successful in all cases. In 39/42 (93%) of patients, the primary safety endpoint was reached; in the 3 remaining patients, 1 disabling ischemic stroke, 1 minor stroke with complete recovery at discharge and 1 TIA were observed. Angiographic (DSA or FDCT) and clinical follow-up were available after 1–3 months in 41/47 (87%), 6 months in 27/47 (57%), and 12 months in 11/47 (23%) aneurysms. Primary efficacy endpoint was reached at 1–3 months in 27/47 (57%), at 6 months in 21/27 (78%), and at 12 months in 11/11 (100%) aneurysms.

Conclusions: Deployment of the FRED Jr. is safe and effective in the treatment of intracranial aneurysms located in small vessels.

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FRED stent for the treatment of intracranial aneurysms
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Background and Objective: FRED (Flow Re-direction Endoluminal Device, Microvention/Terumo) is a second-generation dual layer flow diverting stent for the treatment of intracranial aneurysm. We aimed to review the experience in a regional hospital in Hong Kong under a new antiplatelet alone protocol.

Methods: We retrospectively reviewed all patients with intracranial aneurysms treated with FRED under a new antiplatelet alone protocol in Prince of Wales Hospital in Hong Kong.

Results: Twenty patients with fusiform or saccular aneurysms were included. Four patients had previous coil embolization for ruptured aneurysm with radiological recurrence and two patients had previous Neuroform stent-assisted embolization. Two patients were treated during the acute phase of subarachnoid hemorrhage. All patients were able to have FRED deployed for aneurysm treatment. At 12 months, 77% of aneurysms had complete occlusion and 8% of aneurysm had near complete occlusion. Both of the 2 aneurysms covered with overlapping FRED achieved complete occlusion at 12 months. There were no procedure or post-operative stroke or hemorrhage up to last follow up.

Conclusions: FRED treatment was safe and feasible. The complete occlusion or near complete occlusion were achieved in 85% of aneurysms at 12 months after FRED treatment for intracranial aneurysm. FRED treatment was safe and feasible in all patients in our study.
We had a thrombus formation in the parent artery (A2) at 48 hours post treatment of an acutely ruptured Acom aneurysm that disappeared after Aspirin 75 mg/day intake. All aneurysms had complete or near complete occlusion after procedure. Angiographic follow-up from 6 till 18 months of all patients was done:

- 17 aneurysms (89%) had complete stable occlusion (A) on FU DSA
- In 1 ruptured aneurysm (B), 2 mm remnant at the neck and in 1 compaction of the device (C) (10 mm sac)

**Conclusion:** Our initial experience shows the Medina Coils as a promising, safe and effective tool the treatment of wide neck ruptured and unruptured aneurysms, especially on arterial bifurcations.

So far in our series, the mid and long term follow up showed stability of aneurysmal sacs exclusion but this is to be evaluated in a larger series. This device will have its place between all other tools in our practice.

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The Medina Embolic Device – clinical experience in 34 aneurysms from a single center

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**Purpose:** The Medina Embolic Device (MED, Medtronic) is designed to treat saccular aneurysms. The device is a metallic three-dimensional layered structure made from a radiopaque shape set core wire and shape memory alloy filaments, which form a self-expanding mesh. This resembles multiple leaflets that can provide flow diversion. We describe our initial experience with the Medina Embolic Device (MED) in unruptured intracranial aneurysms either as sole treatment or in conjunction with additional devices.

**Materials and Methods:** 31 consecutive patients (25 women, 6 men) with a total of 34 unruptured aneurysms were treated between September 2015 and May 2017. We retrospectively evaluated the angiographic results at the end of the procedure and at follow-up, the clinical status, complications, and requirement for adjunctive devices.

**Results:** The MED was successfully deployed in all but one case and adjunctive devices, including coils, were required in 33 aneurysms. In 24 aneurysms an endoluminal flow diverter was implanted in the first treatment or at follow-up. Aneurysm locations were middle cerebral artery bifurcation (n = 3), M1 segment (n = 1), internal carotid artery (ICA) bifurcation (n = 1), paraophthalmic ICA (n = 7), supraclinoid ICA (n = 5), cavenosus ICA (n = 5), anterior coroidal artery (n = 1), posterior communicating artery (n = 4), anterior communicating artery (n = 3), A1 segment (n = 1), and basilar tip (n = 3). Four patients had complications although none could be attributed to the MED. Immediate angiographic results were modified Raymond-Roy classification (mRRR I = 3, mRRR II = 5, mRRR IIIa = 23, mRRR IIIb = 3). Follow-up angiography was available in 23 patients with 25 aneurysms, with eighteen showing complete aneurysm exclusion, six showing neck remnants and one patient showing reperfusion of a previously totally occluded aneurysm.

**Conclusions:** The MED represents a novel device for the treatment of intracranial aneurysms by combining flow-diverting technology and the familiarity of standard coils. It has a good safety profile and it can result in a rapid exclusion of large and giant aneurysms from the circulation. A combination with other devices such as coils and endoluminal flow diverters is frequently required.

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The efficacy of parent artery occlusion for internal carotid artery with a combination of coil and NBCA

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**Objective:** We hypothesized that the use of NBCA in addition to coils under flow control can achieve rapid and certain carotid artery occlusion. We assessed the efficacy and safety of this method based on our result.

**Material and Method:** A total of 15 patients treated with endovascular vessel occlusion for 16 internal carotid aneurysms in Nagoya University hospital and affiliated hospitals between 2011 and 2016 were analyzed. We divided 16 procedures into 3 groups as following; N1 group (planned use of NBCA with coils), N2 group (unplanned use of NBCA with coils) and C group (use of coils only). We compared number of coils, cost of embolic materials, procedural complications, procedure time, total radiation dose (AP + lateral) between the 3 groups.

**Results:** The location of NBCA is at petrous segment in 11 arteries and at cervical segment in 3 arteries. The reason for using NBCA in N2 group were as following; no vessel occlusion despite the use of numerous coils, not to add more coils to preserve patency of branch artery, the urgent case due to cerebral herniation. The median amount of NBCA injection was 0.15 ml in N1 and 0.14 ml in N2. The concentration of NBCA was 20–33% in N1 and 50–70% in N2. The number of coils in N1 was significantly lower than of C and N2 groups (C:N1:N2 = 23:5:5:30). Embolic materials cost of N1 group was significantly lower than of C and N2 groups (C:N1:N2 = 25128:5441:26971 US dollars). There was no embolic stroke in any cases. Procedure time and total radiation dose in N1 was less than that of C and N2, but there was no significant difference.
Conclusion: In vessel occlusion for internal carotid aneurysm, the use of NBCA in addition to coils can save the number of coils and procedure time. Flow control using balloon guiding catheter is effective to control the behavior of NBCA.

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Treatment of wide-necked bifurcation aneurysms with the pCONus1: procedural safety and long-term occlusion stability in 144 aneurysms

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Purpose: Wide-necked bifurcation aneurysms (WNBA) are considered to belong to the subgroup of aneurysms with increased difficulty and risks. A variety of devices for the treatment of these aneurysms became recently available. pCONus1 (phenox) consists of an electrolytically detachable laser cut stent with a straight shaft and a distal crown with four petals. The distal end of the device is deployed inside the aneurysm sac with the petals at the level of the aneurysm neck. Our purpose is to present the largest series of patients treated with this device in a single center with special focus in the safety and occlusion stability.

Material and Methods: 140 consecutive patients with 144 wide-necked bifurcation aneurysms underwent endovascular treatment using pCONus1 between February, 2012 and April, 2017 in a single center. We retrospectively evaluated the angiographic results at the end of the procedure and at follow-up, the clinical status and complications.

Results: Aneurysm locations were internal middle cerebral artery (n = 70), anterior communicating artery (n = 38), basilar tip (n = 28), A2 bifurcation (n = 3), carotid artery bifurcation (n = 2), A2 trifurcation (n = 1), basilar artery fenestration (n = 1), and posterior cerebral artery (n = 1). Twenty-seven patients were treated in the setting of acute subarachnoid hemorrhage. Successful treatment with the pCONus was achieved in all but four cases. In 6 aneurysms deployment of the pCONus and coil occlusion of the aneurysm were performed in 2 different sessions, one of these aneurysms is still pending of coiling. One aneurysm ruptured during the treatment without permanent deficit for the patient. Immediate angiographic results were modified Raymond-Roy classification (mRRC) I = 60, mRRC II = 42, mRRC III = 37. Follow-up angiography was available in 109 aneurysms, with 96 (88%) showing sufficient occlusion. During the follow-up period a total of 30 aneurysms were retreated. Intimal hyperplasia in the stented segment of the parent artery or device migration has not been observed to date.

Conclusions: pCONus allows controlled coil occlusion of WNBA, both ruptured and unruptured. pCONus facilitates initial coil insertion and retreatment as well. Major complications are rare.

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The new pCONus2: initial experience in 15 patients

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5Klinikum Stuttgart, Neurology, Stuttgart, Germany

Purpose: A variety of devices for the treatment of wide-necked bifurcation aneurysms became recently available. pCONus1 (phenox) consists of an electrolytically detachable laser cut stent with a straight shaft and a distal crown with four petals. The distal end of the device is deployed inside the aneurysm sac with the petals at the level of the aneurysm neck. Several publications and clinical experience in 500+ patients have shown that the pCONus1 allows an adequate coil occlusion also in very wide necked aneurysms. However, a sharp angle between the parent vessel and the aneurysm remains a limitation for pCONus1, as the petals deploy almost orthogonally from the device shaft, sometimes preventing complete occlusion. The pCONus2 has a modified design that can overcome this issue. The previous junction between shaft and crown has been replaced by a flexible joint to allow centration of the petals according to the aneurysmal neck and -axis. In addition, the previous four petals have been increased to six to provide improved coil retention. The usage per se, including insertion, positioning and detachment are the same as with pCONus1. Our purpose is to present the first series of patients treated with this new device and some technical nuances in a consecutive series of 15 patients.

Materials and Methods: 15 consecutive patients with 15 intracranial aneurysms underwent endovascular treatment using pCONus2 between February and Mai 2017 in three different centers. We retrospectively evaluated the angiographic results at the end of the procedure and at follow-up, the clinical status and complications.

Results: Neither technical failure nor rupture was encountered. Aneurysm locations were internal carotid artery bifurcation (n = 1), middle cerebral artery (n = 9), anterior communicating artery (n = 2), posterior communicating artery (n = 1) and basilar tip (n = 2). Three patient were treated in the setting of acute subarachnoid hemorrhage. After the initial procedure, total occlusion was achieved in 12 aneurysms and a neck remnant was evident in 2. One aneurysm still showed perfusion of the sac at the end of the procedure but an early follow up 3 days later showed improvement of the occlusion rate with a persistant neck remnant. Follow-up angiography was available in 5 patients, with 4 showing complete aneurysm exclusion and 1 a stable neck remnant.
Conclusions: pCONUs2 represents the evolution of the previous pCONUs1 device. The new design improves the neck coverage in sharp angulated aneurysms and increases coil retention.

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Treatment of complex wide-neck MCA aneurysms using pCONUS device – 3 centers experience
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Purpose: Endovascular treatment of intracranial wide-neck and bifurcation aneurysms is a challenge. The pCONUs device is dedicated to endovascular treatment of wide-neck and bifurcation aneurysms. The aim of this presentation is to show the three centers experience with pCONUs device for the treatment of wide-neck unruptured or re-canalised aneurysms.

Materials and Methods: Clinical data, pre and postoperative DSA (including 3D reconstructions) images were collected and analyzed. Aneurysm occlusion was assessed using RROC Scale.

Results: Twenty-four patients (19 women and 5 men) 34–79 years of age with 24 aneurysms treated with the pCONUs device were included. Aneurysm locations were the MCA in 18 patients, the ACoA in 4 patients and basilar tip in 2 patients. All aneurysms were unruptured when using the device. Good clinical outcome was observed in all patients and no new neurological deficits were observed. In one case stent and balloon was used to avoid branch occlusion in MCA trifurcation aneurysm.

Conclusions: Experience and the results proves that the pCONUs device is easy to use, safe and efficient. The device offers good support to avoid coils protrusion into parent artery and to avoid occlusion of the branches arising from the aneurysm dome.

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Visual outcomes of endovascular and microsurgical treatment for large or giant paraclinoid aneurysms
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Background: The optimal treatment for large or giant paraclinoid aneurysms is still controversial. The present study evaluated the results of endovascular coiling and microsurgical clipping with special reference to visual outcomes.

Methods: The clinical data and treatment outcomes of 39 cases of large (>15 mm) paraclinoid aneurysms were retrospectively reviewed. Presenting symptoms were subarachnoid hemorrhage in 16 aneurysms and visual impairment in 18. Twenty-one aneurysms were treated by endovascular therapy and 18 were treated by direct surgery.

Results: Maximal aneurysm diameter ≥25 mm and preoperative visual acuity <20/100 were significantly related to poor visual outcome in univariate analysis. However, preoperative visual acuity was the only significant prognostic factor in multivariate analysis (odds ratio [OR] 0.12, 95% confidence interval [CI] 0.01–0.95, p = 0.04). Although patients treated with endovascular coiling tended to have a more favorable outcome than those with surgical clipping, adjustment for other confounding factors reduced the OR of favorable outcome following each treatment modality to nearly one (OR 1.14, 95% CI 0.17–7.46, p = 0.89). Deteriorations in the visual field showed different patterns: upper visual field deficit after endovascular coiling, and inferior nasal quadrantanopia after microsurgical clipping.

Conclusions: Preoperative visual acuity was the only independent predictor of visual outcome in patients with large paraclinoid aneurysms. Although adjusted visual outcomes with microsurgical clipping and endovascular coiling were almost the same, selection of the optimal treatment for each aneurysm is essential with recognition of the potential risks and mechanisms of visual impairment.

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Occlusion status on magnetic resonance angiography and risk of delayed ischemia after stent-assisted coil embolization
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Management after stent-assisted coiling (SAC) for unruptured intracranial aneurysm is sometimes difficult because close monitoring for ischemic events for a long period of time is necessary. The purpose of this study was to clarify the usefulness of magnetic resonance angiography (MRA) at follow-up after SAC.

Methods: Sixty-six consecutive cases of SAC for unruptured intracranial aneurysm in our institute and affiliated hospitals were retrospectively reviewed for a delayed ischemic event. Occlusion status of the aneurysm and stent apposition on time-of-flight (TOF)-MRA, patient demographics, and characteristics of the aneurysms were analyzed for a possible relationship to delayed ischemic events.
We retrospectively studied patients with ruptured or unruptured vertebral artery dissection, respectively. The objective of this study was to investigate which methods are suitable for ruptured and/or coils, and flow diverters. The objective of this study included parent artery occlusion, internal trapping, stents, and/or coils, and flow diverters. Multivariate analysis indicated that dome filling had a hazard ratio of 4.96 (95% confidence interval (CI), 1.30–23.60) and 3.74 (95% CI, 1.10–13.34), compared to neck remnant and complete obliteration, respectively. Six out of 7 patients who had persistent dome filling during follow-up developed a delayed ischemic event.

Conclusions: In this preliminary study, dome filling on follow-up TOF-MRA could be a modality for tailored management after SAC.

Outcomes of endovascular treatment for vertebral artery dissection

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1Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea, Seoul, South Korea

Objective: Intracranial vertebral artery dissection (VAD) may present as a ruptured form, causing subarachnoid hemorrhage (SAH), or as an unruptured form associated with ischemia or local symptoms. Treatment options are more complicated if the lesion involves the origin of the posterior inferior cerebellar artery, basilar artery, or contralateral vertebral artery. Endovascular treatment options for VAD include parent artery occlusion, internal trapping, stents and/or coils, and flow diverters. The objective of this study was to investigate which methods are suitable for ruptured or unruptured vertebral artery dissection, respectively.

Methods: We retrospectively studied patients with ruptured and unruptured VAD managed with endovascular treatment at our center from January 1998 to December 2016. We classified into 4 groups following treatment modalities: 1) stent only; 2) stent assisted coiling (SAC); 3) coiling only for dissecting aneurysm; and 4) internal trapping. Favorable clinical outcome defined as no complication after treatment, such as symptomatic infarction, recanalization, hemorrhage, and retreatment. Functional outcome was evaluated using the modified Rankin Scale (mRS), and favorable functional outcome defined as mRS score of 0 or 1.

Results: Eighty patients with 24 ruptured VAD and 56 unruptured VAD were identified. The mean age was 51 years and the mean follow-up duration was 36.6 months. Of the 56 unruptured VAD patients, 16 patients (28.5%) were initially treated medically, but subsequently received intervention due to enlargement of the dissecting aneurysm. In patients with unruptured VAD, 13 (23.2%) were treated with single flow-diverter (n = 2) or multiple overlapping stents (5 double stent and 6 triple stent), 35 (62.5%) with SAC (17 one stent, 16 double stent, and 2 triple stent), 1 (1.7%) with coiling only, and 7 (12.5%) with internal trapping. Overall complication rate was 19.6% and no patient died. The patients who underwent multiple overlapping stents (≥2) with or without coil had the most favorable clinical outcome. Favorable functional outcomes (mRS0–1) were in 51 patients (91%) of 56 unruptured patients. In 24 patients with ruptured VAD, favorable functional outcomes (mRS0–1) were in 13 patients (54.1%) and 3 patients (12.5%) died following treatment because of rebleeding (n = 2) and brain edema (n = 1). In patients with ruptured VAD, 2 (8.3%) were treated with stent only, 4 (16.6%) with SAC, 16 (66.6%) with internal trapping, and 2 (8.3%) with coiling only. Favorable clinical outcomes observed in internal trapping group. The complication rate was 31.2% in internal trapping group and overall complication rate was 37.5%.

Conclusion: Internal trapping or parent artery occlusion may be the preferred treatment for acutely ruptured dissecting aneurysms in patients with good collateral circulation. Multiple overlapping stents with or without coils may decrease complications and facilitate aneurysm occlusion in unruptured VAD.

Thursday, 19th of October – Plenary room – 10:30 – 11:15 – Plenary session 12. – Aneurysm biology

Mechanisms of aneurysm thrombosis

Jean-Baptiste Michel
INSERM UMRS 1148 –LVTS, Laboratory for Vascular Translational Science, University Paris Diderot, Paris, France

Aneurysm wall biology

Juhana Fro¨sen
Kuopio University Hospital, Neurosurgery, Kuopio, Finland

Thursday, 19th of October – Plenary room – 11:15 – 12:15 – Plenary session 13. – Predicting aneurysm treatment results by simulation

INV28
Flow simulation: is it clinically relevant?

Gounis Matthew J1
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Predilection of saccular aneurysm sites at the apex of cerebral bifurcations and on the outer radius of curved arteries coincide with locations of high wall shear stress or wall shear stress gradients. This observation has long been believed to potentially serve as a causative relationship to the initiation of aneurysms; a focal fluid mechanic injury to the endothelium in areas of deleterious hemodynamic
stresses. Growth and progression of aneurysms to rupture may also be mediated by hemodynamic stresses, which has been the subject of decades of research. Computational fluid dynamics uses numerical solvers to calculate numerous fluid mechanic variables (velocity, shear stress, etc.) by solving the Navier-Stokes equations. Using patient-specific geometry from 3-dimensional medical imaging datasets (rotational angiography, CT angiography), computer models of the vasculature of interest may be built. Using these models, the fluid domain is solved using CFD, which is often referred to as “patient specific” modeling. However, rarely are the models actually patient-specific. Individual flow rates, blood properties and tissue properties are rarely known, and so population values are often employed. Complexity of the CFD technique varies widely, and the details of the approach should be considered carefully — extent of the CFD domain, pulsatile versus steady flow, rigid geometry or fluid-structure interaction, laminar flow or transition to turbulence. As compared to recent history, CFD solvers are readily available with common computers and as such are available to physicians and engineers. However, validation of the simulations and critical interpretation of the results and their uncertainties are necessary. Leading scientists in the field of CFD have not reached consensus on hemodynamic patterns that expose brain aneurysms to increased risk of rupture. Studies that prospectively follow unruptured aneurysms to rupture are difficult to obtain. Aneurysm pathogenesis is likely a complex process that requires data beyond hemodynamics to fully inform clinical management. CFD does hold the potential to aid physicians in treatment planning. However, for this goal to be realized, more validation and standardized methods are needed prior to widespread implementation. This lecture will review the latest developments towards treatment planning and alternative approaches on the horizon.

Flow simulation: have we learned anything new recently?
Gábor Závodszky
Budapest University of Technology and Economics, Department of Hydrodynamic Systems, Budapest, Hungary

INV29
How to validate simulation results
Valen-Sendstad Kristian1
1Simula Research Laboratory, Oslo, Norway

In traditional engineering disciplines, geometries, boundary conditions, flow conditions, and fluid properties well defined. However, such information is often not well defined in biomedical computing and engineering. We often rely on medical image-based segmentations that involve a significant amount of manual labor, which again could result in inter-laboratory variability. In addition, many studies in the biomedical domain are retrospective and lack patient-specific boundary conditions like flow rates, loads etc. Verification & validation (V&V) is therefore especially important in biomedical computing. Since the concepts of V&V are fairly broad, we will provide a brief introduction to the topics. We’ll provide an overview of the recent challenges held in the aneurysm computational fluid dynamics community. Finally, we will address whether or not V&V is actually needed, or just additional noise.

Thursday, 19th of October – Plenary room – 14:15 – 16:00 – Plenary session 14. – Aneurysm: value of different treatment modalities

Shall we plug the whole? (Is aneurysm packing still needed?)
René Chapot
Alfried Krupp Hospital in Essen-Ruettenscheid, Department of Radiology and Neuroradiology, Germany

Have we improved flow diversion over the past decade? Debate

INV30
Yes
Flow Diversion for Brain Aneurysms – Have we improved the technology over the past decades based on our understanding of Bio-Hemodynamics
Wakhloo Ajay K.1
1University of Massachusetts Medical School, Neuroimaging and Intervention, Worcester, United States

The journey spans nearly three decades of extensive in vivo and in vitro research in hemodynamics and engineering prior to the introduction of a reliable and safe technology in the endovascular treatment of brain aneurysms. Encouraged by impressive results from early clinical studies on treatment for complex and non-treatable aneurysms, multiple medical device manufacturers have created FDs that currently are at various stages of clinical evaluation, improvements of various device aspects, and approval. Experimental studies demonstrate that the device design influences the time required and location of endothelialization on the FDs and that circulating CD34+ progenitor cells participate in the endothelialization of the implant. Understanding tissue engineering, individual biological response to implants and reparative capabilities, will further promote the development of FDs. Clinical data are compelling that use of a single implant, if properly tailored to the flow environment is safe and may help an early and complete high rate of brain aneurysm cure.
References

No
Tommy Andersson
Karolinska Universitetssjukhuset Solna, Stockholm, Sweden

Intrasaccular flow modification: does it work? Debate
Yes
Adam Arthur
Semmes-Murphey Clinic, Memphis, USA

No
Christophe Cognard
Centre Hospitalier Universitaire (CHU) de Toulouse, France

Vasospasm: any improvement in the past years?
Thomas Liebig
University of Cologne, Cologne, Germany

Thursday, 19th of October – Session room 1. – 08:30 – 10:00 – Parallel abstract session - Aneurysm clinical: WEB

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Evaluation of the Safety and Efficacy of Aneurysm Treatment with WEB device in the cumulated population of 3 prospective, multicenter series (WEBCAST, French Observatory, WEBCAST-2)
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1CHU Reims, University Reims Champagne Ardenne, Reims, France

Background and Purpose: Flow Disruption with WEB is an innovative endovascular approach for wide-neck bifurcation aneurysms. Initial series have shown a low complication rate with good efficacy. The purpose of this study is to report clinical and anatomical results of the WEB treatment in the cumulated population of 3 Good Clinical Practice Studies: WEBCAST (WEB Clinical Assessment of Intrasaccular Aneurysm), French Observatory, and WEBCAST-2 series.

Methods: WEBCAST, French Observatory, and WEBCAST-2 are single-arm, prospective, multicenter, GCP (Good Clinical Practice) studies dedicated to the evaluation of WEB treatment. Clinical data were independently evaluated. Post-operative and 1-year aneurysm occlusion was independently evaluated using the 3-grade scale: complete occlusion, neck remnant, and aneurysm remnant.

Results: The cumulated population was 168 patients with 169 aneurysms, including 112 females (66.7%). Age was between 27 and 77 years (mean: 55.5 ± 10.2 years). Aneurysm locations were middle cerebral artery in 86/169 aneurysms (50.9%), anterior communicating artery in 36/169 (21.3%), basilar artery in 30/169 (17.8%), and internal carotid artery terminus in 17/169 (10.1%). Aneurysm was ruptured in 14/169 (8.3%). There was no mortality at one month and procedure-related morbidity was 1.2%. At one-year, complete aneurysm occlusion was observed in 81/153 aneurysms (52.9%), neck remnant in 40/153 aneurysms (26.1%), and aneurysm remnant in 32/153 aneurysm (18.2%). Retreatment during the first year was performed in 6.9%.

Conclusions: This series is at the moment the largest prospective, multicenter, GCP series of patients treated with aneurysms treated with WEB. It shows the high safety and good mid-term efficacy of this treatment.

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Initial experience with the new WEB 17 system in treatment of intracranial aneurysms
Peluso Jo1, van Rooij Sanne1, van Rooij Willem Jan1 and Sluzewski Menno1
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Introduction: The low profile WEB 17 was recently added to the existing size range of the WEB system. These smallest WEB devices have fewer wires and can be delivered through a 0.017 inch microcatheter (VIA 17). We present the first clinical results of this novel system both in ruptured and unruptured aneurysms.

Materials and Methods: Between January 2015 and April 2017, 25 aneurysms in 21 patients were selectively treated with the WEB 17. No supporting stents or balloons were used. Sixteen aneurysms were ruptured. There were 3 men and 18 women. Mean patient age was 59 years (median 60, range 46–70). Mean aneurysm size was 4.6 mm (median 4, range 3–7 mm). Of 25 aneurysms, 13 (52%) had a wide neck defined as ≥4 mm or dome-neck ratio ≤1.5. Location was Acom in 9, MCA in 10, Pcom in 3, pericallosa in 3.

Results: Immediate post intervention WEB position was adequate and showed near complete to complete stasis in 24 of 25 patients. In 1 patient, the WEB was undersized. This was only appreciated after detachment. This aneurysm was additionally coiled after 1 week. There were no procedural ruptures. There was one patient with an AcomA aneurysm had a small thrombus in the A3 segment that resolved completely after Tirofiban. No infarction on subsequent MRI. Permanent morbi-mortality was 0 of 25 (0 %, 95% CI 0.0 – 15.8%). At 3 month angiographic follow up there were no aneurysm remnants and 3 neck remnants. No retreatments were necessary. Adequate occlusion rate was 100%, complete occlusion rate was 88%. Of 25 WEB used, 6 were smaller sizes than previously available in the 21 system.

Conclusion: WEB 17 is safe and effective in the treatment of small ruptured and unruptured aneurysms. The WEB 17 is a valuable alternative to coils without the need for stents or balloons. 

WEB Treatment of Ruptured Intracranial Aneurysms: a Single Center Cohort of 100 Patients

van Rooij Sanne1, Peluso Jo1, van Rooij Willem Jan1 and Sluzewski Menno1
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Introduction: The WEB device was recently introduced for intrasaccular treatment of wide necked aneurysms without the need for adjunctive devices. We present our results of primary treatment of ruptured aneurysms with the WEB, regardless of neck size.

Materials and Methods: Between February 2015 and April 2017, 100 ruptured aneurysms were selectively treated with the WEB. No supporting stents or balloons were used. There were 71 women, mean patient age 59 years (median 60, range 23–82). Mean aneurysm size was 5.6 mm (median 5, range 3–13 mm) and 42 aneurysms were ≤4 mm. Of 100 aneurysms, 66 (66%) had a wide neck defined as ≥4 mm or dome-neck ratio ≤1.5.

Results: Two of 100 aneurysms were initially incompletely occluded followed by early additional coiling in 1 and surgery in 1. Of 64 patients with angiography at 3 months, 1 aneurysm reopened and was additionally retreated with coils. There was 1 procedural rupture without clinical sequelae. In 9 patients, thrombo-embolic complications occurred. One poor grade patient died, neurological deficits remained in 3 patients. Overall morbi-mortality was 4% (4 of 100, 95% CI 1.2–10.2%). Of 66 patients with early or late angiographic imaging, 3 (5%) had an aneurysm remnant, 15 (23%) had a neck remnant and 48 (73%) were completely occluded. Adequate occlusion rate was 95% (63 of 66). There were no rebleeds during follow-up.

Conclusion: WEB treatment of small ruptured aneurysms was safe and effective. The WEB proved to be a valuable alternative to coils without the need for stents or balloons.

Aneurysm Treatment with WEB®: Evaluation of the 21 and 17 Systems in a prospective, single-center series of 38 patients

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1CHU Reims, University Reims Champagne Ardenne, Reims, France

Purpose: WEB Flow disruption is an innovative endovascular treatment for wide-neck bifurcation aneurysms. Prospective multicenter GCP (Good Clinical Practice) studies conducted in Europe (WEBCAST, French Observatory, WEBCAST-2) and USA (WEB-IT) have shown the good safety and efficacy of the device in the treatment of wide-neck bifurcation aneurysms. This series is evaluating the performance of the 21 and 17 Systems.

Materials and Methods: Patients with wide neck bifurcation aneurysms treated with WEB-21 or WEB-17 were prospectively included in this single-center series conducted in Reims (France). Adverse events were reported and analyzed. Aneurysm occlusion was evaluated at the end of the procedure, 24-hour, 3 months, and 6 months using the 3 grade scale: complete occlusion, neck remnant, and aneurysm remnant.

Results: A total of 38 patients (26 females, 68.4%) aged 32 to 78 years were included. Forty-one aneurysms were treated, 37 with WEB-21 and 4 with WEB-17. Aneurysm location was middle cerebral artery in 20/41 aneurysms (48.8%), internal carotid artery in 8/41 (19.5%), anterior communicating artery in 7/41 (17.1%), and basilar artery in 6/41 (14.6%). Aneurysm size (transverse diameter) was between 2.5 and 7.4 mm. Neck size was greater than 4 mm in 17/41 aneurysms (41.5%). Placement of the WEB device was feasible in 40/41 aneurysms (97.6%). In 1 patient, placement of the WEB was not possible due to the angle between the aneurysm and the parent artery. During catheterization of the aneurysm sac, perforation of the parent artery occurring leading to subarachnoid bleeding and death 4 days later (mortality: 1/38,
WEB Treatment of Unruptured Intracranial Aneurysms: a Single Center Cohort of 54 aneurysms

Peluso Jo1, van Rooij Willem Jan3, van Rooij Sanne1 and Sluzewski Menno1

Introduction: The WEB device was recently introduced for intrasaccular treatment of wide necked aneurysms without the need for adjunctive devices. We present our results of primary treatment of unruptured aneurysms with the WEB, regardless of neck size.

Materials and Methods: Between February 2015 and April 2017, 54 unruptured aneurysms in 47 patients were selectively treated with the WEB. No supporting stents or balloons were used. There were 16 men and 31 women. Mean patient age was 60 years (median 62, range 30–76). Mean aneurysm size was 7.4 mm (median 6.5, range 3–25 mm). Of 54 aneurysms, 32 (59%) had a wide neck defined as ≥4 mm or dome-neck ratio ≤1.5. Location was Acom in 10, basilar tip in 8, carotid tip in 4, middle cerebral artery in 16, ophthalmic artery in 1, Pcom in 6, pericallosa in 4, other location in 5.

Results: Immediate post intervention WEB position was satisfactory in all patients. 4 patients had a thromboembolic event. Three patients remained asymptomatic. 1 patient with a basilar tip aneurysm developed a PCA and thalamic infarction with outcome mRS 4. Permanent morbidity was 1 of 54 (1.9 %, 95% CI 0.01 – 10.7%). There were no procedural ruptures. Of 54 aneurysms 48 had 3 month follow up angiography. Of those, 39 (81 %) aneurysms were completely occluded. There was an aneurysm remnant in 2. One was additionally coiled and 1 was left untreated. Seven had a neck remnant. Adequate occlusion rate at 3 months follow up was 96% (46 of 48).

Conclusion: WEB treatment of unruptured aneurysms, regardless of neck size, was safe and effective. The WEB proved to be a valuable alternative to coils without the need for stents or balloons.

Clinical results of WEB treatment in previously treated intracranial aneurysms

Peluso Jo1, van Rooij Sanne3, van Rooij Willem Jan3 and Sluzewski Menno1

Introduction: The WEB device is a novel microbraided flow disrupter designed for intrasaccular treatment of intracranial aneurysms. We present our results of WEB treatment in previously treated aneurysms.

Materials and Methods: Between January 2016 and March 2017, 11 patients with reopening of previously treated aneurysms were treated using the WEB device. Of these 11 aneurysms, 5 were partially thrombosed aneurysms. Location of all aneurysms was as follows: 2 Acom, 2 Pcom, 2 basilar tip, 1 carotid tip, 1 hypophyseal trunk.
Purpose: The impact of oversizing on the efficacy of WEB intrasaccular flow disruptors

Pogácsás Bettina1, Asztalos Lilla2, Nagy Péter3, Bognár Eszter2,3, Vadász Ágnes4 and Szikora István4

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Purpose: Intrasaccular flow disruptors are increasingly used for the endovascular treatment of wide neck bifurcation aneurysms. Shape changes of the device and subsequent recanalization has been reported following application of the WEB implant. To avoid these phenomena, radial oversizing has been recommended. In order to study the effect of sizing, we measured the radial forces acting on the compressing surfaces.

Materials and Methods: A total of 13 WEB SL devices were studied, including diameters of 6–9 mm and length of 3–6 mm. Radial oversizing was simulated by placing the implants in a hole with 1 mm lower diameter compared to the nominal diameter of the device. Elongation was measured on stereomicroscopic images (Olympus SZX16).

Results: Positioning of the WEB proved to be technically simple and accurate in 10 cases. In one basilar tip aneurysm the WEB tilted and a stent was placed to keep the WEB clear of the posterior cerebellar artery. There were no procedural complications. Follow-up consisted of 3-month angiography followed by MRI at 6, 12 and 18 months. 2 patients are planned for follow-up. Of 9 aneurysms with at least 6 month follow up available there was adequate occlusion in 5 (56%) (2 complete occlusion and 3 small neck remnants). There was an aneurysm remnant in 4 (44%).

Conclusion: WEB treatment of previously treated large aneurysms with reopening is technically easy. Permanent occlusion rates in partially thrombosed aneurysms are low and WEB does not seem to have an advantage over other endovascular techniques in preventing reopening.

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Parent artery reconstruction for large or giant cerebral aneurysms using Tubridge flow diverters (PARAT): a multicenter, randomized, controlled clinical trial

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Purpose: To elucidate the safety and efficacy of Tubridge flow diverter in large or giant aneurysms in comparison to Enterprise stent assisted coiling.

Materials and Methods: This study was a prospective, multicenter, randomized trial conducted at 12 hospitals in China. Adults with unruptured large/giant intracranial aneurysms were enrolled, and randomly assigned (1:1) to receive either Enterprise stent-assisted coiling or Tubridge FD implantation (with or without coils). The primary analysis involved a comparison of complete occlusion rate at 6-month follow-up between the treatment and control groups. The analysis was based on a modified intention-to-treat approach, using the x2 test with multivariable logistic regression adjusted for aneurysm size and patients’ age. A sensitivity analysis was performed to assess the effect of missing data.

Results: 185 patients were enrolled, 41 of whom quitted the trial before procedure initiation. Overall, 82 patients underwent attempted Tubridge implantation, while 62 patients were primarily treated with stent-assisted coiling. During 1 distal Pica, 1 superior cerebellar artery and 1 vertebral junction. Average aneurysms size was 23.2 mm (median 26 mm, range 7–40 mm). Previous treatment consisted of coiling in 9, clipping in 1 and WEB in 1. Number of previous treatments ranged from 1 to 6 with an average of 2.8.

Results: As a response to 1 mm oversize, elongation ranged from 8.2% to 39.1%, and axial strain from 0–33.6% depending on the nominal diameter and length. As expected, the increase of longitudinal strain was strongly related to nominal diameter: up to 33.6% of 6 mm devices, a maximum of 20% of 7 mm implants and no more than 10% of 8 mm samples. One mm compression produced 13–37 mN radial forces acting on the compressing surfaces.

Conclusion: The magnitude of radial forces generated by oversizing of WEB implants is small and its physiological impact on the aneurysm wall is likely negligible. The degree of both elongation and axial strain is strongly dependent on the nominal size of the device suggesting that more precise calibration of device parameters might be beneficial. The axial strain produced by oversizing is relatively small and in larger devices/aneurysms its effect may not be sufficient to prevent from shape changes of the device. This study was supported by grant No KTIA_NAP_13-1-2013-0001 from the Hungarian National Brain Research Program. WEB devices were provided by Sequent Medical.
the 6-month follow up, complete occlusion rate was 75.34% for Tubridge group and 24.53% for control group; calculated common odds ratio was 9.4 (95% confidence interval, 4.14–21.38; P < 0.001). Sensitivity analyses and adjusted results also showed superior results for Tubridge group. There was an increased incidence of complications for patients in Tubridge group, but the difference was not significant. Conclusions: This trial showed that there was a significantly higher obliteration rate of aneurysms treated with FD over conventional treatment in selected large or giant aneurysms. However, this higher obliteration rate comes at the cost of a non-significantly higher rate of complications.

Thursday, 19th of October – Session room 2. – 08:30 – 10:00 – Parallel abstract session - Aneurysm clinical: antiplatelet treatment and miscellaneous

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Treatment of challenging aneurysms by flow diverter: Summary series of 140 cases at Bach Mai Hospital
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Background and Purpose: The purpose of this study is to report our experience in treatment of intracranial challenging aneurysms by flow-diverter stent.

Materials and Methods: A consecutive series of 140 patients suffering from intracranial challenging aneurysms were treated by flow diverter stents in 5 years at Bach Mai hospital. Different flow-diverter stents were used including of Pipeline stent 86,43% (121 cases), FRED stent 10,71% (15 cases) and Silk stent 2,86% (4 cases). The aneurysmal morphology and stenting deployment were described. Degree of aneurysmal occlusion were analyzed on MRI angiography contrast after treatment of 3 and 6 months.

Results: The ratio of female/male was 3:3:1. Challenging intracranial aneurysms of internal carotid was mostly common (92,6%), especially in paraphtalmic segment (40,3%). Saciform aneurysm accounted for 95,5% and blister-liked aneurysm was rare about 3,7%. Giant aneurysm was 9,0%. Endovascular treatment was successfully performed in 94,8%. The mortality and morbidity rates were of 1,5% and 3,7% respectively. Complete occlusion of aneurysms post flow-diverter stent after 3 and 6 months were 82% vs 95% respectively. Delay rebleeding and thromboembolic event were 0,7% and 4,3% respectively.

Conclusions: Flow-diverter stent was indicated in challenging intracranial aneurysms with height rate of success and low procedure complication. This method was safety and efficacy.
Intravenous administration of tirofiban versus loading dose of oral clopidogrel for preventing thromboembolism in stent-assisted coiling of intracranial aneurysms

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Background: Thromboembolic complications after stenting of intracranial aneurysms may be affected by antiplatelet administration.

Aims: This retrospective study aimed to assess the safety of intravenous tirofiban versus loading dose of oral clopidogrel for preventing thromboembolism in stent-assisted coiling of intracranial aneurysms.

Methods: From January 2006 to December 2013, 281 patients with cerebral aneurysms were treated with stent-coiling using two antiplatelet strategies in comparison: the initial strategy (a loading dose of 300 mg clopidogrel followed by dual antiplatelet, clopidogrel group) and the modified strategy (intravenous administration of tirofiban 8 mg/kg over 3 min followed by a maintenance dose of 0.1 mg/kg/min for 24 h, tirofiban group). The end points were rates of perioperative thromboembolic events and intracranial hemorrhages.

Statistical analysis: Statistical analysis was performed using the SPSS version 17.0 software (SPSS, IL, USA). The independent samples t test was used for comparing continuous data, and the χ2 (Chi-square) test or Fisher’s exact test for comparing categorical data. A multivariable logistic regression analysis was also performed to predict thromboembolic events and intracranial hemorrhage. The P values were all two-sided, and a P value < 0.05 was considered statistically significant.

Results: Thromboembolic events were observed more often in the clopidogrel group (13/120 aneurysms, 10.83%) than the tirofiban group (6/178 aneurysms, 3.37%; P = 0.010), with no increase in the rate of intracranial hemorrhages (P = 0.164). In the ruptured subgroups, thromboembolic events were significantly fewer in the tirofiban subgroup (5/128, 3.91%) compared with the clopidogrel subgroup (7/53, 13.21%; P1/4 0.043) with no increase in the rate of hemorrhage (P = 0.360).

Conclusions: Intravenous administration of tirofiban is safe in intracranial aneurysms treated with stent-assisted coiling.

Low-dose prasugrel is safe and effective for stent-assisted treatment of intracranial aneurysms

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Background & Purpose: Antiplatelet treatment is important to prevent thrombosis in the treatment of cerebral aneurysms with the utilization of stents. We present experiences of low-dose prasugrel usage in this clinical setting.

Materials & Methods: During the period between November 2014 and March 2017, 209 patients with 219 aneurysms were treated using stents under the low-dose prasugrel regimen, including 7 patients treated with flow diverters. In the majority, the patients were medicated with 20 mg of prasugrel a day before the endovascular treatment and with 5 mg during the following 3 months, and then the medication was switched to aspirin.

Results: Related to the interventional procedures, there were two ischemic events and 2 procedural aneurysmal leakages. During the follow-up period, there was 1 ischemic event and 1 hemorrhagic problem. All the patients recovered without neurologic deficit except a patient with retinal infarction which produced altitudinal field defect. Mean PRU value was 133 and mean percentage inhibition was 54%. PRU values were 60 or less in 42 patients (20%) and were higher than 300 in 5 (2%).

Conclusion: The low-dose prasugrel regimen is quick, safe and effective for stent-assisted treatment in patients with intracranial aneurysms.

Initial response and Long term variation of response to clopidogrel in patients undergoing endovascular treatment

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Introduction: In order to prevent ischemic complications of endovascular neurointerventions, dual antiplatelet therapy using aspirin and clopidogrel is widely used. But Josser et al. reported “delayed conversion to clopidogrel hyper-response” and referred to the increased risk of hemorrhagic complications because of the delayed conversion.

The aim of this study was to inspect the initial response to the standard preoperative clopidogrel medication and the
long term variation of response to clopidogrel including "delayed conversion" to clopidogrel hyper-response.

Materials and Methods Patients: Between December 2015 and September 2016, 18 consecutive patients undergoing the intracranial stent placement who received clopidogrel orally before treatment were included in this single center retrospective study. Clopidogrel efficacy of all of those patients was tested by using VerifyNow platelet function assay (in PRUs). Preoperatively all patients had the results of the initial response to clopidogrel about 7 days medication, while 8 of all also had the results of the later response to clopidogrel about 1 month after the procedure. A hypo-response to clopidogrel was defined as PRU ≥ 240 and a hyper-response to clopidogrel was defined as PRU ≤ 60. While for the analysis of the initial response, we also defined a higher-response to clopidogrel as PRU ≥ 214 and a hyper-response to clopidogrel as PRU ≤ 120 to divide 18 patients into 2 groups. For statistical analysis, the parameters of all cases were confirmed; sex, age, BMI, Hypertension, initial ARU, preoperative medication period, creatinine, eGFR, hemoglobin, hematocrit and platelets.

Statistical analysis: Statistical analysis was performed utilizing Microsoft Excel and SPSS, Version 22.0 (IBM, Armonk, New York).

Results: In initial response analysis, BMI (p = 0.019) and initial ARU (p = 0.001) were significantly different between higher responders and the others. Between the initial PRU and later PRU, the difference was remarkably significant (p = 0.001, t = 5.2).

In the analysis for the delayed conversion, 6 of 8 (75%) patients demonstrated delayed conversion to clopidogrel hyper-response. There are not obvious significant differences, but Platelets ± SD value of delayed conversion (+) group (21.3 ± 7.5) was lower than delayed conversion (−) group (29.7 ± 10.3) (p = 0.096), and 5 hemorrhagic complication cases were observed in only delayed conversion (+) group (p = 0.107).

Discussion: In our study, 6 of 8 (75%) patients demonstrated delayed conversion to clopidogrel hyper-response. So the confirmation of clopidogrel efficacy may need more length than 2 weeks oral use and the reexamination of later PRU due to delayed conversion.

Conclusion: We showed the possibility that antiplatelet effect of clopidogrel might be strengthened because of long term oral use. For safety endovascular neurointervention like flow diverter stent, we should check followed PRU again long after starting oral use for the precaution of hemorrhagic complications.

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Safety and efficacy of antiplatelet response assay and drug adjustment in stent-assisted coil embolization: A propensity score matching analysis

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Purpose: The purpose of this study was to explore the safety and efficacy of an antiplatelet response assay and drug adjustment to prevent delayed thromboembolic events after stent-assisted coil embolization.

Materials and Methods: A total of 370 patients were enrolled in this study between December 2005 and July 2014. Of these, 124 patients were placed into the drug resistance test (DRT) group with drug adjustment according to response to an antiplatelet agent, and 246 patients comprised the control group with a standard antiplatelet regimen. The response to the antiplatelet agent was evaluated with the VerifyNow Rapid Platelet Function Assay. Propensity score matching analysis was performed with one-to-multiple matching.

Results: Among 370 patients, delayed thromboembolic events occurred in 28 (7.6%) patients including 25 (10.2%) in the control group and three (2.4%) in the DRT group. Antiplatelet response test (p = 0.012), DM (p = 0.014), and HTN (p < 0.001) were associated with delayed infarction in multivariate analysis. In propensity score matching analysis, 331 patients were matched (control group (n = 229) vs. DRT group (n = 103)), and antiplatelet response (hazard ratio 0.247, 95% confidence interval 0.070–0.868, p = 0.029) was correlated with delayed infarction. Conversely, the two groups were not significantly different with regard to total (p = 0.368) or major hemorrhagic complications (p = 0.108).

Conclusion: Antiplatelet drug adjustment according to the results of an antiplatelet response assay might be associated with a decreased risk of delayed thromboembolic infarction compared with the standard antiplatelet regimen.
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Endovascular Treatment of Posterior Fossa Spontaneous Intracranial Dissecting Aneurysms: Related outcomes of 56 Cases treated by intracranial Stenting or Parent Vessel Occlusion

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Purpose: To evaluate technical and clinical feasibility, safety and long term results of endovascular treatment of posterior fossa spontaneous dissecting aneurysm, coexisting with subarachnoid haemorrhage.

Material and Methods: Between January 2011 and May 2016, 565 consecutive patients were referred to our department for endovascular treatment due to cerebral aneurysms. Among this group, 56 patients harboring a total of 56 spontaneous PFIDAs were identified, coexisting with subarachnoid haemorrhage. All of them were endovascularly aborded.

Results: Of the 56 PFIDAs, 36 (64.28%) were treated by flow diverter stenting (FDS), 10 (17.85%) with sole small diameter no diverter stenting (SSDS), and 10 (17.85%) by parent vessel occlusion (PVO). 2% of the group treated by FDS showed immediate aneurysm exclusion, and the rest of them total exclusion during follow up. Inside the group of SSDS 8 were exclude during follow up and 2 experienced no changes, but with no rebleeding during the same period. Regarding the group of PVO no recanalization of the PFIDAs was observed. The mean duration of clinical follow-up of the 56 patients was 10.40 months (range, 3–48 months). Imaging follow-up was available for 56 patients (100%) of the patients, with a mean duration of 9.20 months (range, 3–42 months). Of the 56 patients treated, 9 (16.07%) showed major long term persisting disabilities, and 2 (3.57%) partial short term disability. No deaths were observed during follow up.

Conclusions: Endovascular treatment of PFIDAs is safe, effective and the utility of intracranial stenting is a promising tool considering therapeutics options.

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Stents as Adjuncts to Flow Diveters

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Purpose: Placement of a flow diverter inside a stent is thought to lower occlusion rates. We wanted to evaluate the results of conjoined use of stents and flow diverters intracranially by analyzing the results of aneurysms treated with both diverter-in-stent technique and stent-in-diverter technique.

Materials and Methods: All intracranial aneurysms treated with flow diverter and stent during the same session by the senior author were retrospectively evaluated. Procedures were dichotomized as scaffolding stent placement (stent-first group) and apposing stent placement (flow diverter-first group). Aneurysm characteristics and occlusion rates at 1 to 3 months (initial) and 3 to 6 months (early) were compared based on DSA and/or noninvasive angiographic imaging (MRA or CTA).

Results: Twenty one aneurysms were treated with stent-first technique and 54 aneurysms were treated vice versa. The mean aneurysm sizes were 13.1 and 12.4 respectively for each group and the difference was not statistically significant. 95 and 87% of aneurysms were in anterior circulation consecutively. Complete occlusion rates at 3 and 6 months were 43% and 76% for the “stent first” group and 68% and 80% for “flow diverter first” group. The permanent complication rate for both groups were similar.

Conclusion: Although placement of a stent immediately prior to the placement of a flow diverter was associated with a lower early occlusion rate, aneurysm occlusion rate in this group at 6 months was similar to previously reported large series regarding flow diverters. The occlusion of aneurysms with apposing stents were associated with even higher rates of early occlusion. Both strategies appear effective and safe and may be utilized if needed based on operator preference.

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Development of microporous covered stent for the treatment of intracranial aneurysms (NCVC-CS1): its functional features and commencement of investor-initiated clinical trial

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Purpose: To describe the functional features and preliminary clinical results of a novel covered stent graft named NCVC-CS1 for the treatment of large or giant intracranial aneurysms

Materials and Methods: NCVC-CS1 is a balloon-expandable stent which is covered with a thin, microporous segmented polyurethane membrane. (1) Navigability, (2) Aneurysm
occlusion, and (3) patency of branching vessel were assessed using animal models.

**Results:** Non-clinical experiment was carried out as follows; (1) Easy navigation was observed by canine carotid siphon model made by inlaying anastomosed CCAs into a skeletonized acrylic tube designed on the basis of 3D rotational angiography of human ICA and 3D-printing-aided manufacturing. (2) Instant occlusions of large aneurysms, even located at the outer side of the curved arteries, were confirmed by canine sidewall, wide-necked aneurysm model. (3) Patency of perforating arteries was affirmed by stent placement in rabbit aorta at the branching of lumbar arteries.

Upon these results, an investor-initiated, first-in-human, clinical trial to evaluate the safety and efficacy of NCVC-CS1 was started in May 2016 with the support of Japanese Agency of Medical Research and Development. This trial will recruit a total of 12 patients with unruptured, wide-necked aneurysms whose diameter>7 mm, located in petrous/cavernous portion of internal carotid artery, intradural vertebral artery, or basilar artery proximal to the orifice of superior cerebellar artery, in two years. Primary endpoints are any stroke or death related to the procedure within 180 days, and complete obliteration of target aneurysm and patency of target vessel (less than 50% stenosis) at 180 days after the procedure. Preliminary results of the trial will also be presented.

**Conclusion:** A novel, microporous covered stent system (NCVC-CS1) was developed. The ongoing trial will hopefully prove the safety and efficacy of this device, thereby providing a more feasible therapeutic choice.

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**Thursday, 19th of October – Session room 2. – 13:15 – 13:45 – Poster session**

**PP326**

*The natural history of unruptured intracranial aneurysms: A retrospective, single center study*

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**Introduction:** Women, smokers, and patients with multiple aneurysms have been shown to be among those at risk of unruptured cerebral aneurysm enlargement, and treatment intervention is recommended to prevent rupture. We investigated the rate of enlargement, rate of rupture, and characteristics of unruptured cerebral aneurysms.

**Methods:** We carried out a retrospective analysis of 988 patients with aneurysms who had undergone magnetic resonance angiography (MRA) in a single center during a 17-month period between November 2014 and March 2016. We compared 1.5T MRA scans with previous maximum intensity projection (MIP) images, and aneurysm enlargement was defined as an increase in size or new bleb formation.

**Results:** The 988 patients with aneurysms comprised 258 men and 730 women with a median age of 73.5 years. Of these, 148 (14.8%) aneurysms enlarged. The enlarged aneurysms were initially larger than those that did not enlarge (p<0.01), and 29% of those followed for ≥5 years enlarged.

By location, approximately 20% of those in the middle cerebral artery (MCA), internal carotid–posterior communicating (ICPC) artery, or anterior communicating artery (AcomA) enlarged, compared with only 7% in the proximal internal carotid (IC) artery. Subarachnoid hemorrhage occurred in 16 (11.9%) of the 148 patients with enlarged aneurysms, while in 132, the aneurysm remained unruptured. Subarachnoid hemorrhage was confirmed by computed tomography (CT) at the time of rupture in 14 of the 16 patients, with hematoma formation in 10.

Surgery was performed in 11 of the patients with subarachnoid hemorrhage (craniotomy and clipping in all patients) and in 18 of those with unruptured aneurysms (craniotomy and clipping in 2 and coil embolization in 16).

**Conclusions:** Enlargement occurred in 15% of 988 aneurysms, and these enlarged aneurysms had a high rupture rate of 12%, resulting in many cases of subarachnoid hemorrhage with hematoma formation. If enlargement of an aneurysm is observed, it may be necessary to consider appropriately timed surgical treatment to prevent rupture to improve prognosis.

**PP327**

*Incidence and risk factors of intracranial aneurysm: A national cohort study in Korea*

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**Background:** Estimations of the intracranial aneurysm incidence require long-term follow-up of a relatively large at-risk population; as a result, the incidence remains largely unknown.

**Aims:** To investigate the national incidence of intracranial aneurysm in a Korean population.

**Methods:** After excluding 18,604 potential subjects with a previous history of stroke (I6.x.x), 998,216 subjects were included in this observational cohort. The primary endpoint
was the earliest date of diagnosis of either unruptured intracranial aneurysm (UIA; I67.1) or subarachnoid hemorrhage (SAH; I60.x). We collected anthropometric data, blood pressure measurements, laboratory data, and smoking, drinking, and physical exercise habits of 132,355 subjects for whom healthcare screening data were available. Factors influencing intracranial aneurysm were evaluated via multivariate Cox regression.

**Results:** The overall observation size was 8,792,214 person-years. During follow-up, 4,366 subjects were diagnosed with intracranial aneurysm (SAH, 1960; UIA, 2386). The crude incidence of intracranial aneurysm was 49.4/100,000 person-years. The hazard ratio for women was 1.56 (p < 0.01), and older subjects had an increased hazard ratio. Subjects with hypertension had an approximately 1.5-fold higher risk of intracranial aneurysm. A history of heart disease and family history of stroke were associated with respective hazard ratios of 2.08 and 1.77.

**Conclusions:** In this Korean population study, the standardized incidence of intracranial aneurysm was 52.2/100,000 person-years. Older age, female sex, hypertension, history of heart disease, and family history of stroke were independent risk factors for intracranial aneurysm.

**PP328**

**Prevalence of Intracranial Aneurysm in Patients with Aortic Dissection**

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**Background and Purpose:** There is an uncertainty about the association between intracranial aneurysm (IA) and aortic dissection (AD). We aimed to determine prevalence of IA in patients with AD and evaluate independent risk factors for presence of IA in these patients.

**Methods:** 71 patients with a confirmed AD, who performed additional brain imaging, were enrolled as AD group and 2,118 healthy individuals with brain imaging as controls. Demographic data were obtained from their medical records, including age, sex, comorbidities, and arch vessel involvement of AD. Two readers reviewed all brain images independently regarding presence, morphology, size, and location of IA. Baseline characteristics were compared between AD group and controls by propensity score matching and logistic regression analysis was performed for independent risk factors for presence of IA.

**Results:** The prevalence of IA was 12.96 % in AD group and 1.85% in controls (p = 0.022). The mean diameter of IA was significantly larger in AD (5.79 ± 3.26 mm in AD versus 3.04 ± 1.57 mm in controls; p = 0.008) and IA of more than 7 mm in size were also more common in the AD (28.6% in AD versus 5.3% in controls, p = 0.003). On multivariate analysis, arch vessel involvement of AD was an independent risk factor for presence of IA (odds ratio, 6.246; 95% confidence interval, 1.472–26.50, p = 0.013).

**Conclusion:** Patients with AD have a high prevalence of IAs and selective screening for brain could be considered in these patients with arch vessel involvement. Further prospective study is needed to demonstrate a substantial prevalence of IA.

**PP329**

**Crescent sign following Enterprise stent-assisted embolization of distal internal carotid artery aneurysms**

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**Background:** Incomplete wall apposition of the Enterprise stent may be identified by the crescent sign on MR angiography. The purpose of this study was to evaluate the incidence, time course, and clinical significance of crescent signs following Enterprise stent-assisted embolization.

**Methods:** Of the 143 consecutive patients that underwent stent-assisted embolization of unruptured distal internal carotid artery aneurysms, 61 patients with available MR angiographies obtained immediately (<48 hours), 6 months, 1 year, and 2 years after embolization were included.

**Results:** Thirty-three of the 61 patients exhibited crescent signs on immediate MR angiography. In 17 of the 33 patients, the crescent sign persisted for more than 1 year and four of them developed delayed thromboembolic events in association with antiplatelet regimen changes (10–15 months after embolization). None of the patients with disappeared or absent crescent signs developed delayed thromboembolic events during follow-up.

**Conclusion:** Antiplatelet strategy needs to be customized after Enterprise stent-assisted embolization considering an increased risk of developing delayed thromboembolic events in the presence of crescent signs.

**PP330**

**Endovascular Treatment of Complex Cerebral Aneurysms with a Branch Incorporated into the Sac**

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**Purpose:** The optimal management of geometrically complex aneurysms remains challenging. The aim of this retrospective study was to evaluate the safety and feasibility of endovascular treatment in complex aneurysms with a branch incorporated into the sac.
Materials and Methods: Forty-four consecutive patients harboring complex cerebral aneurysms with a branch incorporated into the aneurysm underwent coiling during 5 years. Results: Sixteen (36%) aneurysms located at the terminus of basilar artery, 12 (27%) aneurysms located at the junction of internal carotid-posterior communicating artery. Five (11%) were posterior inferior cerebellar artery aneurysms, 4 (9%) were superior cerebellar artery aneurysms. Twelve two (50%) aneurysms were ruptured. Eighteen (41%) aneurysms underwent stent-assisted coiling, 16 (36%) underwent coiling by using multiple catheter technique. Balloon-assisted coiling was 5 (11%), and microcatheter-assisted coiling was 2 (5%). There was 1 (2%) case of occlusion of branch incorporated into the aneurysm which induced infarction. There was no procedure-related death. Conclusion: Endovascular treatment seems safe and feasible for complex aneurysms with a branch incorporated into the sac. However, long-term follow-up results are needed to evaluate the efficacy of this treatment modality.

PP331
Aneurysmal Rupture during Embolization with Guglielmi Detachable Coils: Causes, Management, and Outcome
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Purpose: Aneurysmal rupture during endovascular treatment is one of the most feared complications of endovascular aneurysm therapy. The purpose of this study was to determine the frequency, causes, management, and outcome of aneurysmal rupture that occurred during treatment with Guglielmi detachable coils (GDCs) in an unslected series of patients with ruptured cerebral aneurysms.

Methods: Between July 1999 and April 2017, we treated 521 acutely ruptured cerebral aneurysms with GDCs. All charts were reviewed, and patients with aneurysmal rupture occurring during embolization were identified.

Results: Five patients had an intraprocedural aneurysmal rupture. In one patient, rupture was due to guidewire perforation of the wall (anterior communicating artery aneurysm). In one patient, the microcatheter itself perforated the aneurysm (p-com aneurysm). In one patient, rupture occurred during placement of the first coil. Endovascular packing was continued in one patient. In another patient, rupture occurred during placement of the last coil. Last coil detaching was continued in one patient. Three patients died as a result of the aneurysmal rupture. No negative long-term effects were observed in the remaining two patients. In summary, we observed intraprocedural aneurysmal rupture in 2.2% of our patients, with a mortality rate of 40% and no long-term morbidity.

Conclusion: Aneurysmal rupture during endovascular treatment with GDCs is a rare event; clinical severity may be variable. Embolization of the aneurysm can be continued in most cases, and 60% of patients with treatment-related subarachnoid hemorrhage survive without serious sequelae.

PP332
Balloon Assisted Coil Embolisation with ECLIPSE (BALT) Balloon – Single Centre, Consecutive, Retrospective Series
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Purpose: Balloon assisted coiling of intracranial aneurysms is a well-established technique. Literature suggests that balloon remodelling has a higher complication rate (5.2%–71.4%) compared to simple coiling (3.4%–11%). The ECLIPSE (BALT) dual lumen balloon has a 6 mm diameter available for endovascular aneurysm treatment, which confers an advantage in clinoidal segment aneurysms. However, its larger size may potentially increase the risk of intra-procedural rupture in distal smaller vessels, such as pericallosal artery and anterior communicating artery.

We report the clinical outcomes, angiographic data and follow up results of 95 consecutive cases of balloon assisted coil embolisation using the ECLIPSE (BALT) balloon between 19/05/2015 and 08/05/2017.

Materials and Methods: Retrospective study of the aneurysm database of embolisation with the ECLIPSE (BALT) balloon between 19/05/2015 and 08/05/2017. We reviewed the rate of intra and peri-procedural complications (asymptomatic or clinically symptomatic), the Raymond-Roy occlusion grade (immediate post procedure and on follow up MRA scan), and the retreatment and rehaemorrhage rates in this cohort.

Results: 95 patients (64 F/31 M) with an age range from 23–80yrs (median 56.5) had aneurysm coiling with ECLIPSE (BALT) balloon assistance. There were 41 ruptured and 54 unruptured aneurysms (7 retreatments). Balloon remodelling was successful in all of these patients.

There were 6 (6.25%) complications: 4 cases of intra-procedural clot formation treated with Reopro (Absciximab) with complete resolution and 2 intra-procedural aneurysmal perforations, both successfully controlled by the balloon. There was no procedure related mortality or permanent disability in the entire cohort.

Post procedure Raymond-Roy grade I occlusion was achieved in 78/95 patients (82%). Follow up MRA data at 6 months is available in 60/95 patients which shows stable grade I occlusion in 42/60 patients (70%). 17 patients developed small aneurysm recurrences due to coil compaction, 2 of which have had a follow up 18 months MRA, both
showing a stable remnant. There have been no retreatments or rebleeds.
In our series we had 26 aneurysms harboured by parent vessels that are ≤ 2 mm in size (2 DACA, 22 ACOM, 2 PCOM). There were no complications in this group of patients. There were 2 cases of dual balloon assisted coil embolisation of MCA aneurysms. This suggests that despite having a larger balloon diameter, the ECLIPSE (BALT) balloon can be used safely in distal vessels.

Conclusion: In this study, balloon assisted coil embolisation with the ECLIPSE (BALT) balloon is a safe and effective technique, with a complication rate that is no different to conventional coil embolisation, and with durable results. ECLIPSE (BALT) balloon can be used safely in distal vessels despite having a balloon diameter of 6 mm.

PP333
Quantitative assessment of cerebral aneurysm wall enhancement using MR imaging

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Purpose: The incidence of wall enhancement of the cerebral aneurysms on MR vessel wall imaging has been described to be higher in ruptured intracranial aneurysms than in unruptured intracranial aneurysms, but the difference in the degree of enhancement between ruptured and unruptured aneurysms is unknown. We compared the degree of enhancement between ruptured and unruptured aneurysms using MR quantitative measures.

Materials and Methods: We performed quantitative analyses of circumferential enhancement along the wall of the cerebral aneurysms in 28 ruptured and 76 unruptured consecutive cases using MR vessel wall imaging. A 3-dimensional T1-weighted fast spin-echo sequence was obtained before and after contrast media injection, and the wall enhancement index (WEI) was calculated. We then compared characteristics between ruptured and unruptured aneurysms.

Results: The WEI was significantly higher in ruptured than in unruptured aneurysms (1.70 ± 1.06 versus 0.89 ± 0.88, respectively; \( P = 0.0001 \)). The receiver-operating characteristic curve analysis found that the most reliable cutoff value of the WEI to differentiate ruptured from unruptured aneurysms was 0.53 (sensitivity, 0.96; specificity, 0.47). The WEI remained significant in the multivariate logistic regression analysis (\( P < 0.0001 \)).

Conclusion: Greater circumferential enhancement along the wall of the cerebral aneurysm correlates with the ruptured state. A quantitative evaluation of circumferential enhancement using MR vessel wall imaging could be useful in differentiating ruptured from unruptured cerebral aneurysms.

PP334
Central fever in relation to perianeurysmal inflammation following endovascular embolization of intracranial aneurysm: case report

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Purpose: the perianeurysmal inflammation is an uncommon complication of intracranial aneurysm following endovascular treatment with different clinical appearances. The purpose of this report is to describe the symptomatic effect, as central fever, of a supraclinoid ruptured large aneurysm treated by means of bare platinum coils and flow diverter stent implantation harboring perianeurysmal inflammation resolved by steroid treatment.

Case: a 45-old female was admitted with Hunt and Hess grade II to our hospital for subarachnoid hemorrhage due to a large left carotid supraclinoid aneurysm (16x23mm) with wide neck. Endovascular treatment was performed in acute phase by means of bare platinum coils. The postoperative period was uneventful and first MRI revealed no perianeurysmal edema. Flow diverter stent was implanted one week later to exclude the aneurysm. The patient was discharged after twenty days with no neurological deficit. After one month from the flow diverter stent implantation she was admitted to hospital for fever started few days before. All causes of infection after thorough investigations were excluded. The MRI detected perianeurysmal edema surrounding the aneurysm involving hypothalamic and left sub-thalamic-anterior commissural-fornix area with enhancement of the aneurysm wall. Central fever was considered in relation to hypothalamic inflammation. Complete clinical examination was performed to exclude infectious causes and antibiotic therapy was not able to resolve the clinical course. Treatment with steroid was therefore started. Follow-up MRI one month later showed no perianeurysmal edema or wall enhancement and the steroid were discontinued. The patient was discharged uneventful.

Conclusion: this report contributes to the evidence about the possible adverse inflammatory reaction and specifically with perianeurysmal edema after aneurysm treatment with a flow-diverter device. It’s more likely to occur in large-giant aneurysm embedded in the surrounding brain.
parenchyma. To our knowledge this is the first report of central fever caused by post-embolization perianeurysmal inflammation involving eloquent area as the hypothalamus. The case reinforced the utility of MRI in the post-treatment period of the large-giant aneurysms adjacent to eloquent area treated today, above all with flow diverter devices, to discover perianeurysmal edema in order to prevent clinical symptomatic events.

Thursday, 19th of October – Session room 3. – 08:30 – 10:00 – Parallel abstract session – Aneurysm clinical: Vasospasm and miscellaneous

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Aneurysms retreatment after over 20 years: the importance of a very long-time follow-up

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Purpose: The Follow-Up duration after cerebral aneurysm treatment is an unspecified topic, so even the international guidelines do not give specific indication, leaving the choice of timing to individual physician decision.

We present two cases of aneurysms treated with endovascular approach in the past and presented with rupture or rehabilitation of the sac more than 20 years after treatment.

Summary of cases

CASE 1: The first case is a 68 years old woman presented in 2016 with SAH due to the rupture of the residual sac of a voluminous right carotid-ophthalmic aneurysm treated 28 years ago in a 2-steps endovascular treatment. At that time, endovascular treatments consisted in positioning a balloon inside the aneurysmatic sac, followed by the closure of the right internal carotid artery with further balloons. After 28 years a portion of this aneurysm has been rehabilitated and ruptured, resulting in SAH. This residual sac was surgically treated due to the impossibility of reaching the neck of the residual sac by endovascular route.

We believe that this rehabilitation occurred for the persistence of retrograde blood flow that from the posterior communicating artery reached the ophthalmic artery, leading to re-opening of the aneurysmatic sac.

CASE 2: The second case is a 67 years old woman retreated for the rehabilitation of basilar tip aneurysm, previously treated in 1994 with clipping after a SAH. Early after treatment, a sac rehabilitation due to surgical clip displacement was observed, requiring coiling of the residual aneurysm that remain stable at angiographic control after 2 years.

After 22 years, during a CT of the head done for another reason, a massive rehabilitation of the aneurysm was highlighted, requiring a new endovascular treatment with Stent Assisted Coiling technique. The 3-month angiographic control showed a slight rehabilitation of the aneurysmatic sac, which remains stable at 6 months FU.

Conclusion: Despite the limit of two anecdotal cases, we believe that cerebral aneurysms, especially when ruptured or of large size, should not be forgotten after treatment, but followed over time, even for very long FUs.

The possibility to perform this Follow-Up by non-invasive brain vessels examinations such as CTA or MRA, can contribute to elong the duration of patient’s Follow-Up, increasing their compliance.

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Endovascular and Surgical Options for Recurrent Aneurysms after Coil Embolization: A Single Surgeon’s Experience in Japan

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Purpose: As a result of the increase in endovascular surgery for cerebral aneurysms, we have more frequently experienced recurrent aneurysms after coil embolization. Although there are many reports that re-coil embolization is safe and efficient for the retreatment, surgical clipping is still an alternative option. We present a single surgeon’s experience of 26 recurrent aneurysms after coiling that were retreated using surgical or endovascular techniques, in order to discuss the choice of retreatment.

Materials and Methods: From 2009 to 2016, 26 recurrent aneurysms after coil embolization were retreated. All the aneurysms were retreated by the first author. In cases with a rapid increase in recurrent lesions, residuals larger than 30% of the original aneurysm, or blebs in the recurrent lesions, retreatment was considered. The retreatment choices were as follows. When the previous frames covered the aneurysms all around (Type 1) or almost around except a part of the neck (Type 2), coil embolization was chosen.

When the remnant neck was sufficiently tall, neck clipping or stent assisted coiling was chosen (Type 3). When the remnant neck was short, and the border between the thrombosed and non-thrombosed portion was distinct, partial clipping of the non-thrombosed portion or stent assisted coiling was chosen (Type 4). Surgical clipping was attempted without removal of embolized coils when technically feasible.

Results: Among the 26 recurrent aneurysms retreated, 13 were retreated with endovascular coating (50%), and 13 were retreated with surgical clipping (50%). Among the 13 cases retreated with coiling, 10 cases (Type 1 or 2) were retreated without a stent, and 3 cases (Type 3) were retreated with a stent. There was a minor thromboembolic complication in 1 case. And in another case, re-retreatment
was required. Among the 13 cases retreated with clipping, neck clipping was performed in 11 cases (Type 3), and partial clipping was performed in 2 cases (Type 4). In all, surgical clipping was accomplished without the removal of coils. There was no neurological deterioration after surgical clipping in any cases. No aneurysms required "re-retreatment".

**Conclusion:** Although utility of a stent expands the endovascular indication for the retreatment of recurrent aneurysms, we should not miss the easy cases for clipping. Strategy for the recurrent aneurysms requires proper choice of retreatment using both endovascular and surgical techniques.

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**Flow diverter treatment of intracranial aneurysms and dissections during the acute phase after SAH**

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**Purpose:** The flow diverter (FD) treatment of unruptured intracranial aneurysms and dissections is established clinical routine. This is not the case during the acute phase after subarachnoid hemorrhage (SAH). We evaluated our experience with the FD treatment of intracranial aneurysms and dissections within 30 days after SAH. The analysis was focused on the ability of FD to prevent recurrent hemorrhage and on potential safety issues, mainly related to dual platelet function inhibition (DPFI).

**Material and Methods:** FD was considered in patients with SAH after failed surgery or if surgery or other endovascular options were considered not feasible. Between 9/2010 and 12/2016 a total of 31 patients (15 women, median age 48 years) were treated with FD within 30 days of SAH (median 2 days after SAH). This included 11 (35%) sacular and 4 (13%) fusiform aneurysms and 16 (52%) intradural dissections. The implanted FD were p64 in 24 (77%) and PED in 7 (23%). All patients received DPFI.

**Results:** Procedural complications occurred in 2 (6%) patients (1 hemorrhagic, 1 ischemic) and both caused death. Postprocedural complications, both unrelated to the endovascular treatment occurred in another 2 (6%) patients and were fatal as well (1 pulmonary embolism, 1 death due to the primary hemorrhage. Recurrent SAH was encountered in no patient. A second treatment was required in 5 patients. Final follow-up DSA in 20 out of 27 eligible (74%) patients showed (near)complete occlusion of the target lesion in all patients.

**Conclusion:** In selected patients with SAH due to ruptured intracranial aneurysms or intradural dissections, FD using p64 or PED is a viable option.

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**Flow Diverter Stent Therapy in Acute Ruptured Cerebral Aneurysms**

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**Purpose:** The use of flow diverters for the endovascular treatment of acute ruptured cerebral aneurysms is usually avoided due to the requirement for dual antiplatelet therapy and concerns for rebleeding / hemorrhage. In some cases, such as rupture of small/blister-like or dissecting aneurysms, in which surgery or routine endovascular coiling have relative high morbidity and mortality rates, the use of flow diverters should be considered as a therapeutic alternative, with the need for an adaptation of the double antiplatelet protocol.

**Material and Methods:** We performed a retrospective review of 130 patients with cerebral aneurysm, treated with flow diverters, between 2008 and 2016. From these, eleven had acute ruptures – nine treated in the first 72 hours and two in the first 6 days. There were seven women and four men, between 34 and 67 years old. Regarding the aneurysm location: 3 were from the anterior circulation (2 P Com and 1 hypophyseal), all smaller than 3 mm or blister-like; 8 from the posterior circulation 8 (2 dissecting in the P2 segment, 1 blister-like in the basilar apex, 3 in the PICA and 2 dissecting in the V4 segment). All the patients initiated a double-antiplatelet protocol – 300 mg clopidogrel and 1000 mg aspirin, 6 hours before the procedure.

**Results:** In all cases the stent was correctly placed in the arterial segment involved by the aneurysm. The angiographic study confirmed the patency of the parent artery and the complete exclusion of the aneurysms in 9 patients. Two patients are waiting for follow up. There was an istent thrombosis in one P2 dissecting aneurysm, with an associated visual field defect. There was no rebleeding or hemorrhagic complications immediately before, during or after stenting, in this series.

**Conclusion:** These results suggest that the use of flow diverters in acute ruptured aneurysms, despite the need for double antiplatelet therapy, may be considered as an alternative therapeutic option, particularly in cases of small/blister-like or dissecting aneurysms due to surgical complexity and the risks of conventional coiling.

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**Double-layer stent for treatment of dissecting carotid artery aneurysm**

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**Purpose:** The use of flow diverters for the endovascular treatment of dissecting carotid artery aneurysm is usually avoided due to the requirement for dual antiplatelet therapy and concerns for rebleeding / hemorrhage. In some cases, such as rupture of small/blister-like or dissecting aneurysms, in which surgery or routine endovascular coiling have relative high morbidity and mortality rates, the use of flow diverters should be considered as a therapeutic alternative, with the need for an adaptation of the double antiplatelet protocol.

**Material and Methods:** We performed a retrospective review of 130 patients with cerebral aneurysm, treated with flow diverters, between 2008 and 2016. From these, eleven had acute ruptures – nine treated in the first 72 hours and two in the first 6 days. There were seven women and four men, between 34 and 67 years old. Regarding the aneurysm location: 3 were from the anterior circulation (2 P Com and 1 hypophyseal), all smaller than 3 mm or blister-like; 8 from the posterior circulation 8 (2 dissecting in the P2 segment, 1 blister-like in the basilar apex, 3 in the PICA and 2 dissecting in the V4 segment). All the patients initiated a double-antiplatelet protocol – 300 mg clopidogrel and 1000 mg aspirin, 6 hours before the procedure.

**Results:** In all cases the stent was correctly placed in the arterial segment involved by the aneurysm. The angiographic study confirmed the patency of the parent artery and the complete exclusion of the aneurysms in 9 patients. Two patients are waiting for follow up. There was an istent thrombosis in one P2 dissecting aneurysm, with an associated visual field defect. There was no rebleeding or hemorrhagic complications immediately before, during or after stenting, in this series.

**Conclusion:** These results suggest that the use of flow diverters in acute ruptured aneurysms, despite the need for double antiplatelet therapy, may be considered as an alternative therapeutic option, particularly in cases of small/blister-like or dissecting aneurysms due to surgical complexity and the risks of conventional coiling.
Purpose: To report the increased efficacy of double-layer stent to treat three patients with extracranial internal carotid artery (ICA) dissecting aneurysms. Summary of cases:

Case 1: A 40 year-old woman presented with right-sided hemiparesia owing to a cortical infarct on motor area documented by a magnetic resonance image. Digital subtraction angiography (DSA) disclosed an extracranial dissection of the left ICA with two pseudoaneurysms. One double-layer stent (Casper®, MicroVention, Tustin, CA, USA) was placed bridging the dissected segment and overlapping at the level of the aneurysm neck. Immediate arteriography showed remarkably reduced filling of the pseudoaneurysms. An arteriogram performed 6 months after stenting documented the disappearance of the pseudoaneurysm without intimal hyperplasia of the vessel wall.

Case 2: A 25 year-old man experienced severe politrauma after a motor vehicle crash. He presented with severe traumatic brain injury, which was treated by conservative management. Computed tomography showed blunt cartotid artery injury. DSA disclosed an extracranial dissection of the left ICA with progressive growing pseudoaneurysm. The Casper® stent was placed 30 days after trauma. Arteriography showed acute reduced filling of the pseudoaneurysm. An angio-CT performed 3 months after stenting documented remodeling of the artery and disappearance of the lesion.

Case 3: A 60 year-old woman with a history of extracranial ICA pseudoaneurysm treated two years ago by overlapping stents (two self-expanding open cell design stents). Patient presented increased pulsatile mass with dysphonia. DSA showed residual filling of the pseudoaneurysm. The Casper® stent were placed overlapping the devices. Immediate arteriography showed reduced filling of the pseudoaneurysm. Dysphonia showed improvement 3 months later. An ultrasonography performed 3 months after stenting documented reduced filling of the pseudoaneurysm.

Conclusion: The double layer stent, initially designed to prevent plaque prolapse for stent-assisted atherosclerotic carotid angioplasty, showed significance efficacy as sole device technique for pseudoaneurysms treatment.


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Significance of posthemorrhagic cerebral vasospasm on clinical outcome in 178 cases from a single center

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Purpose: cerebral vasospasm following rupture of an intracranial aneurysm is a poorly understood condition and negatively affects the clinical outcome. We sought to assess the frequency and the significance of this condition among patients treated at our center over the last decade.

Materials and Methods: we retrospectively reviewed all cases admitted with aneurysmal subarachnoid hemorrhage to our institution over the last decade and identified the patient who developed post-hemorrhage cerebral vasospasm. Notes were made of the administered treatment modalities and the frequency of delayed cerebral ischemia (DCI).

Results: our review identified a total of 178 patients with diffuse cerebral vasospasm affecting multiple vessels and verified by transcranial doppler (TCD) and/or cerebral angiography. Beside the routine administration of intravenous nimodipine and mild elevation of blood pressure, invasive procedures were performed in 121 (68%) cases including stellate ganglion block, endovascular spasmolysis or both in 23 (12.9%), 56 (31.5%) and 42 (23.6%) cases, respectively. DCI was documented in 35 (19.7%) cases, of whom 22 (62.8%) were already under max. endovascular therapy. Poor clinical outcome defined as death or severe disability was observed in 128 (71.9%) of patients with diffuse vasospasm and in 34 (97.1%) of the subgroup with documented DCI.

Conclusion: post-hemorrhagic cerebral vasospasm is a serious complication resulting in high mortalities and morbidities. Management remains challenging and requires early detection and aggressive - endovascular- treatment.

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Stent-plasty for Cerebral Vasospasm: A single center experience

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Purpose: We recently use our use of stent retrievers for vasodilation in cerebral vasospasm. We now present our first single-center series using this technique to determine outcomes at an angiographic segmental level and to confirm the durability of this technique.

Materials and Methods: We created a prospective registry of all SAH with diagnosis of vasospasm in whom neuro-interventional procedures were required to treat symptomatic cerebral vasospasm between January 2002 and October 2016. Cases were analyzed for therapy at pre-defined segments including vertebral, basilar, posterior cerebral (P1 and P2), suprachiasmatic internal carotid, middle cerebral (M1 and M2), and anterior cerebral arteries (A1 and A2). We compared the active treatment to control (standard medical care including PTA). Each patient could included in both the active as well as control arms if they had multiple procedures and treatment modalities were adjudicated twice if infusion occurred concurrent to stent-plasty. Control ICA infusions were considered treatment for all segments within a vascular tree; stent-plasty was considered treatment for all segments within which a device was unsheathed. The primary outcome measure was re-treatment, and occurred if a segment was previously treated with stent-plasty or conventional therapy and specifically targeted for repeat treatment due to severe vasospasm.

Results: Six patients underwent stent-plasty at some point during their course, while ten required some form of conventional neuro-interventional procedure only. There were no differences in regards to demographics, aneurysm or SAH characteristics, or modality of treatment. Active treatment consisted of 9 sessions treating 28 segments, whereas conventional therapy occurred over 28 sessions treating 301 segments. The primary outcome occurred in 1/28 segments treated with stent-plasty compared to 67/301 treated with conventional means (3.6% vs. 22.2%; OR 7.7 [1.0–57.9], p = 0.02). There was one death in the active arm and three in the control arm. One vessel thrombosis occurred in the active arm while one embolism occurred in the control arm; the former was resolved with abciximab infusion and neither resulted in neurological deficit.

Conclusions: Stent retrievers can provide safe, long-lasting cerebral vasodilation in patients with delayed cerebral vasospasm.

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500 mm$^3$ is the critical aneurysm volume determining stability after coil embolization

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Purpose: Recurrence is one of the concerns even after successful endovascular treatment of intracranial aneurysms. We sought to determine the critical aneurysm volume related to aneurysmal stability in patients undergoing coil embolization of intracranial aneurysms.

Materials & Methods: Among those treated during the period between January 2002 and October 2016, aneurysm volume and follow-up imaging data were available in 3490 cases. We analyzed the anatomical outcome in relation to the aneurysm volume and determined the critical aneurysmal volume favoring coil embolization. We also analyzed factors determining angiographic outcome among cases of aneurysmal volume more than 500 mm$^3$.

Results: Recanalization rates were 2%, 5%, 18%, and 67% in each group of aneurysmal volume less than 10 mm$^3$, 10 to 100 mm$^3$, 100 to 1000 mm$^3$, and more than 1000 mm$^3$, respectively. When we looked into the 100 to 1000 mm$^3$ group, the recanalization rate increased remarkably at 500 mm$^3$ (15% vs. 57%, p < 0.0001; odds ratio (OR), 6.883 [95% confidence interval (CI), 8.328 to 19.076]). Among those bigger than 500 mm$^3$, the location (anterior circulation vs. posterior circulation) was a significant prognostic factor (p = 0.0188; OR 4.737 [95% CI, 1.274 to 17.608]).

Conclusion: In our series of cerebral aneurysms treated with coil embolization, 500 mm$^3$ was the critical aneurysmal volume determining stability after coil embolization.

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Predictive factors of medullary infarction associated with endovascular parent artery occlusion for vertebral artery dissecting aneurysms

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Purpose: Endovascular internal trapping (EIT) of the dissecting segment using coils for vertebral artery dissecting aneurysms (VADAs) is the first line of treatment. However, this procedure carries the risk of medullary infarction, and little has been reported the risk factors of this complication. The purpose of this study is to investigate the risk factors causing medullary infarction.

Materials and Methods: We retrospectively reviewed the records of 100 patients who underwent EIT for VADAs. 93 patients presented with subarachnoid hemorrhage. In cases involving the posterior inferior cerebellar artery (PICA), partial internal trapping targeting the ruptured site was performed to preserve the PICA. The VADAs were classified into the distal VA stump group, proximal VA stump group, and entire VA stump group according to the location of VA segments without adequate flow out vessels such as the PICA (VA stump) at risk of delayed thrombosis. The occurrence of medullary infarction was investigated in each group using diffusion-weighted magnetic resonance imaging and/or
clinical symptoms. The findings of digital subtraction angiography were analyzed from various measurements and the risk factors for medullary infarction were examined.

Results: Medullary infarction occurred in 30 cases, 27 cases were posterolateral medulla, and 3 cases were anteromedial medulla. Medullary infarction occurred in 3 of 47 patients (6%) in the distal VA stump group, 10 of 19 patients (53%) in the proximal VA stump group, and 17 of 34 patients (50%) in the entire VA stump group. The length of trapping was significantly longer in the infarction group than in the non-infarction group, but there was no difference between the three groups. Total length (length of trapping plus VA stump) was a risk factor of medullary infarction in the proximal VA stumps.

Conclusions: The primary risk factor for medullary infarction after EIT is not the length of trapping but the anatomical location of the VADAs. In cases with distal VA stumps, the risk of medullary infarction is low, but once it occurs the symptoms are severe. The risk of medullary infarction is high in cases with proximal VA stumps, but the symptoms are relatively mild. Shorter length of trapping, although better, cannot prevent medullary infarction because the total length of VA occlusion depends on the anatomical location of the PICA and not on the surgical technique.

Thursday, 19th of October – Session room 4. – 08:30 – 10:00 – Parallel abstract session – Aneurysm clinical: Flow diversion 3

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Endovascular Reconstruction of Intracranial Large / Giant Wide-Neck Aneurysms: Surpass Flow Diverter Early Experience

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Purpose: Flow diverters represent an important tool for treatment of cerebral aneurysms, particularly large and giant aneurysms. We assessed safety and efficacy of the Surpass Flow Diverter (Stryker Neurovascular) stent in a single center in Medellin- Colombia.

Materials and Methods: Between September 2016 and April 2017, a total of 12 patients with 14 intracranial aneurysms were treated with Surpass in our institution. We retrospectively collected and analyzed clinical and angiographical data of these patients. Procedural complications and short-time outcomes are presented.

Results: All aneurysms were unruptured. Twelve in anterior circulation (ICA :11,MCA:1) and two cases in vertebral – basilar junction. Mean aneurysms size was 10.8 mm. Technical success was achieved in all but one patient (was necessary a FRED device to extend the construct). For all cases an extra support distal access catheter was necessary. None case with additional coils use. DSA control immediately after implantation showed contrast stagnation in all cases. We did not observe any procedural complications, except in one case (Giant, fusiform aneurysm) where the Surpass length wasn’t enough and a second FD was telescoping proximally. Radiological FU was available in 8 aneurysms. Complete total occlusion observed in 7/8. (87.5%) A little remnant in one case with early follow-up (<3 months). A remarkable vascular healing line was observed in all cases during FU and recorded as neointimal hyperplasia with mild and moderate in-stent stenosis entirely asymptomatic. None delayed complications observed.

Conclusion: Surpass FD stent appear to be safe and effective as other flow diverters in the treatment of complex, wide-neck intracranial aneurysms. However the system exhibit tracking and navigability difficulties that can constraint its widespread use.

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Surpass Flow diverter: the Greek experience from a single-center study in 25 consecutive patients

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Purpose: We present our angiographic and clinical outcome of 25 consecutive patients with brain vascular lesions we have treated in one year with the use of the Surpass Flow Diverter exclusively.

Material and Methods: Between January and December 2016, we have treated 25 patients with 27 brain vascular lesions. This series include 20 females and 5 males patients with ages between 40 to 72 years (mean age 50), who presented with 26 aneurysms (2 in the posterior fossa, 2 in middle cerebral artery, 22 in cavernous and supraclinoid internal carotid artery) and 1 post-traumatic high-flow Carotid-Cavernous Fistula.

Results: All patients had a close clinical follow-up in 1, 3 and 6 months time and an angiographic re-evaluation in 6 months. All treated aneurysms as well as the Carotid-Cavernous Fistula have been found totally occluded during this follow-up. No mortality has been noticed in this series without significant morbidity except in 1 patient in which post-procedural intracranial hematoma has been noted and treated by urgent craniotomy with good recovery.

Conclusion: Surpass Flow Diverter is a reliable, safe and effective method in endovascular treatment of well selected vascular brain pathologies.
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Surpass flow diverter in the treatment of acutely ruptured aneurysms – Indian multicenter experience

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Purpose: Use of Surpass FDS (Stryker Neurovascular, Fremont, CA, USA) in the treatment of acutely ruptured aneurysm has not been well studied and reported in literature. We retrospectively evaluated the data on the safety and efficacy of Surpass flow diverter (FD) in the treatment of acutely ruptured aneurysm from four participating Indian centers.

Material and Methods: We retrospectively reviewed 12 patients with SAH who were treated by Surpass FD placement at four centers between June 2016 and April 2017. Detail analysis of medical records were done to obtain patient age, gender, clinical history, Hunt-Hess grade, Fischer grade, results of radiographic and procedural details including technical success and complication, clinical outcome and follow up angiographic results. Informed consent was taken in all the patients. All the patients received 150 mg aspirin and 50 mg prasugrel 2 hours before the procedure. None of our patients require pre or post procedure external ventricular drain placement or VP shunt placement.

Results: Our search identified 12 patients (6 women and 6 men) with ages varied from 35–74 years with a mean age of 52years. All patient had subarachnoid hemorrhage evident on plain CT scan. 9 patients (75%) presented with Hunt and Hess (HH) grade 1 and 3 patients presented with HH grade 2 (25%). Fisher grade was 3 in eleven (91.6%) patients and 2 in one (8.3%) patient. The mean duration between subarachnoid hemorrhage and endovascular procedure was 6.25 days (3–20days).

Ten aneurysms were in the anterior circulation (para-ophthalmic 5, paraclinoidal 2, communicating segment 2, and ICA bifurcation 1) and two in the posterior circulation (SCA 1, VA 1). Overall, Six patients had saccular aneurysm, four had blister aneurysm, one had fusiform and one had fusissacular aneurysm. Aneurysm size ranged from 0.7–7.8 mm with a median of 2.5 mm. Only one Surpass FD was used in each patient with size ranging from 3×25mm to 4×30mm. The size of the FD was based on the vessel size proximally and distally. One patient with fusissacular aneurysm required coiling of the aneurysm and flow diverter placement at the same sitting. Only one patient had intra-procedural thromboembolic complication which was resolved by increasing the ACT levels. Two patient developed transient neurological deficit due to vasospasm which recovered completely on 3 month clinical follow up. Ten (83.3%) patients had follow up angiogram done with in a period of 6 months. Two patients had clinical follow up post procedure. Angiographic follow up results were assessed by O’Kelly-Marotta grading scale. Grade D (no filling) was noted in nine (75%) patients and Grade C2 in 1 patient on 3–6months follow up angiogram.

Conclusion: Single Surpass FD can be safely and effectively utilized for the treatment of ruptured intracranial aneurysm which are difficult to treat by conventional clipping and coiling, however larger and comparative studies are needed to confirm our findings.

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Use of Surpass device together with AXS Catalyst 5 distal access catheter

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Purpose: To present the preliminary angiographic and clinical results of combined utilization of AXS Catalyst 5 (Cat5) distal access catheter and Surpass flow diverter for the endovascular treatment of intracranial aneurysms.

Materials and Methods: Interventional neuroradiology case records were evaluated retrospectively to identify patients who were treated with Surpass flow diverter in combination with Cat5 catheter. Demographic data, technical success, aneurysm occlusion rate, procedure-related morbidity and mortality were noted.

Results: The analysis yielded 21 patients with 22 aneurysms with a mean age of 52.8 years (range 16 to 84). 19 aneurysms were located in the anterior and 3 aneurysms in the posterior circulation respectively. The mean aneurysm diameter was 14.6 mm (range 4 to 32). All treatments except one were performed electively. In one patient, it was not possible to bypass the aneurysm using any large microcatheter (inner diameter >0.0165 inches) so flow diversion was aborted. Of the remaining 21 aneurysms, 19 could be treated with the Surpass device whereas in 2 cases navigation of the device was not successful yielding a technical success rate of 90.4 %. At a mean follow-up period of 4.5 months 80.0 % of aneurysms were totally occluded. The patient treated emergently for an iatrogenic carotid pseudoaneurysm died secondary to consequences of her primary disease. Otherwise there was no procedure-related permanent morbidity and mortality.

Conclusion: Cat5 catheter was specifically designed for use with Surpass device. In this series, combination of Cat5 distal access catheter and Surpass flow diverter was safe and effective for the endovascular treatment of intracranial aneurysms.
Safety and Efficacy of the Pipeline Embolization Device for Treatment of Posterior Circulation Intracranial Aneurysms

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Purpose: To examine clinical and angiographic outcomes in a cohort of consecutive patients with posterior circulation intracranial aneurysms treated with the Pipeline Embolization Device (PED) at a referral center.

Methods: We conducted a retrospective review of all patients with posterior circulation intracranial aneurysms treated with the PED at a referral center between January 23rd, 2012 and January 24th, 2017. Baseline patient and aneurysm characteristics, intra-operative, peri-operative and delayed complications were recorded. Aneurysm volumes in initial and follow-up angiographic studies were calculated using AngioCalc. Clinical outcomes were categorized using the modified Rankin Scale (mRS).

Results: 17 patients underwent 18 PED procedures to treat 19 posterior circulation intracranial aneurysms during the study period. 12 patients were women (71%) and 5 men (29%). Mean age was 60 years (range 13–80 years). 16 patients were premedicated with aspirin/clopidogrel with VerifyNow testing (94%), and 1 with aspirin/ticagrelor without VerifyNow testing (6%). 8 aneurysms were incidental (42%), 5 symptomatic (26%), 2 from mass effect, 4 recurrent (21%) and 3 ruptured (16%). 6 aneurysms were fusiform (32%), 3 dissecting (16%) and 2 blister (11%). 7 aneurysms were located in the basilar trunk (37%), 4 in the posterior inferior cerebellar artery (21%), 2 in the superior cerebellar artery (10.5%), 2 in the posterior cerebral artery (10.5%), 2 in the vertebral artery (10.5%), 1 in the basilar tip (5%) and 1 in a basilar perforator artery (5%). Mean aneurysm size was 8.8 mm (1.7–34 mm), mean neck was 6.7 mm (0.6–32.6 mm), mean dome-to-neck ratio was 1.3 (0.2–2.9). 12 aneurysms were wide-neck (≥4 mm, 63%). Mean number of PEDs deployed per aneurysm was 1.3. Adjunctive coiling was performed in 4 aneurysms (21%). There were 2 intra-operative (11%), 3 peri-operative (17%) and 1 delayed (5.6%) complications, none leading to a disabling neurological deficit (mRS ≥3). There was no treatment-related mortality. There were no post-operative aneurysm ruptures. Overall mortality was 5.9%. Angiographic follow-up was available in 15 aneurysms (79%, 3 follow-ups currently pending), with a mean time to last angiographic follow-up of 19 months. At last follow-up, 11 aneurysms were completely occluded (73%), 3 aneurysms had incomplete occlusion (20%, mean 59.2% volume reduction), and 1 aneurysm had volume increase (7%, 166% increase). The enlarging aneurysm was re-treated with parent artery sacrifice (7%).

Conclusion: The PED is a safe and effective treatment for wide-neck posterior circulation intracranial aneurysms, with high long-term complete aneurysm occlusion rates, low retreatment rates, and a low rate of major treatment-related complications.

Endovascular treatment of large, giant and fusiform aneurysms of posterior circulation with PED

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Purpose: To estimate efficiency of use of Pipeline Embolization Deive (PED) in treatment of large, giant and fusiform aneurysms of the posterior circulation.

Materials and Methods: During the period from 2010 to 2014 in N.N. Burdenko Neurosurgery Institute 22 patients with aneurysms of posterior circulation were operated on PED. Average age of patients was 48 y. There were 7 giant, 6 large and 9 fusiform aneurysms revealed. Aneurysms localization: proximal segment of basilar artery (BA) – 8, BA trunk – 7, BA tip – 5, PCA – 2. Clinical symptoms were found a pseudo-tumorous current in 10 cases, ischemic stroke – in 4 cases, 8 pts were asymptomatic.

Results: In all cases successful implantation of stents with preservation of parent vessel was reached. In total 34 stents were implanted. It has been used from 1 to 5 stents on the patient that has averaged 1.5 stents on an aneurysm. Correct positioning and stent disclosing was the most frequent technical difficulty. The shorting of a stent and dislocation of its proximal extremity in an aneurysm demanded application of telescopic technics for deployment of an additional stent for 6 patients. In cases of fusiform aneurysms, in 3 cases use of several stents was planned initially.

Clinical complications were observed in 3 cases (13.6%). It was ischemic disturbances (1) or increase of brainstem compression (2). Four patients (18.2%) died. Reasons of a lethal outcome was intracranial hemorrhage (ICH) due to perforation of small branch of BA – 1 and delayed aneurysm rupture – 1; ischemic stroke – 2 due to acute thrombosis of a stent.

The long-term results are tracked at 72% of patients in terms from 4 to 12 months. Total occlusion of aneurysm is reached in 54.5%, subtotal occlusion – in 18.2%, partial occlusion – in 27.3%. In 54 % cases improvement or recovery was observed; in 30.8% cases clinical situation remained stable. TIA were observed in 15.4%.

Conclusion: PED usage is an effective option in treatment of large, giant and fusiform aneurysm of posterior circulation.
However, treatment of patients of this difficult group it is closely related with high risk of morbidity and mortality in comparison with patients with aneurysms of other localizations.

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Safety and Efficacy of the Pipeline Embolization Device for Treatment of Ruptured Intracranial Aneurysms

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Purpose: To examine clinical and angiographic outcomes in a cohort of consecutive patients with ruptured intracranial aneurysms treated with the Pipeline Embolization Device (PED) at a referral center.

Methods: We conducted a retrospective review of all patients with ruptured intracranial aneurysms treated with the PED at a referral center between January 20th, 2012 and March 9th, 2017. Baseline patient and aneurysm characteristics as well as complications were recorded. Aneurysm volumes in initial and follow-up angiographic studies were calculated using AngioCalc. Clinical outcomes were categorized using the modified Rankin Scale (mRS).

Results: 16 patients underwent 17 PED procedures to treat 18 ruptured intracranial aneurysms during the study period. 11 patients were women (69%) and 5 men (31%). Mean age was 53 years (range 13–92 years). Mean admission Hunt-Hess scale was 2.4 (median 2, range 1–5). 13 patients were premedicated with aspirin/clopidogrel with VerifyNow testing (81%), 1 with warfarin/clopidogrel with VerifyNow testing (6%) and 2 with aspirin/ticagrelor without VerifyNow testing (13%). 9 aneurysms were blister (50%), 5 saccular (28%), 3 dissecting (17%) and 1 fusiform (6%). 11 aneurysms were located in the internal carotid artery (61%), 3 in the basilar artery (17%), 2 in the middle cerebral artery (11%) and 2 in the anterior cerebral artery (11%). Mean aneurysm size was 3.3 mm (1.5–10.8 mm), mean neck was 2.8 mm (0.6–8.3 mm), mean dome-to-neck ratio was 1.1 (0.7–2.8). Mean number of PEDs deployed per aneurysm was 1.1. There were 1 intra-operative (6%) and 2 peri-operative (12%) complications, none leading to a disabling neurological deficit (mRS ≥ 3). There were 2 post-operative aneurysm re-ruptures (11%), 1 occurring on post-operative day 1 without clinical sequelae, and 1 occurring on post-operative day 14 upon EVD removal leading to the patient’s death. Both aneurysms with post-operative re-rupture were dissecting anterior cerebral artery aneurysms treated acutely without adjunctive coiling. Treatment-related mortality was 6.3%, and overall mortality was 12.5%. Angiographic follow-up was available in 8 aneurysms (44%; 6 follow-ups currently pending), with a mean time to last angiographic follow-up of 12.6 months. At last follow-up, 7 aneurysms were completely occluded (88%) and 1 aneurysm had near-complete occlusion (12%, 92.9% volume reduction). The nearly-completely-occluded aneurysm was re-treated with placement of an additional PED. At last clinical follow-up, 11 patients had mRS 0–2 (68.8%), 3 had mRS 3 (18.8%) and 2 had expired (12.5%).

Conclusion: The PED is a safe and effective treatment for ruptured intracranial aneurysms, with high long-term complete aneurysm occlusion rates, low re-treatment rates, and a low rate of major treatment-related complications. The risk of post-operative aneurysm re-rupture may be minimized by adjunctive use of coils and subacute PED embolization whenever possible.

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Yes, we can: Results of a Large Series of Intracranial Aneurysms Treated with Pipeline Flow Diverter Stent in a Developing Country

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Purpose: To report our vast experience with PED during last 8 years for the endovascular treatment (EVT) of intracranial aneurysms.

Materials and Methods: Between September 2009 and March 2017, a total of 396 patients with 441 aneurysms were treated with PED. Patients demographic data, aneurysm features, technical issues, immediate findings, delayed complications, and clinical and angiographic follow-up were assessed.

Results: Early, (n = 294) aneurysms were treated using PED first generation and Pipeline classic, since 2014 (n = 147) aneurysms has been treated with PED flex. 81% of the aneurysms were located in anterior circulation. Most lesions treated were small aneurysms (55%) of these 31 (12.8%) were blood blister-like aneurysms. 44.4% classified as large/giant wide-neck aneurysms. History of bleeding (SAH) in 62/441. Technical success varied between two groups as consequence of delivery system failures evidenced with PED 1st generation and classic. (270/294, 91%) vs. PED flex (141/147, 95%). A mean of 1.06 device /aneurysm were implanted. PED alone strategy used in 358/441 (81%). Radiological follow-up available in 184/441 aneurysms (41%) median follow-up at 1.25 years (range 0.25–5.5 years). The overall complete or near-complete occlusion rate was achieved in 159/184 (86%), without evidence of recanalization. Most patients were independent (mRS < 2 = 66%) with the most favorable outcomes.
observed in aneurysms with mass effect. Acute and sub-acute intra stent thrombosis was observed in 22 cases, major stroke in 14, intracerebral hemorrhage in eight, nerve palsy and symptoms worsening in five, immediately after procedural hemorrhage evidenced in two, and delayed hemorrhage in four. The overall mortality rate was 4.5%.

**Conclusion:** Despite socio-economical Latin American conditions, we can treat a large number of intracranial wide-neck, fusiform, dissecting and complex lesions with low diverter technology. In our series, PED treatment was safe and effective. Angiographic results showed a high percentage of complete aneurysm occlusion with acceptable morb-mortality rates. A local Cost-effectiveness analysis studies would be required to support the PED use in a developing regions.

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**Safety and Efficacy of the Pipeline Embolization Device for Treatment of Recurrent Intracranial Aneurysms**

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**Purpose:** To examine clinical and angiographic outcomes in a cohort of consecutive patients with recurrent intracranial aneurysms treated with the Pipeline Embolization Device (PED) at a referral center.

**Methods:** We conducted a retrospective review of all patients with recurrent intracranial aneurysms treated with the PED in our center between December 13th, 2011 and March 29th, 2017. Baseline patient and aneurysm characteristics, intra-operative, peri-operative and delayed complications were recorded. Aneurysm volumes in initial and follow-up angiographic studies were calculated using AngioCalc. Clinical outcomes were categorized using the modified Rankin Scale (mRS).

**Results:** 50 patients underwent 53 PED procedures to treat 55 recurrent intracranial aneurysms during the study period. 36 patients were women (72%) and 14 men (28%). Mean age was 58 years (range 29–77 years). 46 aneurysms were recurrent after simple coiling (82%), 5 after PED embolization (9%), 1 after PED/coiling), 3 after stent-assisted coiling (5%), 1 after Onyx HD500 embolization (2%) and 1 after surgical clipping (2%). 4 aneurysms were symptomatic from mass effect (7%) and 1 was acutely ruptured (2%). 3 aneurysms were fusiform (5%) and 1 blister (2%). 39 aneurysms were located in the internal carotid artery (70%), 8 in the middle cerebral artery (14%), 5 in the anterior cerebral artery (9%), 3 in the posterior inferior cerebellar artery (5%) and 1 in the basilar tip (2%). 30 aneurysms had a vessel arising from the aneurysm dome/neck (54%), 14 of which were the posterior communicating artery (47%). Mean aneurysm size was 6.2 mm (1.5–26.2 mm), mean neck was 3.9 mm (0.5–9.3 mm), mean dome-to-neck ratio was 1.6 (0.6–11.5). 24 aneurysms were wide-neck (≥4 mm, 43%). Mean number of PEDs deployed per aneurysm was 0.9. There were 4 intra-operative (7.5%), 15 peri-operative (28%) and 3 delayed (5.7%) complications. 1 peri-operative complication, an ipsilateral intracerebral hemorrhage on post-operative day 4 in a patient with P2Y12 receptor over-inhibition at the time of the hemorrhage, resulted in the patient’s death (1.9%). No other treatment-related complication led to a disabling neurological deficit or death (mRS ≥ 3). Treatment-related mortality was 2%. There were no post-operative aneurysm ruptures. Angiographic follow-up was available in 47 aneurysms (86%, 8 follow-ups currently pending), with a mean time to last angiographic follow-up of 20 months. At last follow-up, 36 aneurysms were completely occluded (77%), 2 aneurysms had near-completed occlusion (4%, mean 97.3% volume reduction), and 9 aneurysms had incomplete occlusion (19%, mean 68.7% volume reduction). No aneurysms required retreatment.

**Conclusion:** The PED is a safe and effective treatment for recurrent intracranial aneurysms, with high long-term complete aneurysm occlusion rates, low re-treatment rates, and a low rate of major treatment-related complications.

**ELECTRONIC POSTERS**

**ANEURYSM - CLINICAL**

**P400**

Endovascular treatment of intracranial aneurysms in acute stage of SAH. A single centre experience

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**Purpose:** In Russia, intracranial aneurysms in acute stage of SAH are still a subject of clipping. The biggest neurointerventional centres are focused mostly on elective cases, although emergency system do not have an option of coiling in most of primary centres. Here we present our own experience of endovascular aneurysm treatment in acute stage of SAH as a result of cooperation with primary neurosurgical departments.

**Materials and methods:** 28 patients were included, aged 31–79, mostly males (21 m/7f) and mostly anterior circulation (25/3). The aneurysms located at Acomm in 13 cases, MCA in 7cases, ICA in 5 cases, VA in 2 cases and PICA - in 1 case. The Hunt/Hess score spread as followed: I - in one
case, II - in 9 cases, III in 5 cases, IV in 7 cases, V in 6 cases. Only 12 of 28 patients were hospitalized within 48 hours after SAH, the rest were admitted to our hospital within 14 days. 23 of 28 patients were operated at the day of admission. 3 of 5 patients who were delayed from the intervention experienced recurrent SAH inside the hospital. Coiling was performed in all out of 28 cases, including one with balloon and one with stent assistance. The outcome at discharge was recognized as favourable if patient was independent and unfavourable, if patient was dependent on care or worse.

Results: Raymond I occlusion was achieved in 75% of cases, Raymond II - in 21,4 and in one case 3,6% there was Raymond III type occlusion. One technical complication (3,6%) occurred in an MCA aneurysm, when one of M2 branches was occluded with the aneurysm. We evaluated the outcomes in relation to initial Hunt/Hess score. Mortality rate was 14%, or four patients, all with Hunt Hess V initial score. No patients in H/H V group had favourable result. There were no mortality among Hunt/Hess I-IV score patients. There were no unfavourable outcomes among Hunt/Hess I-III patients. Outcomes in Hunt/Hess IV group split as four favourable and three unfavourable ones.

Conclusion: In our study endovascular treatment for intracranial aneurysms is safe and effective for the patients with Hunt/Hess score I-IV, with low complication rate, high occlusion rate and no mortality for this group of patients.

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Follow up after treatment of unruptured large and giant fusiform aneurysms with the pipeline embolization device

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Purpose: Numerous reports of treatment of intracranial aneurysms by flow diverters have been published; however, in large and giant fusiform aneurysms (more than 15 mm), follow up result remain uncertain. We reports the follow up results of unruptured fusiform aneurysm (more than 15 mm) treated with the Pipeline Embolization Device (PED).

Materials and Methods: Eleven aneurysms from single center admitted between December 2014 and April 2017 were followed at 6-month, 1-year, and 2+-year post-treatment. Analyses on aneurysm character, sequential change of aneurysm size after PED, and morphology on aneurysm occlusion (the effects of incorporated vessels, previous stent placement) were performed.

Results: Three patients were female and eight were male. Four aneurysms were giant (>25 mm) and seven were large (15 –25 mm). Among 11 aneurysms, 6 cases treated with single PED and 5 cases treated with multiple PEDs. Immediately after the initial PED procedure, flow stasis was occurred in 5 cases (45%) and no flow stasis in 6 cases (55%). Follow-up image was performed in all patients with the longest follow-up duration of 27 months. In sequential change of aneurysm size after PED, 9 cases were decreased pattern gradually and 2 case were mixed pattern during follow up. The cases of mixed pattern change had incorporated vessel, anterior cerebral artery and superior cerebellar artery each other. Two aneurysms had a previous stent and demonstrated occlusion at 6 months follow up. Minor stroke, major stroke and mortality case (delayed rupture) were occurred in 1 case respectively.

Conclusions: In the large and giant fusiform aneurysm, PED seem to be an effective treatment tool with complications and longer angiographic follow up are needed to assess the morphologic outcome, especially the presence of an incorporated vessel.

P402
Flow Diverter: A Study on Safety and Efficacy in a Consecutive Group of 20 Patients and 26 aneurysms

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Background and Purpose: Endovascular flow diverters are increasingly used for the treatment of cerebral aneurysms. We assessed the safety and efficacy of the Flow Divers in a consecutive series of 20 patients and 26 aneurysms.

Materials and Methods: Inclusion criteria were wide-neck, blister-like, or fusiform aneurysms independent of size, treated with the FRED, PIPELINE and SILK between December 2014 and December 2016. Assessment criteria were aneurysm occlusion, manifest ischemic stroke, bleeding, or death. The occlusion rate was assessed at 6 months and 1 year with DSA by using the Raymond classification and the O’Kelly-Marotta grading scale.

Results: Twenty patients with 26 aneurysms were treated with 9 Silk, 5 FREDs and 12 Pipeline. Aneurysm size ranged from 3.0 to 21 mm. Deployment of the Flow diverters was successful in 18 cases. One patient developed mild stroke symptoms that fully receded within days and other occlusion total carotid because resistant antiaggregation. There have been no late-term complications so far and no treatment-related mortality. Initial follow-up at 6 months showed complete occlusion in 88.4% of the overall study group and 92.3% at 1 year.

Conclusions: The flow diverter is a safe device for the treatment of cerebral aneurysms of various types. Our data reveal high occlusion rates at 6 months and 1 year. Long-term occlusion rates are expected.
P403
A rare case of BBLA of the pericalosa artery in the FMD. Endovascular treatment with coiling with severe thromboembolic complication and stent retriever thrombectomy: A case report
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Purpose: Blood Blister-like aneurysms (BBLAs) were originally described typically along the non-branching segment of the dorsal wall of the internal carotid artery (ICA) and account for 0.3–1% of all intracranial aneurysms. A literature review in atypical locations reported 8.6% of BBLAs in atypical sites. The most frequent atypical site was the AcoA (2.7%), followed by the MCA (2.1%), the BA (1.5%), the PCA (1.2%) and the A2 tract and PICA (0.3%). We found only 1 case of BBLA in segment A2 of the anterior cerebral artery and endovascular approach with FD Stent. Some thromboembolic complications could have been expected, but these were not reported to have occurred in cases with endovascular approach. Summary of case: A 56 year-old female was admitted due a severe headache and GCS 14. CT Scan showed a SAH with interhemisferic Fisher I hemorrhage. The DAS and 3D DAS showed a 1.5 mm BBLA dilatation in a right, non-branching segment of pericalosa left artery and signs of type I fibromuscular dysplasia (FMD) in the extracranial internal carotids arteries (ICA). The procedure performed with heparin protocol and the approach of this lesion type was in the first line the hemostatic treatment with remodeling technique with Scepter C balloon (Microvention, Tustin, CA) and two (02) small hypersoft platinum coils and a total occlusion in the microcatheter control angiography. After remove the microcatheter and the final control was observed a total occlusion of the left ICA, ACA and MCA. We immediately used a Solitaire retrievable stent (Covidien, Irvine, CA), first in the left MCA, followed by the left ACA A1 and finally the ACA A2. The final angiographic control with recanalization in 100% and normal CT scan after 24 h. After three days the patient was discharged with dual antiplatelet regimen with GSC 15 and NIHSS 0. In a DSA control after three months, we observed recanalization of the aneurysm and a re-treatment was performed with a low-profile self-expandable stent Leo baby (Balt Extrusion, Montmorency, France) with full occlusion and long-term stability.
Conclusion: BBLAs in atypical sites are rare and difficult to diagnose in DSA without 3D since they are very small lesions. The diagnosis of FMD may be correlated with this type of lesion and with the increased risk of thromboembolic complications. Mechanical thrombectomy with a stent retriever is a safe and first line therapy in severe thromboembolic intraprocedural complications.

References:

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Is there still room for stent-assisted coiling? First experience with Neuroform AtlasTM stent with Y stent or parallel stent technique and early follow up
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Introduction: In the flow-diverter and bifurcation stent era there has been less and less interest about the stent-assisted coiling technique in saccular aneurysms treatment. The introduction of the newest Neuroform AtlasTM stent (Stryker, MI, USA) offers new perspectives to this technique due to the high conformability of the device in small and tortuous vessels, with accurate wall apposition and the advantage of a smaller dedicated microcatheter that can easily navigate in a complex anatomy and can also be used for reaccessing the sac through the stent struts for the subsequent coiling. We report about our first five cases treated with this device.
Methods: We retrospectively reviewed our database looking for patients treated in our Institution with the stent-assisted coiling technique with the new Neuroform Atlas TM stent (Stryker, MI, USA) that has been introduced in our center in September 2015. We considered the patient’s previous history and clinical condition, the aneurysms features and the clinical presentation and reviewed the technical issues and problems encountered during the treatment. We then reassessed the immediate and early postprocedural anatomical results basing on DSA, using the Raymond scale, and the neurological performance after the procedure, using the modified Rankin scale. We then followed the patients with 3 and 6 months CEMRA and a 6 months DSA then a yearly CEMRA.
Results: We have treated five aneurysms (4 anterior communicating artery and one basilar tip) in five different patients so far (2 males and 3 females, age ranging from 54 to 69). All of these patients had wide neck saccular aneurysms with complex anatomy, unsuitable for simple coiling. Four of them were unruptured at the moment of the diagnosis while there was a ruptured case treated in an emergency setting. In one case we used the stent as a rescue: during the treatment of an anterior communicating aneurysm scheduled for a primary coiling with the balloon-remodeling technique we faced a coil prolapse with high risk of vessel thrombosis and we deployed the Neuroform...
Materials and Methods:
The aneurysm ranges from 24% to 34%. Agenesis of ICA, in which the occurrence of aneurysm ranges from 24% to 34%. Cerebral aneurysm formation associated with following arch is very rare. Resulting in separation of the origin of the external carotid artery (ECA) and internal carotid artery (ICA) from the aortic arch. Collateral flow from the vertebral artery via posterior communicating artery (PcomA). There were also 2 aneurysms, which were located in the basilar top and the proximal part of Rt. A1 segment. Conventional angiography also revealed the 2 aneurysms and unvisualization of Lt CCA from the aortic arch. The embryonic explanation of this anomaly has been discussed by Lie. The CCA may be absent as a result of obliteration of the third aortic arch with persistence of the ductus caroticus. An alternative mechanism involves a failure of the ECA to migrate laterally and join the ICA (which arises from the third aortic arch) during development. However, in our case, the ECA or ICA originated from the aortic arch was not. The possible mechanism is that there was regression of the proximal part of the third aortic arch without persistence of the ductus caroticus and there was persistence of the primitive proatlantal artery (Type II). The increased aneurysm development associated with CCA agenesis results from hemodynamic stress such as agenesis of ICA, in which the occurrence of aneurysm ranges from 24% to 34%.

Conclusion: The new devices are a valuable tool since they are easily brought to the target vessel thanks to the smallest dedicated microcatheter and easily deployed as the open cell design offers stability and precision and the greatest radial force. The design of the stent itself allows an easy recatheterization of the sac after deployment but also offers great scaffold to avoid coils protrusion.

P405
Agenesis of Common Carotid Artery associated with a Recurred Basilar Top Aneurysm
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Background: Agenesis of the common carotid artery (CCA) resulting in separation of the origin of the external carotid artery (ECA) and internal carotid artery (ICA) from the aortic arch is very rare. Cerebral aneurysm formation associated with following hemodynamic stress of blood via collateral channel is possible such as agenesis of ICA, in which the occurrence of aneurysm ranges from 24% to 34%. Materials and Methods: A 57-year-old woman with an unremarkable medical history except hypertension presented with 2 days history of blurred vision. Her physical and neurological examinations were normal. On MRI with MRA, acute cerebral infarction (RT. thalamus, hippocampus and occipital lobe) and Lt. CCA agenesis with collateral circulation from posterior cerebral artery (PCA) via posterior communicating artery (PcomA). There were also 2 aneurysms, which were located in the basilar top and the proximal part of Rt. A1 segment. Conventional angiography also revealed the 2 aneurysms and unvisualization of Lt CCA from the aortic arch. Collateral flow from the vertebral artery via the Lt. proatlantal artery (type II) supplied Lt. ECA and ICA. The diameter of Lt. ICA was very small and rudimentary. Main blood supply to the Lt. middle cerebral artery territory was from Lt. PCA via PcomA.

Results: The basilar top aneurysm was treated with stent-assisted coiling and the Rt. A1 aneurysm was treated with simple coiling. F/U conventional angiography after 1 year revealed the recanalization of basilar top aneurysm. Further endovascular coiling for this aneurysm was done without any complication. Discussion: Congenital agenesis of CCA is extremely rare anomaly. The most common finding is separate origins of the ECA and ICA from the braciocephalic trunk or the aortic arch. The embryonic explanation of this anomaly has been discussed by Lie. The CCA may be absent as a result of obliteration of the third aortic arch with persistence of the ductus caroticus. An alternative mechanism involves a failure of the ECA to migrate laterally and join the ICA (which arises from the third aortic arch) during development. However, in our case, the ECA or ICA originated from the aortic arch was not. The possible mechanism is that there was regression of the proximal part of the third aortic arch without persistence of the ductus caroticus and there was persistence of the primitive proatlantal artery (Type II). The increased aneurysm development associated with CCA agenesis results from hemodynamic stress such as agenesis of ICA, in which the occurrence of aneurysm ranges from 24% to 34%.

Conclusion: CCA agenesis associated with aneurysms was reviewed with the view from possible embryologic events. Because hemodynamic stress is increased in such case, we think that long term regular F/U study should be necessary for the patients treated the aneurysms associated with CCA agenesis even though complete clipping or endovascular management was achieved.

P406
Trigeminal neuralgia (TN) caused by intracranial aneurysm treated with endovascular surgery
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TN is chronic pain disorder due to compression of the 5th nerve at root entry zone (REZ) by vascular loop, and good results have been achieved after microvascular decompression (MVD). However, any other structural lesions affecting 5th nerve pathway such as tumors, vascular abnormalities and cysts can occur TN. TN secondary to intracranial aneurysm is rare condition. The mechanism of TN due to intracranial aneurysm is high velocity pulsatile flow through the aneurysm cause nerve demyelination and emphatic transmission or ectopic impulse generation between adjacent denuded axons. Here, we described two cases of TN caused by intracranial aneurysm treated with endovascular surgery. A 62-year-old female with left side V3 dermatome TN and glossopharyngeal neuralgia visited our institution. Symptom duration was 4 years. She was suffered gamma knife radiosurgery 3 years ago in other institution. MR and MRA showed vertebrobasilar fusiform dissecting aneurysm with dolichoectasis was compressed V and IX nerve REZ. We tried MVD at V, IX nerve, but the patient symptom was not changed. To resolve consisting pulsatile flow impulse through the aneurysm, we decided endovascular treatment about vertebrobasilar dissecting aneurysm. Angiographic finding showed fusiform dilatation of verrobasilar junction with dolichoectasis and right vertebral artery dominance. Double pipeline embolization devices (PED) were deployed from distal basilar artery to right vertebral artery.
P407

Triple-stent therapy for the treatment of vertebral dissecting aneurysms: Efficacy and safety
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Purpose: There are several treatment modalities for vertebral dissection aneurysms. The purpose of this study was to evaluate the efficacy and safety of triple-stent therapy for intracranial vertebral dissecting aneurysm (VDA).

Materials and Methods: Eight patients with nine VDAs underwent multiple stent insertion therapy. Seven patients who presented with progressive ischemic symptoms and showed changes in follow-up images underwent triple-stents insertion therapy, and one patient who presented with subarachnoid hemorrhage underwent double-stents therapy twice and one additional single-stent therapy with coil embolization (total five stents). Safety, technical feasibility, and clinical and imaging follow-up data for triple-stents therapy were retrospectively evaluated.

Results: Triple-stents deployment for VDAs was successfully performed in all nine VDAs without any procedure-related complication. Among them, eight unruptured VDAs showed near normalization on follow-up imaging studies within 90 days post-procedure. One case of ruptured VDA showed repeated recurrence without new symptoms and delayed normalization after insertion of five stents. Seven patients with long-term follow-up (median clinical follow-up 22.6 months, median imaging follow-up 17.1 months) showed clinical and imaging improvement without development of new symptoms.

Conclusion: Triple-stents therapy for VDAs was safe and effective. This technique showed favorable results in clinical and imaging follow-up for unruptured VDAs, although caution is advised for ruptured VDAs.

P408
Treatment strategy for isolated posterior inferior cerebellar artery dissection
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Purpose: Isolated dissections that develop on the posterior inferior cerebellar artery (PICA) require intensive treatment due to their potential fatality. However, due to the rarity of these dissections, the optimal treatment has not yet been established. Here we report the clinical manifestations and results of surgical, endovascular, and conservative treatment.

Methods and Materials: We retrospectively reviewed the clinical records of all patients who underwent any PICA dissection treatment in our institute over the last 4 years. Ten patients were enrolled (4 males and 6 females, 40–79 years old), including seven cases of subarachnoid hemorrhage (SAH) and three cases of PICA territory infarction. Dissection was seen at the proximal portion (anterior and lateral medullary segments) in eight patients, whereas the remaining two patients showed distal PICA-dissecting aneurysms.

Results: Among the seven patients with hemorrhage, five were actively treated (trapping and bypass: 2, surgical clipping: 1, coil embolization: 2). Conservative management was performed in the other two patients, one of whom showed minimal change of the PICA and the other one for whom active treatment was not performed due to poor general condition. Among the three patients with infarction, two received conservative treatment. Endovascular treatment was performed in one patient who showed rapid progression, aneurysm formation, and conversion to massive SAH within 10 days after the initial attack. Although seven patients showed relatively good outcomes (mRS: modified Rankin Score ≤2) after 30 days of follow-up, one patient had a final mRS score of 3. Additionally, the other two patients (one in each group) died due to major SAH.

Conclusion: Given the dynamic clinical course and potential fatality of PICA dissection, meticulous evaluation, intensive treatment with a diverse range of modalities, and proper follow-up are required for patients with PICA dissection to achieve favorable outcomes.
P409

Geometric classification of paraclinoid aneurysms for selection of microcatheter in coil embolization

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Purpose: Paraclinoid aneurysms are challenging and difficult lesions to access because of its complex anatomical characteristics. For endovascular embolization, superselection of paraclinoid aneurysms should accompany the consideration on 3-dimensional anatomy around the carotid siphon and the shape of microcatheter. However, no detailed study on the appropriate classifications for endovascular treatment has been reported. We suggest the geometric classification of paraclinoid aneurysms for selection of microcatheter through the analysis on aneurysmal directions and locations.

Materials and Methods: The angiographic and procedural data from 76 patients with 80 paraclinoid aneurysms that underwent endovascular treatments were reviewed retrospectively. Paraclinoid aneurysms were classified by the six directions in which the aneurysm neck lay and were simplified into 3 groups as follows: superior, medial, and lateral groups. We classified the paraclinoid aneurysms according to the origin of the central point of the aneurysm neck via analyzing the lateral view of angiography, which resulted in 3 following groups: proximal, mid, and distal portions. We assessed the success rate of superselection with first chosen pre-shaped microcatheter per each group according to our classification.

Results: According to the aneurysm direction, the medial group showed relatively lower success rate (66.1%) of superselection compared with superior (81.8%) or lateral (85.7%) groups. “S”-shaped microcatheter was most frequently used especially in superior (69.2%) and lateral (62.5%) groups. Among the medial groups, we categorized by aneurysm location, which is then followed by analysis on the success rate when the pre-shaped microcatheters is used for each group. Acutely angled “J” and “C” microcatheters (88.5%) were preferred in proximal portion aneurysms. Obtusely angled “45” and “90” microcatheters (75%) were preferred in distal portion aneurysms. Mid-portion group showed the lowest success rate (45.8%) and more struggle in superselection with the pre-shaped microcatheters. The shape with larger diameter and narrower neck aneurysms exhibited a trend leading to more difficulties in superselection.

Conclusion: Our analysis based on geometric classification of paraclinoid aneurysms revealed that medial directed with mid-portion location aneurysms were more difficult to access with pre-shaped microcatheters. Tailored steam-shaping technique may be a considerable option in this type of paraclinoid aneurysms. Superior and lateral directed aneurysms could be accessed with “S”-pre-shaped microcatheter. It is worthwhile to consider acutely angled microcatheters in proximal portion aneurysms and obtusely angled microcatheters in distal portion aneurysms.

P410

Intra-aneurismal

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Purpose: Giant vertebrobasilar (VB) fusiform dissecting aneurysms, a rare and complex pathology, usually cause progressive brainstem compression and ischemic symptoms, rather than SAH. They generally have severe prognosis. Literature is still controversial about surgical or endovascular option. Moreover, it is unclear whether exist the “best” possible treatment timing.

Authors discuss also the appearance of intra-aneurismatic “parallel basilar channel” sign after endovascular reconstruction of the pathological vessel using multiple flow diverter stents in telescopic fashion as a possible additional bad prognostic sign.

Methods and Materials: Two middle age men (52 and 53 y.o. in 2014 at the time of treatment) presented with giant VB aneurysm and different symptoms. When the first patient underwent endovascular therapy was highly symptomatic (severe ataxia, dysphagia, disaria) while the second one was treated just presenting aspecific headache and transient diplopia. Both underwent neuroendovascular reconstruction of the pathologic VB segment using long flow diverter (FD) stents in a “telescopic fashion” followed by coiling of the contralateral VB junction. No periprocedural complications were reported.

Results: After the treatment, the highly symptomatic one just progressed in VB aneurysmal enlargement with worsening compressive and ischaemic symptoms until he died 6 months after the first treatment and 3 months after an additional stent placement. The second patient has been asymptomatic until September 2016, while he reported increasing headaches, slight ataxia and transient dysphagia for liquids. During this 2-years observation, the aneurysm is still highly perfused and growing 1 mm/year. Plus, the last DSA control (October 2016) has shown an “in stent” basilar occlusion with basilar top reperfusion by anterior circulation.

A parallel intra-aneurismatic “basilar channel” has been detected in DSA control of both patients, not yet adequately interpreted, but probably to be considered as a possible misfunctioning sign of the endovascular treatment with no healing trend.

In particular, in the second case, the intra-aneurismal channel prevailed the reconstructed basilar artery, that has shown to be occluded.
**Conclusion:** The two cases have presented different evolution probably depending on different clinical stage presentation and treatment timing. The evidence of DSA intraaneurismal “parallel basilar channel” sign after FD reconstruction is still unclear, but probably a negative prognostic indicator.

**P411**

**Cobalt chromium based flow diverters in the treatment of acute and symptomatic neurovascular settings**

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**Purpose:** To present our clinical and radiological outcomes with cobalt chromium based flow diverters as a primary treatment tool for hemorrhagic and/or symptomatic intracranial pathologies such as aneurysms, segmental dissections and carotid cavernous fistulae.

**Material and Methods:** A retrospective review from our departments database from January 2013 to May 2017 was conducted for all patients presented with acute rupture or neurologically symptomatic conditions such as aneurysms, carotid-cavernous fistulae or segmental dissections who primarily treated with a cobalt chromium based flow diverter (either Surpass or Pipeline). Relevant data of 16 cases, including cause of hemorrhage, cause of symptoms, aneurysmal characteristics, antiplatelet regimen, technical issues, pre-and post-procedural morbidities and mortalities, angiographic and clinical outcome in modified Rankin Scale (mRS). Patients were followed up with either CTA, MRA or DSA on an average six-month interval.

**Results:** There was no preoperative complication. One death while 13 patients had complete occlusion in the follow ups. There was poor and/or delayed response to the flow diverter in the presence of the previous implants such as previous conventional laser cut stent. No mortality observed.

**Conclusion:** Our case series demonstrated that cobalt chromium based flow diverters are safe and effective treatment option in carefully selected patient group without significantly increase the rate of morbidity and mortality when compared with asymptomatic elective conditions. However further large series studies and trials are necessary.

**P412**

**SURPASS flow diverter inn the treatment of high flow bifurcation aneurysms**

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**Purpose:** To present our experience, angiographic and clinical outcomes with utilizing Surpass flow diverter as a primary treatment tool for treatment of terminal internal carotid artery and basillary tip aneurysms.

**Material and Methods:** A retrospective review from our departments database from January 2013 to May 2017 was conducted for all patients with terminal ICA or basilar tip aneurysms who underwent flow diversion treatment using Surpass device. The data of 15 cases, including the presentation symptoms, presence of hemorrhage or any neurological symptoms, aneurysmal characteristics, antiplatelet regimen, technical issues, pre-and post-procedural morbidities and mortalities, angiographic and clinical outcome in modified Rankin Scale (mRS). Patients were followed up with either CTA, MRA or DSA on an average six-month interval.

**Results:** There was no preoperative complication. Twelve patients had complete occlusion in the follow ups. There was poor and/or delayed response to the flow diverter in the presence of the previous implants such as previous conventional laser cut stent. No mortality observed.

**Conclusion:** Surpass flow diverter is significantly effective tool for the treatment of bifurcation aneurysms that have no previous treatment/implant in situ.

**P413**

**SHIELD: An experience with 5 interesting cases with medical or surgical limitations**

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**Purpose:** To present our experience, angiographic and clinical outcomes with utilizing Pipeline Shield flow diverter as a treatment tool in treatment of 5 interesting cases with operational limitations such as dissected acute haemorrhage, immune suppresses renal transplant and recurrent dissected distal aneurysms.

**Material and Methods:** A retrospective review from our departments database from January 2017 to May 2017 was conducted for all patients with terminal ICA or basilar tip aneurysms who underwent flow diversion treatment using Pipeline Shield device. The data of 5 cases, including the presentation symptoms, presence of hemorrhage or any neurological symptoms, aneurysmal characteristics, antiplatelet regimen, technical issues, pre-and post-procedural morbidities and mortalities, angiographic and clinical outcome in modified Rankin Scale (mRS). Patients were followed up with either CTA, MRA or DSA on an average six-month interval.

**Results:** There was no preoperative complication. Twelve patients had complete occlusion in the follow ups. There was poor and/or delayed response to the flow diverter in the presence of the previous implants such as previous conventional laser cut stent. No mortality observed.

**Conclusion:** Pipeline Shield flow diverter is significantly effective tool for the treatment of bifurcation aneurysms that have no previous treatment/implant in situ.
conducted for all patients who underwent flow diversion treatment using Pipeline Shield. The data of five cases, including the presentation symptoms, presence of hemorrhage or any neurological and general symptoms, aneurysmal characteristics, antiplatelet regimen, technical issues, pre-and post-procedural morbidities and mortalities, angiographic and clinical outcome in modified Rankin Scale (mRS). Patients were followed up with either CTA, MRA or DSA on an average 4-month interval.

Results: There was no preoperative complication. No mortality observed. All cases showed complete occlusion in follow-ups while one case showed complete third nerve palsy in week one.

Conclusion: Pipeline Shield is an effective tool for the treatment of intracranial aneurysms. Its characteristics may also be advantageous in patients with significant general conditions who benefit from reduced time of required antiplatelet regime such as those with renal transplants.

P414
Emergency handling for re-rupture of the intracranial aneurysmal subarachnoid hemorrhage cases during intravascular intervention embolization procedure

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Purpose: To study the reason, emergency handling, and prevention measures of re-rupture for the intracranial aneurysmal subarachnoid hemorrhage cases during intravascular intervention embolization procedure.

Materials and Methods: In this retrospective study, all clinical data of those aneurysmal subarachnoid hemorrhage cases, for which re-rupture occurred during the intervention embolization procedure, were collected from the interventional radiology & vascular surgery department in the affiliated hospital of Hebei university, and the imaging characteristics, selections of the intervention embolization materials, and the features of the technical operations were analyzed.

Results: A total of 510 intracranial aneurysmal subarachnoid hemorrhage cases were treated in the interventional radiology & vascular surgery department of the affiliated hospital of Hebei University from January 2011 to October 2016, and 11 cases (2.2%) re-occurred to bleed during the intervention embolization procedure, among which extruding of the spring coil was occurred in 8 cases, extruding of micro-catheter was occurred in 2 cases, and for 1 case, re-bleeding was occurred during the thrombolyis process in the treatment of acute in-stent thrombosis. After positive management, 10 cases recovered without obvious neurologic defects, and 1 case died after the procedure.

Conclusion: Re-rupture bleeding of the intracranial aneurysms during the intervention embolization procedure, which was mostly due to the extruding of the spring coil or micro-catheter, is a serious, and even disastrous complication. However, as long as a positive and reasonable treatment measures were taken, the mortality and morbidity could be decreased significantly.

Key words: intracranial aneurysm; interventional embolization; re-rupture

P415
Vessel Wall Enhancement in Unruptured Aneurysms using VW-MR technique as a predictor of rupture. A Case Report

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Purpose: The study of intracranial aneurysms has traditionally been done based on their morphologic characteristics using conventional techniques. These techniques base their evaluations on the abnormalities in morphology of the aneurysms, but do not discriminate their risk of rupture. There is an ongoing interest to better characterize the aneurysms walls and parenting vessels using Vessel Wall MR technique (VW-MR). This technique is currently being used as a complement to conventional techniques in the study of diverse vascular pathologies including unruptured and ruptured aneurysms in search for predictors of aneurysms at risk of rupture. We present the case of a patient with an unruptured aneurysm which ruptured when going through the preoperative imaging workup.

Imaging acquisition: CT, AngioCT, DSA were performed on the patient during routine workup, with special attention on the VW-MR using a 3.0 Tesla MR Siemens and a 32 Channels Head Coil. A Multislab sequence is done (3D-TOF-MRA), at the Willis Circle with spot sequences. T2 Turbo Spin Echo (TSE) sequences are done in the axial, coronal and sagittal plane at the site of the aneurysm. Sequence is repeated in the 3 orthogonal planes doing a T1 spin-echo sequence with blood suppression. A T1 3D TSE-SPACE sequence is also obtained. The T1 sequences, 2D and 3D are repeated posterior to the administration of contrast media.

Case Presentation: A 68 year old male with a history of vertiginous syndrome since 5 months before consultation to our hospital. On ambulatory protocol, we performed an Angio CT, diagnosing a right posterior communicating artery (PComA) unruptured aneurysm with irregular morphology and a distal nipple. VW-MR was done showing an irregular contrast-enhanced wall with prominent nipple enhancement. The patient was due for an angiography appointment the next day, however while driving to the hospital, he started vomiting with subsequent loss of consciousness. Rushed to the ER at our hospital, CT was performed and showed acute subarachnoid hemorrhage (SAH); angiography and embolization was performed immediately with complete occlusion of aneurysm. Currently, patient with GCS 15 and no neurological deficits.
Conclusion: This case illustrates that the VW-MR technique is a promising tool for prioritizing treatment in unruptured aneurysm. The enhancement observed in vascular wall can relate to the grade of endothelial inflammation, and so, the risk of rupture of an aneurysm, as this case demonstrates.

P416

Initial experiences of Pipeline Flex

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Purpose: Pipeline Flex is commercially available since 2015 in Japan. We reviewed our initial experiences since August 2016.

Materials: The subject of this study is 12 sessions of Pipeline Flex in 11 patients from August 2016 to March 2017. All patients are females having large (≥10 mm) internal carotid artery aneurysm. Aneurysm is located in the cavernous sinus in 5 cases and intradural proximal to posterior communicating artery in 6 cases. Maximum size of the aneurysm is 11 mm to 28.5 mm. Symptomatic patients are 3.

Results: One patient experienced 2nd session because of shortening of the distal portion resulting in incomplete coverage of aneurysm. Eleven sessions were performed in general anesthesia, and 1 session in patient with severe liver dysfunction was performed local anesthesia. Direct puncture was performed in 2 cases. Coils were used in 4 cases of intradural aneurysms. Pipeline Flex was used only one in each session. The Pipeline Flex used was from 3.75 mm × 16 mm to 5 mm × 35 mm. Six months follow-up was finished in 5 cases. Complete obliteration was achieved in 4 cases and marked shrinkage with clinical deterioration in one.

Conclusion: Clinical results of Pipeline Flex are relatively good. It is available in local anesthesia. Pipeline Flex is difficult in introduction and expansion. Direct puncture is one of the solution for such difficulties. Landing zone long enough is important for prevention of delayed shortening.

P417

Willis covered stent for treatment of intracranial blood blister like aneurysm: clinical application and preliminary experience

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Objective: Intracranial blood blister-like aneurysm (BBA) is a rare type of aneurysm that lacks all layers of the arterial wall. These fragile aneurysms have the propensity to rupture with minimal manipulation, which makes them hazardous and difficult to treat. The present study evaluated the safety and feasibility of endovascular treatment of BBAs with the Willis covered stent.

Materials: Thirteen patients (7 men and 6 women, age range 28–68 years) who presented with ruptured BBAs and were treated with the Willis covered stent were retrospectively reviewed. Results of the procedures and treatment-related complications were recorded. Angiographic and clinical follow-ups were performed 4–6 months after the procedure.

Results: Placement of the covered stent was successful in all patients. Immediate angiography showed complete aneurysm occlusion in 12 patients while one patient showed a mild endoleak. This high rate of aneurysm exclusion ensured the security of postoperative antiplatelet treatment. Occlusion of the ophthalmic artery occurred in two patients and occlusion of the anterior choroidal artery occurred in one patient; however, none of them showed acute or delayed clinical symptoms.

Thrombosis, aneurysm rupture, and other complications did not develop in any case. Angiographic follow-up showed complete aneurysm exclusion without aneurysm recurrence in any patients. Only two patients showed asymptomatic mild to moderate in-stent stenosis. All patients had satisfactory clinical outcomes (modified Rankin Scale score ≤1).

Conclusions: Willis covered stent implementation may be safe and feasible for BBAs. This strategy might be a promising option for this high-risk type of aneurysm.

P418

Bubble formation on detachment of electrically detachable coils

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Coil detachment mechanism is one of the key techniques for the design of reliable embolization coils. Electric systems are very good to be able to detach without any mechanical force to coil and without any change to the mechanical properties to the coils. However, electric current itself possibly electrolyze water to produce bubble. On experimental detachment of a coil, we observed bubble formation. In the pure water, the coil could not be detached. When the coil detachment zone was placed in normal saline, the coil was successfully detached with significant amount of bubbles. The other electric detachable system and a mechanical detachable system did not produce bubbles. The bubble did not observed in pure water, they should produced by electrolysis of water. This phenomenon was observed in still water, not in flow. In blood stream, the size of bubble might be much smaller. At the final stage of embolization, flow in the aneurysm significantly decreased. So bubbles
possibly produced. Bubbles might be possible risk in coil embolization.

**P419**

**Initial and mid-term follow-up results of stent-assisted coil embolization for cerebral aneurysms**

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**Purpose:** Neck bridge stents for coil embolization of wide-neck or large cerebral aneurysms have been available in Japan since 2010. We will report the primary and mid-term follow-up results of stent-assisted coil embolization for cerebral aneurysms, focusing on clinical, angiographic results and anti-thrombotic treatment.

**Materials and Methods:** We reviewed angiographic images and prospectively collected database. Among recent 116 sessions of stent-assisted coil embolization, we have treated 122 cerebral aneurysms in 109 cases (84 female and 25 male, average age was 59.2 year-old). 111 aneurysm were primarily treated and 11 aneurysms were re-treated after initial coil embolization.

**Results:** Anatomical locations of aneurysms were 78 internal carotid, 23 vertebral, 24 basilar, 4 anterior communicating and 2 middle cerebral arteries. Average aneurysm size was 8.98 mm (2.7–26.4, median 7.8 mm) and average aneurysmal volume was 0.34 cc (0.11–3.27, median 0.12 cc). Technical success was achieved in 113 cases (97.4%). Average volume embolization ratio was 23.9% (n = 86, with succular aneurysms). Peri-procedure ischemic events were observed in 10 cases (8.6%), and resulted in ischemic morbidity in 3 cases (2.6%) at 6months (mRS1). Ischemic event during follow-up period were obeserved in four cases (3 minor stroke and 1 TIA). There was one intracerebral hemorrhage which was not related with the aneurysm. 14 aneurysms (12.1%) in this series were re-treated and average size of this group was 14.4 mm. Follow-up angiography was performed in 98 aneurysms (at average 217.4days). Complete occlusion was 19.4% post procedure and increased up to 55.1% at follow-up. Dual anti-platelet agents were used 7 days prior to procedure, which were reduced to single agent after 142 days in average and terminated at 724days in average.

**Conclusion:** Stent-assisted coiling is safe and effective, with permanent morbidity occurring 3.4% of patients and acceptable angiographic occlusion in 87% (complete occlusion and neck remnant) at last angiographic follow-up. Our data demonstrated that large and wide-neck aneurysms were likely to recanalize and cause chronic ischemic event. Suitable case selection and appropriated peri-procedural anti-thrombotic therapy are essential for the safe and effective treatment.

**P420**

**Case of the endovascular treatment of thrombosed superior cerebellar artery aneurysm following cerebral revascularization**

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**Introduction:** Thrombosed superior cerebellar artery aneurysm is difficult to treat. We experienced endovascular coil embolization of the symptomatic thrombosed superior cerebellar artery aneurysm following superior temporal artery – superior cerebellar artery bypass with good outcome. We report this case with review of literature.

**Case presentation:** 67 years old woman was pointed out right superior cerebellar artery aneurysm 1 year ago and referred to our hospital for the purpose of treatment. The patient noticed right ptosis and headache for 1 week before admission. Anisocoria was also detected on admission. Brain computed tomography and magnetic resonance imaging suggested thrombosis of the aneurysm. Digital subtraction angiography showed enlargement of the aneurysm. In case of parent artery occlusion during endovascular treatment because the aneurysm was pure superior cerebellar aneurysm, superior temporal artery – superior cerebellar artery bypass was performed 2 days before endovascular procedure.

Digital subtraction angiography obtained just before the endovascular procedure showed advancement of thrombosis of the aneurysm. Coil embolization was performed using balloon assist technique subsequently. Eventually, parent artery occlusion was confirmed, and complete occlusion of the aneurysm was obtained.

After the procedure, no neurological deterioration occurred, and the patient discharged 19 days after the endovascular treatment.

**Conclusion:** Endovascular treatment following cerebral revascularization have been reported. Superior cerebellar artery aneurysm could be treated in a same manner and favorable outcome could be obtained.

**P421**

**Transradial approach for diagnosis and treatment of 50 ruptured cerebral aneurysms. Case series**

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Objective: Many benefits were described for transradial approach against femoral one for coronary endovascular therapy. The goal of this study is to describe the authors institutional experience with the transradial approach for diagnosis and treatment of ruptured cerebral aneurysms in patients with subarachnoid hemorrhage (SAH) and to report its technical feasibility.

Methods: The authors reviewed their institutional database to identify patients who underwent diagnosis and effective treatment with coils of cerebral aneurysms in SAH from July 2015 up to April 2017.

Results: Fifty patients were identified with ruptured cerebral aneurysms diagnosed and treated through right radial artery approach. 46 were anterior circulation aneurysms with 25/21 right/left internal carotid catheterization respectively and 4 cases were posterior circuit aneurysms. All aneurysms were treated with coils. No access-related complications occurred.

Conclusions: Transradial access for diagnosis and treatment of ruptured cerebral aneurysms is safe and feasible. Further comparative studies are needed to determine criteria for selecting the transradial approach in this setting.

P422

Treatment Results of Endovascular Coil Embolization for Small Unruptured Intracranial Aneurysms (≥5 mm)

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Objective: The natural history and proper treatment of small unruptured intracranial aneurysms (UIA) smaller than or equal to 5mm have not been clearly figured out. Clinicians ponder between close observation and surgery about small UIA. We performed the prospective study about endovascular treatment of small asymptomatic UIA that were incidentally found. So we analyzed about the procedure-related complication and outcome in order to find its safety and usefulness when endovascular coil embolization was done for UIA smaller than or equal to 5mm.

Methods: We analyzed cases that had been done in Presbyterian Medical Center from January, 2011 to December, 2015. We treated 150 small asymptomatic UIA smaller than or equal to 5mm with coil embolization. Sizes of aneurysms were measured with 3 dimensional angiogram. We evaluated procedure related morbidity and mortality, immediate post-operative angiographic results, brain CT follow-up results on post-operative day one, and clinical progresses.

Result: The locations of UIA were mainly at anterior circulation area, 142 cases (94.67%). Posterior circulation ones were 8 cases. After coil embolization, aneurysms with total occlusion were 137 cases (91.3%). Those with subtotal occlusion were 5 cases (3.33%). Failed cases were 8 cases (5.33%). Procedure related morbidity and mortality were 5 cases (3.33%) and 0 cases respectively.

Conclusion: From this study, the endovascular treatment of small asymptomatic UIA showed good short-term outcome without permanent neurologic complications. This study may be helpful to determine ways of treatment for small asymptomatic UIA.

Keywords: Endovascular procedures, Embolization, Intracranial aneurysm, Mortality

P423

Multiple intracranial aneurysms associated with Behçet’s disease

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Purpose: To report a rare case of Behçet’s disease with multiple intracranial aneurysms.

Materials and Methods: We would like to present a 41-year-old female patient with Behçet’s disease who showed symptoms of severe headache due to subarachnoid hemorrhage. Brain computed tomography revealed multiple aneurysms. We also present a literature review of intracranial arterial aneurysms associated with Behçet’s disease.

Results: Behçet’s disease is an inflammatory disorder involving multiple organs. Its cause is still unknown, but vasculitis is the major pathologic characteristic. The common vascular lesions associated with Behçet’s disease are aneurysm formation, arterial or venous occlusive diseases, and varices. Arterial aneurysms mostly occur in large arteries. Intracranial aneurysms hardly occur with Behçet’s disease.

Conclusion: Behçet’s disease with intracranial aneurysm is rarely found, but continues to be reported. We should not underestimate this critical disease, and proper choice of treatment is necessary for the safe and effective management of intracranial aneurysms in Behçet’s disease.

Key Words : Behçet’s disease, Aneurysm.
Anterior circulation aneurysms comprise majority of the intracranial aneurysms. They are the most common site of rupture and cause of subarachnoid hemorrhage. Technical success of endovascular management of aneurysm has improved over the last two decades and has virtually replaced surgery in appropriate settings. We report the outcome of endovascular management of anterior circulation aneurysm from an interventional neurovascular centre in Northern India.

**Methods:** We reviewed the case records of consecutive cases undergoing endovascular procedures for aneurysms of the anterior circulation over a 5-year period.

**Result:** In the 187 patients treated during the study period, there were 192 aneurysms. 168 aneurysms (88%) were located in the anterior circulation and 24 (12%) in the posterior circulation. Anterior circulation aneurysms were more common in females, with a 1:1.3 male-to-female ratio. They were frequently found in the anterior communicating artery segment. Mean age was 51.2 years and mean aneurysm size was 6.2 mm. They were multiple in 24% of cases. 96.4% were of saccular type in morphology. Eighty-four percent presented with ruptured aneurysm. Endovascular procedures employed were coiling, stent-assisted coiling, balloon-assisted coiling, double catheter technique, balloon test occlusion followed by parent artery occlusion and flow diversion technique. Complete occlusion was achieved in 95% of cases in the immediate postcoiling angiography. Procedure-related complications occurred in 2.3%. Overall morbidity and mortality were 10% and 4.7% respectively.

**Conclusions:** Endovascular procedure in the treatment of anterior circulation aneurysm in the present study is associated with good immediate angiographic and clinical outcome and low procedure-related complications.

**P425**

**Strategy for coiling of wide-necked aneurysm**

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**Objectives:** To study some strategy for coiling in cases of wide-necked aneurysm

**Material & Methods:** Serial case report

**Result:** There are several methods to occlude wide-necked aneurysm, including balloon/stent assisted technique and multiple microcatheter technique. In most of our cases, we did by double microcatheter technique, the stent assisted technique only used for fusiform aneurysm. We present some illustrated cases. We found that the double microcatheter technique is helpful to do coiling in wide-necked aneurysm cases. The advantage of this technique is simple, easy and cheaper than the other technique.

**Conclusions:** Double microcatheter and stent assisted coiling technique are feasible and helpful for coiling of wide-necked aneurysm.

**Keywords:** Double microcatheter technique – Stent assisted coiling – Wide-necked Aneurysm

**P426**

**A Case of Turner Syndrome Presenting as Aneurysmal Subarachnoid Hemorrhage**

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We report a rare case of cerebral aneurysmal subarachnoid hemorrhage (SAH) with a Turner syndrome. A 34-year-old woman presented with aneurysmal SAH originated from a saccular aneurysm of the right anterior communicating artery. The patient was treated by an endovascular coil embolization of aneurysm. Postoperatively the patient recovered favorably without any neurological deficit. She had a previously recognized with Turner syndrome managed with medical treatment including estrogen hormone replacement therapy. It is an uncommon that Turner syndrome is presented with aneurysmal SAH, but could be a clinical concern. Further investigations are needed to reveal risk factors, vascular anatomy, and causative mechanisms of Turner syndrome with aneurysmal SAH.

**P427**

**Flow-diverter stenting of internal cerebral artery mycotic aneurysm: A case report**

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The use of flow-diverter stent (FD) against mycotic aneurysm has not reported yet. We describe a case of internal carotid artery (ICA) mycotic aneurysm treated with Pipeline FD. A 35-year-old man presented with left eye pain and swelling, and fever for two weeks. Before that, he went to Viet Nam and developed a flu-like illness there, and antibiotic was not effective. Then he began to develop headache, diplopia, and rash on his face for one week, and was admitted to our hospital. MRI revealed cerebral infarctions of the right frontal and occipital lobe. CTA and MRA demonstrated multiple intracranial aneurysms, including a large left cavernous aneurysm. Blood and CSF cultures were negative, but serum titers elevated for Brucella. Because transesophageal echocardiography demonstrated no valvular vegetations, we were diagnosed with mycotic aneurysm by Brucella infection. He was started on intravenous cefotaxime, and became afebrile two weeks later. But his large aneurysm was not reduced, and we placed Pipeline FD at left ICA. Follow up angiogram four months later showed no residual aneurysm, and his cranial nerve palsy had completely resolved. We experienced a case of large mycotic aneurysm by Brucella infection, which was treated with Pipeline FD.
Results: Endovascular internal trapping.

Between November 2007 and December 2016, 7 aneurysms located distal posterior circulation were treated in our institution, all of them were treated by simultaneous coil occlusion of the aneurysm and parent artery or occlusion of the parent artery just proximal to the aneurysm. 4 aneurysms were treated by simultaneous coil occlusion of the parent vessel and in determining a working projection for catheterization and coil occlusion. To understand the anatomy of perforating arteries, when infarction did occur, however, this deconstructive approach may lead to infarction in the territory of the occluded artery if collateral circulation is insufficient. The aim of this retrospective study was to determine the incidence, clinical presentation and midterm clinical and imaging of vascular anatomy of distal posterior circulation aneurysms in 6 patients.

Materials and Methods: Between November 2007 and December 2016, 7 aneurysms located distal posterior circulation were treated in our institution, all of them were endovascular internal trapping.

Results: There were 2 men and 4 women, ranging from 42 to 79 years of age. 5 patients presented with subarachnoid hemorrhage, 1 patient presented dizziness with unruptured aneurysm. Aneurysm location was the Superior cerebellar artery (SCA) in 2, Anterior inferior cerebellar artery (AICA) in 2, Posterior inferior cerebellar artery (PICA) in 4. 4 aneurysms were treated by simultaneous coil occlusion of the aneurysm and parent artery or occlusion of the parent artery just proximal to aneurysm. 4 aneurysms were occluded with glue proximal to the aneurysms. Outcomes were measured with modified Rankin Scale (mRS) at 3 months. The scores for mRS1: 2 patients, mRS2: 3 patients, mRS3: 3 patients.

Conclusion: In most patients, adequate collateral circulation prevents infarction in the territory of the occluded vessel. However Balloon Occlusion Test (BOT) are often difficult to perform. High-resolution cone beam CT are valuable in evaluating the anatomy of the aneurysm and its relation with parent vessel and in determining a working projection for catheterization and coil occlusion. To understand the anatomy of perforating arteries, when infarction did occur, the clinical consequences were limited.

Bilateral dissecting aneurysms presenting with subarachnoid hemorrhage (SAH) are rare. The treatment strategy for bilateral vertebral artery dissecting aneurysms (VADA) is controversial because the contralateral vertebral artery is already dissected and can easily undergo enlargement or bleed after non-reconstructive treatment procedures such as trapping or proximal occlusion. Here, we report a case of bilateral VADA presenting with SAH that was treated with stent-assisted coiling for the ruptured side. A 42-year-old man was admitted to our hospital with sudden headache (WFNS grade 1). Computed tomography (CT) showed a high-density region in the basal cistern and posterior fossa with more hemorrhage on the right side (Fisher group 3). Three-dimensional CT and three-dimensional rotational angiography demonstrated a bilateral round protrusion on the vertebral arteries (VA) with a diameter of 5 mm just distal to the posterior inferior cerebellar artery (PICA). Stent-assisted coiling was performed for the ruptured right side and conservative therapy was selected for the contralateral side. The ruptured side was well embolized, and the contralateral side was stable over the 12-month follow-up period after treatment. The treatment strategy for bilateral VADA presenting with SAH is different from that for unilateral VADA. Non-reconstructive treatment procedures such as trapping may cause contralateral enlargement or rupture; therefore, reconstructive treatment may be appropriate for the ruptured side.

Background and Purpose: In recent years, 3D coil plays the major role for embolization of a saccular aneurysm. Appropriate selection of coil size is essential for good embolization. Selection of small size or early down-sizing may result in unsatisfactory embolization. But, choosing large size may cause catheter drop out of an aneurysm. In this report, embolization rate of an aneurysm was analyzed in regard to the secondary diameter of a 3D coil, and it was compared to other factors.

Methods: From January 2014 to February 2017, 79 patients with saccular aneurysms were treated with coiling technique. Their angiograms were reviewed in regard to following factors: aneurysmal size (height, width, and depth), aspect ratio, dome/neck ratio, relationship to its parent artery.
Cerebral aneurysms with incorporated branch

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Purpose: Clipping and coiling are treatment options for intracranial aneurysms. But if an aneurysm including incorporated branches, we have many difficulties in treatment. Therefore, we tried to research effective treatment options by analyzing past cases.

Materials and Methods: Total 31 patients (32 cases) with incorporated aneurysm who underwent surgical and endovascular therapy between August 2006 and September 2011 were included. We retrospectively evaluated the medical records, radiographs.

Result: The mean age of patients was 57.1. The locations of incorporated aneurysm included the following: Lt ICA (n = 8), Rt ICA (n = 6), A-com (n = 2), Rt MCA (n = 4), Rt VA (n = 4), BA (n = 6), Lt VA (n = 2). And they are classified into five types; Near type (n = 22), Central type (n = 4), Far type (n = 2), Variant type (n = 2), Complex type (n = 2). 12 of all were treated by surgical clipping and endovascular therapy.

Conclusion: Incorporated branch with cerebral aneurysm is very difficult to manage. However, there was no definite way to facilitate treatment. For the best outcome, we have to establish the most suitable treatment strategy based on the following considerations-aneurysmal location, type of incorporating branches, preservation of the vital branches and minimization of the major complications. Moreover, highly technical expertise are required.
vicinity of the aneurysm neck that cannot be controlled by the action of anti-platelets alone. Using DOACs could be an effective means of preventing this.

**P433**

**Treatment strategy for posterior cerebral artery aneurysms**

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**Background:** Endovascular treatment and microsurgery are effective for the occlusion of PCA (posterior cerebral artery) aneurysms. The preservation or reconstruction of the parent vessel is crucial for favorable treatment outcomes. Clinical data suggest that parent vessel occlusion is high risk for patients with fetal-type PCA aneurysms.

**Objective:** To analyze treatment strategy including endovascular treatment and microsurgical approach for PCA aneurysms.

**Method:** From January 2013 to December 2015, we identified 8 patients of PCA aneurysms who were treated at our institutions. Periprocedural data and clinical and angiographic records were studied retrospectively.

**Results:** PCA aneurysms were located on P1 (n = 1), P1-2 junction (n = 3), P2-3 junction (n = 2), P3-4 junction (n = 2). Type of aneurysms were sacular (n = 6) and fusiform (n = 2). Treatment strategy were coiling (n = 2), clipping (n = 3), and distal P1 occlusion (n = 1) for 6 sacular aneurysms. In 2 fusiform PCA aneurysms, trapping with STA-PCA bypass and proximal P3 occlusion with OA-PCA bypass were performed. In all cases, complete occlusion of aneurysms was obtained. Perforator infarction were detected in 2 cases, in one case, the aneurysm was located near the perforator origin, in another case, parent artery occlusion was performed. Postoperative outcomes were good in all cases.

**Conclusion:** Endovascular treatment and microsurgery are both effective for PCA aneurysms. For the treatment of fusiform PCA aneurysms, revascularization is required to perform trapping or PAO (parent artery occlusion) of fetal-type PCA. PAO could be risk of perforator infarction followed parent artery become blind end.

**P434**

**Indications of direct carotid exposure for endovascular cerebral aneurysm repairs**

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**Objective:** The transfemoral approach is a common route for catheterization of the supra-aortic vessels in neuroendovascular therapy. However, in some cases, the patient’s anatomy prevents transfemoral catheterization or distal access to the carotid s.In such cases, direct carotid exposure (DCE) for neuroendovascular approaches may be used to treat cerebrovascular diseases.

**Methods:** We present 11 cases in which we were unable to perform the distal approach and DCE was the preferred neuroendovascular treatment procedure.

**Results:** DCE was performed on 11 patients with cerebral aneurysm (n = 8), carotid cavernous fistula (CCF) (n = 1), malignant brain tumor (n = 1), and carotid angioplasty and stenting (n = 1). Ten patients were female; one was male. Ages ranged from 63 to 87 years (mean: 71.36 years). Coil embolization was performed on patients with cerebral aneurysm and CCF. The patient with a malignant brain tumor underwent polyvinyl alcohol particle embolization. The only complication was a carotid artery dissection that occurred in one patient during stenting.

**Conclusion:** DCE for neuroendovascular approaches can be used as an alternative for patients with tortuous vasculature access in the femoral route. In such patients, a combination of neuroendovascular treatment and surgery in a hybrid operating room with angiography is preferred.

**P435**

**Early rebleeding after coiling for ruptured cerebral aneurysm and the value of 3D rotational angiography as a predictor of rebleeding**

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**Background and Purpose:** In treatment of ruptured cerebral aneurysm, rebleeding event occurs frequently in coil embolization compare to clipping. In addition, early rebleeding could suggest that treatment may have been performed incompletely. However, it would be difficult to decide exactly
Management for recurred aneurysm due to coil migration following endovascular treatment

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Introduction: Recently, indications of endovascular treatment are gradually widened for intracranial aneurysms. However, various complications associated with endovascular treatment can still occur. In addition, the more case number and follow up period, the more complications will be increased. In particular, coil migration led to severe neurologic deficit which may occurs due to thrombosis or stenosis of the parent artery. In this report, we present case of clipping for recurred aneurysm due to coil migration following endovascular treatment.

Case reports: A 69-year-old woman was invited to our hospital with dizziness and nausea. Magnetic resonance imaging (MRI) and transfemoral cerebral angiography (TFCA) showed a 5-mm diameter aneurysm in anterior communicating artery with superior direction. Considering the age and complex medical history with diabetes and hypertension, we judged that the endovascular treatment was good choice rather than aneurysmal clipping despite neck of aneurysm was slightly wide. We performed coil embolization using six detachable coil through the right common femoral artery. We confirmed that aneurysm was completely obliterated and normal both distal anterior cerebral artery (ACA) flow in completion angiogram.

The patient was re-visited to our hospital with lasting headache and dizziness after four months later. TFCA was performed because recurred aneurysm was suspected in MRI. TFCA scan revealed that coil migration from anterior communicating artery (A-com) aneurysm to right distal A2 segment and recurred aneurysm. Anterior interhemispheric approach was performed. There was accessory A2 ACA, with a total of three A2 after dissection was finished. The firmly fixed coil and perforating artery was observed in right A2 segment. Only aneurysmal clipping was performed using Yasagil clip without bypass and removal of coil. The patient was taking anti-platelet agent after one week. The headache was improved after surgery, and there was no neurological deficit including cerebral infarction, or cerebral hemorrhage.

Conclusion: If migrated coil does not cause the symptom such as cerebral infarction, close observation is necessary after clipping of recurred aneurysm and antiplatelet agent medication without removing the coil.

P437

Clopidogrel Response Variability in Unruptured Intracranial Aneurysm Patients Treated with Stent-assisted Endovascular Coil Embolization: Is Follow-up Clopidogrel Response Test Necessary?

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Purpose: The purpose of this study was to analyze the variability of clopidogrel responses according to duration of a clopidogrel drug regimen after stent-assisted coil embolization (SAC), and to determine the correlation between the variability of clopidogrel responses and thromboembolic and/or hemorrhagic complication.

Materials and Methods: A total of 47 patients who underwent SAC procedures to treat unruptured intracranial aneurysms were enrolled in the study. Preoperatively, patients...
received more than seven days of 100 mg of aspirin and 75 mg of clopidogrel, daily. P2Y12 reaction unit (PRU) was checked with the VerifyNow test one day before the procedure (pre-PRU) and one month after the procedure (post-PRU). PRU variability was calculated as the decrease from initial response to follow-up response. Patients were sorted into two groups based on their response to treatment: responsive and hypo-responsive.

Results: PRU variability was significantly greater in the Hypo-responsive group when compared to the Responsive group (p = 0.019). Pre-PRU and serum platelets counts were significantly correlated with PRU variation (p = 0.005, Odds ratio [OR] 1.034, 95% confidence interval [CI] 1.010–1.059; p = 0.004, OR 1.043, 95% CI 1.013–1.073, respectively). Although thromboembolic complication had no significant correlated factors, hemorrhagic complication was correlated with pre-PRU (p = 0.033, OR 0.983, 95% CI 0.968–0.999).

Conclusion: In conclusion, variability of clopidogrel responses during treatment with medication was correlated to the serum platelet count and initial clopidogrel response. Thromboembolic and hemorrhagic complications were not correlated to the variability of clopidogrel response or clopidogrel response after one month of medication, but hemorrhagic complication was associated with initial clopidogrel response. Therefore, it is recommended that patients be tested for an initial clopidogrel response, as no further test would be necessary.

P438
Nitinol Clip Distal Migration and Resultant Popliteo-tibial Artery Occlusion Complicating Access Closure by the StarClose SE(TM) Vascular Closure System
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Introduction: Lower extremity ischemia after use of vascular closure device after transfemoral approach for endovascular procedure is infrequent. We report the embarrassed case about this event.

Material and Method: A 68-year-old woman with mental change was hospitalized and diagnosed subarachnoid hemorrhage due to ruptured anterior communicating aneurysm. Endovascular coil embolization via right femoral access was performed for the patient and a StarClose device was deployed with immediate hemostasis. The deployment sequence included exchanging a 6F femoral sheath with the StarClose sheath. The StarClose delivery shaft was then inserted into the StarClose sheath until the shaft and sheath “clicked” after the guidewire was removed. The shaft was held with the right hand and on the end of the shaft, the vessel locater was deployed by pressing the U-shaped button on the end of the shaft. The shaft of the device was then maintained in the same angle as the tissue track and the shaft withdrawn until resistance was met with the vessel locater. And then, the shaft was raised within optimal angle and the clip was deployed. After removal of the shaft, manual compression was performed due to minor bloody leakage through the femoral puncture site.

Result: At two days after the procedure, the patient’s right lower extremity below knee was cool and pale with decreased pulsation of dorsalis pedis. Popliteal and a CT angiography showed long segmental hemodynamically significant stenosis at the medial proximal superficial femoral artery and popliteal artery, suggestive of acute embolic occlusion. Emergent surgical embolectomy for the right femoral and tibial artery was performed. During the surgery, the nitinol metallic clip was captured and removed at proximal one-third portion of the tibial artery. Finally, the pulsation and blood flow of the lower extremity were fully recovered.

Conclusion: The nitinol clip of the vascular closure device could be distally migrated after intravascular malposition of the clip and occur lower extremity ischemia.

P439
Delayed perianeurysmal cyst formation after unruptured intracranial aneurysm coiling: A case report with 10-year follow-up
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Perianeurysmal cyst formation after intracranial aneurysm coiling is a very rare complication of endovascular procedures, of which only a few cases have been reported to date. The authors report a case of a 53-year-old woman with an unruptured intracranial aneurysm treated by endovascular coiling who underwent more than 10 years of follow-up. The patient developed hydrocephalus, contralateral hemiparesis, and gait disturbance because of the cyst development. The cyst expansion continued despite a series of surgical interventions but was finally controlled after Ommaya catheter insertion.

P440
Recanalization of small ruptured anterior communicating artery aneurysm treated by endovascular coiling
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Purpose: The study aimed to analyze the risk factors of recanalization of ruptured small anterior communicating artery (AcomA) aneurysms, in order to suggest a mechanism of recanalization after endovascular treatment.
Results: During follow-up, 71 (80.7%) patients showed angiographic improvement and stable occlusion and 17 (19.3%) patients experienced worsening. The factors of vascular angle made by the aneurysm with the parent vessel, procedural rupture, hypoplastic or absent contralateral A1, and combined intra-parenchymal hematoma were unable to account for the difference between recanalization and non-recanalization groups. Incomplete embolization was 33 (37.5%) patients and vasospasm of the ipsilateral A1 was 11 (13.6%). And these factors were independent risk factors for recanalization by multivariate analysis.

Conclusion: Early angiographic follow-up is recommended for coiled ruptured small AcomA aneurysms judged to be high-risk, such as incomplete embolization or spasm on A1.

Materials and Methods: Eighty-eight patients with a ruptured small AcomA aneurysm treated initially by coil embolization and with at least 1 follow-up angiogram were enrolled. In addition to the generally considered risk factors (larger aneurysm size, larger neck size, and incomplete embolization), five suggested factors regarding potential recanalization were formulated as follows: vascular angle made by the aneurysm with the parent vessel, procedural rupture, hypoplastic or absent contralateral A1, combined intraparenchymal hematoma, and spasm of the ipsilateral A1. Clinical and radiological characteristics in the recanalization and non-recanalization groups were compared.

Purpose: Moyamoya disease (MMD) is a well described phenomenon. But unusual anastomosis pattern (moyamoya-like) associated with isolated middle cerebral artery (MCA) stenosis or occlusion and the relationship with aneurysm have not been well described. We report a case of ruptured aneurysm treated with N-butyl cyanoacrylate (NBCA) located in moyamoya like pattern collateral network with isolated middle cerebral artery occlusion.

Materials and Methods: A 54-year-old woman with a history of hypertension was admitted to our hospital with a sudden, thunderclap headache. Computerized tomography (CT) scan revealed subarachnoid hemorrhage in the right sylvian fissure and in right frontal lobe. CT angiography showed proximal M1 segment occlusion and there is no definite aneurysmal sac. Conventional and 3D rotational angiogram defined a moyamoya pattern collateral network in occluded MCA and small aneurysm – suspicious pseudoaneurysm, was visible in internal carotid artery (ICA) bifurcation area.

Results: At first, we thought ICA bifurcation aneurysm, but selection of microcatheter and microwire into aneurysm was not achieved despite several attempts. Looking closely at angiogram, we considered the aneurysm could be arisen from collateral artery behind ICA bifurcation. Microcatheter was navigated collateral artery and microcatheter angiogram showed the aneurysm was located in collateral network. Our initial plan was to reach as close to the aneurysm as possible and use coils or embolic agent. However, distal catheter placement was extremely demanding work due to complex vascular network. In parent artery as possible as close to aneurysm. the microcatheter could not provide enough supporting for coiling. Lower concentration (about 30%) of NBCA glue was chosen so that it can reaches the pseudoaneurysm. Embolization was successful and aneurysm was not visible in angiography. Ten days later, follow up angiography was performed and there was no recanalization of aneurysm. The patient was discharged without neurologic deficit.

Conclusion: Moyamoya pattern collateral network can occur in MCA occlusion (preferably with hypoperfusion) and can be associates with intracranial aneurysms or pseudoaneurysms. These aneurysms can cause hemorrhagic presentations, therefore endovascular treatment (aneurysm obliteration and/or parent artery occlusion) with NBCA was conducted for in complex vascular anatomy state.

P441

Embolization with NBCA for Ruptured Aneurysm Located in the Moyamoya Like Pattern Collateral Network Associated with Isolated Middle Cerebral Artery Occlusion

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Purpose: Moyamoya disease (MMD) is a well described phenomenon. But unusual anastomosis pattern (moyamoya-like) associated with isolated middle cerebral artery (MCA) stenosis or occlusion and the relationship with aneurysm have not been well described. We report a case of ruptured aneurysm treated with N-butyl cyanoacrylate (NBCA) located in moyamoya like pattern collateral network with isolated middle cerebral artery occlusion.

Materials and Methods: A 54-year-old woman with a history of hypertension was admitted to our hospital with a sudden, thunderclap headache. Computerized tomography (CT) scan revealed subarachnoid hemorrhage in the right sylvian fissure and in right frontal lobe. CT angiography showed proximal M1 segment occlusion and there is no definite aneurysmal sac. Conventional and 3D rotational angiogram defined a moyamoya pattern collateral network in occluded MCA and small aneurysm – suspicious pseudoaneurysm, was visible in internal carotid artery (ICA) bifurcation area.

Results: At first, we thought ICA bifurcation aneurysm, but selection of microcatheter and microwire into aneurysm was not achieved despite several attempts. Looking closely at angiogram, we considered the aneurysm could be arisen from collateral artery behind ICA bifurcation. Microcatheter was navigated collateral artery and microcatheter angiogram showed the aneurysm was located in collateral network. Our initial plan was to reach as close to the aneurysm as possible and use coils or embolic agent. However, distal catheter placement was extremely demanding work due to complex vascular network. In parent artery as possible as close to aneurysm. the microcatheter could not provide enough supporting for coiling. Lower concentration (about 30%) of NBCA glue was chosen so that it can reaches the pseudoaneurysm. Embolization was successful and aneurysm was not visible in angiography. Ten days later, follow up angiography was performed and there was no recanalization of aneurysm. The patient was discharged without neurologic deficit.

Conclusion: Moyamoya pattern collateral network can occur in MCA occlusion (preferably with hypoperfusion) and can be associates with intracranial aneurysms or pseudoaneurysms. These aneurysms can cause hemorrhagic presentations, therefore endovascular treatment (aneurysm obliteration and/or parent artery occlusion) with NBCA was conducted for in complex vascular anatomy state.

P442

Treatment of aneurysms at MCA-twig of retre with aplastic MCA trunk

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In the fetal stage of MCA development, the multiple primitive MCA plexus would normally evolve into a single main MCA trunk by fusion and regression. If the evolution of MCA from the fetal stage to the normal adult type is stopped due to an unknown underlying mechanism, we called it as MCA twig with aplastic MCA trunk. Aneurysms can occur at main artery and also at the fine arterioles of twigs of retre. We report 2 cases of aneurysms, which ruptured at small fine arterioles of twigs of retre with aplastic MCA trunk. Also, we focused therapeutic concern of theses rare cases.

Case 1; A 57-year-old female who presented with sudden onset loss of consciousness. Temporal ICH and IVH was found. An angiogram showed large aneurysm at the twigs of retre with aplastic MCA trunk. We could not approach to aneurysm itself and selective angiogram showed profuse collateral flow with surrounding brain. Therefore, we decided to do the proximal flow control with coils. Case 2; A 57-year-old male who complained of headache only. Small amount of ICH and IVH was found. Small aneurysm at the twigs of retre with aplastic MCA trunk was found. We were unable to approach to distal arteriole enough and
aneurysm was so small. So we could not do proximal flow reduction. In both cases, we identified aneurysms were disappeared after several months later. To the best of my knowledge, this is the first report of spontaneous occlusion of ruptured aneurysm with this congenital MCA anomaly. These developmentally abnormal vessels should be differentiated with Moyamoya disease, MCA dissection and atherosclerotic disease. The aneurysm with this anomaly should be differentiated by location. The aneurysm proximal to the twigs of rete is usually at the main artery and might result from hemodynamic pressure loading. The aneurysms at distal network like vessels itself might be due to fragile property of vessels with hemodynamic insult. From the surgical point of view, these distal aneurysms are very difficult to clip because usually located in deep parenchyma, furthermore surrounding fine vessels and brain are vulnerable to injury. In neurointerventional field, embolization is problematic, too. From angiographic point, we can see these aneurysms are in the middle of the twigs of rete. Often we could not advance to aneurysm across the complex fragile network with endovascular approach. So, proximal flow reduction with coil might be effective when complete aneurysmal obliteration is impossible. Aneurysm at twigs of rete itself with aplastic MCA trunk, proximal flow control at arteriole can be option of treatment. Besides spontaneous resolution can be occur with very small aneurysm with this anomaly.

P443

Semi-Jailing Technique Using a Neuroform3 Stent for Coiling of Wide-Necked Intracranial Aneurysms

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Purpose: The semi-jailing technique (SJT) provides stent-assisted remodeling of the aneurysm neck during coil embolization without grasping the coil delivery microcatheter. We retrospectively evaluated the efficacy and safety of SJT using a Neuroform3 stent for coiling of wide-necked intracranial aneurysms.

Materials and Methods: We collected the clinical and radiological data between January 2009 and June 2015 of the wide-necked aneurysms treated with SJT using a Neuroform3 stent.

Results: SJT using a Neuroform3 stent was attempted in 70 wide-necked aneurysms (68 patients). There were 56 unruptured and 14 ruptured aneurysms. The size of aneurysm ranged from 1.7 to 28.1 mm (mean 6.1 mm). The immediate angiographic results were complete occlusion in 55 aneurysms (78.6%), neck remnant in 7 (10.0%), and aneurysm remnant in 8 (11.4%). Overall, periprocedural complications occurred in 13 patients (19.1%), including asymptomatic thromboembolism in 7 (10.3%), symptomatic thromboembolism in 4 (5.9%), and symptomatic hemorrhagic complications in 2 (2.9%). Conventional angiography follow-up was obtained in 55 (78.6%) of 70 aneurysms (mean, 10.9 months). The result showed progressive occlusion in 7 aneurysms (12.7%) and recanalization in 1 aneurysm (1.8%). At the end of the observation period (mean, 17.5 months), all 54 patients without subarachnoid hemorrhage showed excellent clinical outcomes (mRS 0), except two (mRS 1 or 2) and seven of 14 patients with subarachnoid hemorrhage showed symptomatic complications (mRS 0).

Conclusion: In this report of 70 aneurysms, SJT using a Neuroform3 stent for coiling of wide-necked intracranial aneurysms showed good technical safety, as well as favorable clinical and angiographic outcomes.

P444

Regression of an intracranial aneurysm after resolution of vasospasm: A case report

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Purpose: The morphological changes of an aneurysm, i.e., growth or shrinkage, may be dependent upon changes in hemodynamics. We describe a case which showed spontaneous size reduction of an unruptured aneurysm after resolution of subarachnoid hemorrhage (SAH)-associated vasospasm.

Summary of case: A 43-year-old woman presented with SAH. On initial CT angiography (CTA), multiple intracranial aneurysms were noted; two aneurysms at each middle cerebral artery (MCA) bifurcation and one at the anterior temporal artery origin site of the right MCA. The aneurysm at the right MCA bifurcation was considered ruptured because it was the largest aneurysm embedded within the SAH. The right MCA was diffusely narrowed, which suggested vasospasm on preoperative CTA. The patient underwent surgical clipping and we were able to confirm that the right MCA bifurcation aneurysm had ruptured. On 10th day after the operation, the patient complained of persistent headache, and digital subtraction angiography (DSA) was performed. DSA showed severe vasospasm at the right MCA; therefore, nimodipine was intravenously infused until discharge. The patient recovered and was discharged on the 21st day after the operation without neurologic deficits. Follow-up DSA taken three months after discharge showed complete resolution of vasospasm and significant size reduction of the unruptured aneurysm at right anterior temporal artery origin. This was found only at the aneurysm on the side with vasospasm, whereas another unruptured aneurysm at the contralateral side unaffected with vasospasm did not undergo size change. Although there was no information about the exact size of the aneurysm before the SAH, we assumed that it may undergo transient enlargement...
followed by regression. Our hypothesis is that unruptured small aneurysm may presumably undergo transient enlargement and after that, reduction in size, which could be related to altered hemodynamics during the vasospastic period. We speculated that blood flow in the branching vessel or aneurysm can be increased when it originates from a severely spastic parent vessel, according to the report from Soustiel et al (Stroke, 2001;32(3):629–35)

**Conclusion:** During the vasospastic period, the size of an unruptured aneurysm may be enlarged transiently or show regression and therefore, follow-up DSA is required to re-evaluate the aneurysm after resolution of vasospasm.

**P445**

**Endovascular Treatment for Symptomatic Vertebral Artery Dissecting Aneurysms**

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**Objective:** Vertebral artery dissecting aneurysms (VADAs) are rare and many debates are present about treatment options. We review types and efficacy of our endovascular treatments, and establish a safe endovascular therapeutic strategy regard to the angio-architecture of VADAs.

**Methods:** Between July 2008 and October 2015, we treated 22 patients with symptomatic VADAs. Fifteen patients presented with subarachnoid hemorrhage from the ruptured VADAs, digital subtraction angiography and magnetic resonance image confirmed the diagnosis and endovascular treatments were followed as their angio-architecture.

**Results:** Clinical results were good in 13 patients (86.7%), and there were no technical problems during endovascular procedures. The other 2 patients with poor prognosis showed severe neurological deficits at the initial evaluation. Among the three different endovascular strategies, there was no radiologic cure in one patient with stent insertion alone, but the patient had no significant clinical symptoms either.

**Conclusions:** Endovascular treatments are safe and effective treatment option for managing VADAs and can be the first treatment of choice for most patients. To select proper endovascular strategy according to the angio-architecture of VADAs can reduce the risk of the treatment.

**Keywords:** Vertebral artery, Dissecting aneurysms, Embolization

**P446**

**Angiographic perfusion imaging in the treatment of cerebral arterial spasm in aneurysmal subarachnoid hemorrhage**

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**Purpose:** Vasospasm following cerebral aneurysm rupture is one of the most devastating sequelae and the most common cause of delayed ischemic neurological deficit. We evaluated the usefulness of angiographic perfusion imaging (API) in the treatment of cerebral arterial spasm in aneurysmal SAH.

**Materials & Methods:** 15 angiographic perfusion images were acquired from 12 patients who suspected cerebral arterial spasm after coiling or clipping of ruptured cerebral aneurysms.

API was acquired on an AXIOM Artis dBA (Siemens, Forchheim, Germany) and acquisition protocols were as follows. Neuro PSV IR (70 kV/0.36 μGy/8 s), dilution (contrast/saline, 50:50), injection volume (85 ml), injection rate (5 ml/s), duration of injection (17 s), X-ray delay (9 s), catheter position (SF multipurpose catheter placed just above the aortic valve). Reconstruction protocols were full VOI size, 512 slice matrix, smooth image characteristics, Neuro PBV reconstruction mode, Neuro PBV IR viewing preset.

We compared the API with both sides internal carotid angiographic findings and peak systolic velocity (PSV) of transcra-nial Doppler US (TCD) of both M1 segments.

**Results:** Angiographic and API severity of both sides was concordant in 8 cases, discordant in 3 cases, questionable in 4 cases. TCD and API severity of both sides was concordant in 9 cases, discordant in 5 cases, questionable in 1 case. Intraarterial infusion of nimodipine.

**Conclusions:** We observed good agreement between API and angiographic findings and PSV of TCD in the evaluation of brain perfusion in patients with cerebral arterial spasm following cerebral aneurysm rupture.

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**P447**

**Endovascular treatment of distal Anterior cerebral artery aneurysms with a Low-profile Visualized Intraluminal Support (LVIS Jr) device**

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**Objective:** Aneurysms of the anterior cerebral artery (ACA) located distal to the anterior communicating artery (ACOM) is always challenging for surgical clipping as well as endovascular embolization. This study focus on the embolization of distal anterior cerebral artery aneurysms with Low-profile Visualized Intraluminal Support (LVIS Jr) stent.

**Materials and Methods:** The database of our institution were reviewed. Patient with distal anterior cerebral artery aneurysms between 2014 and 2016 were included in the analysis. The retrospective data of these patients including the clinical presentation, procedural complication, clinical and angiographic follow-up information was collected and analyzed.
Results: Seven patients who underwent endovascular treatment of distal AICA aneurysms with LVIS Jr stent were identified. All devices were deployed successfully and all patients received good clinical outcomes. There were two aneurysms which were treated in the acute phase of subarachnoid hemorrhage (SAH). One patient had internal carotid artery severe stenosis of ipsilateral side pre-operatively and treated with stent in the same operation. One patient had aneurysms associated with cerebral arterial venous malformations (AVMs) which was treated with embolization. No in-stent stenosis or occlusion was seen on short-time MRI follow-up and the aneurysms were all occluded with no morbidity found.

Conclusions: This small series suggests that LVIS stent is relatively feasible and effective way for the treatment of distal anterior cerebral artery aneurysms.

P448

Endovascular management of massive oronasal bleeding after surgical removal of skullbase tumor

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Purpose: Iatrogenic cerebrovascular injury with massive oronasal bleeding after surgical removal of skull base tumor is uncommon complication. The purpose of this study is to report our experiences of endovascular management of oronasal bleeding after trans-sphenoid removal of skull base tumor.

Materials and Methods: Over a 3-year period, a total of 8 patients underwent trans-arterial embolization to manage massive oronasal bleeding after trans-sphenoid removal of skull base tumors. There were 6 men, 2 women; age ranged from 48 to 63 years old (mean: 53 yrs). We retrospectively analyses angioarchitecture of affected artery, tumor pathology, selection of embolic material and technique of embolization. Angiographic and clinical outcomes were evaluated as well.

Results: Of these 8 patients, five was pituitary macroadenomas, two was hemangiopericytomas and one was clival meningioma. The affected artery was cavernous internal carotid artery (n=7), proximal basilar artery (n=1) associated with pseudoaneurysm in parent artery. Active contrast extravasation was identified in 5 patients. Coil occlusion of parent artery and pseudoaneurysm after balloon occlusion test was performed in 5. Occlusion of pseudoaneurysm by coil (n=2) or combined coil and liquid adhesive (n=1) with preservation of blood flow of parent artery in 3. There was no significant procedure-related neurological complication. All massive oronasal bleeding was ceased immediately after embolization. No significant procedural-related neurologic complication was observed. The follow-up period varied from 3 to 48 months (mean: 19 mos)

Conclusion: Endovascular embolization is an effective, safe and salvage procedure to manage massive oronasal bleeding resulted from cerebrovascular injury after surgical removal of tumor. In patients with active contrast extravasation from pseudoaneurysm, endovascular coil occlusion of affected artery and pseudoaneurysm after balloon-occlusion test is an option. Endovascular coilings pseudoaneurysm with preservation of parent is an alternative in those patients without contrast extravasation. Liquid embolic embolization may enhance the effect of embolization, and it should be done under balloon-assisted technique to avoid thromboembolic event.

P449

Coiling vertebral artery dissecting aneurysm with intracranial stent for preserving involved posterior inferior cerebellar artery

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The treatment of ruptured posterior inferior cerebellar artery (PICA) involved type vertebral artery (VA) dissecting aneurysm is tend to be troublesome, because we must preserve the flow of PICA with trapping VA. We have experienced the case of coiling a ruptured dissecting VA aneurysm with stenting for preserving involved PICA.

A 53-year-old man was transferred with an ambulance to our hospital because of a severe headache. There was a diffuse thick subarachnoid hemorrhage (WFNS grade II, Fisher group3) on his head CT scan, and dissecting aneurysm in his left VA on his 3DCT Angiography. PICA diverged from dissecting part of VA. We performed the endovascular treatment under the general anesthesia. Aspirin200mg, clopidogrel 300 mg were given through the nasalgastric tube, and intravenous heparin was 4000 units. We put the microcatheter in the aneurysm, before the intracranial stent (Enterprise2 4.0 mm 23mm) was placed from PICA to VA. We put the coil in the aneurysm with jailing technique, finished the complete occlusion. After the treatment, the distal part of VA from the aneurysm was occluded because of being kinked by the coil mass, but the flow of PICA was preserved by the stent on his MR angiography. He was discharge after the treatment with mRS grade 2.

We usually perform OA-PICA anastomosis following internal trapping for PICA involved type VA dissecting aneurysm. The treatment, however, is tend to be complicated. There are some reports performing endovascular treatment with intracranial stent for PICA involved type VA dissecting aneurysm in these days. We must care not to kink PICA by the coil mass, and focus on filling the coil in the part of ruptured point for the case of SAH. In this case, we found that VA, which was distal side from PICA was occluded by the coil mass, and the flow of PICA was kept by the intracranial stent. We could success this treatment, because the angle between PICA and VA was not so sharp, and the diameter of PICA was closed to it of VA. Actually, We,
however, are sure that all of PICA involved type VA dissecting aneurysms are not able to get the indication, and bleeding risk must be concerned about giving the dual anti-platelet therapy in spite of the case of SAH. Coiling PICA involved type VA dissecting aneurysm with stent for preserving PICA is useful treatment without open surgery in some cases.

P450
The procedural merits and demerits of preshaped microcatheter
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Purpose: The tip end shape of microcatheter is very important point for endovascular coiling of cerebral aneurysms. Operator should choose steam-shaped microcatheter (S-S) or preshaped microcatheter (P-S) based on each characteristic. We assessed the procedural merits and demerits of P-S.

Material and Method: We retrospectively reviewed 169 patients and 172 aneurysms treated by endovascular embolization between September 2005 and April 2015, and excluded parent artery occlusion cases for dissecting aneurysm or giant aneurysm or complicated technique, because of difficulty in evaluating effectiveness of the shape. Cases were come under the three categories, conclude in 1st catheter chosen from preoperative image, conclude in appropriate one of some opened devices consequently and the cases those are reasonable for some catheters use. We evaluate the ground of judgement to be improper and the reason that more than one needed.

Result: 54 cases were excluded, so 118 case were reviewed. In 70 (59.3%) cases, we conclude in 1st P-S only, and in 28 (23.7%) cases conclude to choose P-S in the first time and change S-S additionally. We judged that more than one of use was proper for 20(17.0%) cases. A three-dimensional mismatch, the length or radius of the tip and large size aneurysm were reasonable for inadequacy of the tip end shape.

Conclusion: PD, the tip shape is stable, so provides the decision making of 2nd catheter (SS) with useful information. On the other hand, variation of the standard is limited, and it's difficult to add steam shape.

P451
Coil embolization without stents for bifurcation aneurysms
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Background: Recently, stent-assisted coiling is a widespread method for wide neck, unruptured intracranial aneurysms (UIAs). However, relatively high incidence of ischemic complications and prolonged antiplatelet therapy are still of concern.

Objective: To examine the safety and efficacy of our strategy for bifurcation aneurysms in which use of stents were evaded as much as possible.

Materials and Methods: A total of 113 bifurcation UIAs which underwent endovascular therapy between April 2005 and April 2016 at our institute were retrospectively reviewed. The aneurysmal size, neck width, aspect ratio (AR), volume embolization ratio (VER), ischemic complications, and retreatment were analyzed.

Results: 109 cases (96.5%) were treated without stents. The average size, the neck width, AR were 6.81 ± 2.68 mm, 4.13 ± 1.72 mm, 1.40 ± 0.55, respectively. Wide-necked aneurysms (WAn) were 59 cases (53.2%). Adjunctive technique (AdT) was used in 53 cases (48.6%), in which balloon assist technique (BAT) were 43 cases (79.2%). The locations of aneurysms were as follows: Acom 53 (48.6%), BA bifurcation 45 (41.3%), IC bifurcation 7 (6.4%), distal ACA 4 (3.7%). There was no difference in VER by aneurysmal locations (p = 0.21). In BA bifurcation aneurysms, higher rates of WAn (77.8%, p < 0.0001) and lower AR (1.21 ± 0.54, p = 0.0002) were noted compared with other sites, resulting in higher incidence of using AdT (93.3%, p < 0.0001). On the contrary, simple technique were more used (86.7%, p = 0.0001) in ACA territory, and use of distal access catheter (DAC) s led to higher VER (p = 0.0086). Symptomatic ischemic complications occurred in 4 patients (3.7%), and only 4 patients (3.7%) required retreatment with a follow-up period of 56.1 ± 32.4 months.

Conclusions: Our results of coiling for bifurcation aneurysms were feasible even without stents. The proper use of balloons for BA bifurcation cases and use of DAC for ACA territory seemed effective in avoiding recurrence.

P452
Results and Current Trends of Multimodality Treatment for Infectious Intracranial Aneurysms
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Purpose: The authors retrospectively reviewed their cases of infectious intracranial aneurysms and discuss results and trends of current treatment modalities including medical, neurosurgical and endovascular.

Materials and Methods: Twenty patients (10 males and 10 females; mean age 46.0 years) with 23 infectious aneurysms were treated by various treatment modalities during a 15-year period.

Results: Fifteen cases (75.0%) were caused by infective endocarditis. Eleven aneurysms (47.8%) were ruptured.
Two aneurysms (8.7%) presented a mass effect and 7 (30.4%) were unruptured and asymptomatic. The average aneurysm size was 6.5 ± 4.8 mm (range 1–22 mm). The aneurysms were located in proximal cerebral circulation in 7 (30.4 %) and distal in 16 (69.6%). Six (26.1%) aneurysms were treated surgically (5: trapping, 1: neck clipping), 10 (43.9%) endovascularly (7: trapping, 2: proximal occlusion, 1: saccular coiling), and the remaining 7 (30.4%) medically. Endovascular treatment was gradually increased with time. Medical and surgical treatment was continuously performed during the study period. Surgery was preferred for the patient with intraparenchymal hematoma or treated by bypass surgery. Three periprocedural minor complications occurred in endovascular treatment. There was one postoperative infarction with permanent deficit developed from surgical treatment. During the follow-up period (mean 28.8 months), none of the aneurysms presented a recurrence or rebleeding. Thirty patients (65.0%) had favorable clinical outcomes (modified Rankin Scale: 0–2), although four (20.0%) had poor outcomes (modified Rankin Score: 5–6).

Conclusion: A multimodal approach for the management of infectious aneurysms achieved satisfactory results. Endovascular intervention is a feasible and efficacious treatment option and surgical intervention is still an indispensable procedure.

**P453**

**Usefulness of FRED flow diverter (FD) in distal supraclinoid aneurysms avoiding jailing A1: clinical and angiographic short term follow up**

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**Introduction:** Use of FD at distal supraclinoid segment, even more Anterior choroidal (Achor) aneurysms carry a high risk of occlusion or severe stenosis of A1, loosing many times an anterior circle of Willys competent or a dominant A1.

**Objective:** We present our initial retrospective experience with Flow-Redirection Endoluminal Device FRED, a dual layer device with proximal and distal 3 mm free of flow diverter mesh for these aneurysms.

**Methods:** Patients harboring blister like, wide-necked, and/or artery emerging of sac intracranial aneurysms located at choroideal segment sometimes associated with Pcom aneurysms were selected for treatment. Technical success (defined as the implant of the mesh at the level or below ICA bifurcation covering all the neck/s of the aneurysms leaving free of mesh ICA bifurcation), device conformability, repositioning rate, occlusion rate at short term FU and clinical evolution were evaluated.

**Results:** Since dic/2014 up to mar/2017 overall 41 FRED were implanted. We had the intention to treat 11 patients with distal ICA aneurysms avoiding A1 jailing. Technical success was 9/11 (81%). 2 inaccuracies was registered, one implanted from M1 and the other with mesh at middle of A1. All of them were small aneurysms and 11 FREDs were implanted. Non procedural morbi-mortality was registered. Good conformability was registered in 10/11 (90%). Repositioning rate was 1.9 times, encountered in three patients the benefit of begin unsheathing from A1 to get best conformability regarding the anatomy.

8/10 patients were evaluated with Digital Subtraction Angiogram at 6 months FU. A1 remained open without stenosis in all of them achieved technical success. Aneurysm total occlusion rate was 75% (6/8) 1 reduce size, 1 without changes. Clinically, there have been no adverse events at FU.

**Conclusion:** Distal supraclinoid aneurysms are a challenge for FDs in order to keep ICA bifurcation indemnity. In our initial experience with FRED device endovascular reconstruction of these aneurysms represents a safe procedure with experimented operators, and effective about avoiding A1 jailing and rate of occlusion at short term FU.

Keywords: cerebral aneurysm, Flow Re-Direction Endoluminal Device, FRED, flow diverter.

**P454**

**Endovascular treatment of intracranial aneurysms with DERIVO Embolization Device (DED): clinical and angiographic short term follow up**

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**Objective:** We present our initial retrospective experience with DERIVO Embolization Device (DED) since april/2015 up to april/2017 in intracranial aneurysms, periprocedural results and short term follow up (FU).

**Methods:** Patients harboring large and giant wide-necked, small nonsaccular, recurrent, and artery emerging of sac intracranial aneurysms were selected for treatment. Technical success, device conformability, occlusion rate at short term FU and clinical evolution were evaluated.

**Results:** Twenty one patients with 24 intracranial aneurysms were treated with DERIVO FD (18 female). Small n = 15 that include those with artery emerging of sac (4) and segmental defect (9), large (n = 8), giant (n = 1). 20 were sacular, 3 fusiform and one pseudoaneurysm post sellar surgery. 18 incidental and 6 symptomatic. 22 devices were used and 20 were implanted in 21 procedures. Technical success was 95%. In one patient two devices used without implant. One (5%) conformability defect resolved with balloon.
16/20 patients (17 aneurysms) were evaluated with Digital Subtraction Angiogram at 6 mo FU. 13 with complete occlusion (76%) and 4 aneurysms partially open reduce in size. Non procedural neither FU morbi-mortality was encountered. Non significant stenosis was found in angiograms. Conclusion: Endovascular reconstruction with the DERIVO Embolization Device in our initial experience represents a safe procedure with good rate of aneurysms occlusion at short term FU. Mid and long term FU are expected.

P455
Distal anterior circulation aneurysms treated with stent and coils: clinical and angiographic mid term follow up

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Objective: We present our experience with coils stent assisted with different neurostents for distal anterior circulation aneurysms, periprocedural results and mid term follow up.

Methods: Descriptive and Retrospective analysis of reports of endovascular treatment of intracranial wide neck aneurysms when was planned treatment with coils and neurostents distal to ICA bifurcation. Type of device, size of aneurysms, conformability, clinical and angiographic at mid term FU.

Results: Since September 2010 to September 2016 thirty eight patients (22 female) were registered. Small n = 25 (65%) and large n = 11 (28%) aneurysms, 2 fusiform/ dissecting. In 36 cases as a planned procedure and two cases devices were implanted as a rescue during balloon remodeling technique 39 different devices were implanted: Enterprise, Neuroform, Leo Baby, Lvis Jr and Solitaire. One callosal haemorrhage was registered related to microguide with transient morbidity and mRS 4 at 6 months. 34/38 patients were controlled with DSA at 6 months FU with total occlusion of 88% (30/34) with stable rate at 12 months FU control DSA 22/25 controlled. One stroke was registered due to in stent severe stenosis resolved with balloon expandable stent.

Conclusion: Endovascular reconstruction with neurostents and coils for distal aneurysms of anterior circulation in our experience represents a safe procedure and effective about rate of occlusion at mid term FU with low procedural morbi-mortality.

P456
Early endovascular treatment of ruptured brain aneurysms

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Early endovascular treatment of ruptured brain aneurysms is directed against rerupture of aneurysm, which can cause in 70% deep invalidization or lethality. Endovascular embolization of ruptured aneurysm practically excludes rerupture. Early intervention may enable a decrease in neurological disability and increase in good outcome. It has been performed endovascular embolization on 45 patients, during year 2016, with diagnosis of acute subarachnoidal hemorrhage. In all cases embolization was performed during the first 72 hours after the rupture.

Before operation patients condition was assessed by Hunt-Hess scale. In compensation condition (By Hunt-Hess 1-2 point) was 15 patients (33.3%), Subcompensation condition (By Hunt-Hess 3 points) 18 patients (40%) and decompensation condition (By Hunt-Hess 4-5 points) 12 patients (26.7%).

After operation mortality was 13.3%. (6 patients)
After operation patients condition was evaluated by Glasgow Outcome Scale (GOS) – GOS (5) 29 patients (64.5%), GOS (4) - 6 patients (13.3%); GOS (3-2) -4 patients (8.9%).

In the case of acute subarachnoid hemorrhage, in respect to avoidance of rerupture, urgent endovascular treatment is indicated.

Findings indicate, that early endovascular treatment improves outcome of the disease.

P457
Variation of stent-assisted coil embolization for anterior communicating artery aneurysm

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Purpose: Anterior communicating artery aneurysm (Acom AN) is one of the good targets for endovascular treatment (EVT) because of its deep location and complexity of direct surgery. Stent-assisted coiling (SAC) can be utilized for wide neck Acom AN, though it requires several consideration and specialized techniques for its application.

Materials and Methods: Authors reviewed our EVT database since 2010 when SAC became on-label in Japan. Number of
cases of Acom AN was 57 out of 427 unruptured aneurysms treated by EVT during the period. **Results:** Among these, SAC was utilized in 23 cases for Acom AN. Deployment of stent pattern was the following. 1) ipsilateral A2-A1:5, 2) contralateral A2-A1:10, 3) Y-stenting (both A2 to ipsilateral A1):3, 4) X-stenting:1, 6) half-T stenting:4, 7) parallel stenting:0. Closed cell (Enterprise) or open cell (Neuroform) were used dependent on anatomical characteristics of Acom complex, though braided stent (LVIS Jr) has been used predominantly in recent cases because of availability of smallest delivery microcatheters. **Conclusions:** SAC for Acom AN is useful and technically feasible in most cases for this location if necessary. Complex stenting may be required in some cases dependent on variation of Acom anatomy. Alteration of branching angle was often observed after deployment of stent, which should be taken into account before SAC. Technical tips and pitfalls will be discussed with presentation of illustrated cases.

**P458**

The predictive factors of progressive occlusion after incompletely occluded aneurysm with stent assisted coil embolization

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**Purpose:** Some intracranial aneurysms treated by stent-assisted coil embolization (SAC) with incomplete occlusion underwent progressive occlusion (PO) during follow-up period. We analyzed the predictors for the occurrence of PO. **Materials and Methods:** Among 75 patients harboring 76 cerebral aneurysms treated by SAC from 2010 to 2015, we included 43 aneurysms with occlusion grade of neck remnant (NR, n = 36) or residual aneurysm (RA, n = 7) at the post-procedure. We defined PO as improved occlusion grade of NR from RA, or complete occlusion from NR or RA on angiographic follow-up imaging at 6 months after the procedure. We investigated the associations between the occurrence of PO and patients’ characteristics, used devices, and angiogram findings. Moreover, we analyzed the independent predictors for PO by multivariate logistic regression model and receiver operating characteristic (ROC) curve analysis. **Results:** Forty-three aneurysms were analyzed, and their mean volume embolization ratio was $30.3 \pm 6.7\%$. Twenty aneurysms (47%) achieved the progressive occlusion spontaneously at 6 months after SAC. Compared with the aneurysms with no change of occlusion grade, the mean max diameter and the median neck diameter of the aneurysms were shorter in aneurysms with PO. Multivariate logistic regression analysis also found that the odd ratio of neck diameter of the aneurysm for PO was 0.44 (95% CI: 0.19 - 0.82). Moreover, ROC curve analysis for PO found that the optimal cut-off value of the neck diameter was 5.5 mm, with a sensitivity of 95%, specificity of 57%, and an area under the ROC curve of 0.76 ($P < 0.01$). **Conclusion:** The incompletely occluded aneurysms with the neck diameter of 5.5 mm or less might be more likely to occur progressive occlusion within 6 months after stent-assisted coiling. If the adequate packing density has been obtained, additional coiling to the remnant neck space of these aneurysms might not be always necessary.

**P459**

Juntendo University Hospital Experience of Pipeline™ Flex Embolization for Large/Giant Intracranial Aneurysms

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**Purpose:** The Pipeline™ Flex embolization device (PED: Medtronic Neurovascular, Irvine, CA, USA) is the first and only approved flow diverter in Japan. The purpose of this study is to report the clinical outcome of PED embolization at Juntendo University Hospital. **Methods:** A retrospective review of the medical records, outpatient charts, and operative records of the patients endovascularly treated with PEDs between June 2015 and June 2016 was performed. **Results:** 72 patients (mean age, 62.8 yrs.; female 64, 88.9%) with unruptured 77 aneurysms were the subject of this study. Among these aneurysms, 29 were symptomatic due to the mass effect and 48 asymptomatic. The aneurysm locations were C6 segment of internal carotid artery (37), C3 (3), C2 (30), C1 (7). The mean maximum sac diameter was $16.7 \pm 6.8$ mm and the mean neck length was $8.5 \pm 4.5$ mm. 47 patients with 49 aneurysms were underwent follow-up catheter angiography (mean 9.2 ± 4.0 mos.). Anatomical outcomes with O’Kelly- Marotta scale showed grade D (31), C3 (4), C2 (5), C1 (2), B3 (2), B2 (1), B2 (1), B1 (1), A3 (1), A2 (1). Procedure/Device related complications occurred in 9 patients; hemorrhagic event related to antiplatelet therapy (1), thromboembolic event (3), delayed intraparenchymal hemorrhage (2), delayed aneurysm rupture (2), femoral puncture site hemostatic trouble (1). Permanent morbidity and mortality rates related to the procedure were 2.8% and zero, respective. But 1 patient died of systemic organic failure related to the pneumoniae. **Conclusions:** The results of this report indicate that PED embolization is safe and effective for large/giant unruptured UIAs in Japanese populations.
P460

Usefulness of modified 3D time-of-flight (TOF) MRA for follow-up of cerebral aneurysm after stent assisted coil embolization; Comparison with contrast-enhanced MRA and standard 3D TOF MRA

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Purpose: To evaluate the feasibility and usefulness of modified-3D TOF MRA (Short TE / high flip angle) for follow-up of intracranial aneurysms after stent-assisted coil embolization through comparison of standard 3D TOF MRA and contrast enhanced (CE) MRA.

Materials and Methods: From April 2014 to December 2016, 6 consecutive patients with unruptured cerebral aneurysms treated by stent-assisted coil embolization (Stent; 4 Enterprise, 1 LVIS, 1 LVIS Jr). All patients underwent standard 3D TOF MRA and modified 3D TOF MRA, and CE MRA was performed 4 patients using Enterprise. We evaluated the depiction of parent artery and aneurysmal occlusion on each MRA.

Results: Enterprise group (4 patients with CE MRA); Modified 3D TOF MRA was best in the depiction of parent artery. In evaluation of aneurysmal occlusion, modified 3D TOF MRA was best in 2 patients, was equal to CE MRA in one patient. In only one patient, CE MRA was superior to modified 3D TOF MRA for evaluation of aneurysmal occlusion. LVIS group (2 patients without CE MRA); No aneurysmal remnant/recurrence was seen, and modified 3D TOF MRA was superior to standard 3D TOF in the depiction of parent artery.

Conclusion: In evaluation of post stent-assisted coil embolization of cerebral aneurysms, modified TOF MRA is superior to CE MRA in depiction of parent artery, and has equal ability for evaluation of aneurysmal occlusion.

P461

Intraprocedural leak during aneurysmal coil embolization

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Purpose: Intraprocedural leak during aneurysmal coiling has been reported to occur from 2 to 5%. This study aims to present intraprocedural leak during aneurysmal coil embolization.

Materials and Methods: Among 74 patients who treated with aneurysmal coil embolization, intraprocedural leak happened to occur in three patients. They were evaluated focusing on angiographic and clinical features and clinical outcome, related with intraprocedural leak.

Results: The incidence of intraprocedural leak during aneurysmal coiling is 4.1%. The coiling procedures were conducted for ruptured dissecting aneurysm in distal ICA in two patients and ruptured PICA aneurysm in one patient. The angiographic findings demonstrated the displacement of coil loop, coil mass, or microcatheter that could be related with device-device interaction in some cases. In one patient, contrast leak was found just after systemic heparinization in partial coil embolization. In all cases, rapid occlusion of leak point as soon as possible, was done, as well as reversed heparinization if injected. Time interval between the detection and the termination of leak was less than five minutes except recurrent leaks in one patient. One patient was found to become worse neurologically after procedure. One patient was expired four days after procedure, who had ruptured dissecting aneurysm in distal internal carotid artery in the condition of invasive aspergillosis with meningoencephalitis and probable angioinvasion. one patient was not recovered with deep stuporous mentality and the other one was fully recovered.

Conclusion: Intraprocedural leak could be accidently and unexpectedly developed, even though quite low incidence. Although the outcome could be sometimes grave, early detection and rapid occlusion of leak point lead to benign clinical outcome.

P462

Retrograde stent-assisted coil embolization through posterior cerebral artery for posterior communicating artery aneurysm, with long-term follow-up results

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Purpose: Some wide-necked posterior communicating artery (PcomA) aneurysms incorporating the origin of PcomA at an acute angle could be facilitated by retrograde stenting through posterior cerebral artery (PCA) to terminal internal carotid artery (ICA) due to the limited protective effect of antegrade stenting and the difficulties of navigation and stenting. This study present the coil embolization of PcomA aneurysm with retrograde stenting through PCA in three cases with long-term follow-up results.

Materials and Methods: When retrograde stenting was more feasible, a microcatheter for stent delivery was advanced from the vertebral artery to the terminal ICA through ipsilateral proximal PCA (P1) and PcomA. Then, another microcatheter for coil delivery through ipsilateral ICA selected PcomA aneurysm. Coil embolization in three cases was performed under the protection of a stent deployed from PcomA to terminal ICA. And, the coil mass has been angiographically evaluated for more than one and half years.
Results: Retrograde stent-assisted coil embolization was successfully achieved in all aneurysms by retrograde stenting through P1 and PcomA in vertebral artery approach. All aneurysms were occluded properly with the coils through the jailed microcatheter, without procedure-related complications. No significant coil impaction or aneurysmal recurrence have not been demonstrated on serial follow-up angiographic studies for more than one and half years.

Conclusions: Retrograde stent-assisted coil embolization in wide-necked PcomA aneurysms could be a good alternative treatment strategy, when aneurysms are incorporating the origin of PcomA in the condition that the ipsilateral P1 and PcomA are of adequate size to pass a microcatheter for stent delivery. Successful and stable coil embolization with retrograde stenting could be achieved.

P463
Safety of Preprocedural Antiplatelet medication in coil embolization of SAH
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Background and Purpose: Preoperative antiplatelet medication for coil embolization during acute period of SAH is not common. We tested the hypothesis that preprocedural antiplatelet medication in SAH may prevent complications due to ischemia or induced bleeding.

Materials and Method: Retrospectively reviewed 23 patients who received preprocedural antiplatelet medication that underwent coil embolization. Total 200 mg Aspirin and 150 mg Clopidogel were administered at least 1 hour before coilings. Systemic heparinization was also done after inserted Guiding system.

Results: Among 23 cases, assisted techniques were used in 14 cases. There was no case that we inserted intracranial stent. Postoperative EVD or lumbar drainage was done in 2 and 14 cases, but there was no bleeding complication. And there was no thrombotic complication case.

Conclusion: Preoperative antiplatelet medication leads to a low rate of thromboembolic complications and may have no adverse effect on bleeding complications.

P464
Relationship between MR-DWI-Positive Lesions and Symptomatic Ischemic Complications after Coiling of Ruptured Intracranial Aneurysms
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Purpose: The aims of this study were to evaluate the risk factors for developing symptomatic ischemic complication (SIC, transient ischemic attack or stroke) and microembolism detected as Magnetic resonance diffusion-weighted imaging positive (DWI positive) lesions in coiling of ruptured intracranial aneurysms. Plus, relationship between each factor and modified Rankin Scale (mRS) after 3 month was studied.

Methods: From March 2010 and to March 2013, forty two subarachnoid hemorrhage patients with ruptured intracranial aneurysm underwent both coiling and postoperative Magnetic resonance diffusion-weighted imaging (MR-DWI). The incidence and risk factors for SIC and DWI positive were retrospectively analyzed. The relationships between 3-month mRS and DWI positive or SIC were also analyzed.

Result: The incidence of DWI positive was 50%. There is no big difference from incidence of unruptured aneurysm (54.5%). The incidence of SIC was 9.5% (4/42). Patients aged older than 65 years have a tendency for SIC (p = 0.011). Patients with SIC appeared unfavorable 3 month mRS (mRS 3 ~ 6, p = 0.032).

Conclusion: When endovascular surgeon tries coil embolization to ruptured intracranial aneurysm, should try to reduce the occurrence of SIC, particularly in patients older than 65 years old.

P465
Clinical Outcomes caused by Intraprocedural Rupture during Coil Embolization of Intracranial Aneurysms: seven year’s two-center experience
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Purpose: Intraprocedural rupture (IPR) is a serious complication that may occur during intracranial aneurysm treatment with endovascular technique. The purpose of this study is to report our two-center experience of management for IPR.

Materials and Methods: We retrospectively reviewed the medical records of Inje University Haeundae Paik hospital and Busan Paik hospital. Between January 2010 and April 2017, 2052 intracranial aneurysms were treated with endovascular technique, and IPR occurred in 14 patients (0.68%). We focused on management of IPR, leakage time, angiographic and clinical follow-up results.

Results: Of the 14 patients with IPR, 10 cases were ruptured. Ten were woman and 4 were man with mean age of 55.3 years. Protamine sulfate for reversing heparin was not used except one case. Additional coiling was carried out in all
cases, and additional stent deployment within 1st stent was performed in 1 case. Mean leakage time was 6.7 minutes. Recent 3 cases were treated under intraoperative monitoring (IOM) with somatosensory evoke potential (SSEP) and motor evoke potential (MEP). Particularly, SSEP sensitively reflected changes in blood flow dynamics. Complete occlusion was achieved in 9 cases and incomplete occlusion (residual neck, residual sac) was 5 cases. The mean Glasgow Outcome Scale score at the time of discharge and modified Rankin scale at the last clinical follow-up were 2.1 and 1.6, respectively. Median follow-up duration was 17 months (except 1 dead patient). One patient (Hunt-Hess grade 5) died, yielding a rate of mortality rate of 7.1%.

Conclusion: Favorable outcome after IPR can be expected with immediate management to reduce leakage time. In particular, IOM is reflects changes in blood flow due to IPR in real time, and might be useful modality for predicting clinical outcomes.

P466

Alternative method of ‘Flow Diverting Stents’ for treatment of patients who have intracranial aneurysm

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Purpose: The use of flow diverting stents (FDS) is a new concept in the treatment of intracranial aneurysm. FDS are a reconstructive treatment in which altered flow within an aneurysm induces gradual remodeling and eventual thrombosis of the aneurysm. Several studies have demonstrated good safety and efficacy of FDS for the treatment of intracranial aneurysm. However, some countries including Korea, there is very narrowing insurance permission standard for FDS. Many patients who are needed to treat using FDS can’t take proper management. In this report, we suggest alternative method for FDS. We call it ‘hand-made flow diverting’.

Materials and Methods: A 57-year-old woman admitted emergency department of Samsung Medical Center, presenting with seizure movement. After using a restroom in her house, she showed a sudden collapse and general tonic-clonic movement during 1 minute. She had no medical history of hypertension and diabetes mellitus but one month-ago, she had been diagnosed with SAH. In that time, she had diagnosed with left para-clinoid internal carotid artery aneurysm. And this aneurysm was treated with coil embolization.

In emergency department, emergent computed tomography angiography and digital subtraction angiogram demonstrated subarachnoid hemorrhage (SAH) and blister-type aneurysm in the right middle cerebral artery M1 segment, measuring 10.2 × 13.6 × 10.0 mm and 4.0 mm of aneurysm neck. First choice of intervention treatment for her aneurysm was FDS. However, in Korea, ruptured and below 15 mm-sized aneurysm was not under condition of insurance. We planned alternative method FDS called ‘hand-made flow diverting’. First, we insert micro-catheter for delivering enterprise stent (4 × 16 mm). After deploying first stent in position which is covered aneurysm neck, we inserted another micro-catheter for coil delivering. Detachable helical coil (2 × 3 mm) is selected for the key of flow diverting. This coil winded up first stent cells and blocked blood flow around aneurysm neck. Two more stents (4 × 23 mm and 4 × 16 mm) are deployed around aneurysm neck area. This stents added coil stabilizing and flow diverting effects.

Results: Post-procedure angiography and delayed follow-up angiography presented stagnation in aneurysm, which means diverting effect of blood flow. Before procedure, she had stupor mentality and large volume of SAH. After procedure, her mental status was not changed but no more SAH was occurred. She had treated in ICU and further follow up was needed.

Conclusion: FDS is a relatively new technology, and this is widely used to treat intracranial aneurysm. However, this new technology is still not covering all intracranial aneurysm in some countries. Hand-made flow diverting using basic mechanism of FDS might be possible to use alternative flow diverters for patients who do not taken insurance in some countries. This need more procedure time and long learning cover than FDS but it is possible more selective flow diverting effect.

P467

Endovascular-first treatment for poor grade ruptured middle cerebral artery aneurysm with intracerebral hemorrhage

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Purpose: The treatment of poor grade subarachnoid hemorrhage (SAH) due to a ruptured middle cerebral artery (MCA) aneurysm represents a unique set of challenges. Despite the current trend of increasing endovascular treatment of aneurysms, these lesions remain a distinctly open neurosurgical disease. We report the results of some cases of endovascular treatment for the poor grade SAH due to a MCA aneurysm.

Materials and Methods: We had performed the endovascular treatment for the ruptured aneurysm first and then decompressive craniectomy later in some patients. In these cases, there were no available operating room immediately after evaluation of SAH, so we had performed the coiling first. After endovascular coiling for MCA aneurysm we had performed decompressive craniectomy.

Results: 11 patients had an acute subarachnoid hemorrhage (SAH), of which were due to a ruptured MCA aneurysm. Decompressive craniectomy was performed after coil
embolization in patients who had higher grade of SAH (H-H 4 or 5).
Clinical outcome was analyzed with GOS and were showed excellent outcome 3, moderate disability 1, severe disability 4 and death 3.

Conclusion: Patients often present in extremis with rapidly deteriorating neurologic function requiring emergent neurosurgical intervention. Endovascular coil embolization can be performed safely and effectively in selected MCA aneurysms. It can be the alternative modality that decompressive craniectomy after coil embolization performed in high grade SAH patients who especially have a hematoma.

P468
Technical and clinical results of therapeutic parenteral vessel occlusion with WEB device
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Introduction: The WEB device is a novel microbraided flow disrupter designed for intrasaccular treatment of intracranial aneurysms. We present our results of parent vessel occlusion with the WEB device, a novel application.

Materials and Methods: Between May 2015 and March 2017, 12 patients were treated with parent vessel occlusion using the WEB device. Of these 12, 7 underwent internal carotid artery occlusions for petrous-, cavernous- or ophthalmic segment aneurysms presenting with mass effect. Four patients with SAH from vertebral or PICA dissection were treated with WEB occlusion of the V4 segment. One patient with a ruptured distal SCA aneurysm was treated with WEB occlusion of the aneurysm including the SCA.

Results: Positioning of the WEB proved to be technically simple and very accurate in all cases. In general, 2 WEBs were sufficient for immediate vessel occlusion. In 1 early case a petrous segment aneurysm was trapped with 4 WEBs. The remaining 6 ICAs were occluded with 2 WEB proximal to the aneurysm. Of 4 vertebral/pica dissections 2 were trapped and the other 2 were proximally occluded, all with 2 WEBs. One ruptured distal SCA aneurysm was occluded with 1 WEB including the parent vessel. In all patients follow up MRA and/or angiography confirmed complete parent vessel occlusion and exclusion of the aneurysms from the circulation.

Conclusion: Parent vessel occlusion with the WEB was technically simple and clinically effective. The WEB could be very ac

P469
Retrospective Study of the Pipeline Embolization Device: Aneurysm Treatment Study in Neuroendovascular Center of University of Puerto Rico
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Purpose: In this retrospective study carried out at the University of Puerto Rico - Medical Sciences Campus - Endovascular Neurosurgery program, the authors reviewed the total number of cases of cerebral aneurysms treated with a flow diverter device, Pipeline Embolization Device® (PED). The purpose was to compare our results at the international level and to assess proper treatment protocols in Puerto Rico’s unique population.

Materials and Methods: Number of Subjects (30) Retrospective evaluations of the Endovascular Center databases of the University of Puerto Rico, were performed to identify patients with intracranial aneurysms treated with the PED between February 2012 and May 2016. A total of 30 patients were identified harboring 37 internal carotid artery (ICA) aneurysms treated with the PED.

Procedures Performed
We defined 2 groups by largest diameter of aneurysmal sac: one group with aneurysms <7 mm, and another group with aneurysms ≥7 mm. Localization or arterial segment of aneurysms was identified as follows: petrous, cavernous, ophthalmic, superior hypophyseal, posterior communicating artery (Pcomm) and communicating segment.

Analysis: Patients were followed with routine neuroimaging (MRA and DSA) at 6-month intervals for first year after embolization, and annually thereafter.

Methods: Patient demographics and ICA aneurysm morphologic features were obtained from chart and image review and analyzed using Descriptive Statistics in Excel 2010 (Mean, Median, and Standard Deviations). The occlusion rate of aneurysms (complete vs residual) was compiled and compared using Chi-square statistical analysis where P value was significant below 0.05.

Results: A total of 30 patients’ records were reviewed of which; 26 (86.67%) were female and age distribution was a Mean/Standard deviation of 62.5 +/- 11 and a Median of 64.5. Locations were divided as segment of ICA: petrous 1 (2.7%), cavernous 11 (29.7%), ophthalmic 12 (32.4%), superior hypophyseal 13.5% and posterior communicating segment 8 (21.6%). Of these 25 (67.6%) cases were of a pre-embolized size of >7 mm. The obliteration rate total was 33 (89.2%), > 7 mm 21 (84%), and <7 mm 12 (100%). However, using T-test assuming equal variances, there was no statistically significant difference between the two aneurism size groups with a P value of 0.30. No patient had permanent neurologic deficit or death.
Conclusions: Our clinical experience has shown that the use of PED achieves a high rate of occlusion with low morbidity in ICA aneurysms, with no distinction of size and location.

P470
Evolving perianeurysmatic cyst developed after a giant carotid-ophthalmic aneurysm treatment with Flow Diverter assisted coiling
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Purpose: Aneurysmal wall enhancement and perianeurysmal brain edema following endovascular aneurysms treatment, arteriovenous malformations and cavernomas are well known and demonstrate even if their natural course is largely unknown. These MRI patterns, due to the presence of inflammatory process, in which lytic enzymes are produced and micro-bleeding occurring in the vaso vasora, can result in the progressive aneurysm wall impairment, leading the possibility of rupture. Even if inflammation and brain edema are usually asymptomatic and self-limited, we present a case in which the perianeurysmal inflammatory reaction subsequent to endovascular treatment has developed an evolutive cystic formation with real lumen that enlarges like an expansive neoformation.

Summary of case: A 56 years old woman with asymptomatic giant left carotid-ophthalmic aneurysm was treated with Flow Diverter assisted coiling. Due to four medicated coronary stents a double antiplatelet therapy was going on, raising early aneurysmal neck re-opening. The patient performed standard MRI FU at 1, 3 and 7 months, until a perianeurysmatic cyst was discovered. Despite the patient’s symptoms absence, the 15th month MRI FU discovered a perianeurysmatic cyst evolution. An angiographic control was then performed, highlighting the aneurysm occlusion but the presence of a small endoleak area, with minimal flow on aneurysm’s neck.

Conclusion: This report describe a rare complication, resulting in an evolving perianeurysmatic cyst linked to post-flow-diversion inflammation and thrombosis.

FD are secure and safe endovascular devices that has improved giants and wide neck aneurysms treatment, but sometimes they can develop fast thrombosis of the sac, turn the aneurysm into a thrombosed aneurysm, with aneurysmatic and vessel wall inflammation.

In our case, the prolonged double antiplatelet therapy might have allowed a small endoleak area persistence in the aneurysmal neck that maintains a blood flow, which constantly moisten the thrombosed aneurysmal sac and preventing its stabilization.

The double antiplatelet therapy prevents FD occlusion, but also a stable aneurysmatic thrombosis. More definitive conclusions about the double antiplatelet therapy lasting after FD deployment had to be identify.

P471
The benefit of platelet reactivity testing before flow-diverter device placement: meta-analysis
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Purpose: The flow-diverter device (FDD) necessitates dual antiplatelet therapy to decrease thrombotic complications while possibly increasing bleeding risks. The use of platelet reactivity testing before FDD placement remains controversial. This meta-analysis explored the relationship between the complication rate and the pre-procedural response to P2Y12.

Materials and Methods: We searched electronic databases and relevant references for published studies comparing responder and non-responder to P2Y12 in patients undergone FDD placement. The searches were limited to studies available in English and published to April 2017. Pooled odds ratios (ORs) for complications were determined using random-effects models.

Results: Review of the bibliographies of the retrieved articles yielded 5 observational studies consisting of 946 patients received FDD placement. Responder was 691 and non-responder was 255. Pooled OR showed thromboembolic complications were more frequent in non-responder (OR: 0.172, 95% CI: 0.061–0.485). However, there was no significant difference between two groups in overall complication rate did not significantly increased in non-responder (OR: 0.361, 95% CI: 0.115–1.138). There was no difference in hemorrhagic complications (OR: 1.195, 95% CI: 0.292–4.888).

Conclusion: The non-responders to P2Y12 could have the higher risk of the thromboembolic complications in FDD placement. Therefore, platelet reactivity testing before FDD placement needs to predict the complications.

P472
Comparison of Neuroform ATLAS stent with LVIS jr stent-assisted coil embolization of unruptured intracranial aneurysms
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Background and Purpose: Stent-assisted coil embolization of intracranial aneurysms has become a useful tool in the
Materials and Methods: Twenty-two intracranial aneurysms (3 MCA, 6 AcoA, 3 ICA, 4 basilar tip, 2 BA-SCA, 1 vertebral, 3 distal ACA) in 22 patients (15 women, 7 men, mean age 65 years) were treated with either LVIS Jr. stent (16 cases) or Neuroform ATLAS stent (6 cases) assisted coil embolization. All LVIS Jr. stents were deployed using a Headway 17 microcatheter while all Neuroform ATLAS stents were deployed using an Excelsior SL-10 microcatheter. In all cases, a microcatheter was jailed into the sac of aneurysm, and then the assist-stent was deployed to the parent artery through a second microcatheter.

Results: All Neuroform Atlas stents were deployed successfully and there was no angiographic and neurological peri-procedural complication on this group. Y stenting assisted coiling for a wide-necked basilar bifurcation aneurysm using ATLAS stents were performed easily without any neurological complication. LVIS Jr. stent deployment failed in one case (a-com aneurysm) due to tortuosity of the parent artery which caused kink of the stent strut and insufficient expansion of stent mesh, so that Enterprise 2 stent was delivered as a substitute in this case. In-stent thrombus formation was visualized during the endovascular procedures in 2 cases with LVIS Jr. stent group. Two of these patients were treated by using an intra-arterial infusion of Argatroban. After a stent placement, high resolution cone beam CT were performed in some cases, revealing stent strut herniation into aneurysmal neck in cases with both stents. Crossing the stent strut with a microcatheter used for deployment of assist-stent were comparatively easy in both LVIS Jr. and Neuroform ATLAS stents.

Conclusion: Advantages of LVIS Jr. include the ability of the stent to be partially deployed, recaptured, and redeployed. The LVIS Jr. stent also has visibility under fluoroscopy. Insufficient expansion of stent strut occasionally occurred when the tortuosity of the parent vessel is extreme in LVIS Jr. stent. Thromboembolic complication might be induced by insufficient stent expansion in LVIS Jr. group. Neuroform ATLAS was easier to deploy compared to LVIS Jr. stent and any complications were not experienced under the low number of our medical cases. The cell-design of Neuroform ATLAS allows easy mesh crossing to perform Y-stenting procedure.

P473
Endovascular treatment of life threatening epistaxis secondary to Internal carotid artery (ICA) injury - An Institutional experience
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Background & Purpose: Craniofacial trauma or mishaps during trans-sphenoidal surgeries, can injure Internal carotid artery (ICA) – particularly its cavernous segment – leading to life threatening epistaxis. Rarely it can also be spontaneous secondary to rupture of giant, dissecting or mycotic cavernous ICA aneurysms. Surgical management of them is often cumbersome and difficult, whereas endovascular methods can offer better solutions. Here, we share our experience in the endovascular management of these difficult conditions.

Materials and Methods: We retrospectively analysed 16 patients who presented to our Institution, with severe and recurrent epistaxis, during 2011 to April 2017. Clinical and imaging records were analysed for demographics, clinical presentation, angiographic features, treatment instituted and follow up.

Results: All the 16 patients were male, with mean age of 33.5 yrs (18–60 yrs). All except one had ICA injury -the lone patient had sphenopalatine artery involvement. Seven patients (43.7%) had associated carotico-cavernous fistula (CCF). Eleven patients developed epistaxis post-trauma, three patients post – skull base surgery and two patients had spontaneous epistaxis. 14 patients were managed with endovascular modes of treatment, while two patients underwent surgery. Out of 14 patients in the endovascular group, 5 patients were managed with coiling of the pseudoaneurysm with parent vessel preservation, 5 patients with detachable balloons, 2 patients with parent vessel sacrifice, one with glue embolization and one with trans-venous coiling. Both patients who underwent surgery had trapping of the pseudoaneurysm with additional ECA-MCA bypass in one patient. All the 16 patients had a minimum follow up of 6 months, with all of them showing complete resolution of symptoms. One of the patient treated with detachable balloon showed asymptomatic recurrence, which was treated with stent assisted coiling.

Conclusion: Cavernous ICA involvement as the cause of epistaxis, can be effectively by endovascular means. The mainstay of endovascular mode of treatment is either coiling or use of detachable balloons, latter being commonly used when CCF is associated.
Recanalization after Complete Endovascular Occlusion of a Ruptured Dissecting Aneurysm of a Distal Posterior Cerebral Artery

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**Purpose:** Endovascular occlusion has been accepted as a safe, minimally invasive, and reliable treatment for ruptured dissecting aneurysms when a test occlusion is tolerated and adequate collateral circulation is present. However, there have been few reports regarding recanalization after treatment. We present an extremely rare case where recanalization occurred after endovascular occlusion of a ruptured dissecting aneurysm of a distal posterior cerebral artery (PCA).

**Summary of Case:** A 57-year-old female presented with subarachnoid hemorrhage caused by rupture of a right distal PCA. Endovascular treatment was performed. The dissecting aneurysm was completely occluded. One year after the embolization, follow-up angiography was performed, which revealed recanalization of the occluded right distal PCA with a normal arterial configuration. We decided that no further intervention was needed.

**Conclusion:** We should be alert to the fact that revascularization may occur even in cases successfully treated with endovascular occlusion. Careful angiographic follow-up after endovascular occlusion is required.

Endovascular treatment of vertebral artery dissection according to clinical presentations and radiologic findings

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**Purpose:** This study was aimed to consider proper treatment for vertebral artery dissections (VADs) depending on clinical presentations and radiologic findings.

**Methods:** From March 2013 to February 2016, 20 patients (male:female ratio, 6:14; aged 39–71; mean age 57.1 years) with VADs were treated at our institution. Six patients had previous trivial trauma history including excessive neck rotation, coughing, etc. Eighteen patients had symptomatic VADs (hemorrhage 6; ischemia 5; intractable suboccipital headache 6; Trigeminal neuralgia 1). Radiologic findings were classified according to morphology of dissecting segment, the relation between the origin of posterior inferior cerebellar artery (PICA) and VADs, and collateral circulations. To consider clinical courses and radiologic findings, 17 patients were received with endovascular treatments (Simple coiling 1; alone stent-deployment 4; stent-assisted coiling 8; parent artery occlusion 3; Pipeline flow diverter stent deployment with opposite VA parent artery occlusion 1). Mean clinical and radiologic follow-up duration were 16.45 and 8.35 months, respectively.

**Results:** All patients achieved good clinical outcomes (mRS score: 0–2). Angiographic follow-up images showed complete exclusion of VADs from the normal circulation except 3 cases. Two had mild neck remnant after stent-assisted coiling, and one had incomplete flow diversion of Pipeline stent. Procedure-related complication was seen subarachnoid hemorrhage (SAH) in 1 patient received with pipeline stenting. Postoperative thromboembolic events happened 3 patients in only SAH cases, but they gradually recovered at their normal activity. Among 3 patients with conservative treatments, 1 patient suffered from additional medulla infarction due to aggravation of VADs. In 10 cases without hemorrhage, there were no procedure-related or postoperative complications and their clinical symptoms were improved.

**Conclusion:** Depending on clinical courses and radiologic findings, if there were minimal risk and reasonable treatment modality, patients with any symptom would be preferentially considered indications of active treatments.

Endovascular treatment of brain aneurysms with flow diverters - p64 our experience and follow up

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During recent decades, endovascular treatment of cerebrovascular aneurysms has evolved to include unassisted coil embolization techniques, assisted coil embolization techniques, and newly developed techniques using flow diverters. While the different type of coil embolization techniques, including balloon assisted and stent assisted coiling, are targeted towards the aneurysm sac, flow diverters represent treatment of the flow with the intervention carried out in the parent artery. Flow diverter aneurysm embolization can be combined with coil embolization, further expanding the options available to the patients. Conceptually, flow diverters allow endoluminal reconstruction rather than endosaccular filling.

We present our experience with embolization of brain aneurysm with flow diverter stents and more specific our series with the p64 stent ( Phenox) in more than 40 cases with up to 18 months follow up.
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The results of Stent assisted coil embolization using LVIS and LVIS Jr in our hospital
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Purpose: Low-Profile Visualized Intraluminal Support Device (LVIS stent) developed for cerebral aneurysm coil embolization support. It has the small cell unlike Enterprise and Neuroform. Target vessels became 2.0-3.0 mm, and LVIS Jr. enabled in particular the treatment for peripheral artery aneurysms of small mother blood vessel. We report the stent assisted coil embolization using the LVIS and LVIS Jr. stent which took effect in our hospital this time.

Object: From August, 2015 to September, 2016, we operated 12 cases stent assisted coil embolization using the LVIS or LVIS Jr. stent in our hospital.

Result: There were 2 LVIS used case and 10 LVIS Jr. used case. Un-ruptured and ruptured cerebral aneurysms were 9 and 3 case each. About the location, vertebra aneurysms was 4 case, middle cerebral artery, anterior communicating artery, posterior communicating artery, basilar aneurysms were 2 cases each, and posterior cerebral aneurysm was 1 case. 1 case used LVIS Jr. stent in basilar artery died of subarachnoid hemorrhage after an operation. 1 case used LVIS Jr. stent in middle cerebral artery occluded the stent 7 days after an operation. The other cases was good course. In the case of posterior communicating artery aneurysm, we took the T-stent technique by the combination with Enterprise. The case got a good treatment result.

Conclusion: Either clipping or coiling gives a good prognosis for oculomotor palsy caused by ICPC aneurysm.

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Comparison of the prognosis by the treatment of oculomotor nerve palsy caused by IC-PC aneurysm
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Purpose: It has not been clarified whether clipping or coiling is better treatment as the treatment of IC-PC aneurysm with oculomotor nerve palsy. We investigated the prognosis by treatment of oculomotor nerve palsy caused by IC-PC aneurysm.

Materials and Methods: The study included patients who successfully had been undergone clipping or coil embolization against ICPC aneurysm with oculomotor palsy from January 2004 to June 2016 in our hospital and excluded perioperative death cases. Each case was investigated the presence of SAH, the aneurysmal size, the severity of oculomotor palsy (complete or partial), the days from onset to treatment, the degree of recovery of oculomotor palsy and the days to evaluate of recovery.

Results: Eleven cases were treated by clipping, and 4 cases were treated by coil embolization. There was no significant difference between clipping and coiling cases in age, gender, the presence of SAH or the aneurysmal size. But clipping cases tended to be elder and larger aneurismal size. Complete oculomotor palsy cases tended to be more in clipping cases (7 cases: 63.6% in clipping group, one case: 25% in coiling group). The days from onset to treatment were significant longer in clipping cases (3.8 days in clipping group, 46 days in coiling group). The improvement degree of oculomotor palsy in clipping group was significant better than clipping group. But there was no difference in the number of full recovery cases between clipping group (10 cases: 90.9%) and coiling group (3 cases: 75%). There was no significant difference between clipping and coiling cases in the days to evaluate of recovery. But coiling cases tended to be longer (40.7 days in clipping group, 98.8 days in coiling group).

Conclusion: Either clipping or coiling gives a good prognosis for oculomotor palsy caused by ICPC aneurysm.
complication was observed after administration of ozagrel which due to thromboembolism. No intracranial bleeding developed during prophylaxis administration had permanent neurological deficits. In 15 patients prior to or during the procedure, thromboembolism occurred in 12 of which were symptomatic. Procedure-related permanent neurological complication in neurointervention. We retrospectively analyzed the incidence and the outcome of thromboembolism during coil embolization of cerebral aneurysms. Ozagrel sodium, a thromboxane A2 synthase inhibitor, was administered as a rescue in 8 patients and as a prophylaxis in 6 of whom early recanalization could salvage the patients, but it was complicated with cerebellar and medulla infarction frequently.

**Results:** Clinical outcome at 30 days were as follows, modified Rankin scale (mRS) 0: 1, mRS 1: 1, mRS 3: 2, mRS 5: 3. Six patients were occurred cerebellar infarction and four patients were occurred infarction at medulla oblongata. External decompression was carried out for two patients and ventricular drainage was performed for three patients. One patient who had AICA-PICA anastomosis occurred no ischemic complication.

**Conclusion:** Internal trapping and sacrifice of PICA for the ruptured PICA involved vertebral artery dissecting aneurysm could salvage the patients, but it was complicated with cerebellar and medulla infarction frequently.

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The efficacy of ozagrel sodium as a rescue or prophylaxis in the preoperative management of thromboembolism during coil embolization of ruptured and unruptured cerebral aneurysms

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**Objectives:** Thromboembolism is the leading cause of neurological complication in neurointervention. We retrospectively analyzed the incidence and the outcome of thromboembolism during coil embolization of saccular cerebral aneurysms.

**Materials and Methods:** Since 2012, we treated 90 patients with 93 aneurysms, in whom 101 procedures were performed. 31 patients were male, and 59 patients were female. The median age was 66 years (range 21–88). Fifty-five aneurysms were ruptured, and 38 aneurysms were unruptured. In two patients, coil embolization of a ruptured aneurysm and an unruptured aneurysm was performed simultaneously. Retreatment was performed in 8 patients and one aneurysm was treated in 2 sessions. Ozagrel sodium, a thromboxane A2 synthase inhibitor, was administered as a rescue in 8 patients and as a prophylaxis in 15 patients prior to or during the procedure, and thrombectomy using Penumbra system® was performed in a patient. Functional outcome was assessed using modified Rankin Scale (mRS).

**Results:** Thromboembolic events occurred in 24 procedures (24%), in 12 of which thromboembolism were symptomatic. Cerebral artery occlusion was observed in 9 patients during and after the procedure, in 6 of whom early recanalization could be achieved. Procedure-related permanent neurological deficit was observed in 5 patients (5.0%) exclusively in ruptured group, and two of them had poor outcome of mRS 3. None of 15 patients in whom ozagrel sodium was prophylactically administered had permanent neurological deficits due to thromboembolism. No intracranial bleeding complication was observed after administration of ozagrel sodium. Coil embolization in the acute phase of SAH, and wide neck (>4 mm) were significantly associated with thromboembolic events compared with the elective procedure (p < 0.01, Fisher exact test). Logistic regression test showed that older age was significantly associated with thromboembolisms.

**Conclusion:** Our data showed that the procedure in the acute phase of subarachnoid hemorrhage, wide neck (>4 mm), and older age were significantly associated with periprocedural thromboembolisms. Ozagrel sodium can be a viable option in the perioperative management of endovascular embolization of ruptured and unruptured cerebral aneurysms.

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Risk factors of recurrence after endovascular treatment of saccular cerebral aneurysms

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**Background and Purpose:** Endovascular coiling has been established as the standard treatment in the management of unruptured as well as ruptured cerebral aneurysms worldwide. However, the long term durability of it remains inferior to surgical clipping in spite of remarkable advancement of the endovascular technique and technology. We analyzed risk factors of recurrence after endovascular treatment of cerebral aneurysms.

**Materials and Methods:** Between April 2012 and Aug 2016, we treated 101 patients with 104 saccular cerebral aneurysms. We included the patients who have been followed-up at least six months, and the follow-up head MRA or cerebral angiography were available. Seventy-two patients with 75 aneurysms were included in this analysis, and median follow-up period was 14 months. Thirty-three aneurysms were classified as side-wall aneurysms, and two of them had an axis parallel to the parent artery. Forty-two bifurcation aneurysms had an axis either perpendicular (25) or parallel (17) to the parent artery.

**Results:** Eleven recurrences (14.7%) were observed during the follow-up period, and in nine of which retreatment was conducted after 3 to 28 months. In all the patients, retreatment was conducted endovascularly without any neurological complications. In univariate analysis, aneurysm dome size, neck width, and the internal carotid artery-posterior communicating artery (ICA-Pcom) aneurysms were risk factors of recurrence (p < 0.05). On the other hands, the Raymon-Roy classification (class 1 vs. class 2 and 3), rupture presentation, branch incorporation and age did not affect recurrence. In multivariate analysis, the ICA-Pcom aneurysms and a parallel axis to the parent artery were risk factors of recurrence (p < 0.05).

**Conclusion:** The location of ICA-Pcom and an axis parallel to the parent artery were clinical predictors of recurrence after endovascular coiling.
Dual Microcatheter Coil Embolization of Wide-Necked Intracranial Aneurysms: Predictors of Immediate Aneurysm Occlusion and Recurrence

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Background and Purposes: Dual microcatheter technique is an alternative treatment for stent-assisted coiling in wide-necked intracranial aneurysms, however, long-term stability is the most controversial issue due to the high rate of the immediate incomplete occlusion and aneurysm recurrence. The purpose of this study was to evaluate our institutional experience with dual microcatheter coil embolization of wide-necked intracranial aneurysms and to identify predictors for immediate aneurysm occlusion and aneurysm recurrence.

Methods: Between March 2008 and March 2016, a total of 84 patients with 84 aneurysms were treated with dual microcatheter coil embolization. The clinical data, immediate and follow-up angiographic results were documented. A multivariate analysis was performed to determine predictors of immediate aneurysm occlusion and recurrence.

Results: Of 84 aneurysms, 56 (66.7%) aneurysms were ruptured and 28 (33.3%) were unruptured. On the immediate postembolization angiograms, 40 (47.6%) aneurysms showed complete occlusion (Raymond 1), 20 (23.8%) showed neck remnant (Raymond 2), and 24 (28.6%) showed body remnant (Raymond 2). Female sex, large aneurysm neck width, and low packing density were significantly associated with immediate incomplete intracranial aneurysm and to identify predictors for immediate aneurysm occlusion and aneurysm recurrence.

Immediate incomplete aneurysm occlusion may be the risk factor of aneurysm recurrence.

The usefulness of Vertebral artery Surface Anatomical Scanning (VSAS) in patients of vertebral artery dissection for anatomical diagnosis

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Purpose: Basiparallel anatomic scanning (BPAS)-MR imaging is useful to evaluate the surface appearance of the vertebrobasilar artery. However it is sometimes difficult for only BPAS-MR imaging to detect the transverse direction of the vertebral artery due to running from lateral to anterior surface of medulla oblongata. We try to evaluate the surface imaging along the transverse direction of the vertebral artery using BPAS-MR imaging technique.

Materials and Methods: We obtained the surface imaging along the transverse direction of the vertebral artery, in addition to BPAS-MR imaging and 3D TOF MRA, for 32 consecutive patients who underwent brain MR imaging and MRA in our hospital between August 1, 2014 and November 30, 2016. Comparing Between BPAS-MR imaging and surface imaging of the transverse direction of the vertebral artery, we evaluate the character and determined the role and value of displaying vascular outer contour.

Results: The surface imaging along the transverse direction was useful information to reveal the whole appearance of the V4 segment. Especially vessel surface imaging of elongated VA cases was easily recognized with VSAS. However it is difficult for only VSAS to estimate the association between vertebral artery and posterior cerebellar artery due to limited information about vessel outer contour.

Conclusion: The surface imaging along the transverse direction of the vertebral artery had a possibility that anatomical recognition of V4 segment became easy and gave useful information.

Overlapped Stenting Combined with Coiling for Blood Blister-like Aneurysms: Comparison of Low-profile Visualized Intraluminal Support (LVIS) Stent and Non-LVIS Stent

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Purpose: To evaluate the safety and efficacy of overlapped stenting for blood blister-like aneurysms (BBAs) and to compare the outcomes between LVIS and non-LVIS stents.

Materials and Methods: A retrospective review of the aneurysm database identified 37 patients carrying internal carotid...
artery (ICA) BBAs treated by overlapped stenting in our institution from June 2013 to June 2016. The clinical characteristics and angiographic results were reviewed. **Results:** Overlapped stenting combined with coil were applied in 37 BBAs, including LVIS stents in 18 cases and non-LVIS stents in 19. For the LVIS group, angiographic results at 3–24 months were complete occlusion in 15 cases (83.3%), improved in 2 cases (11.1%), and recanalized in 1 case (5.6%). The modified Rankin Scale (mRs) scores at 3–36 months follow-up were 0–2 in 15 cases (83.3%) and 3–6 in 3 cases (16.7%). For the non-LVIS group, angiographic results at 3–46 months were complete occlusion in 12 cases (63.2%) and recanalized in 7 cases (36.8%). Clinical outcomes at 6–58 months were mRs scores of 0–2 in 17 cases (89.5%) and 3–6 in 2 cases (10.5%). Use of the LVIS stent was less likely to result in recanalization (OR = 0.10, 95% CI: 0.01–0.93, P = 0.042) than the non-LVIS stent. The LVIS group had a lower average number of stents than did the don-LVIS group (2.2 vs 2.6, P = 0.016). In terms of complication rate (11.1% vs 5.3%, P = 0.604), good outcome rate (83.3% vs 89.5%, P = 0.660), and immediate angiographic result (P = 0.424), no statistically significant difference between the two groups was found. **Conclusions:** Overlapped LVIS stenting combined with coil is feasible and safe for BBAs. Overall, the LVIS stent provided less risk of BBA recurrence compared with the non-LVIS stent and did not increase the risk of procedure-related complications.

**ANEURYSM - RESEARCH**

**P485**

Management of recurrent coiled aneurysms

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**Purpose:** Recurrent aneurysms with potential to bleed are the main drawback of aneurysmal coiling. Optimal management of recurrent aneurysms remains unclear.

**Material and Methods:** We retrospectively studied seven patients (three men, four women, mean age, 57.7 years) with recurrent coiled aneurysms, re-treated between April 2015 and March 2017 at our hospital. During the same period, we performed neck clipping in 17 cases and coil embolization in 58 cases.

**Result:** At initial presentation, six patients had aneurysmal subarachnoid hemorrhage (SAH) and one patient had unruptured aneurysm. The aneurysms were located in the anterior communicating artery (n = 3), internal carotid artery (n = 2), posterior cerebral artery (n = 1), and vertebral artery (n = 1). After initial coiling, complete occlusion of the aneurysms was achieved in five cases and neck remnant in two cases. The mean interval between initial treatment and re-treatment was 6.1 years. At second presentation, three patients had aneurysmal SAH and four patients had unruptured recurrent aneurysms. The mean sizes of the fundus and neck, and the fundus/neck ratio were 6.0 mm, 2.6 mm, and 2.33, respectively. The mechanisms of aneurysm recurrence were coil compaction (n = 2) and aneurysmal regrowth (n = 5). Re-treatment was performed with a simple technique in six cases and stent-assisted coil embolization in one case. No periprocedural complications occurred during any of the re-treatment procedures. At follow-up, six lesions were stable and one required additional stent-assisted coil embolization.

**Conclusion:** Endovascular re-treatment of recurrent coiled aneurysms is associated with low procedural risk. Stent-assisted coil embolization may be beneficial for re-treatment of wide-necked and large-sized recurrent aneurysms without presentation of acute phase SAH.

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The Use of Chitosan Gel as an Embolic Agent

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**Background and Purposes:** For the purpose of overcoming anatomic and biological limitations, such as difficulty in filling completely and little organized thrombus in large cerebral aneurysms treated with the Guglielmi detachable coils (GDCs), biological modifications to the platinum coil or the use of liquid polymer which has potential to fill the entire aneurysm cavity have been investigated as an alternative method for treating aneurysms. The purpose of this study is to evaluate the feasibility of endovascular treatment of experimental aneurysms of rabbits using chitosan gel as an embolic agent, in the hope of giving clues to overcome these facing problems.

**Materials and Methods:** As the first step, activated clotting times (ACTs) were compared between the pure blood group and the chitosan gel-blood mixture group in 17 patient’s blood in vitro study. Additionally, ACTs were compared between the heparinized blood group and the chitosan gel-heparinized blood mixture group. As a main experiment, an aneurysm was created in the proximal common carotid artery in 13 rabbits and embolized with chitosan gel in 10 rabbits (3 controls with non-embolized aneurysms and 10 embolized aneurysms). These were evaluated by serial follow-up intravenous digital subtraction angiography (IV-DSA) on 1 week (n = 13), on 2 weeks (n = 12), on 4 weeks (n = 10) and on 6 weeks (n = 8) after embolization. Then histopathologic evaluation was also done on 3 days (n = 2), 1 week (n = 1), 2 weeks (n = 1), 3 weeks (n = 1).
4 weeks (n = 2), 6 weeks (n = 1), and 8 weeks (n = 1) after embolization.

Results: The results of in vitro study revealed a much faster ACT in the chitosan gel-blood mixture and chitosan gel-heparinized blood mixture groups than in the pure and heparinized blood groups. On follow-up of the IV-DSA study of aneurysms with embolization, in 7 rabbits, more than 75% decreased aneurysm size was noted, 75%--50% decrease in 2 rabbits, and less than 50% decrease in 1 rabbit. Histopathologic findings showed well organization thrombus and neointima formation in the aneurysmal sac.

Conclusions: The results of this study suggest that chitosan gel may be a possible gel embolic agent that can be used in human aneurysms by not only a mechanical embolization effect but also a biological effect for eliciting or promoting fibrosis and neointima formation. Further studies are needed to overcome the technical difficulty of injecting the chitosan gel through the microcatheter and to develop a new endovascular delivery system of chitosan gel.

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Comparison of the efficacy of Angiographic Vaso Computed Tomography and T2-Drive Magnetic Resonance Imaging for Differentiation between Intradural and Extradural Paraclinoid Internal Carotid

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Background: It is important to distinguish the exact location of intradural or extradural paraclinoid ICA aneurysm because the treatment policy can be different between the two. In this study, we compared the findings of angiographic VasoCT and T2-weighted Drive MRI for confirming the accurate location of paraclinoid ICA aneurysm.

Materials and Methods: Since March 2013, fifteen patients with paraclinoid ICA aneurysm were evaluated with angiographic VasoCT and T2 Drive MRI, prospectively. All patients underwent digital subtraction angiography with angiographic VasoCT and subsequent T2-weighted Drive MRI studies. Of these cases, we confirmed the exact anatomical locations of paraclinoid aneurysms intra-operatively in two cases.

Results: Eight patients showed concurrent results from both VasoCT and T2-weighted Drive MRI. Among them, only one patients had intradural aneurysms, 7 had extradural aneurysms. On the other hand, 7 patients showed contrasting findings from VasoCT and T2 Drive MRI. All 7 patients were diagnosed with extradural aneurysms by the T2-weighted Drive MRI whereas VasoCT results showed that these aneurysms were rather intradural. VasoCT has clear visualization of bony compartments around the aneurysm and has nice spatial resolution, but there were some difficulties to find out aneurysms in axial view. The coronal view, T2-weighted Drive MRI was superior in detecting the location of most aneurysms due to the hyperintensity of subarachnoid space, though it is not ideal in detecting aneurysms with inferior-medial directions in the axial view.

Conclusion: A combined study of VasoCT and T2-weighted Drive MRI can be a powerful tool for identifying the location of paraclinoid ICA aneurysm.
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Clinical Application of Insertion Force Sensor System for Coil Embolization of Intracranial Aneurysms

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Introduction: In endovascular embolization for intracranial aneurysms, it is important to properly control coil insertion force. However, the force can only be subjectively detected by the subtle feedback experienced by the neurointerventionists at their fingertips. The authors envisioned a system that would objectively sense and quantify that force. In this article, coil insertion force was measured in cases of unruptured intracranial aneurysm using this sensor, and its actual clinical application was investigated.

Methods: The sensor consists of a hemostatic valve (Y-connector). A little flexure was intentionally added in the device and it creates a bend in the delivery wire. Sensor measures the change in the position of bent wire depending on insertion force and translates them into a force value. Using this, embolization was performed for 10 unruptured intracranial aneurysms.

Results: Sensor adequately recorded the insertion force and it reflected the operators’ usual clinical experience. Presence of sensor did not affect the procedures. Force records demonstrated the characteristic patterns. A basic sinusoidal force pattern was generated by push-pull-push movement of the interventionist’s hand to advance the delivery wire. Recording of the curve was sometimes altered in accordance with the painting movement of the microcatheter. In filling, the record showed a regular sinusoidal pattern. In finishing, the force tended to be increased when the coil did not advance smoothly.

Conclusions: The safety and efficacy of this sensor in clinical application were demonstrated. This system is effective for assisting during coil embolization for intracranial aneurysms, and should provide safer and more reliable treatment.

P490
Complex MCA aneurysm with all branches arising from the dome

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Purpose: Endovascular treatment of intracranial wide-neck, bifurcation or trifurcation aneurysms is a challenge, especially with branches arising from the aneurysm dome. The aim of this presentation is to show the treatment technique of complex aneurysm with three branches arising from the aneurysm dome.

Materials and Methods: Clinical data, pre and postoperative DSA (including 3D reconstructions) images were collected and analyzed. Aneurysm occlusion was assessed using RROC Scale.

Results: One patient, man 34 years old with left middle cerebral artery complex aneurysm with three branches arising from the aneurysm, one from the top of the dome, treated with the combination of endovascular techniques. Aneurysm was unruptured when treated. Good clinical outcome was observed and no new neurological deficits were observed. Stent, pCONus device and balloon were used to avoid branch occlusion in MCA trifurcation aneurysm. At 6 and 15 months follow-up all three branches were patent.

Conclusions: Experience and the results proves that the combination of endovascular techniques in treatment of complex intracranial aneurysms is safe and efficiency.

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Microcatheter shaping considering curved configuration by the package container

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Introduction: Straight microcatheters are generally wearing curved configuration because they are packed in spiral containers. In this study, we evaluated whether this curved configuration affects the shaping and performance of the microcatheter or not.

Material and Methods: We prepared two different types of microcatheters by different shaping methods using the same curved mandrels as follows. One type of shaping was made by steam when the mandrel’s curve was along the curved configuration of the microcatheter (same direction type: SDT). Another type was made when it was opposite direction to the curved configuration (opposite direction type: ODT). The differences of accessibility, the position of the catheter in the dome, and the resistance of the catheter tip out from the dome in excessive insertion of microguide-wire were evaluated in these two types of microcatheters using a flow model of cerebral aneurysms (EVE, FAIN-Biomedical, Aichi, Japan).

Results: The SDT catheters have easier accessibility and the deeper catheter tip position to aneurysms in the lesser curvature of carotid siphon than the ODT catheters. On the contrary, the ODT catheters have easier accessibility and the deeper catheter tip position to aneurysms in the greater curvature of it than the SDT catheters. The ODT catheters have larger resistance against the kick-back force in pushing out of the tips from the dome in both lesser and greater curvature aneurysms.
Discussion: The present study clearly showed that the curved configuration of microcatheters shaped by spiral containers affected the catheter performance. The curved configuration may fit the curve of the parent artery. Therefore, SDT catheter has good accessibility to the aneurysm in the lesser curvature (aneurysm exists on the same curve), and ODT catheter has good accessibility to that in greater curvature (aneurysm exists on the opposite curve). The reason why ODT catheters have larger resistance against the kick-back force is because ODT catheters have much longer contact to vascular walls of the parent artery compared to SDT catheter.

Conclusion: The catheter-tip shaping considering the curved configuration is important for good accessibility to the aneurysm dome. The opposite direction shaping to the curved configuration is useful for stable placement of the catheter tip in the dome.

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Better wall apposition of Surpass device with Atlas stent: A new and easy technique
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Purpose: The current version of the Surpass flow diverter has a high mesh density and is associated with a short-term aneurysm obliteration rate of about 75 percent. It may also be associated with suboptimal apposition at either end once deployed. We present a new and easy technique to enhance apposition of the Surpass flow diverter in order to increase its safety and efficacy.

Materials and Methods: All intracranial aneurysms treated with Surpass flow diverter with Atlas stent in a single center were retrospectively reviewed and patients treated with Surpass and Atlas were identified. In these patients Atlas stent was delivered directly through the pusher catheter of the Surpass Streamline device which has an inner diameter of about 0.017 inches, without a need for performing an exchange maneuver or another microcatheter.

Results: 23 patients with 24 aneurysms treated with this technique. 19 aneurysms were saccular, 4 were fusiform and 1 was a blister-like aneurysm. The mean aneurysm and neck diameters were 12.6 ± 7.5 and 4.7 ± 1.9 mm, respectively. 12 aneurysms originated from supraclinoid ICA, 9 from cavernous ICA, 1 from transtional ICA and 2 from basilar artery. Two of them had ruptured and were treated in the acute phase of the bleed. In 22 patients only a single Atlas was used, in 2 overlapping stent were used since a single stent was not able to cover the long flow diverter. Intracatheter treatment was also performed in addition to flow diversion in 2 patients. There was no mortality or permanent morbidity related to the procedures. One patient had access related minor cervical ICA dissection and was treated with stenting. All patients had imaging follow up with CTA, MRA or DSA. Complete occlusion was noted in 17 (%70), 20 (%83), 22 (%92) and 23 (%95) aneurysms at 3, 6, 12 and 12+ months follow up respectively. The only small residual aneurysm was noted in a patient in whom the deployed Surpass device was not long enough and secondary placement of Atlas was insufficient to achieve full apposition. None of the aneurysms were retreated.

Conclusion: Using Atlas stent through Surpass delivery system to enhance the wall apposition of the flow diverter resulted in high occlusion rates and relatively early complete occlusion. This technique has been simple to perform, safe and effective in our series.

P493
Endovascular treatment of saccular aneurysms arising from fenestrated basilar arteries using detachable coils: The Princess Alexandra Hospital experience
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Purpose: The Princess Alexandra Hospital is one of two major tertiary hospitals in Brisbane, the capital city of Queensland, Australia. It has a dedicated neurovascular team home to one of two Gamma Knife Radiosurgery units in the country treating all vascular pathology related to the central nervous system. Fenestrated basilar arteries are a well recognised but uncommon anatomical variant most commonly occurring superior to the verteobasilar junction. Histopathological examination of the vessel wall has shown the media to be defective in these variants arteries predisposing patients to the formation of saccular aneurysms. This case review series analyses the morphology, treatment and long-term outcome of saccular aneurysms treated at a major tertiary hospital. This series will add to the limited material pertaining to the treatment of saccular aneurysms arising from fenestrated basilar arteries.

Materials and Methods: Since the introduction of endovascular techniques at the PAH in 2006, 733 cerebral aneurysms have undergone treatment with detachable coils. Of these, two were saccular aneurysms arising from fenestrated basilar arteries. Therefore this uncommon entity has an estimated prevalence of 0.27%.

Summary of cases:
CASE 1: SP was a 49-year-old female who presented with rupture of a saccular aneurysm arising from a fenestrated basilar artery. The ellipsoid aneurysm had a 2 mm neck, 2 mm dome diameter, 4 mm length and average volume of 10 mm³. Stand alone coiling of the aneurysm with detachable coils was performed on the 23/12/2009. Completion angiograms demonstrated a small focus of filling within the interstices of the coil ball, which resolved by two weeks evident on a follow up MRA. The treated aneurysm has been followed with MRA for 7.1 years now demonstrating residual neck filling to be stable. Retreatment has not been required.
CASE 2: JK was a 27-year-old male who presented with rupture of a saccular aneurysm arising from a fenestrated basilar artery. The ellipsoid aneurysm had a 4 mm neck, 4 mm dome diameter, 5 mm length and average volume of 43 mm3. Stand alone coiling of the aneurysm with detachable coils was performed on the 12/11/2013. Completion angiograms demonstrated a small residual neck but no filling of the aneurysm sac. The treated aneurysm has been followed with MRA for 3.3 years now demonstrating residual neck filling to be stable. Retreatment has not been required.

Conclusion: Fenestrated basilar arteries are well recognised but uncommon anatomical variants which are known to be associated with the formation of saccular aneurysms. Data pertaining to the treatment of such entities is limited. Our retrospective analysis of two saccular aneurysms arising from fenestrated basilar arteries demonstrates endovascular exclusion with detachable coils to be a well-tolerated and effective treatment option for such patients.

P494

Determination of the natural history of aneurysms treated with detachable coils according to the Modified Raymond-Roy Occlusion Classification assessed with Magnetic Resonance Angiography

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Purpose: Most intracranial aneurysms are now treated with detachable coils however there is an increased incidence of recurrence compared with clipping. Following coiling, the degree of aneurysm occlusion has been shown to predict long-term outcomes. This study aims to determine the natural history of coiled aneurysms according to the Modified Raymond-Roy Classification (MRRC) using magnetic resonance angiography (MRA).

Material and Methods: A retrospective study of all aneurysms treated with coils from 2006 to 2016 was performed. A senior radiology trainee reviewed all imaging under the supervision of two Interventional Neuroradiologists. Statistical analysis and class differences were determined using a Pearson Chi2, calculations were performed using Stata version 13.

Inclusion criteria included: age at least 18 years, first treatment of an aneurysm, treatment with detachable coils and a minimum of 36 months follow up. Exclusion criteria included: age less than 18 years, aneurysm retreatment, complex aneurysms and less than 36 months follow up. At the time of coiling, the degree of aneurysm occlusion was assigned a MRRC class I, II, IIIa or IIIb. On subsequent MRA studies, the aneurysm was reassigned a further MRRC class. The time and date of aneurysms requiring retreatment was also recorded.

Results: During the 11-year period, 466 aneurysms underwent coiling, of which 180 met inclusion criteria. Aneurysms arose from the anterior circulation in 78.89% cases and posterior circulation in 21.11%. Class I occlusion was achieved in 3.89%, class II in 72.78%, class IIIa in 8.33% and class IIIb in 15.00%.

Aneurysm recurrence occurred in 14.29% class I aneurysms, 19.08% class II aneurysms, 33.33% class IIIa aneurysms and 22.22% class IIIb aneurysms. No statistically significant difference in recurrence rates was demonstrated (p-value 0.596). The mean time to recurrence was 1.65 years for class II, 0.77 years for class IIIa and 0.62 years for class IIIb. Overall, aneurysm recurrence occurred in 20.56% of cases on average 1.46 years following the original coiling. Aneurysms requiring retreatment occurred in 0.00% class I aneurysms, 10.69% class II aneurysms, 26.67% class IIIa aneurysms and 13.89% class IIIb aneurysms. While there was a trend towards higher retreatment rate in class IIIa and IIIb aneurysms, statistical significance was not demonstrated (p-value 0.056). Overall, retreatment was required in 13.88% aneurysms on average 1.92 years post coiling.

Conclusion: The natural history of coiled cerebral aneurysms can be determined according to the MRRC using MRA. No statistically significant difference between recurrence and retreatment rates was demonstrated between MRRC classes. Given that retreatment rates were similar between both class IIIa and class IIIb aneurysms, this extra level delineation may not be necessary.

P495

Experimental Safety Evaluation at the Time of Each Assist Balloon Expansion in the Coil Embolization

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Purpose: In coil embolization, a cerebral aneurysm with a wide neck or branch vessels, and many encounter on the use of adjunctive technique using an assist balloon. During balloon expansion, instead of to protect the aneurysm neck and branch vessel, join pressure damage to the parent vessel. Using a T-silicon vessel model, allowed to expand each balloon assisted constant diameter, it was measured with a pressure monitor.

Method: Using a T-junction silicon model, allowed to expand the balloon was measured at a pressure fibers in a quantity of balloons entering the T-shaped channel (height). As assist balloon, SHOURYU HR 4 mm—7 mm (Kaneka, Osaka, Japan), Hyperform TM 4 mm—7 mm (Covidien / ev3 Endovascular, Inc, Irvine, CA, USA), Scepter XC TM 4 mm—11 mm (Microvention, Inc, Tustin, CA, USA), we used Transform TM 4 mm—7 mm (Stryker Neurovascular, Freemont, CA, the USA). SHOURYU HR 7 mm—7 mm, we were compared with Hyperform TM 7 mm—7 mm.

Result: Necessary pressure balloon entering the T-shaped path reaches a certain height, was lower SHOURYU, Scepter XC, Hyperform, Transform, of the order.
Conclusion: Assist balloon applications at the time of coil embolization is a variety, when you protect the aneurysm neck and branch vessel, pressure damage it is also necessary to keep in mind to parent vessel. This experiment was useful for safety assessment to ascertain the characteristics of various balloon.

P496

Hemodynamics analysis before and after parent artery occlusion of the internal carotid artery giant aneurysm

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Purpose: Parent artery occlusion (PAO) is a therapeutic modality with excellent curability for large and giant internal carotid aneurysm. However, there is raising concern for increased stress being applied to other blood vessels due to hemodynamic changes after PAO. The objective was to quantify the changes and observe the long term effect in overall hemodynamics and wall shear stress (WSS) in the remaining intracranial blood vessels before and after PAO.

Materials and Methods: We used magnetic resonance fluid dynamics (MRFD) using time-resolved three-dimensional phase-contrast MRI (4D-Flow) at 3.0 T and MR-based computational fluid dynamics (CFD) to analyze hemodynamics of six patients treated with PAO. Intracranial vessel geometry was reconstructed from 3D TOF MR angiography. Blood flow was simulated with CFD and accurately analyzed under the patient specific boundary condition obtained from MRFD. Four patient underwent pre- and post-procedural 3D TOF MRA and 4D-Flow, and two patients underwent post-procedural imaging only. Changes in mean flow volume and velocity in internal carotid artery (ICA) and basilar artery (BA), as well as maximum peak value of wall shear stress (WSS) in systolic phase were analyzed.

Result: In the first 4 patients, mean flow volume of healthy contralateral ICA increased 1.29 times, velocity increased 1.44 times, mean flow volume of BA increased 1.43 times and velocity increased 1.23 times after PAO. In three of 4 cases, sum of flow volumes of bilateral ICA and BA before PAO compared to post-PAO contralateral ICA and BA alone did not change. In one case, 4D-Flow failed before PAO and accurate measurement could not be performed. Interestingly, in the two cases, sum of flow volumes initially decreased one month after PAO but normalized after 6 month. Post-PAO maximum WSS in contralateral ICA C1 part increased by an average of 1.2 times (9.3 Pa to 11.1 Pa). In the latter two patients, maximum WSS in the healthy contralateral ICA C1 part was as high as 12 Pa and 23.6 Pa after 4 years and 8 years of PAO respectively.

Conclusion: Post PAO, rise in WSS in the healthy contralateral ICA C1 part was observed due to an increase in flow volume and velocity of the contralateral ICA, suggesting a long term hemodynamic effect on surrounding vessels.

P497

Does treatment for unruptured cerebral aneurysm decrease an incidence rate of subarachnoid hemorrhage?

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We sought to determine whether or not treatment for unruptured cerebral aneurysm decreases an incidence rate of subarachnoid hemorrhage by analyzing our simplified cohort model. In our model, an age of the targeted population is between 40 and 80 years old. Mortality rate by age, prevalence rate of cerebral aneurysm, and averaged rupture rate of unruptured aneurysm in a year, that are given by government’s annual reports or previously published literatures, are incorporated in the model. Based upon our mathematical analysis of the simplified cohort model, it will take 28 years to decrease the prevalence of unruptured cerebral aneurysm by 5.75%. Although, in Japan, the number of cases for subarachnoid hemorrhage tends to be decreased approximately by 10% for the last 5 years, we conclude that this recent tendency is not contributed to prophylactic treatment of the unruptured cerebral aneurysm, but to something else.

AV MALFORMATIONS

P498

Combined treatment of brain AVMs using embolisation and cyberknife radiosurgery

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Purpose: To report the results of our use of radiosurgery in a series of 59 patients with brain AVM, most of them being previously embolized and treated in our institution by cyberknife radiosurgery from July 2010 to September 2013.

Materials and Methods: Of these 59 patients, 11 being foreign patients were lost to follow-up. In the remaining 48 patients 41 (85%) were previously embolised. AVM was revealed by hemorrhage in 19 (40%) of these 48 patients.
Spetzler Martin grade was 1 in 5 patients (10%), 2 in 15 patients (31%), 3 in 17 patients (35%) and 4 in 11 patients (23%). The mean nidus volume before radiosurgery was 2.6 cm³ (0.3–11.2). 18 Gy was prescribed to the 70% isodose in 1 single fraction in all AVMs. The mean volume receiving 12 Gy was 5.34 ¸± 2.77 cm³. The mean follow-up after radiosurgery was 41 months (12–66 months). MRI with dynamic MRA and clinical evaluation were performed every 6 months. DSA with DSA angiography was performed to confirm cure of AVM and MRA showed no residual arteriovenous shunt.

Results: Total obliteration rate was 59% at 36 months. 44 out of 48 patients (92%) were symptoms free. MRI demonstrated peri-nidal oedema in 32 patients (66%), 2 of them classified as grade 4 using classification of adverse radiation effects being symptomatic with good clinical issue under steroid therapy.

Conclusion: Radiosurgery with cyberknife of previously embolised brain AVMs provides a significant obliteration rate at 3 years with few adverse events.

P499

Multi-modality managment of complex brain arterio-venous malformations, Early experience

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Background and Purpose: To report our experience in the treatment of complex brain arteriovenous malformations.

Patients and Methods: From November 2010 to August 2014, 22 patients with brain arteriovenous malformations were treated endovascularly. They were 9 men and 13 women with a mean age of 32 years. A total of 34 endovascular procedures were performed with Onyx or Squid embolic agent.

Results: The course of endovascular treatment was completed in 18 patients. In 8 patients, an angiographic cure was achieved using embolization as the sole therapeutic technique. 6 patients underwent radiosurgical treatment after nidal size reduction <2 cm was accomplished by endovascular treatment. 4 cases underwent surgery after embolization. Further endovascular treatment was planned in 4 patients. Procedure-related transient neurologic deficits were observed in 1 patient, experienced mild transient hemiparesis resolved soon after treatment. There were no procedure related permanent morbidity or deaths.

Conclusion: Liquid embolic material allows obtaining higher rates of anatomic cures compared with those obtained previously with other embolic agents in the treatment of brain arteriovenous malformations.

P500

Medullar arteriovenous fistula: case report

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A 68-year-old man with an angiography revealed a medullar arteriovenous fistula. Initial symptoms were sudden plegia of right leg.

The treatment with Onyx embolization, with occlusion total medullar fistula. One week after the treatment, the patient presented regular force in right leg. The pathogenesis and embroyogenesis of this finding including the management of AVMs are discussed.

Spinal dural arteriovenous (AV) fistulas are the most commonly encountered vascular malformation of the spinal cord and a treatable cause for progressive para- or tetraplegia. They most commonly affect elderly men and are classically found in the thoracolumbar region. The AV shunt is located inside the dura mater close to the spinal nerve root where the arterial blood from a radiculomeningeal artery enters a radicular vein. The increase in spinal venous pressure leads to decreased drainage of normal spinal veins, venous congestion, and the clinical findings of progressive myelopathy.

On MR imaging, the combination of cord edema, perimedullary dilated vessels, and cord enhancement is characteristic. Therapy has to be aimed at occluding the shunting zone, either by superselective embolization with a liquid embolic agent or by a neurosurgical approach. Following occlusion of the fistula, the progression of the disease can be stopped and improvement of symptoms is typically observed.

P501

Cranial Nerve Palsy after Onyx Embolization

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The Onyx liquid embolic system is relatively safe and commonly used in treatment of vascular malformation such as arteriovenous fistula (AVF) and arteriovenous malformation (AVM). However, studies on possible complications after onyx embolization in vascular malformation patients are limited and the occurrence of cranial nerve palsy is occasionally reported. This article aims to report the progress of two different types of cranial nerve palsy after the embolization. The onyx embolization was performed in both cases for vascular malformation, and oculomotor and facial nerve palsy in ipsilateral side were observed in each case. Both patients were treated with steroid and showed improvement of symptom after several months.

The most common types of neuropathy that can occur after the onyx embolization are facial nerve palsy and trigeminal neuralgia. There is hypothesis that the mechanism is not clear, but it may be a traction injury when extracting...
microcatheter, mass effect by thrombi and edema, and onyx reflux to vasa nervorum. As you can see from this article, neuropathy appears to be relieved naturally for several months after the procedure.

P502

Spontaneous conversion of venous drainage pattern in dural arteriovenous fistula following Onyx embolization: A case report

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Background: Dural arteriovenous fistula (DAVF) is a disease in which abnormal arteriovenous shunts develop in the dura mater. Cortical venous reflux is a potential and important predictor for a clinical course of the disease. Developing to aggressive lesion with angiographic conversion of venous drainage pattern is rare, however, could be potentially fatal.

Material and Methods: We report a case of DAVF that showed a spontaneous conversion of venous drainage pattern from Borden type II to type III within a four month period of follow-up. The patient admitted presenting with aggravated neurologic status and newly developed seizure.

Results: Onyx® embolization was performed with successful obliteration of AV shunt through the superselected left MMA in a single session. Abnormal vascular structure including cortical venous reflux did not shown in follow-up MRA. GOS score was '2' when the patient was discharged, an improvement of the hemiparesis from the status at admission. And during the clinical follow-up over the 3 years, patient was tolerable.

Conclusion: Although the most cases of conversion of venous drainage pattern in DAVF showed benign clinical course without any developed symptoms, aggressive conversion is existed rarely. Therefore, close clinical and radiological follow-up is needed for detection of these lesions. The angiographic features should be the most important factor in deciding the treatment modality. And the endovascular embolization with Onyx® can be considered one of the reliable treatment with acceptable safety and efficacy.

P503

GIant post-traumatic carotido-cavernous sinus fistula and flow-diverter stent: a possible safe solution

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Purpose: Post-traumatic giant carotido-cavernous sinus fistulas has been described as dangerous and challenging circumstances requiring a fast diagnosis and therapeutic planning. With this paper authors would suggest a possible option for treating this threatening event.

Methods and Materials: 62 y.o, female, after a car accident, has experienced LeFort III fracture, right ICA dissection, extensive SAH and multiple bilateral hemorrhagic cerebral foci. Some days later she has worsened and developed right anisochoria, left hemiplegia and right esophtalmus with mCTA diagnosis of giant carotid-cavernous sinus fistula (CCF). A first DSA study, associated with right ICA occlusion test, has confirmed the giant CCF and also important ipsilateral hemispheric ischemia. After an accurate planning, two days later, we performed an endovascular reconstruction of the right ICA using one 4.75 x 20 mm flow-diverter stent (FD) Pipeline, (Medtronic), with no complications.

Results: After 15 days an mCTA study, still demonstrating the CCF, suggested a reduced flow over the carotido-cavernous A-V communication. Respectively 3 and 4 months later mCTA and DSA has shown complete healing of the CCF and regular intracranial artero-venous flow. The patient, after 8 months rehab, is mRS = 2-3.

Conclusion: CCF endovascular treatment can be performed via venous or arterial side. Even if traditional venous approach or arterial balloon assisted techniques are more described in Literature, endovascular reconstruction of the demaged arterial side using a FD stent has been proven to be an effective option.

P504

Endovascular removal of a glued microcatheter during AVM embolization

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Background: Entrapment or gluing of a microcatheter during embolization of brain AVMs (arterio-venous malformations) of DAVFs (dural arterio-venous fistula) is a known and feared technical complication that can occur with or without clinical sequelae. While the removal of entrapped MCs from a non-adhesive Onyx cast is often possible using various techniques and has been reported, the same has not been described for a glued microcatheter after using adhesive embolics such as NBCA. We report a case where such maneuver was successfully performed in a patient with a choroidal AVM.

Case Report: A 26 year old female admitted with headaches and vomiting for 11 days and a large intraventricular hemorrhage on CT. CTA revealed a right choroidal AVM
Cerebral Proliferative Angiopathy: A case report

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Purpose: To report a rare case of cerebral proliferative angiopathy.

Materials and Methods: We present a 61-year-old male patient who presented with stuporous mentation and left side hemiplegia. Brain computed tomography revealed characteristics of ruptured cerebral proliferative angiopathy. We also present a literature review of the cerebral proliferative angiopathy.

Results: Cerebral proliferative angiopathy is a rare and peculiar type of cerebral vasculopathy characterized by diffuse network with normal brain tissue intermingled, multiple nondominant arterial feeders, relatively small draining veins, angiographic capillary angioectasia and vascular proliferation. These characteristics make should be separated from cerebral AVMs in angioarchitecture, nature history, clinical presentation.

Conclusion: Although cerebral proliferative angioopathy (CPA) is very rare, we should remember characteristics and treatment options of CPA clearly.

Key Words: Cerebral proliferative angiopathy.

P506

Via internal jugular vein to cure complex ruptured brain arteriovenous malformations

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Purpose: To explore the efficiency and safety of the via internal jugular vein to cure complex ruptured brain arteriovenous malformations

Materials and Methods: Between November 2016 and May 2017, the Via internal jugular vein embolization protocol was implemented at the authors’ institution for 6 consecutive patients with ruptured brain AVMs.

Results: Six patients receiving 7 procedures were included, with initial Spetzler-Martin grades were, 41 and 1. All arteriovenous malformations were cured completely demonstrated by angiography. No compilation occurred, and all patients get good outcome by the 30-day follow-up with mRS ≤ 2.

Conclusion: Via internal jugular vein to cure complex ruptured brain arteriovenous malformations is feasible and safety.

P507

Endovascular Treatment of Direct Pial AV Fistulas in Young Adults

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Aim: Presentation of endovascular treatment direct pial fistulas in different locations

Material and Method:
5 young men 15–16 years old with direct pial fistulas:  
1 in anterior cerebral artery  
2 fistulas located in the posterior artery, P1  
2 in middle cerebral artery

Endovascular therapy was performed from the arterial rout:  
1 fistula was exluded with coils and balloon-assisted remodeling.

2 cases embolization of the main venous outflow with coils was performed,  
1 parent artery occlusion

DSA control was performed in a period of 3–6 months

Results: in all cases, the fistula was closed in a single session, without any complications
Control DSA confirmed the complete exclusion of fistulas, with no neurological deficits. **Conclusions:** Single channel pial AV fistulas can be treated safely by strategy of endovascular flow disconnection. Endovascular treatment of direct pial fistulas is an effective method of treatment, with low procedural risk.

**P508**

**Endovascular management of a traumatic carotid cavernous fistula accompanied by a pseudoaneurysm: A case report**

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**Objective:** Carotid cavernous fistula (CCF) accompanied by a pseudoaneurysm is a rare life-threatening condition that requires emergency treatment. Herein, we report a case of traumatic CCF accompanied by a pseudoaneurysmal intracranial hemorrhage from the intradural internal carotid artery.

**Case:** A man aged 29 years developed a traumatic intracranial hemorrhage after a motor vehicle accident. Cerebral computed tomography (CT) showed an acute subdural hematoma on the left frontal and temporal lobes. There was also an intracranial hemorrhage in the left inferior frontal lobe and a diffuse subarachnoid hemorrhage involving the prepontine cistern, basal cistern, bilateral sylvian fissure, and interhemispheric fissure. Decompressive craniectomy was immediately performed. In a follow-up CT, contrast extravasation in the left inferior frontal lobe with simultaneous venous filling in the left cavernous sinus was detected, concomitant with a high-flow CCF. Cerebral angiography showed that a CCF developed in the left internal carotid artery and a pseudoaneurysm was also detected above the CCF. The fistula was occluded through coil embolization and the pathologic lesions were covered in the left internal carotid artery. Angiography showed that a CCF developed in the left cavernous sinus, concomitant with a high-flow CCF. The fistula was occluded through coil embolization and the pathologic lesions were covered in the left inferior frontal lobe. The patient was treated conservatively for one week. Despite our recommendation, the patient refused any further investigation or treatment.

**Discussion:** Tentorial and meningeal feeders indicate that the lesion is located on the dura mater, i.e. the lesion is Galenic dAVF. On the contrary, the transmesencephalic feeders clearly indicates that the lesion is intraparenchymal, tectal AVM. Co-existence of these lesions can be explained in three ways; pure coincidence, tectal AVM with dural AVM feeders, and transmesencephalic arteries arising from the basilar tip. The shunt drained exclusively into the vein of Galen and straight sinus. There was no stenosis or occlusion in the draining route. The patient was treated conservatively for one week. Despite our recommendation, the patient refused any further investigation or treatment.

**P509**

**Co-existence of Tectal Arteriovenous Malformation and Galenic Dural Arteriovenous Fistula: Case report**

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**Background:** Tectal arteriovenous malformation (tectal AVM) and Galenic dural arteriovenous fistula (Galenic dAVF) are located at nearly the same region of the brain and look similar to each other on angiography. We experienced a case of arteriovenous shunt which was difficult to differentiate either tectal AVM or Galenic dAVF. We would like to analyze the angiography of the case and try to diagnose the lesion.

**Case presentation:** A 62-year-old man presented with sudden onset of headache, without neurological deficits. CT revealed right thalamic haemorrhage. MRI revealed enlarged flow void of the Galenic region. Angiography was performed and demonstrated arteriovenous shunt in the same region. The shunt was not only fed by bilateral tentorial arteries arising from the internal carotid arteries and bilateral middle meningeal arteries running along the falx cerebi, but also bilateral posterior cerebral arteries and trans-mesencephalic arteries arising from the basilar tip. The shunt drained exclusively into the vein of Galen and straight sinus. There was no stenosis or occlusion in the draining route. The patient was treated conservatively for one week. Despite our recommendation, the patient refused any further investigation or treatment.

**Discussion:** Tentorial and meningeal feeders indicate that the lesion is located on the dura mater, i.e. the lesion is Galenic dAVF. On the contrary, the transmesencephalic feeders clearly indicates that the lesion is intraparenchymal, tectal AVM. Co-existence of these lesions can be explained in three ways; pure coincidence, tectal AVM with dural AVM feeders, and transmesencephalic arteries arising from the basilar tip. The shunt drained exclusively into the vein of Galen and straight sinus. There was no stenosis or occlusion in the draining route. The patient was treated conservatively for one week. Despite our recommendation, the patient refused any further investigation or treatment.

**P510**

**Target embolization for ruptured cerebral AVM**

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**Objective:** Patients with ruptured cerebral AVMs are at considerable risk of repeat haemorrhage, particularly when associated intranidal aneurysms are present. Although the complete exclusion of the AVM is necessary for prevention of rebleeding, it is sometimes difficult to achieve when the nidus sit in the eloquent area. We report two cases of ruptured cerebral AVM, successfully treated by target embolization for intranidal aneurysms associated with initial bleeding.

**Case presentation:** Case 1: A 73-year-old woman presented with sudden headache and was transferred to the hospital. CT demonstrated subarachnoid haemorrhage surrounding brainstem. Angiography showed a pontine AVM with an intranidal aneurysm as the source of haemorrhage. The right short circumferential artery arising from the basilar artery was feeding the nidus. The transarterial embolization (TAE) using NBCA was performed. The obliteration of intranidal aneurysm and partial obliteration of the nidus...
was achieved. Stereotactic Radiosurgery (γ-knife) was performed 3 months after TAE. DSA obtained 24 months after TAE revealed complete obliteration of AVM. No rebleeding was observed for 24 months after the TAE. Case 2: A 37-year-old man with left frontal AVM received the partial embolization using ONXY followed by the stereotactic radiosurgery. He had intracerebral haemorrhage 4 years after the first embolization and radiosurgery. He suffered 3 haemorrhagic attacks in total for 4 months. Angiography showed a left frontal AVM that had received incomplete embolization. The nidus with intranidal aneurysm as the origin of haemorrhage was located in the left frontal lobe including the motor cortex. The targeted embolization of the intranidal aneurysm by using NBCA was performed and the obliteration of the aneurysm was achieved. No rebleeding was observed for 12 months after the target embolization.

Conclusion: Target embolization for intranidal aneurysm associated with haemorrhage may reduce the risk of repeat haemorrhage.

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Multi-Detector Row CT Angiography in Patients with Suspected Spinal Dural Arteriovenous Fistula

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Purpose: Multi-detector computed tomographic (MDCT) angiography is a recently minimal invasive developed imaging technique that can provide high-resolution and high-contrast images of small vessels such as medullary arteries and veins. The purpose of this study is to assess the ability of MDCT angiography in diagnosing spinal dural arteriovenous fistula (SDAVF).

Materials and Methods: Nine patients with initial magnetic resonance (MR) imaging and clinical findings suggestive of SDAVF and 8 control subjects underwent sixteen-detector row CT angiography. Both MDCT angiography and catheter angiography were done within 5 days in patients with SDAVFs. The acquisition protocol for MDCT angiography was 0.75-mm collimation, a table speed of 18 mm per rotation (36 mm/s), and a 0.5-second gantry rotation period. The results of MDCT angiography in patients with SDAVFs were compared with those of catheter angiography.

Results: MDCT angiography correctly localized the feeding artery, fistula, and perimedullary draining veins of the SDAVFs, and correlated with catheter angiography in 7 patients. Fistula was at the thoracic level in 8 patients, and sacral level in 1 patient. MDCT angiography did not visualize abnormal venous drainage and engorged perimedullary venous plexus in the control group.

Conclusion: MDCT angiography correlates with catheter angiography in diagnosing SDAVFs with spinal perimedullary venous drainage. It can be complementary to spinal transcatheter angiography, and the technique can reduce the amount of time required for catheter angiography.

P512

Balloon-assisted Onyx embolization of intracranial dural arteriovenous fistula

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Purpose: Endovascular Onyx embolization is an effective method to manage intracranial dural arteriovenous fistula (DAVFs) with promising results, however, there still some inherent procedural-related risks and limitations. The purpose of this study is to report our experiences of Onyx embolization of intracranial DAVFs by using various balloon-assisted techniques to enhance the treatment effect and safety of embolization.

Materials and Methods: Over a 3-year period, a total of 21 patients with intracranial DAVFs undergoing trans-vascular Onyx embolization by various balloon-assisted techniques. There were 16 men, 5 women; age ranged from 23 to 81 years old (mean: 63 yrs). We retrospectively analyses the grading of DAVFs, balloon-assisted techniques, and procedure-related complication. Angiographic and clinical outcomes were evaluated as well.

Results: Of these 21 DAVFs, two was Cognard type I, type II in 5, type III in 9 and type IV in 5. There were 4 techniques of balloon-assisted techniques in our series and included (1) trans-arterial Onyx injection via a balloon catheter (n = 10), (2) trans-arterial Onyx injection via a balloon catheter in dural feeder with a protective balloon in another crucial dural feeder (eg. ICA, n = 3), (3) trans-arterial Onyx injection with a protective balloon in adjacent dural sinus (n = 3), (4) trans-venous Onyx injection with a protective balloon in a crucial dural feeder (n = 5). There was no significant procedure-related neurological complication. No instance of inadvertent Onyx reflux to crucial dural feeder or adjacent dural sinus or sticking of balloon in dural feeders. All DAVFs were totally occluded in immediate post-embolization angiogram. One patient had recurrent fistula and underwent a second embolization. The follow-up period varied from 3 to 48 months (mean: 19 mos)

Conclusion: In our experiences, there were 4 balloon-assisted techniques for Onyx embolization of intracranial DAVFs. The selection of these techniques is depended on the fistula anatomy. These techniques have the capability to enhance the effect and safety of embolization, to reduce the Onyx reflux to dural feeders and to avoid inadvertent Onyx reflux to other crucial dural feeders and adjacent dural sinus.
Comparison of Sedimentation Rates and Fluoroscopic Visualization Thresholds of Liquid Embolic Agents

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Purpose: We sought to objectively compare fluoroscopic visualization quality of three of liquid embolic agents, Onyx® (Medtronic), SQUID® (BALT), and PHIL® (MicroVention), by using a previously described calibrated vascular phantom as well as comparing the sedimentation rates.

Methods: The rate of sedimentation of liquid embolics was measured by imaging Onyx 18®, SQUID 12®, SQUID 18®, and PHIL 25® for 30 minutes after preparation. Using a previously described method, DICOM pixel data was then used to calculate signal to noise ratios (SNR) of the suspension. To compare visualization of the liquid embolics from 100 to 500 microns, we utilized a previously described vascular phantom. Injections were performed manually using a 5 ml syringe and were connected to the phantom via a female luer lock. Injections of undiluted Omnipaque®, 300 mg I /ml were made into the vascular phantom. Tantalum based embolics were injected into the model at 2 min and 10 minutes after preparation. DICOM pixel data was again used to calculate SNRs for each tube.

The following formula was used to calculate SNR from pixel DICOM data:

\[
SNR = \frac{\text{Signal} - \text{Noise}}{\sqrt{\text{STD}(\text{Signal})^2 + \text{STD}(\text{Noise})^2}} / 2
\]

\[
\text{SNR} = \frac{\text{Signal} - \text{Noise}}{\sqrt{\text{STD}(\text{Signal})^2 + \text{STD}(\text{Noise})^2}}
\]

\[
\text{BG} = \text{mean background value for pixel data.}
\]

\[
X = \text{ROI within area of interest (separate values measured for each tube, 100 micron to 500 micron).}
\]

\[
\text{STD}(X) = \text{standard deviation of pixel data for area of interest}
\]

\[
\text{STD}(\text{BG}) = \text{standard deviation of pixel data for background data.}
\]

Results: Onyx® 18 demonstrated the fastest sedimentation rate with 76% drop in SNR over 30 minutes. SQUID 12® and SQUID 18® demonstrated a 38% and 30% drop in SNR over the same time; whereas, PHIL 25® maintained constant SNR. Onyx 18® demonstrated the highest SNR from 100 to 500 micron at 2 minutes and 10 minutes post preparation. Most significant, PHIL 25® was not detectable at 500 micron or below on Philips Allura System.

The strategy of endovascular treatment for vertebral arteriovenous fistula: The level of fistulous point can predict whether vertebral artery can be preserved or not

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Purpose: The goal of treatment for vertebral arteriovenous fistula (VAVF) is occlusion of the fistula with preservation of the vertebral artery. However, there are cases, in which parent artery occlusion should be considered. Anatomically, paravertebral venous system forms venous plexus around vertebral artery at the higher than C6 level. On the other hand, the venous plexus at the level of C6 drains into vertebral vein.

Material and Methods: We experienced 6 cases, 2 men and 4 women aged between 49 to 67 years, with 2 traumatic and 4 spontaneous. The strategy for endovascular treatment, whether vertebral artery can be preserved, is retrospectively investigated from the view point of the level of fistulous point and venous out flow.

Results: In all cases, a complete occlusion of the fistula was achieved with the endovascular procedure. The vertebral artery patency was preserved in 4 cases (67%). Transarterial coil embolization of the venous outflow was performed in 3 cases, which demonstrated VAVF at the C6 cervical level or higher. In these cases, the high flow through the fistula drained into the paravertebral venous plexus. The other 3 cases had fistulous point at the lower cervical level draining into dilated vertebral vein. In these cases, transarterial fistulous occlusion with the preservation of vertebral artery is difficult because there is possibility that embolic material can be migrated into the pulmonary venous system. Then in two cases, the parent vertebral artery occlusion was performed. In the other case, vertebral artery could be preserved by the covered stent placement.

Conclusion: In case of VAVF at the higher position beyond C6, transarterial embolization with the patency of vertebral artery can be achieved. However, in case of VAVF at lower position, parent occlusion should be considered. The identification of the level of fistulous point is important to determine the strategy whether the vertebral artery can be preserved or not.
A case of anterior condylar confluent dural arteriovenous fistula treated by deep cervical vein approach

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Purpose: Anterior condylar confluent dural arteriovenous fistulas (ACC dAVF) are commonly treated by internal jugular vein (IJV) approach. In our series, IJV drainage was not observed in four of 12 patients with ACC dAVFs. The IJV approach was possible in 3 of the 4 patients without IJV drainage and the deep cervical vein (DCV) approach was used in the remaining patient.

Summary of case: A 67-year-old female was presented with pulsatile tinnitus, blephaloptosis, and diplopia. A DSA revealed an ACC dAVF fed by bilateral ascending pharyngeal arteries, which drained into the cavernous sinus via inferior petrosal sinus, the DCV via vertebral venous plexus, and the prevertebral vein. The DCV approach was used because the connection between the IJV and the ACC was not recognized by CT angiography. A microcatheter was easily introduced into the ACC through the DCV, the vertebral venous plexus, and the lateral condylar vein. The ACC was embolized with coils and near total occlusion was achieved.

Conclusion: DCV approach is safe and feasible, and can be an alternative approach in cases without IJV drainage.

Head and Neck Arteriovenous Malformations managing by absolute alcohol: cases report

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Purpose: Arteriovenous malformations is a complicated and difficult to treat. There are many kinds of embolization materials which we usually use for managing AVMs, but result is controversy and sometimes need combined treatment.

Material and Methods: We report 5 cases which we manage head and neck AVMs by using absolute alcohol via direct puncture access to reach target.

Results: Our result is successfully get rid in 2 cases, and 3 of them partially reduce AVMs niduses. However, we tend to treat 3 of them with more sessions, but this technique seems to have a trend to get rid AVMs.

Conclusion: Absolute alcohol seems to be a strong embolization material, it can be used to destroy AVMs nidus. Moreover, targeting directly into nidus is also a key for totally destroy AVMs.

Gamma Knife® for Brain Arteriovenous Malformations: Experience from Neuroendovascular program of University of Puerto Rico

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Purpose: In this retrospective study carried out at the University of Puerto Rico - Medical Sciences Campus - Endovascular Neurosurgery program, the authors reviewed the total number of cases of cerebral arteriovenous malformations (AVMs) treated with Gamma Knife Radiosurgery (GKRS). The purpose was to compare our results at the international level and to assess proper treatment protocols in Puerto Rico’s unique population.

Materials and Methods: Number of Subjects (46) Retrospective evaluations of Gamma Knife radiosurgery databases of the University of Puerto Rico, were performed to identify patients who underwent AVM radiosurgery between 2001 and 2015. The inclusion criteria were AVM patients with sufficient baseline data to assess demographic information, nidus angioarchitecture and ≥12 months of neuroimaging and clinical follow-up.

Procedures Performed (GKRS, Embolization, Open Surgery) The baseline data included patient, AVM, and radiosurgery variables. Patient attributes were sex, age, and time interval from clinical presentation to treatment with radiosurgery. AVM variables were maximum diameter, volume, eloquent location, deep venous drainage, and presence of associated intranidal or pre-nidal arterial aneurysms. Eloquent locations were defined as sensorimotor, language, and visual cortex, hypothalamus and thalamus, internal capsule, brainstem, cerebellar peduncles, and deep cerebellar nuclei. The AVM score was determined for each AVM.

Analysis: Patients were followed with routine neuroimaging (Magnetic Resonance (MRI), Digital Subtraction Angiography (DSA) or computed tomographic angiography (CTA)) when MRI or DSA was not feasible) at ≈6-month intervals for the first year after radiosurgery, and annually thereafter. Additional neuroimaging was performed for neurological deterioration after radiosurgery. Obliteration was defined by a lack of flow voids on MRI or anomalous arteriovenous shunting on angiography. Angiography was typically performed to confirm MRI-defined obliteration or to reevaluate a residual nidus for further intervention(s).

Methods: Patient demographics and AVM morphologic features were obtained from Chart Review Meditech; Image Review PACS Vue Motion and analyzed using Descriptive Statistics in Excel 2010 (Mean, Median, and Standard Deviations). Furthermore, the obliteration rate of pre-GKRS
embolized vs non-embolized patients were compiled (complete, residual, and minimal) and compared using Chi-square statistical analysis where P value was significant below 0.05.

Results: A total of 46 patients’ records were reviewed of which; 27 (58.7%) were Male and age distribution was a Mean/Standard deviation of 40.5 +/- 17.1 and a Median of 38.5. Locations were divided as categories of functional neurological groups which include; 1. Frontal, parietal, and temporal, 2. Occipital, 3. Cerebellum, 4. Insula, 5. Thalamus, basal ganglia, and brainstem. Of these 36 (58.7%) cases were embolized with N-butyl cyanoacrylat glue (NBCA) before GKRS. The obliteration rate of pre-embolized was 63.9% and non-embolized of 60% with a P-value of 0.057 which is not significant.

Discussion/Conclusions: As compared to previous large multicenter studies of AVMs treated with GKRS, our patient demographic does not differ greatly. However, a larger percentage of Cortical AVM was seen versus previous studies 78.3% vs 66.6%, most likely due to the fact that few AVMs are treated surgically in our institution. An important finding that differs to previous GKRS findings is that we did not find any statistical significant difference in obliteration rate in patients that were previously embolized. Previous studies have stated “no prior embolization portend a greater chance for radiosurgical obliteration” (1). However, this was not seen in or institution’s cohort. Most likely, due to the fact that the material used was NBCA which does not obscure angiographic delineation of AVM during planning. Radiosurgery offers an effective, minimally invasive therapeutic option for patients with AVMs. The rate of complete obliteration is reasonable. Using the technology currently available, one can treat complex AVMs in difficult locations with a multimodal approach achieving favorable rates of obliteration.

P518

Subdural hematoma in ruptured brain arteriovenous malformations are associated with distal flow-related aneurysms

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Purpose: To report frequency of subdural hematoma (SDH) in ruptured brain arteriovenous malformations (BAVMs) and determine the relationship of SDH with angio-architectural features.

Materials and Methods: This is a retrospective monocentric study of patients admitted for BAVM rupture between 2003 and 2017. Patients with rupture following partial embolization procedures were excluded. Univariate followed by multivariate logistic regression analysis was used to determine factors significantly and independently associated with SDH and angio-architectural features.

Results: One hundred eighty one patients with 188 BAVM ruptures admitted during the study period were included. Eleven cases of SDH were identified (6%). Only 2 cases of isolated SDH were found. The presence of a distal flow-related aneurysm was the only feature independently and significantly associated with SDH (OR 8.1, 95%CI 1.9–34.5, P = 0.003). Distal flow-related aneurysms were associated with proximal flow-related aneurysms (OR 28, 95%CI 10–85, P = 0.01) and subarachnoid hemorrhage (SAH) (OR 4.5, 95%CI 1.7–12.2, P = 0.003).

Conclusion: Ruptured BAVM rarely present with SDH. SDH in ruptured BAVM are associated with distal flow-related aneurysms.

P519

Transarterial embolization for anterior cranial base dural arteriovenous fistulas

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Purpose: Anterior cranial base dural arteriovenous fistula (dAVF) presents aggressive clinical manifestation due to the cortical venous drainage. This has been previously treated by the surgical disconnection because of its difficulty in catheterizing to the feeding artery and easier accessibility under craniotomy; however recent endovascular techniques provide us less invasive and curative endovascular treatment. We demonstrate clinical results of transarterial embolization for anterior cranial fossa dAVFs.

Materials and Methods: Five cases of anterior cranial base dAVFs were treated by transarterial embolization. All cases were asymptomatic; one of them had a history of surgical clipping for unruptured intracranial aneurysm and the another one presented a concurrent Borden type I transverse-sigmoid sinus dAVF. Transarterial embolization using n-BCA (n-butyl cyanoacrylate) were performed. The angiographic findings and treatment results were evaluated.

Results: The dAVFs were fed by ethmoidal arteries in all, infraorbital artery in one, sphenopalatine artery in one, superficial temporal artery in one, and middle meningeal artery in one. The shunts were located besides the crista galli in all, and drained into superior sagittal sinus and/or cavernous sinus with forming varices in all. The low-concentrated nBCA (20–25%) were injected via microcatheters which were advanced as closed to the shunts as possible.
The nBCA was successfully penetrating into the venous side in four cases. The remaining one, mainly fed by infraorbital artery, presented residual shunt due to unsuccessful navigation of microcatheter close to the shunt. In this case, asymptomatic arterial injury was observed during the procedure. **Conclusion:** Transarterial embolization using low-concentrated nBCA is a safe and effective treatment for anterior cranial base dAVFs. When the nBCA is sufficiently delivered into the draining venous side through the distal ethmoidal artery, the complete obliteration can be expected.

### P520

Evaluation of Precipitating Hydrophobic Injectable Liquid (PHIL), a novel liquid embolic agent, in an animal endovascular embolization model

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**Purpose:** The aim of this study was to evaluate a novel iodosinated copolymer-based liquid embolic agent (precipitating hydrophobic injectable liquid (PHIL)) in the porcine rete mirabile (RM), serving as an endovascular embolization model. Onyx, as an established liquid embolic agent, served as control agent.

**Materials and Methods:** Sixteen embolization procedures were performed using PHIL (n = 8) or Onyx (n = 8) as liquid embolic agent. Waiting time between injections was set to 30 or 60 s (n = 4 per study group). Survival time after intervention was 2 hours or 7 days. Embolization characteristics (e.g., procedure times, number of injections and volume of embolic agent) and embolization extent (percentage of embolized RM in post-interventional x-ray) were assessed. Moreover, post-interventional CT and histopathological analyses were performed.

**Results:** Embolization characteristics and embolization extent were not significantly different for PHIL and Onyx (including sub-groups; e.g., embolization extent: 44% vs. 69% [median]; p = 0.101). For PHIL, extension of the waiting time from 30 to 60 s lead to a significant higher embolization extent (24% vs. 72% [medians]; p = 0.035). Moderate disinflammation and mild inflammation of the embolized blood vessels were present for both embolic agents.

**Conclusion:** PHIL is feasible for transarterial embolization in an acute and subacute endovascular embolization model. In this preliminary experimental in vivo study, embolization characteristics, embolization extent and biocompatibility seem to be similar to those of Onyx.

### P521

Sandwich technique (= stent assisted coil) for carotid-cavernous fistula treatment

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**Purpose:** Endovascular procedure such as occlude the cavernous sinus with detachable balloon or detachable coil, has been widely accepted to treat direct carotid cavernous fistula (CCF). Authors report our 9 cases of CCF patients who were successfully treated by endovascular procedures with review articles.

**Materials and Methods:** 9 patients (6 men and 3 women; age range 35–62 years old, mean = 40.5) with high flow CCFs underwent endovascular treatment. We retrospectively analyzed endovascular treatment of the CCFs. First 3 patients treated with coil embolization only and next 6 patients treated with stent assisted coil. Stent assisted coil embolization, author used larger sized coil (about 2 times larger than sinus size) place into the cavernous sinus until the contrast media filling markedly decreased in to CCF, and then Enterprize or Solitair stent paced over the cavernous sinus along the cavernous portion of ICA. In 2 patients the cavernous sinus was not completely occluded after Enterprize stenting, in such cases authors applied additional Solitair stent over the Enterprize stent.

**Results:** All patients treated completely by the endovascular method. 3 patients treated coil only, required mean 8.4 pieces of coil while 6 patients treated with stent assisted coil, used 5.2 pieces of coil. In one coil embolization patient, the offending side ICA was occluded by protruded coil from the cavernous sinus, but cross filling throw the opposite ICA was enough to prevent ischemic symptom.

**Conclusion:** Various skull base approaches tried for the CCF until the endovascular treatment developed. Now endovascular treatment became the treatment of choice for CCF. But in some cases the coil for filling the cavernous sinus required large amount. Authors would like to propose stent assisted coil embolization for CCF treatment is easy and safe method of endovascular treatment.

### P522

Rescue catheter technique for glued catheter retrieval in embolisation for brain arteriovenous malformation: A technical report

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During embolisation using N-butyl-2-cyanoacrylate for a brain arteriovenous malformation in a 20-year-old...
woman, a microcatheter became trapped in a feeding pedicle. A rescue catheter was advanced into the same pedicle and a vasodilator was intra-arterially injected to resolve spasm. The adhered region was then mechanically detached using a micro guidewire, and the trapped catheter was safely removed while pushing the rescue catheter into the vessel for countertraction. Using this set of these techniques named "rescue catheter technique", a rescue catheter was safely navigated proximally to the adhered region, vascular distortion was prevented during the pull-out procedure, and the pulling traction of the trapped catheter was effectively transmitted to the adhered point. This technique may be useful for retrieving a glue-trapped catheter during embolisation for brain arteriovenous malformation.

Conclusion: The results of the current study revealed that the expression profiling of circulating miRNA in patients with dAVF is altered compared to controls. Angiogenesis while developing arterio-venous shunt can be related to these changes.

P524
Combination therapy with hybrid OR for cerebrovascular disease
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Objective: With advent of an endovascular suite in the operating room (hybrid OR), it has been reported recently that combination therapy with endovascular and surgical procedures in hybrid OR for complex cerebrovascular diseases is feasible.

Materials and Methods: We analyzed the 11 consecutive cases who underwent combination therapy with hybrid OR in our hospital from October 2014 to December 2016 (7 Aneurysms, 3 carotid artery stenosis, and 1 dural arteriovenous fistula (DAVF)).

Results: All procedures were performed successfully. We performed bypass surgery and internal trapping with endovascular procedure for all aneurysm cases. In 3 cases of carotid artery stenosis, we performed carotid artery stenting (CAS) with direct puncture of common carotid artery for 2 cases and rescue stenting with carotid endarterectomy for 1 case. Perioperative antiplatelet therapy were performed for all cases of unruptured aneurysms and carotid artery stenosis. In the case of DAVF, we performed transvenous embolization with direct puncture of superficial middle cerebral vein. Systemic full heparinization was performed during all endovascular procedures. There was no symptomatic hemorrhagic and ischemic complication. There was no neurological deterioration of modified Rankin scale at discharge except for the case of symptomatic hyperperfusion after CAS.

Conclusion: Combination therapy with hybrid OR for complex cerebrovascular disease is safe and feasible.

P525
Initial single center experience with newly introduced distal access guiding catheter: Clinical efficacy and safety in the treatment of coil embolization
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Objective: With advent of a newly introduced distal access guiding catheter, we aimed to evaluate clinical efficacy and safety of coil embolization.
Purpose: The purpose of this study was to evaluate the clinical efficacy and safety of 6F Envoy distal access (DA) guiding catheter, the newly developed distal access guiding catheter, through single center experience.

Materials & Methods: We retrospectively reviewed 132 patients who underwent coil embolization using a 6F Envoy DA guiding catheter and 127 patients who underwent coil embolization using the 6F Envoy guiding catheter for comparative study from October 2015 to November 2016 in Inje University Busan Paik Hospital. Of these, 40 cases of posterior circulation aneurysm, 27 cases using double guiding catheter system, and 4 cases using 5F guiding catheter were excluded. The analysis included age, gender, status of rupture, tortuosity of cervical internal carotid artery (ICA), location of initial guiding catheter tip, location of final guiding catheter tip, use of additional catheter to navigate guiding catheter, and the incidence of complication. The comparison between the 6F Envoy guiding catheter and 6F Envoy DA guiding catheter groups was performed with the Mann-Whitney U test or Chi-square test.

Results: Among 188 cases, 89 cases used the 6F envoy guiding catheter and 99 used the 6F Envoy DA guiding catheter. There was no case in which the tip of the guiding catheter reached the petrous segment in the group using 6F Envoy guiding catheter, but 20 cases (10.6%) were observed in the group using 6F Envoy DA guiding catheter. The guiding catheter tip was located more distally in the group using 6F Envoy DA guiding catheter significantly. (p < 0.001).

In order to position the guiding catheter in the appropriate position, additional catheter was needed in the group using 6F envoy DA guiding catheter. (6F Envoy group: n = 7, 3.6%, 6F Envoy DA group: n = 20, 10.6%) (p = 0.016). There were no significant differences in the age, gender, status of rupture, tortuosity of cervical ICA, and incidence of complication between the two groups.

Conclusion: Compared with the conventional guiding catheter, the 6F Envoy DA guiding catheter can reach to distal portion without increasing the complication rate. It may be helpful to improve distal accessibility and stability without complication, using 6F Envoy DA guiding catheter.

P526

Spectrum of neurological presentations in patients with coarctation of aorta: empirically demonstrated by angiography

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Purpose: Coarctation of aorta accounts for 5% - 8% of congenital heart disease and neurological presentations of this disease are not an uncommon association. The objective of this paper is to highlight the variety of neurological presentations and angiographic findings of our four cases of coarctation of aorta during the past 20 years.

Case 1: A 48-year-old female presented with right opthalmoplegia and audible bruit. The diagnosis of coarctation of aorta was achieved at the time of angiographic study. Right brachial artery was accessed to demonstrated a huge right cavernous aneurysm with carotid-cavernous fistula. Evidence of fibromuscular dysplasia was also recognized. She underwent surgery for both coarctation of aorta and cavernous aneurysm, successfully. The follow up study 8 years later revealed a de novo saccular aneurysm at M3-M4 segments of right middle cerebral artery.

Case 2: A 57-year-old female presented with acute subarachnoid haemorrhage. Coarctation of aorta was revealed during transfemoral angiographic procedure. Then the access was changed to the right brachial artery approach, and a small ruptured basilar tip aneurysm demonstrated.

Case 3: A 58-year-old male presented with progressive sensory impairment and weakness of lower extremities. Provisional diagnosis from MRI was spinal arteriovenous shunt with a spinal aneurysm at C5-6 level. Without information of coarctation of aorta in mind, transfemoral approach was failed to reach the aortic arch. Transbrachial access was then performed and finally revealed that the pouch was the flow related aneurysm of anterior spinal artery to be collateral circulations for abdominal aorta.

Case 4: A 12-year-old boy with underlying of Goldenhar syndrome presented with strabismus, left hemifacial microsomia and left upper limb weakness. He also had cervical vertebrae deformities that warranted for further investigation. MRI showed abnormal dilated perimedullary spinal vessels, raising the suspicion of spinal arteriovenous fistula. Thus, diagnostic spinal angiogram was performed. Difficult intracranial vascular access encountered during the procedure, due to abrupt stenosis of the descending aorta at just distal to left subclavian artery. Dilatation of the anterior spinal artery, arising from left vertebral artery was recognized as a collateral circulation to distal aorta. In addition, collateral pathways from left subclavian artery to the large supreme intercostals artery were also identified. The diagnosis of coarctation of aorta was confirmed by CT angiography, subsequently.

Conclusion: The coarctation of aorta can present with symptoms of neurological complications. Thus, an appropriate assessment for these patients should be warranted before considering catheter angiogram assessment. The more we understand the disease and its physiology, the lesser we need for invasive diagnostic procedure.
P527
Can vascular endoscopy combined with narrow band imaging improve diagnostic?
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Purpose: Endoscopy offers high quality images of surfaces of inner anatomy. Narrow band imaging (NBI) is an additional technique for endoscopy to enhance structures on these surfaces that is in use in different medical fields. NBI uses blue (415 nm) and green (540 nm) wavelength light to highlight features that are not typically seen using white light imaging (WLI). The shorter wavelength can penetrate only the superficial layers while the longer one can penetrate deeper. At these wavelengths the haemoglobin absorption of light is at a maximum. The representation of cicatrizes, cuts, vascularisation or inflammations can be improved by NBI. This work shows some first results of the use of endoscopy combined with NBI intravascular. Ex-vivo imaging was performed on porcine specimen.

Materials and Methods: The porcine specimen of arteries (a.iliaca) were resected freshly and fixed in a phantom holder. Small defects like burns and mechanical tears were created on the walls of these arterial vessel samples. The holder was filled with blood because the presence of haemoglobin inside the tissue is necessary for NBI imaging. Ex-vivo imaging was performed with a rigid endoscope (WA96205A 70° 4 mm Ø, Olympus, Germany) and flexible fibre endoscope (Prototype, Ø = 0.5 mm, L = 1500 mm, KARL STORZ, Germany). For imaging, the samples were flushed with water to remove blood for short time. This procedure is similar to the strategy used in vascular optical coherence tomography (OCT). During the flushing sequence images were acquired using endoscopic WLI and NBI. Images were evaluated using imageJ.

Results: Images of the created defects could be acquired. Target structures were identified in WLI and NBI. The appearance and enhancement were compared. The comparison of the images proved that NBI enhances the visualisation of lesions and defects on the artery walls compared to normal WLI.

Conclusion: WLI provides a direct image of the vessel lumen and its anatomical shape. It is suitable for observation and documentation of intravascular therapies. NBI images are more distinct and have more contrast. This helps to detect even small defects or changes on the inner vessel wall that could provide additional information and lead to more precise and personalised therapies. The used rigid endoscope provides high image quality compared to the flexible fibre but is not usable for real vascular applications. The flexible endoscope needs to be improved to achieve better resolution and more flexibility. The image protocol as used for intra vascular OCT works also for vascular endoscopy. The flushing creates a blurry appearance of the images. Further studies have to be done to improve that protocol to achieve higher image quality.

P528
Brain inflammatory amiloid angiopathy - difficult imagistic diagnosis
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Purpose: Cerebral amyloid angiopathy (CAA) is a common pathology in the elderly characterized by the deposition of amyloid protein in leptomeninges and cortical arteries. It can coexist inflammation at patients with CAA which resembles the clinically central nervous system vasculitis, which were recognized as cerebral amyloid angiopathies inflammatory, very rare disease worldwide (50 cases in the literature).

Results: We present the case of a 76-year-old, known with, hypertension, cognitive moderate cortical atrophy, presenting for: speech disorder, headache, dizziness, suddenly onset for about 12 hours. On neurological examination we found that gait and posture was possible with unilateral support, spastic right hemiparesis 4/5 BMRC, osteotendinous reflexes exaggerated on right side, bilateral Babinski sign, awareness, mixt aphasia. Cerebral CT scan: no signs of acute intracranial pathology, cortical atrophy, leukoaraiosis. MRI examination shows multiple microbleeds lesions associated with leucopathy throughout the entire left hemisphere and the posterior half on the right hemisphere.

Conclusions: We draw attention to the atypical localization of microhemorrhagic lesions for amyloid angiopathy. The use of computerized tomography in the diagnosis of stroke in the emergency service does not allow the identification of such a pathology, and the orientation towards a thrombolysis or an eventual anticoagulant may be fatal.

Keywords: amyloid angiopathy, leucopathy, microbleeds.
embarking on this procedure. The presentation will be useful for all members of the care team including interventionists, nurses and radiation technologists.

P530
Virtual radiopacity enhancement of neurovascular stents

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Purpose: X-ray visibility of laser-cut intracranial stents, which are usually made of nitinol because of its favorable mechanical properties, depends mainly on the amount and shape of material. Markers made of materials with higher absorption (e.g. gold, platinum) facilitate positioning, but assessment of the wall apposition and opening of the stent corpus is frequently impossible. To solve this problem, we developed a method to virtually enhance stent visibility by simulation of the mechanical behavior with prior knowledge of patient, stent and catheter design.

Materials and Methods: From a preoperative 3D-DSA, the vessel of interest was selected, segmented and a surface grid was reconstructed. Then a 2D-3D-registration was performed, matching the contrast agent enhanced 2D projection images which were used for the implantation procedure to the 3D vessel tree. The 3D marker and catheter positions were calculated from two projections from different angles. The marker and catheter coordinates as well as the surface grid were imported into a finite element method (FEM) simulation (performed by the Abaqus FEA software). Simulation was based on an ideal elastic 3D beam model of nitinol. The estimated stent geometry was exported and voxelized to a 3D data set containing only the deformed stent geometry. Finally, the 3D data set was forward-projected and the result was superimposed on the initial 2D image. Three vessel phantoms with fully and half deployed ACCLINO flex (ACANDIS GmbH & Co KG, Pforzheim, Germany) stents were used for validation.

Results: In all 3 cases, the stent corpuses were well visible in the final 2D image. In case 1 the simulation result and the phantom agreed well concerning opening and caliber changes. The same holds true for case 2, which contained an artificial stenosis. In case 3, containing a vessel with a sharp bending, the simulation revealed a kink not present in vitro. The reason for this is that the superelastic properties of nitinol have not been considered in the simulation which was due to increased computational time. However, it was shown that there was no complete wall apposition.

FEM simulation lasted for case 1 53 minutes, case 2 108 minutes, case 3 78 minutes.

Conclusion: The approach shows that augmenting 2D projection images by FEM simulation of stent deployments can increase the stent visibility without changing their design or composition. However, some improvements are needed to achieve clinical application.

P531
Prevalence of venous sinus stenosis in Pseudotumor cerebri (PTC) using digital subtraction angiography (DSA)

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Objectives: To study the prevalence of intracranial venous stenosis in Pseudotumor cerebri patients.

Patients and Methods: Thirty patients were diagnosed having PTC according to Dandy criteria. All underwent general and neurological assessment. Radiological assessment included CT scan brain ± MRI brain without contrast, MRV. All underwent digital subtraction angiography (DSA) (venous phase) to confirm the validity of filling gaps seen at the level of MRV.

Results: MRV brain showed that 24 patients (80%) showed filling gaps. Digital subtraction cerebral angiography (venous phase) showed 9 patients (30%) had stenosis in their dural sinuses. MRV showed to be a good screening tool since it had 100% sensitivity and negative predictive value. However, since it has a moderate specificity (62%) with a positive predictive value (PPV) of only 35%, then lesions detected should be confirmed with digital subtraction cerebral angiography (venous phase) particularly those involving the transverse and sigmoid sinus.

Conclusion: Studying the intracranial venous system in patients with PTC is an important step in understanding the pathophysiology of the disease. Detection of venous sinus stenosis opens the way to a novel therapeutic option for refractory patients like venous sinus stenting. 2014 Production and hosting by Elsevier B.V. on behalf of Egyptian Society of Radiology and Nuclear Engineering.
**Introduction:** We present a case of developmental venous anomaly (DVA) in the pons associated with cavernous malformation (CM).

**Case presentation:** A 36-year-old woman presented with a week history of pain and numbness in the left side of her face. Neurological examination showed hypalgesia in the left side of her face and limbs, and mild left facial palsy. CT scan revealed high density lesion in the right dorsal portion (tegmentum) of the upper half of the pons. T1- and T2-weighted images showed a well-demarcated mass with heterogeneous intensity, which were seen as uniformly hypointensity lesion on susceptibility-weighted image (SWI). SWI also revealed abnormal vessels caudally adjacent to this lesion. Cerebral angiography did not demonstrate any arteriovenous shunts. Cone-beam CT confirmed many intraparenchymal veins in the right side of pons centripetally converging into the right lateral pontomesencephalic vein, which drained into the right petrosal vein. Therefore, we diagnosed as DVA in the pons associated with CM. Both lesions were treated conservatively. Then, her symptoms slightly improved at 3 months follow-up.

**Conclusion:** Developmental venous anomaly (DVA) is considered as an extreme anatomic variation that occurs as a form of embryonic or fetal adaptation. The etiology of DVA is not well understood. Some authors insist that it may be associated with cortical cell migration, so DVA does not exist in the brainstem and spinal cord. However, from this case and current reports, DVA in the brainstem and spinal cord exists probably.

**Keyword:** developmental venous anomaly, pons, cavernous malformation

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**P533**

**Study of the intracranial stent visualization using the stent enhancement software in X-ray image**

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**Purpose:** During the stent-assisted coil embolization procedures, it is important to check the deployment of the stent strut. However, in X-ray image, the stent marker is clearly visible, but the stent strut is not clearly visible. Therefore, we focused on the stent enhancement software (CLEAR STENT) that is application of coronary intervention, and we thought the intracranial stent strut can be visible in X-ray image by using CLEAR STENT. The aim of this study is to evaluate the ability of visualization about intracranial stent by using CLEAR STENT.

**Materials and Methods:** This study used the Flat panel detector (FPD)-equipped angiography machine (Artis Q.zen, Siemens) and head phantom. First, we fixed two stents (Enterprise and Neuroform) to head phantom, and acquired X-ray image. Then, X-ray images acquired from different C-arm position. Second, we performed the CLEAR STENT process to acquired images and evaluated the ability of visualization about intracranial stent.

**Result:** In the case of the C-arm angle that the intracranial stent overlapped with a petrous bone or paranasal bone structure, the intracranial stent visualization was poor. But in the case of the C-arm angle that the intracranial stent didn’t overlap with a petrous bone or paranasal bone structure, the intracranial stent visualization was good quality. Clear Stent processing is performed after recognizing a stent marker. Therefore, we thought that the recognition accuracy of the stent marker influences the image quality.

**Conclusion:** In the case of the C-arm angle that the intracranial stent didn’t overlap with a petrous bone or paranasal bone structure, intracranial stent was clearly visible. During the stent-assisted coil embolization procedures, there is a possibility that CLEAR STENT can check the deployment of the stent strut quickly. So, we thought this study suggests that CLEAR STENT is useful in clinical cases.
Aggressive Dural Arteriovenous fistulas (DAVFs) at cavernous sinuses: Presentation, Aggressive venous connection, Endovascular treatment and results. Experience from Ramathibodi Hospital, BKK

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Introduction: We review our cases of DAVFs at cavernous sinuses between January 2014 to April 2017 in term of presentation, feeders and venous reflux and embolization techniques and complications.

Material and Method: Retrospectively review of cases of DAVFs at cavernous sinuses between January 2014 to April 2017 is done in term of presentation, arterial feeders and venous refluxes with endovascular therapy and complication occurred.

Results: Between January 2014 to April 2017, there are 89 cases of dural AVFs at cavernous sinuses with 39 cases of dural AVFs with aggressive venous reflux (43.8%), including 11 males and 28 females with mean age of 64.9 years. 18 cases present with conjunctival injection and redness on the right eye, 15 cases on the left and 7 cases bilaterally. Cerebral angiogram shows multiple arterial feeders of the AVFs at the cavernous sinuses, including:
- Meningophyophyseal trunk and dural branches of cavernous ICA; 28 cases
- Artery of foramen Rotundum; 30 cases
- Meningeal artery; 31 cases
- Accessory meningeal artery; 31 cases
- Ascending pharyngeal artery; 11 cases
- Pterygopalatine artery; 4 cases
- Inferolateral trunks; 10 cases
- Internal maxillary artery; 1 cases
- Occipital artery; 1 cases
- Venous draining includes:
  - Ophthalmic veins; 33 cases
  - Intercavernous veins; 19 cases
  - Sphenoparietal veins and middle cerebral veins; 32 cases
  - Uncal veins; 14 cases
  - Basal vein of Rosenthal; 7 cases
  - Posterior communicating veins; 2 cases
  - Posterior fossa veins and perimesencephalic veins; 10 cases
- Anterior spinal vein; 1 case

Associated venous occlusion or stenosis are found in 21 cases.

Treatment are done with endovascular embolization by trans-venous fiber coils in 31 cases, using between 3~45 fiber coils (average 16 coils/case), with trans-venous NBCA in 25 cases, and trans-arterial NBCA in 1 cases, with only 1 cases with spontaneous thrombosis of the AVFs. Results of endovascular treatment is cure or improvement in 34 cases.

Procedural complications include MCA reflux with partial stenosis 1 case, intercavernous venous perforation 1 case and retained tip of microcatheter with transvenous NBCA in 1 case.

Conclusion: Cavernous sinuses dural AVFs are not uncommon condition, most likely present as consequence of thrombosis of the cavernous sinus, following by secondary AVFs, which most likely causing clinical headache, proptosis and conjunctival injection and edema, and uncommonly present with visual failure. Aggressive venous refluxes are commonly found and usually associated with some degree of venous drainage stenosis, whereas neurological deficit from intracranial venous hypertension is rare. However CT and MR angiogram are nowadays the gold standard of investigation to exclude aggressive venous reflux and planning of endovascular treatment. The favorable embolic materials are still fibered coils and intravenous NBCA still the treatment of choice with high success rate and low complication rate.

A comparison between Ultrasound-guided and fluoroscopy-assisted common femoral artery puncture in a vascular procedure for diagnostic and/or neuro-interventional purposes

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Introduction: Common femoral artery (CFA) is the main access site for angiography and interventional procedures. In experienced hands, standard CFA access can be successful in most cases. Although the technique has been ameliorated through time, complications still happen considerably. Even greater technical difficulty in obese patients. With the better availability of ultrasound in angiography suites, the use of ultrasound guided arterial access is becoming more popular.

Materials and Methods: Between Jan 2016 and October 2016, 160 patients were included. CFA access for diagnostic and/or interventional neurovascular procedures under the local anesthesia. Only 5Fr sheath used. Closing device was not used. The intensity of arterial pulse was examined and subjectively graded as “non-palpable”. “Non-palpable” patients used Ultrasound. All the CFA access were done by one neurosurgeon.

Results: Of the 160 patients, only 20 had ultrasonography, and they had a BMI of 27.8, which was higher than that of patients using fluoroscopy. A total of 3 patients who underwent ultrasonography after the procedure developed a hematoma at the puncture site. Eight of the patients with fluoroscopy had hematoma and one patient had pseudoaneurysm. This was not statistically significant.

Conclusion: The Ultrasound-guided CFA access was useful in determining the proper site of CFA puncture, enabling real-time identification of the bifurcation level. The method was
particularly helpful in the patients with un-palpable pulsation of CFA, such as obese patients.

**P537**

**Patient Immobilization System for Safer Thrombectomy under Conscious Sedation**

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**Purpose:** For the intra-cranial thrombectomy using Stentriever, there’s an ongoing debate about the better method between conscious sedation and general anesthesia. For the thrombectomy under conscious sedation state, adequate patient immobilization is one of the most important prerequisites for the safer and efficient procedure. Here we present our own patient immobilization system.

**Materials and Methods:** We have designed and revised our own patient immobilization solution for some intra-cranial procedures such as thrombectomy using Stentriever and chemical angioplasty for vasospasm under conscious sedation. In this presentation, we will show you the developmental processes for the most updated version.

**Results:** We have done more than 85 cases of intra-cranial thrombectomy under conscious sedation with this system without any unintended events. To use this system was helpful for the safer and efficient procedures.

**Conclusion:** Our own patient immobilization system for intracranial procedure under conscious sedation is a helpful tool for the better results.

**P538**

**In Vitro, and In Vivo Testing of a New Stirable Microcatheter for Neurointerventional Surgery**

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**Purpose:** To evaluate a new stirable microcatheter in brachiocephalic catherization

Catheterization of torturous vessels can be very difficult. We are introducing a catheter design able to stire and bend the shape of the distal catheter tip.

**Material and Methods:** The BenditTM is a steerable laser cut coaxial hypotube designed to achieve optimal navigation results with a small outer diameter, and without compromizing the inner diameter. The user is able to shape (bend) the catheter in any direction with controlled steering abilities ±1⁰ spheric degree up to 180⁰. The currently available catheter has an 2.7 Fr outer diameter, with an inner diameter of 0.55 mm / 0.021”. The bending capability is ±180⁰ with 3 mm radius.

**Results:** It was possible to reproduce catheterization of different vessels and experimental aneurysms without guidewire, the microcatheter was also able to bend and stir within the aneurys. We were also able to use the microcatheter as the inner acces catheter to a 6F larger sheath with no shape, despite LTCCA commun origen with the inominate, and its implications for ischemic stroke catheterization.

**Conclusion:** This new catheter design has a high potential to navigate and change the way we catheterize vessels in neurointervention.

**P539**

**Patient Radiation Exposure during Diagnostic and Therapeutic Procedures for Intracranial Aneurysms: A Multicenter Study to Provide Reference Level**

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Purpose: To assess patient radiation doses during cerebral angiography and embolization of intracranial aneurysms across multi-centers and propose a diagnostic reference level (DRL).

Materials and Methods: We studied a sample of 490 diagnostic and 371 therapeutic procedures for intracranial aneurysms, which were performed at 23 hospitals in Korea in 2015. Parameters including dose-area product (DAP), cumulative air kerma (CAK), fluoroscopic time and total angiographic image frames were obtained and analyzed.

Results: Total mean DAP, CAK, fluoroscopy time, and total angiographic image frames were 106.2 ± 66.4 Gy-cm^2, 697.1 ± 473.7 mGy, 9.7 ± 6.5 minutes, 241.5 ± 116.6 frames for diagnostic procedures, 218.8 ± 164.3 Gy-cm^2, 3365.7 ± 2205.8 mGy, 51.5 ± 31.1 minutes, 443.5 ± 270.7 frames for therapeutic procedures, respectively. For diagnostic procedure, the third quartiles for DRLs were 144.2 Gy-cm^2 for DAP, 921.1 mGy for CAK, 12.2 minutes for fluoroscopy times and 286.5 for number of image frames, respectively. For therapeutic procedures, the third quartiles for DRLs were 271.0 Gy-cm^2 for DAP, 4471.3 mGy for CAK, 64.7 minutes for fluoroscopy times and 567.3 for number of image frames, respectively. On average, rotational angiography was used 1.5 ± 0.7 times/session (range, 0–4; n = 490) for diagnostic procedures and 1.6 ± 1.2 times/session (range, 0–4; n = 368) for therapeutic procedures, respectively.

Conclusion: Radiation dose as measured by DAP, fluoroscopy time and image frames were lower in our patients compared to another study regarding cerebral angiography, and DAP was lower with fewer angiographic image frames for therapeutic procedures. Proposed DRLs can be used for quality assurance and patient safety in diagnostic and therapeutic procedures.

P540
Novel Hybrid Operating Table for Neurovascular Treatment

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Background: The integration of interventional and surgical techniques is requiring the development of a new working environment equipped for the needs of an interdisciplinary neurovascular team. However, conventional surgical and interventional tables have only a limited ability to provide for these needs. We have developed a concept mobile hybrid operating table that provides the ability for such a team to conduct both endovascular and surgical procedures in a single session.

Methods: We developed methods that provide surgeons with angiography-guided surgery techniques for use in a conventional operating room environment. In order to design a convenient device ideal for practical use, we consulted with mechanical engineers.

Results: The mobile hybrid operating table consists of two modules: a floating tabletop and a mobile module. In brief, the basic principle of the mobile hybrid operating table is as follows: firstly, the length of the mobile hybrid operating table is longer than that of a conventional surgical table and yet shorter than a conventional interventional table. It was designed with the goal of exhaustively meeting the intensive requirements of both endovascular and surgical procedures. Its mobile module allows for the floating tabletop to be moved quickly and precisely. It is important that during a procedure, a patient can be moved without being repositioned, particularly with a catheter in situ. Secondly, a slim-profile headrest facilitates the mounting of a radiolucent head cramp system for cranial stabilization and fixation.

Conclusion: We have introduced a novel invention, a mobile hybrid operating table for use in an operating suite.

P541
A comparison between MRA and CTA to evaluate the access route before endovascular treatment

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Purpose: Assessment of access route such as femoral artery or Aortic arch, before endovascular treatment is now essential. While Computed tomography angiography (CTA) can be obtained high resolution, it may lead to the patients’ burden and can occur various complications. In addition to that, it is hard to use for patients with renal dysfunction.

On the other hand, although Magnetic resonance angiography (MRA) is lower in resolution than CTA, it is a device that can be performed safely and less complications than CTA. A few research on peripheral artery by non-contrast MRA are
reported, but no one report the assessment of access route before endovascular treatment.

This study aim to compare MRA with CTA to evaluate the efficacy of MRA before endovascular treatment.

**Materials and Methods**: Patients who underwent CTA and MRA before endovascular treatment were retrospectively studied from October 2015 to August 2016. 10 subjects were included and evaluated.

The blood vessels from common carotid artery to femoral artery was evaluated by CTA and MRA. We evaluated Quality score, Vascular property, Stenosis, Aorta type classification, presence / absence of aneurysm, meandering degree.

Two radiologists evaluate the above items blindly. 1.5-Tesla (Philips), non-contrast enhanced MR angiography, 3D turbo-spin echo (TSE) method was used in all subjects.

**Result**: For Stenosis, reader 1 was 100% in sensitivity, specificity, positive predictive value, negative predictive value, reader 2 was 75%, 100%, 100%, 85.7%. Diagnosis quality score and blood vessel meandering were the same as CTA.

**Conclusion**: The evaluation of access route by using MRA was useful. The possibility of a less invasive access route evaluation method was suggested based on MRA as screening, and CTA only when detailed examination is required. Even with renal impairment, there is a possibility that it may be a substitute for CTA.

**P542**

**Value of external carotid artery resistive index (RI) for diagnosis of cavernous sinus dural arteriovenous fistula (CSDAVF) and determination of the most contributory feeding artery**

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**Purpose**: Cavernous sinus dural arteriovenous fistula (CSDAVF) is a skull based intracranial arteriovenous shunt frequently presented with ocular complaints. It causes hemodynamic disturbance in the feeding arteries, which can be detected by a carotid doppler sonography (CDS). The objective of the study was designed for validation of the CDS in the diagnosis of CSDAVF.

**Materials and Methods**: 42 patients with CSDAVF that were confirmed by cerebral angiography were enrolled. All patients were performed CDS before angiographic confirmation within a month. Evaluations of the CDS parameters were reported and were compared with those of reference control subjects to obtain a diagnostic performance.

**Results**: 42 patients with CSDAVF, 33 were females and the patient’s age ranged from 40–80 years. Angiographic findings showed varying arterial feeders from single vs. multiple, ECA vs. ICA, and right vs. left vs. bilateral. 24 patients had malignant-type venous reflux. The diagnostic performance, compared between the patient’s group and the reference control group, demonstrated the best performance on the basis of the ECA RI. The highest yield shown on the left ECA RI parameter of the sensitivity (78.6%), specificity (75.6%), PPV (76.7%), NPV (77.5%), and accuracy (77.1%). While the sensitivity of the left ECA RI increased from 78.6% to 91.7% on the malignant-type CSDAVF patients.

**Conclusion**: Carotid Doppler sonography may not suitable for diagnosis of cavernous sinus dural arteriovenous fistula. However, the CDS may be beneficial as the tool for screening a malignant-typed CSDAVF.

**P543**

**Morphological Analysis of Occipital Sinuses for Occipital Screw Fixation using Digital Subtraction Angiography**

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**Purpose**: Numerous methods of achieving occipito-cervical stabilization have been described, including the use of occipital plate/screw construct. Bicortical screw may increase the pullout strength, but the potential for intracranial injuries to venous sinuses have been reported. This study was performed to analyze the variations of occipital sinuses to prevent sinus injury by the bicortical screw.

**Materials and Methods**: Occipital sinuses of one 1720 patients were examined using DSA. The data were collected: patient’s age, gender, occipital sinus type, distance between occipital sinus and midline, distance from inion to occipital sinus and the distance between the occipital sinus and the midline occurred at different levels.

**Results**: The mean age of the total patients was 57 ± 13 years. 807 (46.9%) patients were male and 913 (53.1%) were female. The highest occurrence was noted on single occipital sinus off-midline (Type B2). The lowest occurrence was in patients with absent occipital sinuses (Type A, 8.7%). There was no significant difference between age and type (p = 0.310). Also, the difference between genders was not significant in occipital sinus type in general. However in subgroup analysis of type B1 and B2, presentation of type was significantly different between genders (p < 0.01). The mean depth from bone to occipital sinus was 19.913 ± 7.437 mm.

**Conclusions**: The occipital sinus shows several variations and many morphological differences can be seen. Therefore, preoperative detailed examination by MRV or vertebral angiography may be required for the cases in which bicortical occipital screw fixation is necessary to avoid occipital sinus related complication.
**P544**

**Meningioma associated dural arteriovenous fistula: A single center’s 10-year experience**

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**Purpose:** It has been previously reported that intracranial tumors including meningioma might be associated with dural arteriovenous fistula (dAVF). The objective of this study is to examine the relationship between meningioma and dAVFs. Also it is the first quantitative analysis of association of meningioma and dAVFs.

**Materials and Methods:** We performed a retrospective review of records at a single institution from January 2007 to April 2017, identified patients with meningioma undergone digital subtraction angiography. Collected data include demographics, clinical presentation, tumor characteristics (location, maximal diameter, histopathology, sinus occlusion/invasion), dAVF characteristics (location, arterial supply, relationship to tumor), treatment details and follow-up.

**Results:** 511 meningioma patients had been performed digital subtraction angiography from 2007 January to 2017 April. 10(2.0%) patients had intracranial meningioma and dAVFs. Nine patients diagnosed dAVF before tumor surgery. Two patients diagnosed dAVF after tumor surgery. One patient had intracranial meningioma and dAVF before surgery. Two patients had intracranial meningioma and dAVFs. Also it is the first quantitative analysis of association of meningioma and dAVFs.

**Conclusions:** Meningioma might be associated with dAVF by multiple mechanisms including sinus occlusion, hypervascular tumor feeder and tumor angiogenesis factors. Especially, whether meningioma invades sinus or not is significant factor for development of dAVF in meningioma patients.

**P545**

**Fluoroscopic Visualization thresholds in Neuro-Biplane systems: a Comparison of Philips Allura, Siemens Artis Q, and Siemens Artis Zee**

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**Purpose:** In need of a more realistic tool for assessment of angiographic visualization quality of small cerebral arteries, a new dynamic vascular phantom was developed that allows for active visualization of liquid radiopaque agents injected simultaneously into calibrated tubings ranging from 100 to 500 microns - sizes which correlate with small cerebral vessels such as dangerous ECA-ICA anastomoses and essential perforating cerebral vessels. This approach is used to compare 3 Neuro-Biplane angiographic systems.

**Methods:** Injections of undiluted Omnipaque 300 mg/l/ml were made into the phantom. All injections were performed using a “blank Road Map setting” under optimized conditions for clinical use of each of the 3 systems: Allura with Clarity (Philips Healthcare), Artis Zee (Siemens Healthcare), and Artis Q (Siemens Healthcare). The following settings were used: Philips Allura (with Clarity), FD 15 cm, SID 90, fluoro mode 3, Roadmap.

Siemens Artis Q; FD 16 cm, SID 90, RM(+).

DICOM pixel data was extracted using region of interest (ROI) tool in Osiris MD version 7.0.4. A previously described formula was used to calculate signal to noise ratios (SNR) using pixel data stored in DICOM images: 

\[
SNR = \frac{BG - Tube ROI}{\sqrt{STD(tube)^2 + STD(BG)^2}}
\]

BG = mean background value for pixel data, Tube ROI = ROI within a particular tube (separate values measured for each tube, 100 micron to 500 micron), STD (tube) = standard deviation of pixel data for a particular tube size, STD (BG) = standard deviation of pixel data for background data.

**Results:** The Allura system using flat detector (FD) size = 15 cm demonstrated a superior SNR compared to Artis Q, system, FD = 16 cm (22 vs 14) and Artis Zee system, FD = 16 cm (22 versus 12) and FD = 11 cm (22 versus 12). In addition, Philips Allura demonstrates superior SNRs at lower diameters compared to Siemens.
Artis Q at FD = 16 cm and Siemens Artis Zee at FD = 16 cm and FD = 11 cm.

Conclusions: Visualization quality of small cerebral arteries plays a key role in guaranteeing highest possible safety standards during embolizations in patients with cerebrovascular lesions where poor visual control could result in inadvertent embolization of non-target vessels. We have described a novel method of objectively comparing visualization of radiopaque liquids allowing for objective comparisons of fluoroscopy and RM quality between different vendors. Future studies should repeat these methods with inclusions of PMMA to simulate tissue absorption, as well as real time dose monitoring, for more accurate comparisons.

P546

Angioarchitecture and clinical presentation of high cervical spine arteriovenous shunts

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Purpose: High cervical spine arteriovenous shunts (HCSAVS) are relatively rare spinal vascular lesion that may present not only with venous hypertension but also bleeding. We investigated the angioarchitecture of HCSAVS in relation to the clinical presentation.

Materials and Methods: We reviewed ten consecutive patients (eight males and two females; mean age, 59 years) with HCSAVS treated at our institutions from 2005 to 2017. Eight patients presented with bleeding, and one patient with tinnitus. The findings of angiography including 3D rotation images were carefully investigated.

Results: Eight cases were supplied not only rediculo-meningeal arteries but also vasa corona from spinal arteries. The only one case was supplied by only rediculo-meningeal artery and another case was supplied by only vasa corona. Six cases carried aneurysm dilatation on vasa corona as feeders and presented with bleeding. Nine cases could be dural AVS and one case would seem epidural AVS with the small possible diagnosis as radicular or perimedullary AVS. However there is no obvious concomitance of dural and perimedullary AVS. AVS drained cranially in 8 cases and caudally in 2 cases without any varics.

Conclusion: Most of HCSAVS would seem dural AVS supplied not only by rediculo-meningeal arteries but also vasa corona with aneurysmal dilatation, which could cause bleeding. Presentations of bleeding and pial supplies are singular points comparing to spinal dural AVS. However, some cases of HCSAVS could be perimedullary, radicular or epidural AVS with segmental spread.

P547

Traumatic arteriovenous fistulas at the basilar artery. A case report

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Introduction: Traumatic arteriovenous fistulas (AVF) at the basilar artery (BA) and the clival venous plexus are rare. Case report: An 18 years old female involved in a severe traffic accident. She presented a shock status due to multiple injuries of trunk, and was deeply comatose. Plane computed tomography (CT) revealed a subtle subarachnoid hemorrhage and hydrocephalus. Contrast CT revealed an abnormal enhancement in front of the BA. After stabilizing vital signs, the patient underwent cerebral angiography. Right vertebral arteriography revealed a fistula at the BA adjacent to the superior cerebellar artery (SCA) origin. The shunt flowed into the extradural venous plexus of the clivus and the spinal canal. The posterior circulation was not detected in bilateral common carotid arteriography (CCAG).

Initial strategy was to close the shunt and venous plexus. A microcatheter was navigated into the clival extradural venous plexus via the BA. The venous plexus was occluded with detachable coils until the microcatheter pushed back to the BA. However, the shunt still remained. Next strategy was to trap the BA with detachable coils. A micro-balloon catheter was used to occlude the BA in short segment to protect the connection between bilateral posterior communicating arteries (Pcom), posterior cerebral arteries (PCA), and SCAs. The shunt disappeared by trapping the BA. Right PCA and SCA were preserved by internal carotid artery via Pcom. However, the patient suffered cerebral infarction in posterior circulation area. The patient died due to a primary brain damage after 23 days.

Discussion: The mechanism of shunt formation at the BA and the clival venous plexus is unclear. There were no similar case reports.

In this case, the venous plexus embolization was unsuccessful and additional embolization of BA was necessary to occlude the shunt. It might have been possible to block the shunt with not only coils but also with liquid embolic materials under flow control using balloon.

Conclusion: We experienced a rare case of traumatic AVF at the BA and the extradural venous plexus. In this critical situation, both procedure and clinical decision were difficult.
P548
Endovascular treatment of complex vascular pathology in neck and brain region
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Purpose: Authors present complex multistage endovascular treatment of female patient with an intradural infiltrative, inoperable tumor of the glomus jugulare, a stenosis of the internal carotid artery and an aneurysm of middle cerebri artery.

Methods: In the literature our case report is the first announcement in which three pathology coexist ipsilateral in one patient and the patient has been treated step by step by endovascular procedures.

Results: Beside the endovascular treatment steps we display glomus jugulare tumor’s symptoms, staging, treatment options and also the current treatment guidelines of internal carotid artery stenosis and intracranial aneurysms.

Conclusion: Complex vascular pathology in neck and brain region can treat by endovascular treatments.

P549
Infiltrated embolization of meningioma with dilute cyanoacrylate glue
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Purpose: Meningiomas are often embolized before their surgical resection to reduce blood loss during surgery. We have used low concentration n-butyl cyanoacrylate (NBCA) since 2011. We report the efficacy and technical aspect of infiltrated preoperative embolization for meningiomas with the penetration of very-diluted glue.

Materials and Methods: In this method 13% NBCA-lipiodol mixture is extremely slow injected from the middle meningeal artery like a plug and push injection of Onyx after the tortuous side feeders are proximally embolized. The glue is infiltrated into small tumor arteries and extends to the inacessible feeders from pial artery or deep meningeal arteries. If the careful embolization not to reflux too much and migrate the glue into the normal arteries is achieved, this method is very useful to get the extremely effective devascularization on surgical extirpation, and also may applicable to the surgically untreatable meningiomas as a semi-radical treatment option.

Results: Since 2011, 32 cases preoperatively diagnosed with meningioma were embolized with this technique. Intratumoral embolization was possible in 30 cases (94%), and more than 50% reduction of contrast area in T1 Gd was achieved in 18 cases (56%). 2 cases achieved complete devascularisation, showing a remarkable shrinkage in tumor size after embolization.

Conclusion: Preoperative embolization of meningioma with the penetration of very-diluted glue was useful. We assessed the extent of intratumoral embolization and its effect on tumor removal.

P550
A case of growing epidural hematoma treated by embolization of the middle meningeal artery
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Objective: We report a case of the growing acute epidural hematoma treated by embolization of the middle meningeal artery.

Case report: An 18-year-old man was admitted with head trauma sustained in a traffic accident. Initial CT revealed a linear fracture and a small epidural hematoma in the left frontal region. As the hematoma was small and neurological deficits were absent, it was treated conservatively. A second CT assessment three hours later showed that the hematoma had enlarged and external carotid angiography showed extravasation from the frontal branch of the middle meningeal artery. Embolization of the middle meningeal artery gradually decreased the hematoma.

Conclusion: Embolization of the middle meningeal artery effectively treated a small acute epidural hematoma.

P551
Evaluation of patient radiation dose according to the craniocaudal angle in cerebral angiography
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Purpose: The posteroanterior (PA) projection with 15–20 degrees in a cranial direction have been a standard angiographic view for cerebral angiography, and it may increase radiation dose compared to true PA view. Our purpose was to estimate the patients dose according to the craniocaudal (CC) angle in frontal digital subtraction angiography.

Materials and Methods: Thirty patients who underwent cerebral angiography for unruptured intracranial aneurysm were prospectively included in this study. Both sides of internal carotid arteriography were obtained with different angles in each patient. The modifiable parameters (field-of-view, source-detector distance, and table height) were the same, and the other settings (mA, kVp, and filter) were automatically determined by angiographic system within a fixed protocol. The kerma-area product (KAP; μGy-m2) and air-kerma (AK; mGy) per frame (f) were measured and compared between two different angle groups using paired T-test.
Results: The mean CC angles were 1.5 degree in true PA setting, and 19.2 degree in conventional. The average KAP (22.5 vs. 25.3, p = 0.01) and AK values (1.4 vs. 1.6, p = 0.007) with true PA angle were significant lower compared to the standard angle. In four patients, the doses particularly increased with dropping out of a copper filter in the conventional angle. The copper filters were automatically introduced in 40% (n=12) of the true PA and 53.3% (n=16) of the conventional angled PA. The tube current (mA) and peak kilovoltage (kVp) did not show significant difference between the groups.

Conclusion: Reducing the angulation is a simple and effective way that may be considered to lower radiation dose during cerebral angiography.

P552

Case-control study of arterial puncture site hemorrhage after neuroendovascular treatment

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Purpose: Puncture site hemorrhage following femoral artery catheterization is a significant cause of morbidity. In recent years, new vascular closure devices have been developed with excellent safety and efficacy. However, even with new vascular closure devices and appropriate bed rest, puncture site hemorrhage may occur. The aim of this case-control study is to retrospectively review the post-procedural puncture site hemorrhage and look for possible predisposing risk factors.

Materials and Methods: Over a 23-month period, we retrospectively reviewed 255 patients treated endovascularly at our institution and classified them into hemorrhagic and non-hemorrhagic group. Including criteria were any arterial bleedings and subsequent hematoma formation around puncture site after hemostasis. Oozing was excluded.

Result: Puncture site hemorrhage occurred in 15 (5.9%) patients. Cause of bleeding was failed initial hemostasis (3 patients, 20%) and not following bed rest as instructed (8 patients, 53%). The cause for the remaining 4 patients was unknown. All cases were within 42 hours of neuroendovascular intervention of which 10 cases (66%) were right after stopping compression hemostasis. After categorization by treatment, balloon assisted coil embolization of intracranial aneurysm (5 patients, 10.4%) and slant assisted coil embolization of intracranial aneurysm (5 patients, 12.8%) were associated with a higher incidence, whereas simple coiling (1 patients, 3.0%) and carotid artery stenting (1 patients, 2.1%) were associated with a lower incidence. Clinical characteristics were significantly different in post-operative heparinization (7 patients, 13.2%, p < 0.05) and post-operative ACT level of 300 or more before removal of the sheath (9 patients, 11.8%, p < 0.05). Anti-platelet therapy was significantly different between single antiplatelet therapy (SAPT) (2 patients, 3%) and triple antiplatelet therapy (TAPT) (4 patients, 17.4%) (P < 0.05). PRU less than 95% (10.5%), sheath size, hemostasis methods, and operative time did not showed any clinical significance.

Conclusion: ACT level of 300 or more, TAPT and postoperative heparinization were associated with increased puncture site hemorrhage. Furthermore, management of patient with risk factors by appropriate bed rest duration and education is necessary.

P553

Transvenous embolization for dural AVF using liquid embolic material

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Objective: Intravenous embolization for dura arteriovenous fistula is a treatment to mainly block the outflow path of shunt using coil. However, because it is necessary to shut off the outflow tracts completely, cranial nerve palsy may appear due to the need for a large amount of coil or excessive packing. If a liquid embolic material is used intravenously, it is possible to occlude the outflow channel in a short time without failing to press the cranial nerve reliably. Treatment results of dura arteriovenous fistula with intravenous embolization using liquid embolic material were examined.

Method: For 7 cases (CCF: 1 case, ACC: 2 cases, TS-S: 4 cases) of 56 dura arteriovenous fistulae treated after October 2008 after ONYX domestic introduction respectively. Target cases were injected intravenously with liquid embolic material (16–20% NBCA, Eudragit, ONYX) in various forms and treated. In 6 cases, coil was used in combination and liquid embolic material was supplementarily injected, but in one case only ONYX injection was performed.

Results: In all cases, the dura arteriovenous fistula was curable and no recurrence was observed. Particularly in ACC and CCF, excessive packing by coil was avoided, and it was useful for prevention of cranial nerve palsy. In one case, coil embolization was performed intravenously, but cortical venous reflux had not disappeared, so ONYX was injected from within the coil mass to occlude the venous outflow tract. Intravenous embolization with a liquid embolic material can also flow back into the inflow artery by making a plug in the coil mass. This will also be a new treatment choice, but conversely if you do not pay enough attention you have the risk of causing unexpected complications.

CONCLUSION: Intravenous embolization using a liquid embolic material for a dural arteriovenous fistula was able to cure the dura arteriovenous fistula without shortening the cranial nerve reliably in a short time.
**PEDIATRIC INTERVENTIONS**

**P554**

**Imaging of Pediatric Neurovascular Lesions**

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**Objective:** To provide a visual review of the contemporary imaging features of a wide array of vascular lesions found in the brain, spine, and head/neck in children.

**Material and Methods:** A well-organized poster will visually display a wide array of pediatric neurovascular lesions of interest to neurosurgeons, endovascular neurosurgeons, and interventional neuroradiologists caring for these children.

**Results:** Multimodality contemporary imaging will be provided for a range of educational cases. Anatomic variants: persistent trigeminal and hypoglossal arteries, aberrant carotid, persistent falcine sinus, great vessel/aortic arch anatomic variants, vein of galen "malformations."

**Artifacts:** MIMics of dural venous sinus thrombosis, AVM mimics.

**Intracranial:** sinus thrombosis, AVM, Developmental Venous Anomaly with gliosis, cerebral proliferative angiopathy, dissections, angiographic brain death evaluations, cavernomas, ICA compression by pituitary adenoma.

**Head and Neck:** ICA pseudoaneurysm due to retropharyngeal abscess, juvenile nasopharyngeal angiofibroma, venous malformations of the face, tongue, neck, orbit; facial AVM and AVF, tumefactive fibroinflammatory lesion of neck/ICA.

**Spine:** AVM, Cobb Syndrome, epidural hematomas from various etiologies.

**Conclusions:** Diagnostic pediatric neuroradiologists can play an important role in assisting pediatric neurosurgeons and endovascular neurosurgeons in arriving at an accurate diagnosis prior to intervention. This involves high quality, state-of-the-art imaging. This poster will attempt to provide a valuable reference guide to some of the more common, as well as some esoteric cases, that would be encountered in caring for these children.

**Keywords:** Imaging, vascular, pediatric, brain, spine, head & neck.

**P555**

**Intra-arterial administration of chemotherapeutic agents in retinoblastoma**

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The use of intra-arterial chemotherapeutic agents for the treatment of advanced or extensive retinoblastomas has gained wide acceptance since its introduction. Initially administered into the internal carotid artery and later directly into the ophthalmic artery, the advantages of lower systemic side-effects combined with the ability to administer a much higher therapeutic dose translated into dramatic regression of advanced tumours.

The technique most commonly used is the selective catheterisation of the ophthalmic artery and the administration of the therapeutic agent. The arterial anatomy the ophthalmic artery specifically the origin of the carotid artery can make this selective catheterisation tricky and time consuming. The embryological connection between the middle meningeal artery (MMA) and the ophthalmic artery can therefore often be used if and when selective catheterisation of the ophthalmic artery is not possible.

We endeavoured to examine in what percentage of our patients we were unable to selectively catheterise the ophthalmic artery or rather chose to use the MMA and in those patients in which we used the MMA there was any difference in response to the chemotherapeutic agents when compared to those patients who had direct ophthalmic artery administration.

**P556**

**Mynxgrip Vascular Closure Device Use in Pediatric Neuro-interventional procedures**

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**Purpose:** To assess the efficacy and safety of Mynxgrip closure device use after neuro-endovascular procedures in the pediatric population where closure devices remain off-label despite their validation and widespread use in adults.

**Materials & Methods:** We performed a retrospective review of all pediatric patients undergoing diagnostic or interventional neurovascular procedures at our institution. Mynxgrip use was predicated by an adequate depth of subcutaneous tissue and common femoral artery (CFA) diameter. Patients remained on supine bedrest for 2 hours after diagnostic and 3 hours after therapeutic procedures. We recorded patient demographics, procedural details, hemostasis status, and complications.

**Results:** Over 36 months, 83 Mynxgrip devices were deployed in 53 patients (23 male and 30 female, mean age 14.5 years) undergoing neuro-endovascular procedures through a common femoral artery access. Diagnostic angiography comprised 46% of procedures. Median CFA diameter was 6.6 mm and ranged from 4 mm to 8.5 mm. A single device failure occurred (1.2%) without any sequel, the clot was extracted and a safe guard was used instead. No other immediate or delayed major complications were recorded.

**Conclusion:** The Mynxgrip can be used safely in the pediatric population with effective hemostasis and the advantage of earlier mobilization.
Table 1: patients’ demographics and procedure characteristics:
Variable Mean (SD) or n (%)
Age (years) (mean (SD)) 14.52 ± 3.08
Gender (n (%))
Male 23 (43.3%)
Female 30 (56.7)
Age-adjusted BMI (Mean (SD)) 23.48 ± 4.95
Underweight (BMI < 18.5) (n (%)) 4 (7.5)
Overweight (25 ≤ BMI < 30) (n (%)) 13 (24.5)
Obese (BMI ≥ 30) 5 (9.4)
Status (n (%))
Inpatient 40 (48.2)
Outpatient 43 (51.8)
Common Femoral Artery Diameter (mm) (Mean (SD)) 6.24 (1.16)
Side of arteriotomy (n (%))
Right 82 (98.7)
Left 1 (1.3)
Type of interventional procedure (n (%))
Diagnostic Angiography 38 (45.7)
Angiography + embolization 45 (54.4)
Time between initial and subsequent 21 ± 16.97 procedure (days) (Mean (SD))

SPINAL INTERVENTIONS

P557

The role of intraoperative transoral or transpedicular vertebroplasty in the treatment of C2 osteolytic vertebral body and dens tumors with occipito-cervical posterior fixation

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Objective: Metastatic spinal tumors of the atlanto-axial region are quite uncommon thus surgical treatment is difficult and challenging procedure. The aim of our study was to evaluate the safety and efficacy of simultaneous intraoperative transoral or transpedicular vertebroplasty combined with posterior fixation in case of C2 vertebral metastatic disease.

Methods: We enrolled 5 patients with osteolytic C2 vertebral metastasis. In 3 cases we made purely posterior approach by dorsal open C2 biopsy and transpedicular vertebroplasty followed by posterior occipito-cervical fixation. In the other 2 cases patients underwent transoral C2 biopsy and vertebroplasty and dorsal occipito-cervical fixation in the same session. The patients were followed with regular fluoroscopy, MRI, CT scans and neurological examinations.

Results: During our 8–19 months (average 13) follow up period we had no surgical or neurological complications with respect to this combined approach. In all cases we detected spinal stability and pain reduction according to pain visual analog scale (VAS) where pain reduction was 3.5 (2–5) points. The average volume of PMMA injected was 4 ml. We filled more than 60% of each patient’s C2 vertebral body and dens.

Conclusion: In this small series of simultaneous intraoperative transoral or transpedicular vertebroplasty and dorsal occipito-cervical fixation proved to be a safe and effective treatment for patients with osteolytic C2 metastatic tumors. These techniques may provide excellent pain relief and improvements in quality of life. The true value of these combined techniques should be evaluated in larger series.

P558

3D visualization of residual lumen and coil by double contrast M

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Objectives: Recurrence is a problem in coil embolization of aneurysms, it should be helpful to work out the strategy for re-treatment to visualize 3D structure of coils and residual space. Superimposing time of flight MR angiography and high resolution T2 weighted image, all of residual space, coil mass and parent arteries could be visualized. By some volume rendering software, coil mass and residual lumen were visualized in 3D.

Materials and Methods: In cases after coil embolization of the aneurysm, high resolutional time of flight MR angiography was obtained. At the same time, high resolutional 3D T2 WI was acquired. MR equipment was 1.5 T Achieva Nova dual gradient (Philips Medical Systems, Best, The Netherlands). 3D TOF resolution was 0.25 mm3 and scan parameters were FA 17, TR 21, TE 3043D T2 WI was acquired by VISTA (Volume Isotropic Turbo Spine Echo). The size was 0.8 mm3 and scan parameters were FA 90, TR 1600, TE 78. Acquired 3D data were sent to a viewer and observed by multiplaner reformation, surface rendering or volume rendering.

Results: The residual lumen and the coil mass were successfully visualized which were helpful for planning retreatment.

Discussion: Close and careful follow up is necessary for the aneurysms after coil embolization because of possible coil compaction or aneurysm regrowth. X ray based modalities have high spacial resolution, but they are not very good at
visualization of the residual space. The platinum coils are designed to have very high radiopacity, so they produce severe artifacts. Magnetic resonance angiography can show the residual flow in the aneurysm. However, MRA has not enough contrast between coils in the aneurysm and the surrounding tissue especially cerebrospinal fluid. To visualize 3D structure of coils and residual space, we tried to superimpose outline of the aneurysm obtained by T2 weighted image and MR angiography. Patients’s movement, time consuming and relatively unstable signal intensity of thrombus might be problem.

P559
Spontaneous intracranial hypotension - A novel intervention method in a series of 3 patients
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Purpose: To suggest effective intervention technique for the treatment of headache due to spontaneous intracranial hypotension.

Methods: Spontaneous intracranial hypotension (SIH) is characterized by orthostatic headache, low cerebrospinal fluid pressure, and diffuse pachymeningeal gadolinium enhancement. We present here the case series of three patients.

Results: All of the three patients showed a CSF leak with myelogram, and recovered completely with epidural blood patch (EBP) with 15 cc of autologous blood, after which immediate and complete symptomatic relief was obtained.

Conclusion: Although SIH is not common, we should consider the possibility of SIH in mind and EBP can be effective treatment in patients unresponsive to conservative measures.

Keywords: Epidural blood patch, spontaneous intracranial hypotension

P560
Efficacy of dynamic 3D-DSA and conebeam CT for diagnosis and treatment of iatrogenic vertebrobasilar insufficiency caused by screws of posterior spinal fusion
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We report a case of iatrogenic vertebrobasilar insufficiency caused by posterior cervical spinal fusion in which dynamic 3D-DSA and conebeam CT were useful for diagnosis and treatment. A 74-year-old patient suffered from positional dizziness at cervical extension 7 months after posterior spinal fusion. Dynamic 3D-DSA and its 3D-reconstruction and conebeam CT demonstrated vertebrobasilar insufficiency due to stenosis of the right vertebral artery with cervical extension position and the left vertebral artery occlusion. Stenosis of the right vertebral artery was revealed at the tip of the right C2 screw in the cervical extension position, not in the neutral position. The screws were removed and the C2-C7 rod was replaced with C4-C7 rod. Intraoperative dynamic DSA revealed that spinal re-fixation released the compression. The dizziness with cervical extension position disappeared after the operation. Vertebral artery injury is one of the most dangerous complications of screw fixation and is usually due to incorrect cervical pedicle screw entry with vertebral artery injury. It is difficult to obtain dynamic images and diagnose positional vertebrobasilar insufficiency by CT-angiography (CTA). In our case, dynamic 3D-DSA, its 3D-reconstruction images, and conebeam CT were effective for diagnosis of vertebrobasilar insufficiency due to malposition of screws.

Background and Purpose: Direct injection of Oxygen-Ozone in the cervical discs has proved to be the effective alternative to surgery in patients with cervical disc herniation in many countries around the world. We report our experience with ozonucleolysis with patients effected by pain in cervical region (Brachalgia) due to disc herniation including post operative recurrence or disc prolapse.

Methods: 4000 patients were treated with single session of Oxygen Ozone therapy from 2005–2016. All the patients had CT or MRI evidence of cervical disc prolapse with clinical signs of cervical nerve root compression. The procedure was performed under angio fluoroscopy using 22/23 G spinal needle with out any form of anesthesia. All the patients received intra discal injection of Oxygen Ozone mixture at a ozone concentration 30 ugm/ml. Among 4000 patients 3000 were males and 1000 were females between the age of 20–70 yrs. Therapeutic out come was assessed 5 months after treatment by using modified MacNab method.

Results: A satisfactory therapeutic outcome was obtained. 60% of the patients showed complete recovery with resolution of symptoms. 20% of the patients complained of occasional episodic neck pain and arms pain with no limitation of occupational activity. 5% of cases showed insufficient improvement. 5% of cases had no improvement and went for surgery. 10% of cases never turned up after the first visit.

Conclusion: Intradiscal and periganglionic injection of Ozone for herniated cervical disc has revolutionized percutaneous
approach to nerve root diseases making it safer, cheaper
and easier to repeat than treatments currently in use.

P562
A case of paraspinal AVF with double holes of fistula
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Introduction: Parachodal arteriovenous fistula(AVF) is a
group of disease, which is consisting of brachial AVF and
paraspinal AVF. We report a case of paraspinal AVF with
double holes of fistula.

Case: A 1-year-old female was pointed out a wide range of
continuous murmur on her back when she was 8 months
old. The contrast CT scans showed spinal AVF. She was
introduced to our hospital. Her body weight was no more
than 10 kg. We followed up observation until her weight
gain. When one year and 7 months after birth, endovascular
treatment was underwent. Angiogram showed paraspinal
AVF which was fed by right T8 and T9 segmentary arteries.
Slab maximum intensity projection(MIP) with 1 mm slice
showed clearly identified fistulas. Microcatheters were
introduced into each fistulas. Transarterial embolization
using NBCA was underwent. Postoperative angiogram
showed no evidence of fistulas. Postoperative course was
uneventful.

Conclusion: This case was a first report of paraspinal AVF
with double holes of fistula.

P564
Concomitant perimedullary arteriovenous fistula of the conus medullaris and radicular arteriovenous malformation, suggested spinal arteriovenous metameric syndrome (SAMS25): a case report
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Purpose: To present a rare case of two separate arteriovenous shunts at the conus medullaris and left L5 nerve root, suggested spinal arteriovenous metameric syndrome.

Materials and Methods: A case report and literature review. Summary of case: We report a case of a 40-year-old man presented with radicular pain and paresthesia of the left foot (L5 dermatome). The spinal MRI/MRA revealed dilated perimedullary flow voids without cord edema. Initial selective spinal angiogram showed perimedullary AVF at dorsal aspect of left-sided conus medullaris fed by left L1 radiculopalpial artery. According to questionable complete obliteration of the fistula after glue embolization and persistent abnormal of vessels on follow-up spinal MRA/MRI, repeated spinal angiogram was performed, demonstrating the second fistula at the left L5 nerve root, fed by left L4 radicular artery, that had never selective injection before. No residual perimedullary AVF is observed, then glue embolization of the radicular AVM with complete obliteration.

This is the first case of concomitant perimedullary AVF of the conus medullaris and radicular AVM in Ramathibodi hospital and given the few reported in reviewed literatures. The association of spinal cord AV shunt and radicular AV shunt is rare and potentially incomplete metameric disease if the myelomere involved with the spinal cord AV shunt corresponds to that of the involved nerve, like our case.

We think, it is generally accepted that follow-up spinal MRA/MRI after treatment should be performed in all cases. The persistence clinical symptom and MRI abnormalities, that suggestive of AV shunt should have led to a repeat angiogram. If there is no previously seen residual shunt, we’ll recommend injection into the segmental arteries that had not previously been injected to search for second AV shunt.

STROKE - CLINICAL
P565
Rescue mechanical thrombectomy using a retrievable stent for thromboembolic occlusion occurring during coil embolization of ruptured intracranial aneurysms
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Purpose: The safety and efficacy of mechanical thrombectomy using a retrievable stent for thromboembolic occlusion occurring during coil embolization of ruptured intracranial aneurysms has rarely been reported.

Materials and Methods: Between June 2011 and June 2015, 631 consecutive patients with ruptured intracranial aneurysms underwent coil embolization at 5 hospitals. Among 53 patients who suffered from thromboembolic complications, 15 patients harboring 15 aneurysms underwent rescue mechanical thrombectomy with retrievable stent for the treatment of thromboembolic occlusion during the coiling of ruptured aneurysms. The patients' clinical and radiologic outcomes were retrospectively reviewed.

Results: Of the 15 aneurysms, coiling alone was used for 13 (86.7%), and stent-assisted coiling was performed for 2 (13.3%). Thromboembolic occlusion most frequently
occurred distal to the aneurysm (n = 10, 66.7%), followed by proximal to the aneurysm (n = 3, 20%), and coil-parent vessel interface (n = 2, 13.3%). All patients underwent mechanical thrombectomy with stent retriever, including 5 patients who were initially treated with intra-arterial thrombolysis with tirofiban. Complete recanalization (TICI 3) was obtained in 13 (86.7%) and partial recanalization (TICI 2b) in 2 (13.3%). Two patients who had received intra-arterial thrombolysis with tirofiban before mechanical thrombectomy suffered from hemorrhagic complications. At 6 months after discharge, mean mRS was 1.87 ± 1.46 (range, 1–6).

Conclusion: Rescue mechanical thrombectomy using a retrievable stent can be a useful treatment option for thromboembolic occlusion occurring during coil embolization of ruptured cerebral aneurysms.

P566
A case of in-stent acute occlusion following carotid artery stenting for restenosis after carotid endarterectomy

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Purpose is to present a case of in-stent acute occlusion following carotid artery stenting for restenosis after carotid endarterectomy. 77-year old female underwent carotid endarterectomy (CEA) for asymptomatic right internal carotid artery stenosis. The stenosis had been progressive and the NASCET index was 74 %. In two months after the CEA, there was no sign of restenosis in the surgical site on MRA. Although in five months after the CEA, restenosis was demonstrated on MRA and the stenosis progressed to more than 80% by NASCET index on DSA and to 3 m/sec by peak systolic velocity on US for one-month follow up. Although in the asymptomatic lesion, carotid artery stenting (CAS) was performed to prevent new ischemic event. Although CAS was performed uneventfully, she complained dizziness and numbness in the left side of her body four days after the procedure. On emergent MRI, the right internal carotid artery was occluded and multiple infarcts of the same area were demonstrated, and furthermore, in-stent occlusion was detected on DSA. Fortunately, collateral flows were well-developed ipsilaterally from the external carotid artery and contralaterally from the anterior communicating artery. As a result of conservative observation, her symptoms fully recovered. In recent Japanese report, 9.1% of patients underwent CEA experience restenosis. Majority of restenosis is asymptomatic and shows spontaneous remission, but in symptomatic or progressive cases, intervention should be considered. A cause of restenosis is thought to be intimal hyperplasia due to invasive surgical procedure, while plaque development and plaque rupture are infrequent causes. As far as we know, in-stent occlusion after CAS for restenosis following CEA has never been reported before. In our patient, intimal hyperplasia was suspected as a cause of the restenosis, therefore the risk of complication in the CAS considered low. In conclusion, interventional indication for restenosis following CEA should be considered carefully, especially in asymptomatic lesion.

P567
Single-Session Hematoma Removal and Transcranial Coil Embolization for a Cavernous Sinus Dural Arteriovenous Fistula: A Technical Case Report

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Background: Patients with cavernous sinus dural arteriovenous fistulas (CS dAVFs) with cortical venous varix are indicated for aggressive treatment because of the associated risk for intracranial hemorrhage.

Case Description: We present a case of surgical transvenous embolization in an 84-year-old woman with CS dAVF who presented with massive intracerebral hematoma. Cerebral angiograms revealed the dural AVF drained only into the superficial middle cerebral vein. Because an emergent mass reduction and prevention of rebleeding were necessary, single-session hematoma removal and transcranial embolization of a CS dAVF were performed in the neurosurgical operating room, using a mobile C-arm fluoroscopy. After the right frontotemporal craniotomy, intracerebral hematoma was removed and coil packing of the affected cavernous sinus was successfully performed via the dilated superficial middle cerebral vein. Because an emergent mass reduction and prevention of rebleeding were necessary, single-session hematoma removal and transcranial embolization of a CS dAVF were performed in the neurosurgical operating room, using a mobile C-arm fluoroscopy. After the right frontotemporal craniotomy, intracerebral hematoma was removed and coil packing of the affected cavernous sinus was successfully performed via the dilated superficial middle cerebral vein.

Conclusion: The transcortical vein approach enables occlusion of CS dAVF with isolated cortical venous drainage and may be a valuable alternative approach for some cases needed emergency craniotomy.
Object: To investigate the effect of endovascular recanalization treatment of acute ischemic stroke (AIS) with intracranial atherosclerosis stenosis (ICAS).

Methods: According to the inclusion and exclusion criteria, we selected fifteen patients who received emergency endovascular recanalization treatment and moderate or severe intracranial atherosclerosis stenosis (the degree of stenosis ≥ 50%) which were detected by digital subtraction angiography (DSA) in the neurology department of the 306th hospital. The clinical feature, imaging data, treatment and the prognosis of 90 days follow ups were analyzed retrospectively. The effectiveness of the treatment was assessed through recanalization rate which were evaluated by modified thrombolysis in cerebral infarction (mTICI) after endovascular recanalization treatment. The National Institute of Health Stroke Scale (NIHSS) before and after treatment and the modified Rankin Scale (mRS) after 90 days. The surgery-related complications such as intracranial hemorrhage, artery dissection and so on and the mortality of patients were used to evaluate the safety of the treatment.

Results: 1. The NIHSS at admission: the scores were from 6 to 31, the average score was (16 ± 7). There were 6 patients with severe stroke (NIHSS scores 15–25) and 2 patients with very severe stroke (NIHSS scores > 25) which accounted for 53.3%. 2. Treatment modes: the 15 patients all received endovascular treatment. Four patients received the drug therapy in the artery without further endovascular treatment, 2 patients received emergency stenting, and the other 9 patients received mechanical thrombectomy. Among the 9 patients, 2 patients were treated with balloon angioplasty also, 2 patients were treated with emergency stenting, and one patient was treated with balloon stent implantation and a stent selectively. 3. The surgery-related complications: one patient got asymptomatic intracranial hemorrhage, and 4 patients got symptomatic intracranial hemorrhage. The incidence of sICH was 25%. No patient got artery dissection. 4. The recanalization rate: mTICI 2b or 3 was achieved in 9 patients, the recanalization rate was 60%. 5. Prognosis follow ups: there were 6 patients with a favorable outcome (40%) which defined as mRS ≤ 2 at 90 days, 7 patients with moderately severe disability (mRS 3–4) and one patient with severe disability (mRS 5). There was one patient who died and the mortality was 6.7%. 6. Good prognosis was significantly related with recanalization (P = 0.028).

Conclusion: There is no standard treatment protocols on the patients of acute ischemic stroke with intracranial atherosclerosis stenosis at present. There are many endovascular treatment methods, but the specific choice of treatment and how to combine a variety of treatment methods should be followed by the principle of individualization for restoring perfusion.

P569

Intracranial and Vertebral Artery Angioplasty and Stenting with Neuroform Atlas stent

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The Sampris trial, showed that medical treatment of intracranial stenosis is safer than intracranial angioplasty and stenting (IAS). One of the reasons for the worse outcome with IAS was the occurrence of ipsilateral cerebral hemorrhage, which may be associated with an intracranial exchange maneuver. Newly developed mini intracranial stents may enhance the safety of IAS by obviating the need for this maneuver.

We retrospectively evaluated 8 intracranial and 1 vertebral artery stenoses (8 patients, 7 men, mean age 60.8) which were treated with an Atlas stent. In 7 cases (6 intracranial and 1 vertebral V1 segment) there was a high-grade atherosclerotic stenosis which did not optimally respond to medical treatment, one patient had radiotherapy-induced stenosis and in one patient there was a chronic arterial dissection with a distal aneurysm. All intracranial lesions were located in the petrocavernous segment of the internal carotid artery. All of the procedures were performed electively under dual antiplatelet therapy and general anesthesia. After performing angioplasty of the stenosis with an over-the-wire balloon (e.g. Gateway balloon), the Atlas stent was delivered directly through the lumen of the angioplasty balloon, without a need for an intracranial exchange maneuver.

The procedure was successful in all patients. There was no mortality or permanent morbidity related to the procedures. At a mean follow-up of 10.8 months (range 1 - 19 months), there was one case of asymptomatic occlusion and otherwise no evidence of restenosis. None of the patients suffered a recurrent ipsilateral stroke.

Although further studies are needed for demonstrating safety and efficacy of self-expandable mini-stents in IAS, our results indicate that a single step angioplasty/stenting is feasible with these devices. We suggest the optimization of the currently available over-the-wire balloons for this technique.
P570

Stent Retrieval Thrombectomy using Intracranial Support Catheter Advance Technique (CATCH) for Acute Ischemic Stroke

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Current guidelines for mechanical thrombectomy (MT) via stent retriever device, recommend to first place an 8 French (Fr) balloon guide catheter proximal to occlusion site and to place the retriever device through the occlusion distal to the clot by using a guide wire. Balloon guided catheter is used in order to create temporary blood flow arrest to minimize the possibility of further distal occlusion form thrombus fragments while retrieving the thrombus. However, even with such excellent aspects, authors have experienced retrieval failure when the distance between the balloon guider and occlusion site is remote especially when it is increased due to tortuosity of the vessel. In this study, we present a case of successful MT of an obstruction in acute ischemic stroke by the using an intracranial support catheter advance technique (CATCH), with good angiographic and clinical outcome. CATCH should be considered as a preferable method of treatment for vessel occlusion of acute ischemic stroke.

P571

An efficacy comparison between Trevo and SWIFT with IA thrombolysis in acute ischemic stroke

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Background and Purpose: Recent reports have indicated that mechanical thrombectomy may have potential to treat acute ischemic stroke. However, few comparative studies of thrombectomy devices are reported. We compared safety and effectiveness between Trevo and SWIFT devices in acute ischemic stroke patients.

Materials and Methods: A retrospexitve study comparing clinical, radiological, and functional outcome of 37 patients with angiographically verified occlusion excluding ICA. Patients were treated either with Trevo or Solitaire according to neurointerventional preference. Successful recanalization was defined as TICI grade 2b to 3 and clinical outcome was assessed as NIHSS.

Results: Revascularization was tried in 16 patients with Trevo and in 21 with Solitaire. The lesions were MCA occlusion 33 and BA 4 patients. Successful recanalization was achieved in 88% of patients by Trevo compared with 76% of patients by Solitaire. Average number of passes was 1.75 with Trevo and 2.24 with Solitaire. And especially, first pass was superiorly showed in 58.3 % of Trevo rather than 36.4% of Solitaire and patients treated with Trevo had a shorter treatment time. In outcome, most of patients treated with stent retrievers (58%and 59% in each) had achieved improved scores of NIHSS in both groups without significant differences (F/U NIHSS < 7). Rate of symptomatic ICH related with procedure was 8.3% for Trevo versus 11.1% for Solitaire.

Conclusion: No significant differences in functional outcomes and symptomatic ICH could be demonstrated between Trevo and Solitaire. However, patients treated with Trevo had a better revascularization rate, lower number of passes and a shorter treatment time than Solitaire. Further studies will be needed.

P572

Improving mTICI 2b reperfusion to mTICI 2c/3 reperusions: A retrospective observational study assessing technical feasibility, safety and clinical efficacy

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Purpose: Recent studies have suggested that modified Thrombolysis in Cerebral Infarction grade (mTICI) 3 reperusions are associated with superior outcome than mTICI2b reperusions, questioning if neurointerventionalists should generally strive to achieve mTICI3.

Materials and Methods: Retrospective analysis of successfully reperfused MCA occlusions (n = 215) with available angiography runs between every maneuver. Final reperfusion success and reperfusion successes between single maneuvers were evaluated applying the modified version of the TICI score (including TICI2c). Final TICI2c/3 reperusions were dichotomized in ‘direct’ (reperfusion before final maneuver ≤ mTICI2a) or ‘secondary improved’ (mTICI 2b was already achieved).

Results: Patients with mTICI2c reperfusion resembled the outcome of patients with mTICI 3 rather than mTICI2b reperusions. Compared with mTICI2c/3-patients, mTICI2b-patients had fewer rates of neurologic improvement (33.3% vs 61.2%, P = 0.001) and good functional outcome (48.7% vs. 61.1%, P = 0.028). In 27 patients, mTICI2b reperfusion was improved to mTICI2c/3 without complications. Outcome of patients with direct or ‘secondary improved’ mTICI2c/3 did not differ (P > 0.5).

Conclusion: Improving mTICI2b reperusions to mTICI2c/3 reperusions is sometimes technically feasible and safe and is associated with a clinical benefit comparable to
‘direct’ mTICI2c/3 reperusions. If confirmed, a more aggressive treatment approach in cases of already achieved mTICI2b may be justified, although proper patient selection is needed.

P573

Treatment using stent placement alone for symptomatic mild stenosis with recurrent cerebral infarction

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Purpose: To date, no randomized controlled trials (RCTs) have provided clear evidence to recommend surgical treatment for symptomatic mild stenosis with a stenosis rate of <50%. Thus, we aimed to investigate the efficacy of using a stent placement alone for mild stenosis with recurrent cerebral infarction within a short timeframe that is resistant to medical treatment.

Materials and Methods: The target was symptomatic mild stenosis resistant to medical treatment, with 3 or more minor strokes or transient ischemic attacks (TIAs) caused by the same lesion (internal carotid artery stenosis, n = 2 and stenosis at the origin of the brachiocephalic artery, n = 1). None of the patients underwent balloon angioplasty, and all the patients only had a self-expandable stent placement.

Results: Two cases were ulcerative lesions in the preoperative plaque diagnosis (internal carotid artery stenosis, n = 1 and brachiocephalic artery stenosis, n = 1). All the patients had an unstable plaque. After operation, one case had one incident of TIA, but no new symptoms were observed during the subsequent observation period (8–87 months; mean, 47 months).

Conclusion: Treatment using a stent placement alone for symptomatic mild stenosis resistant to medical treatment may be effective for inhibiting recurrence of cerebral infarctions. This study included only a small number of cases, so further investigations with more patients are essential.

P574

Clinical results of endovascular thrombectomy for acute cerebral infarction in hospitalized patients aged 85 and older

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Purpose: As a result of five randomized trials reported in 2015, the effectiveness of acute endovascular thrombectomy has been proven and the widespread use is beginning in Japan. The proportion of elderly individuals within the overall population of Japan continues to increase, thus potentially exposing increasing numbers of elderly people to acute endovascular thrombectomy; however, there is no consensus as to the effectiveness of the procedure in this population. We examined the outcomes of endovascular thrombectomy in hospitalized patients, aged ≥85 years.

Materials and Methods: Between January 2015 and February 2017, we examined 12 and 22 patients aged ≥85 years (Group A) and <85 years (Group B), respectively, who underwent endovascular thrombectomy for acute cerebral infarction at our hospital.

Results: The mean age was 89.9 (87–96) and 73.5 (47–84) years in Group A and Group B, respectively. The baseline scores of the modified Rankin Scale (mRS) ≤2 were 75% in Group A and 86% in Group B. The mean National Institutes of Health Stroke Scale was 18.6 and 19.3 in Groups A and B, respectively. The rate of t-PA use was 83% for Group A and 64% for Group B. The mean time from onset to door was 100 (28–304) minutes in Group A and 117 (33–353) minutes in Group B. The mean time from door to puncture was 93 (45–152) minutes in Group A and 86 (43–157) minutes in Group B. The mean time from the puncture to recanalization was 64 (20–102) minutes in Group A and 93 (21–196) minutes in Group B. The mean time from onset to recanalization was 271 (156–483) minutes in Group A and 284 (143–507) minutes in Group B. The recanalization rate of TICI 2B and 3 was 58% in Group A and 66% in Group B. Postoperative symptomatic intracranial hemorrhage was 0% in Group A and 18% in Group B. The rate of mRS ≤2 at 90 days was 20% in Group A and 28% in Group B. Except age, we found no significant differences in any of the variables between Group A and B.

Conclusion: Endovascular thrombectomy is effective in patients aged ≥85.

P575

Feasibility and safety of endovascular recanalization of symptomatic chronic intracranial vertebral artery occlusion: experience of a single center and review of literature

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Purpose: The optimal treatment of symptomatic chronic intracranial vertebral artery (ICVA) occlusion remains elusive. We report a single-center experience of endovascular recanalization of chronic ICVA refractory to medical therapy. In this case study, we assess the feasibility and estimate the safety in comparison with the previous literature.
Materials and Methods: From Jan 2009 to Jan 2017, we retrospectively reviewed 12 consecutive patients presenting with recurrent symptoms attributed to the chronic occlusion of ICVA. Pre-operative neuroimaging evaluations, intra-operative technical nuances, and post-procedural complications were analyzed. We searched the published literature using PubMed databases during the same period with keywords intracranial vertebral artery chronic occlusion and endovascular recanalization. Study population and the major outcomes were extracted from literature.

Results: The median time between onset of symptoms and treatment was 30 days (range: 18 days to 1 year). Eleven patients out of 12 presented symptoms to treatment less than 90 days. We documented 10 patients using roadmap fluoroscopy with simultaneous 2-vessel injection and 9 lesions with high-resolution MR imaging (HRMRI) scan to extrapolate the occlusion course, respectively. Seven patients had ICVA occlusion beyond PICA origin with the occlusion distance ≤2 cm roughly estimated on HRMRI, simultaneous 2-vessel injection or the anastomosis between distal cerebellar arteries; 5 had the occlusion distance >2 cm because the ICVA terminated before PICA origin. The technical success rate of recanalization with TICI (Grade ≥2 b) and residual stenosis (<20%) was 83.3% (10/12). Among the 10 patients successfully treated with recanalization, symptoms were improved in 5 patients, unchanged in 3 and worsen in 2 immediately after treatment. Two (16.7%) patients had peri-procedural complication: 1 developed TIA; 1 presented with perforator occlusion syndrome who was safely discharged with mRS 3 at 30-day follow-up. No patients died. Eight patients were followed-up with a medium of 39 months (range: 1–86). The medium mRS score of the latest follow-up was 1 (range: 0–1). Using the keyword-based search, we identified 4 studies with the recanalization rate at 94.4%, peri-procedural complication rate at 16.7% and death rate at 5.6%, respectively.

Conclusion: Our single-center study reported an acceptably high rate of recanalization and low rate of complication of chronic ICVA when compared with previous studies, which was likely related to short occlusion stage/distance, and the utility of the neuroimaging modality with HRMRI and simultaneous roadmap technique.

P576
Transradial approaches in neurointerventions
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Purpose: To report our experiences of neurointerventions via transradial approaches and review related articles.

Materials and Methods: We reviewed 27 consecutive cases using transradial approaches and catalogued the indications, the catheter used, the sheath size, the length of procedure and the result of procedures.

Results: Neurointerventions using transradial approaches were done successfully in all the cases. Sheath used ranged in size from 5 F to 6 F. 22 cases were simple cerebral angiography, 3 cases were carotid artery stenting and 2 cases were mechanical thrombectomy.

Conclusion: Although a transradial approach is widely used in cardiovascular interventions, transfemoral approach has been used popularly in neurovascular interventions. But, transradial approaches have many advantages compared to conventional transfemoral approaches.

Key Words: Transradial approach, Neurointervention

P577
Angiographic evidence of the dynamics of atherosclerotic process involving cerebral vasculature: Involution and evolution in the same patient
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Natural history of atherosclerotic process involving cerebral vasculature, both intra-cranial and extra-cranial, is essential in decision making. Angiographic evidence, in form of a long term follow up of these patients shall form the cornerstone of all future protocols in treating such patients. We present a case of both intra and extra cranial atherosclerotic disease. Angiographic evidence in this patient demonstrates regression of intracranial atherosclerotic disease (ICAD), while the carotid atherosclerosis has progressed.

While progression of carotid disease is a known phenomenon, an angiographic evidence of regression of ICAD is relatively rarely reported. The plausible mechanisms of this include decreased atherogenic apolipoproteins, cholesterol efflux from plaques, influx of healthy phagocytes, emigration of foam cells out of the lesion over a period of time. The limitation of angiography in assessing only the luminal diameter and branding an ICAD; may also contribute to false diagnosis of regression in cases like spontaneous lysis of local thrombus, vasculitis, vasospasm. Currently available clinical, angiographic evidence and therapeutic agents are grossly lacking in regards to pathological evolution or involution of atherosclerotic disease involving cerebral vasculature. Angiographic long term follow up of these cases and possible therapeutic modulation remain an important question to be answered in the future.
P578
Outcome after thrombectomy for acute basilar artery occlusion

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Purpose: The benefit of endovascular thrombectomy (TE) for patients with acute intracranial large vessel occlusion of the anterior circulation is well established. The data is less robust for acute basilar artery occlusion (aBAO). We analyzed in retrospect the outcome results for patients with aBAO who underwent endovascular treatment, focused on TE.

Material and Methods: Between 1/2008 and 4/2017 N = 228 patients with aBAO were treated by endovascular means in a single center. Treatment included TE in 206 (90%) patients. The initial NIHSS score for eligible patients was 15 (median), not counting for 44 (21%) comatose patients. The time interval between clinical onset and 1) - initiation of treatment was 278 minutes (median), 2) - final endovascular result was 324 minutes (median).

Results: The recanalization was rated poor (TICI 0–2a) in 13 (6%) patients, partial (TICI 2b) in 39 (19%) patients and complete (TICI 3) in 154 (75%) patients. The clinical outcome at 90 days was mRS 0–2 in 59 (29%), mRS 3–5 in 56 (27%), and mRS 6 in 78 (38%) patients.

Conclusion: Despite a high recanalization rate of endovascular treatment, the outcome after aBAO is poor in many patients. An even better primary and secondary prevention is required.

P579
Monitoring of regional saturation of oxygen during endovascular thrombectomy for two carotid artery occlusion cases

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Background: We report monitoring of regional saturation of oxygen (rSO2) during endovascular thrombectomy and evaluated near-infrared spectroscopy (NIRS) as a real-time monitoring for acute ischemic stroke.

Case 1: A 71-year-old man with a history of MPO-ANCA associated alveolar hemorrhage was treated with pneumo-nia in other institute. Although the patient had atrial fibril-lation, warfarin was discontinued because of a prolonged prothrombin time. He became disoriented and magnetic resonance (MR) images showed acute ischemic stroke and a left carotid artery occlusion. The patient was initially treated with ozagrel sodium and edaravone in the same hospital. However, His symptoms was progressing and the patient was transferred to our institute. The patient was somno-licence and had aphasia and right hemiparesis. National Institution of Health Stroke Scale (NIHSS) was 20 and Alberta Stroke Program Early Computed Tomography Score (ASPECTS) – Diffusion-weighted image (DWI) was 10. We performed the endovascular thrombectomy. Pre-treatment rSO2 was lower in the left frontal region than in the right frontal region. Thrombus in the carotid and middle cerebral arteries were retrieved by the endovascular thrombectomy and complete recanalization was achieved (Thrombolysis in Cerebral Infarction (TICI) score 3). After recanalization, the left rSO2 recovered to the same level as the contralateral rSO2.

Case 2: A 65-year-old man with multiple systemic atrophy admitted with acute pyelonephritis to our institute. The patient became unconscious and MR images revealed a left internal carotid artery occlusion. The patient had aphasia and right hemiparesis. NIHSS was 23 and ASPECTS-DWI was 9. Although a recombinant tissue-plasminogen activa-tor (rt-PA) was intravenously administered, symptoms did not improved. A left rSO2 was lower than a right rSO2. The left internal carotid artery was completely recanalized after endovascular thrombectomy. The left rSO2 recovered to the same level as the right rSO2.

Conclusion: The rSO2 decreased in the frontal region of an affected side when the carotid artery was occluded, and recovered after complete recanalization in two cases. The rSO2 monitoring by NIRS could be useful to detect reca-nalization when the rSO2 is monitored at administration of rt-PA.

P580
Intracranial endovascular stent implantation of middle cerebral artery stenosis

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Introduction: Intracranial stent-assisted angioplasty is an emerging treatment modality for intracranial atherosclerotic stenosis. There are many reports that stent-assisted angioplasty is useful and safe. However, stent placement in MCA still remains as a challenge due to the risk of vascular dissection, elastic recoil, vasospasm stenosis.
Purpose: The purpose of this study is to evaluate the initial success rate of the stent-assisted angioplasty for reducing the risk of second attack stroke in MCA stenosis.

Materials and Methods: 39 lesions of 35 patients were included in this study from March 2004 to September 2015. All patients had symptoms of acute cerebral infarction with stenoses in MCA (more than 50%). The locations of the stent implantation were all in M1 segment in MCA.

Results: The stent implantation was successful in 34 patients (87.1%). We had one case of microselection failure due to the tortuosity of the target vessel. There was one case (2.56%) of MCA rupture during the procedure and the patient expired after 1 week. There was no periprocedural thromboembolism in our study.

Discussion & conclusion: In our study, initial success rate of MCA stenoses stent implantation was 87.1%. Stent implantation in MCA stenosis is technically feasible and has relatively low rate of periprocedural complication. Long-term follow up study is necessary.

P581

Therapeutic strategy for cases of acute cerebral infarction with an unknown onset time based on our experience with endovascular thrombectomy cases

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Purpose: Endovascular thrombectomy has been shown to be efficacious during recent years. Although adaptation to treatment is limited to patients with a known onset time, there are some patients with unknown onset times, for whom adaptation to treatment is controversial. At our institution, we assessed Arterial Spin Labeling (ASL 2.5 s) for all patients suspected of having a cerebral infarction. If differences were detected between the high signal area in diffusion weight imaging (DWI) and the hypoperfusion area in ASL, we performed endovascular thrombectomy. In this study, we reported on the therapeutic strategy for cases with an unknown onset time based on our experience with endovascular thrombectomy cases.

Materials and Methods: This study included 12 patients who underwent endovascular thrombectomy for anterior circulation of the circle of Willis at our institution from July 2015 to March 2017. In cases where the onset time was clear, patients underwent endovascular thrombectomy, unless there was a contraindication for T-PA. In cases where the onset time was unknown but there was a difference between the high signal area in DWI and the area of decreased blood flow in ASL, endovascular thrombectomy was performed. Patient background, image findings before treatment, reopening rate (TICI 2b or more), NIHSS after 24 h, and modified rankin scale (mRS) after 90 days were evaluated.

Results: Of the 12 cases, occluded blood vessel was observed in the horizontal part of the middle cerebral artery (MCA) in nine cases and in the insular part of the MCA (M2) in three cases. Among the 12 patients, 10 (83%) had achieved TICI 2b or more. In cases with reopening of the occluded vessel, four patients had NIHSS scores that improved to >4 points after 24 h. All of these patients had a clear onset time. In five cases (50%), the prognosis was good, with mRS of ≤2 at 90 days after onset. There were four cases with unclear onset times. Among these, three cases (75%) had reopened TICI 2b or more; however, there were no cases with symptom improvement after 24 h. However, there were two cases (50%) with good prognosis, with mRS of ≤2 at 90 days after onset.

Conclusions: It is possible that the long-term prognosis of patients can be improved by assessing the mismatch between ASL and DWI and judging the indication for unknown onset time.

P582

Clinical usefulness of the measurements of cerebral blood perfusion parameters with advanced C-arm angiography system for neuroendovascular treatment in ischemic cerebrovascular diseases

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Background: C-arm angiography systems have been recently equipped with advanced flat panel detectors and innovative software algorithms that allow more sophisticated intra-procedural image and data processing. This innovation is allowed to assess cerebral blood perfusion within angio suites (dynamic C-arm CT perfusion). We report our initial experience, and present clinical usefulness of the measurement of cerebral perfusion parameters during neuroendovascular treatment in ischemic cerebrovascular diseases.

Materials and Methods: All imaging data acquisitions were performed on biplane flat-detector angiographic system, and data analysis was processed prototype perfusion software. The dynamic C-arm CT perfusion data acquisition protocol consists of 10 bidirectional rotations (5 forward and 5 reverse) with intra-venous contrast injection (40 ml of contrast material, flow rate of 4 ml/s followed by a 30 ml saline flush). In five cases of revascularization therapy and ten cases of CAS treatment, the dynamic C-arm CT perfusion studies were performed before and immediately after the treatment. Perfusion parameter maps (CBF, CBV, MTT and TTP) obtained by both studies were made for evaluation of the effect of the procedures.

Results: All studies were successful, without complications. 1. In the cases of the revascularization therapy, perfusion abnormalities as the ischemic lesions were detected in all
cases before and after treatment. The region of abnormality on the MTT and TTP maps was more distinct than that on CBF and CBV maps. In the CAS cases, no patient had ischemic complication and hyperperfusion phenomenon. The CBF and CBV maps acquired before and just after CAS treatment showed no significant differences, however, MTT and TTP maps were remarkably improved in severe stenosis cases.

**Conclusion:** While further work is required to define its ultimate clinical utility, the dynamic C-arm CT perfusion may provide important information for the management of interventional neurorodovascular treatment.

### P583

**A case of perimedullary dural arteriovenous fistula at cranio-cervical junction: A case report**

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A 78-year old man, with chronic renal failure due to polycystic kidney, complained headache and right hypesthesia for three days, however, on admission right hypesthesia improved. We could not find intracranial lesion on magnetic resonance imaging (MRI) and computer tomography (CT). One day after admission, patient complained urinary incontinence, and the next day, his left hemiparesis and urinary retention appeared as new symptom and progressed. Retrospectively, we noticed the mass lesion at the C1 level on initial intracranial MRI, furthermore, cervical MRI demonstrated intramedullary 10 mm mass lesion at the left side of spinal cord. T2 weighted imaging (T2WI) showed the low intensity mass with high intensity area from medulla to C7 level in the spinal cord, accompanying by no flow void on T2WI and time of flight imaging (TOF). We initially suspected cavernous angioma, however, we performed digital subtraction angiography (DSA) in spite of no flow void on T2WI and time of flight imaging (TOF). DSA revealed perimedullary DAVF, supplied from dural branches of left vertebral artery and drained only into ascending perimedullary vein, contained the varix on the drainage vein herniating into spinal cord at the C1 level. We selected direct isolation of the shunt via lateral suboccipital approach. At first, we put temporarily clip on drainage vein and confirmed to disappear the shunt on intraoperative DSA and indocyanine green-veidoangiography (ICG-VAG), then we coagulated and cut down the drainage vein at the proximal to the varix. On intraoperative DSA, the fistula disappeared completely. Postoperative MRI demonstrated that the varix thrombosed and high intensity area in the spinal cord improved, furthermore, the left hemiparesis improved.

Perimedullary DAVF at cranio-cervical junction has been reported to be difficult to diagnosis. In this case, the herniating varix into spinal cord that made difficult to diagnosis.

### P584

**Predictors for Early Successful Revascularization in Patients with Acute Ischemic Stroke Undergoing Mechanical Thrombectomy**

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**Purpose:** Endovascular revascularization therapy (ERT) using stent retriever has been proven to improve clinical efficacy in patients with acute ischemic stroke (AIS). For the clinical benefit, complete revascularization within a short time window was very important. However, little is known which patient has a chance to be achieved early successful revascularization after ERT in AIS patients.

**Materials and Methods:** After retrospectively reviewed registry of consecutive acute ischemic stroke (AIS) patients who underwent endovascular recanalization therapy (ERT) between January 2011 and September 2015 (n=329), patients with following criteria were excluded from this study. The patients who 1) were treated by intraarterial fibrinolytics (n=13) and 2) were not treated by stent retrievers as a first tool for mechanical thrombectomy (n=6). We defined the early successful revascularization (ESR) as a complete revascularization with modified TICI 2b or more within 30 minutes after groin puncture. We compared the baseline characteristics and clinical outcomes between the patients with ESR and those without ERS. And then, we performed multivariate analyses using binary logistic regression models to identify independent predictors for ERS.

**Results:** After excluding, 310 patients recruited this study. One hundred twenty-three patients were categorized as the ESR, and the remained 187 patients were categorized as late revascularization (LS). The sites of occlusion, stroke etiologies defined as TOAST classified thrombus, vasculopathy, dyslipidemia, time from door to groin puncture were significantly different between the groups. In the multivariate analysis, the occlusion in the middle cerebral artery (OR=1.798, 95% CI : 1.029–3.141, P=0.039, occlusion in the internal carotid artery as a reference), history of dyslipidemia (OR=0.513, 95% CI 0.269–0.978, P=0.043), 3rd (OR=0.467, 95% CI 0.238–0.915, P=0.027) and highest (OR=0.391, 95% CI 0.194–0.789, P=0.009) quintiles of the time from door to groin puncture were significantly associated with ESR.

**Conclusion:** Our results showed that the occlusion in the middle cerebral artery rather than those in the internal
Carotid artery, history of dyslipidemia and the time from door to groin puncture were independent predictors for ERS.

**P585**

Efficacy of remote proximal aspiration thrombectomy using balloon-tipped guide catheter for acute intracranial internal carotid artery occlusion

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**Background:** Mechanical thrombectomy (MT) for acute intracranial internal carotid artery (ICA) occlusion is often complicated by difficult recanalization and non-involved territory embolization possibly related with larger clot-burden. This study aims to evaluate the efficacy of remote proximal aspiration thrombectomy (r-PAT) using a balloon-tipped guide catheter for clot-burden reduction in such cases with period-to-period analysis (period 1: standard MT without r-PAT; period 2: r-PAT first, then standard MT for the remaining occlusion).

**Methods:** Eighty-six patients who underwent MT for acute intracranial ICA occlusion were included in this analysis from the prospectively maintained stroke registry (33 patients in period 1 and 53 in period 2). In period 2, ‘responder’ was defined as a case where some amount of clot was retrieved by r-PAT and the following angiography showed partial or full recanalization.

**Results:** Fifteen of fifty-three patients in period 2 (28.3%) were ‘responders’ to r-PAT. There was a significantly higher incidence of atrial fibrillation in the ‘responder’ subgroup. Period 2 showed a significantly shorter puncture-to-recanalization time (94.5 mins versus 56.0 mins; P = 0.002), a significantly higher Thrombolysis In Cerebral Infarction (TICI) grades 2b-3 (45.5% versus 73.6%; P = 0.009), but only a trend for better 3-month favorable outcome (modified Rankin Scale 0–2; 36.4% versus 54.7%; P = 0.097). There was no increase in the incidence of procedure-related complications or intracranial hemorrhage in period 2.

**Conclusions:** A strategy of r-PAT before standard MT may result in shorter puncture-to-recanalization time and better angiographic outcome than a strategy of standard MT for acute intracranial ICA occlusion.

**P586**

Endovascular thrombectomy for M2 occlusions: comparison between forced arterial suction thrombectomy and stent retriever thrombectomy

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**Background:** To date there has been no direct comparison of two frequently used endovascular thrombectomy (EVT) methods (forced arterial suction thrombectomy (FAST) and stent retriever thrombectomy) in M2 occlusions. We review our experiences with EVT performed using FAST and stent retriever thrombectomy in such cases.

**Methods:** The subjects comprised 41 patients with an M2 occlusion who underwent EVT (25 with FAST, 16 with stent retriever thrombectomy). The patients’ data were retrospectively analyzed to evaluate the technical characteristics and angiographic outcome of the two EVT techniques.

**Results:** Thrombolysis In Cerebral Infarction (TICI) grades 2b-3 using the first chosen technique did not differ significantly between the two techniques (FAST 64.0% vs stent retriever thrombectomy 81.2%, p = 0.305). Time from groin puncture to reperfusion was significantly shorter for stent retriever thrombectomy (53.0 vs 38.5 min; p = 0.046). Distal embolization occurred in three cases (12.0%) in the FAST group and in four (26.7%) in the stent retriever group (p = 0.362). However, the two techniques did not differ significantly in the final TICI 2b-3 rate (72.0% vs 87.5%; p = 0.441). A frequent angiographic finding regarding the failure of FAST was that the M2 occlusion was located immediately after severe acute angulation between M1 and M2.

**Conclusions:** Stent retriever thrombectomy may provide faster reperfusion than FAST, while the FAST technique might be associated with lower distal embolization and a higher reperfusion rate for the first thrombectomy attempt, but without any significant difference in clinical outcome. When choosing the EVT method for M2 occlusions, consideration of the location of the occlusion and tortuosity between M1 and M2 might be helpful to achieve a better angiographic outcome.

**P587**

A case of innominate artery stenosis complicated with carotid artery stenosis

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**Background and Purpose:** Intravascular interventions for arterial stenosis have been getting more common recently and their indications have become versatile for lots arteries.
Over the period of this progress in the vascular interventions, how to approach multiple vascular stenoses remains controversial.

**Case presentation:** A 70 year old male presented with left hemiparesis. His past medical history were type 2 diabetes and hyperlipidemia. The MRI revealed the infarction in the right caudate nucleus area and watershed area between anterior cerebral artery and middle cerebral artery. Initial angiography showed 60% stenosis in the right carotid artery and 70% stenosis in the innominate artery. We diagnosed him as the cerebral infarction caused by the carotid stenosis and/or the innominate artery stenosis. We scheduled the percutaneous angioplasty and stenting for them. Under local anesthesia, we inserted 6-French guiding sheath into the right brachial artery and advanced it to the right common carotid artery. In order to obtain the distal protection, the balloon (PercuSerge, 200 cm) was placed in the right internal carotid artery and the pre-dilation was performed for the carotid artery stenosis by 3.5 mm balloon device (Jackal 3.5 mm*40mm). After obtaining the dilation, the stent (Precise 8*40) was deployed in the right carotid artery. We then inserted 8-French sheath into right femoral artery and advanced 8-French guiding catheter (8-French Rancher) to the transverse aorta. The balloon expandable stent (8*20 mm Assurant Cobalt iliac stent) was deployed in the innominate artery. A good patency was obtained and there have been no restenosis until 10 months after the stenting.

**Case summary:** How to treat the patients with multiple artery stenoses remains unsolved issue and no consensus has obtained. In this case, the patient had the two possible lesion that could be the causative stenoses of the infarction and there was a discussion over which was responsible for the infarction in the right caudate nucleus area and the watershed area. We performed the carotid artery stenting first and then deployed the innominate artery stent. The other possible strategy for this patient is performing the innominate artery stenting first in order to secure the route for the carotid artery stenting. However, this innominate artery stenosis was ostial lesion and, therefore, performing innominate artery stenting first might have caused difficulty or unnecessary complications such as guide wire entrapment. In conclusion, we treated the patient with two possible arterial stenoses in right carotid artery and innominate artery successfully at a time by performing carotid artery stenting first. As intravascular approaches have become more versatile, discreet discussion and determination of indication for multiple arterial stenoses are indispensable.

**P588**

**Shortening and migration of Carotid Wallstent: a case report and review of the literature**

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We report a case of carotid artery stenting with shortening and migration of the stent on the day following the operation. A 74-year-old man who presented with sudden apraxia was admitted. Diffusion-weighted magnetic resonance (MRI) revealed multiple acute infarct in the middle cerebral artery territory. Second attack occurred in spite of taking aspirin 2 weeks later, and warfarin could not avoid third attack after 2 months from the first attack. Carotid ultrasonography revealed left cervical internal carotid artery (IC) stenosis. He was transferred to our hospital. Digital subtraction angiography (DSA) revealed left cervical IC stenosis (North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria; 68%). Black blood MRI and carotid ultrasonography revealed unstable plaque. Carotid artery stenting (CAS) was performed using Carotid Wallstent (Boston Scientific, Natick, MA, USA) under general anesthesia on the 109th day from the onset. Carotid Wallstent was placed just in the IC. A plain skull radiography on the day following carotid artery stenting revealed shortening and migration of Carotid Wallstent. The distal edge of Carotid Wallstent migrated to the most stenotic lesion. Second Carotid artery stenting (CAS) was performed using Carotid Wallstent (Boston Scientific, Natick, MA, USA) under general anesthesia on the day. We reviewed the literature of carotid artery stent shortening. There are 6 cases of carotid artery stent shortening. Carotid Wallstent was used in all cases. Second CAS was performed in 4 cases. Shortening of the stent was revealed at chronic period (1–24 months) after CAS in 4 cases, early period (1–3 days) after CAS in 2 cases. Cause of carotid artery stent shortening was postoperative elastic recoil of the vessel and inappropriate size and/or position of the stent. We categorized shortening of carotid artery stent into 2 types based on the period form the CAS to shortening of stent and cause of shortening. We also discuss the method of retreatment for shortening of the stent.

**P589**

**Case Report: Casotid Artery Stenting with persistent primitive hypoglossal artery**

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**Purpose:** We use some protection devices (filer device, proximal balloon device, distal balloon device) considering clinical cases. We report a case of symptomatic internal carotid artery (ICA) stenosis with a persistent primitive hypoglossal artery (PPHA), which was treated by carotid artery stenting (CAS) with double distal balloon protection devices at ICA and PPHA.

**Material and Methods:** A 72-year-old man suffering from heart failure was referred to our hospital. He admitted to cardiology. He had chronic renal failure and had been receiving dialysis. When he was undergoing dialysis, he suffered from loss of consciousness. Diffusion-weighted image showed a left cerebral infarction and MR angiography...
P590

Delayed middle cerebral artery stenosis following mechanical thrombectomy with stent retriever

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Purpose: The aim of the study is to assess the delayed stenotic changes of affected vessels following mechanical thrombectomy.

Materials and Methods: We retrospectively reviewed operative records of consecutive patients who had undergone stent-using mechanical thrombectomy for acute ischemic stroke between July 2014 and December 2016 at our institution. Magnetic resonance angiography (MRA) as baseline was carried out within 24 hours after treatment and the follow-up MRA performed 3 months after mechanical thrombectomy. Thirty-seven patients underwent mechanical thrombectomy for acute ischemic stroke. Mean age was 78.8 ± 8.1 years, and baseline median National Institute of Health Stroke Scale (NIHSS) score was 18 (range, 4–31). Five patients had an occlusion of the vertebral-basilar artery, 28 patients had an occlusion of the vertebral-basilar artery, 28 patients had an occlusion of the vertebral-basilar artery, 28 patients had an occlusion of the vertebral-basilar artery, and 4 had an internal carotid artery occlusion. Recanalization results were assessed by follow-up angiography immediately after the procedure. Neurologic status was evaluated before and after treatment (90-day follow-up) according to NIHSS and modified Rankin scale.

Results: Successful revascularization was achieved in 36 of 37 (97.3%) patients (thrombolysis in cerebral infarction [TICI] 2b and 3), a TICI 3 state was accomplished in 14 patients, and partial recanalization with filling of more than two-thirds of the vessel territory was achieved in 22 patients (TICI 2b). The stent was removed in its unfolded state in all patients. The mean time from stroke symptom onset to recanalization was 214 minutes, with a standard deviation of 114 minutes. Mean NIHSS score on admission was 17.9, with a standard deviation of 7.6. More than half of the patients (52.5%) showed a modified Rankin scale score of ≤2 at 90 days. Mortality rate was 8.1%. A fatal heart failure on the following day in 1 case, 1 patient suffered from aspiration pneumonia, and 1 patient had a symptomatic intracranial hemorrhage. MRA within 24 hours after the procedure revealed that recanalized vessels was observed in all cases. Long-term follow-up MRA showed that 3 of 26 patients (11.5%) developed diffuse severe stenosis of treated vessels. Occlusion site of all of those three patients was the middle cerebral artery. Two of them had undergone treatment with the Solitaire FR, and the other had received with the Trevo prove. They had been administered only anticoagulants, but not any antiplatelets. In 1 case, we needed to perform balloon angioplasty, because of the developed neurological deficit with progressive delayed stenosis. The average number of attempts with device at occluded vessels was 1.6 times in this study, however in 3 stenosis cases the attempt was just one time.

Conclusion: Since vascular stenosis may occur after recanalization therapy using a stent type thrombectomy device for acute cerebral artery occlusion, strict postoperative follow-up is necessary.

P591

Delayed Cerebral Hyperperfusion Syndrome After Carotid Artery Stenting

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Purpose: Cerebral hyperperfusion syndrome (CHS) can occur after carotid endarterectomy or carotid stenting (CAS). Typical clinical symptoms of the CHS are headache, vomiting, blood pressure crisis, confusion, brain edema, seizures and focal neurological deficits. CHS is caused by loss of autoregulation, hypertension, and ischemia-reperfusion injury resulting in increased regional blood flow and vascular congestion. CHS mostly occurs within one week after CAS. We report a case with delayed CHS, 3 weeks following CAS.

Materials and Methods: A 74-year-old male patient with hypertension and left carotid stenosis was admitted due to transient global aphasia. His vital signs were stable and there was no focal neurological deficit on initial neurological examination. Initial brain MRI showed no definite abnormality. However, brain MR angiography revealed a severe stenosis on the left proximal internal carotid artery. A cerebral angiography was performed, showing 90% luminal narrowing and plaques on the left internal carotid artery. Percutaneous transluminal angioplasty and stenting was performed successfully and he was discharged without any complications. Three weeks after the procedure, the patient presented to the emergency room with a sudden global aphasia, dysarthria and right side weakness. Follow-up diffusion-weighted image and FLAIR images did not show any new lesion compared to initial exam. However, post-enhanced FLAIR images showed high signal...
intensity in the CSF space of the left hemisphere, which raised a suspicion of CHS. Therefore, aggressive blood pressure control was performed. The patient’s symptoms were completely subsided 3 days later.

**Results:** We described a patient with delayed CHS three weeks after CAS who was completely treated with strict blood pressure control.

**Conclusion:** Outcomes of CHS are dependent on early recognition and prevention of precipitating factors. Although a delay in the onset of CHS of over one week after CAS is very rare, suspicion of delayed CHS and performing contrast enhanced FLAIR images in patients who have undergone CAS can help timely recognition of CHS.

**P592**

**Efficacy of 8fr SEL-E guiding catheter for tortuous aortic arch**

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Placing a guiding catheter into a stable position is the first important step of endovascular treatment. However in some cases, for example Bovine arch or type II III, it will be difficult to stabilize. We develop 8fr catheter “SEL-E” Medikit, Tokyo) for support coaxial system and investigate the utility. Catheter length is 83 cm, effective length 75 cm, inner diameter is 0.088 inch. Catheter is made of hard material and have curve on its tip.

155 endovascular treatment was done from January 2014 to July 2015. SEL-E was used to 12 cases which failing to stabilize with other usual guiding catheter. Shape of aortic arch was, 2 bovine arch 5 type II aorta, 5 type III aorta. Procedure of the cases were 7 intra aneurysmal coil embolization, 3 CAS or PTA, 2 for Thrombolysis. 11 cases succeeded to complete treatment, 1case could not place guiding catheter even usage of SEL-E(rt VA dissecting aneurysm).

8Fr support guiding catheter SEL-E is useful for cases which is difficult to stabilize usual guiding catheter. However guiding catheter fixed to 6fr system and balloon-guiding catheter cannot be used.

**P593**

**Neuroendovascular therapy (NEVT) in patients with end staged renal failure (ESRF)**

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**Background:** As the improvement of hemodialysis technique arrows long-term survival of end staged renal failure (ESRF) patients, number of candidates for Neuroendovascular Therapy (NEVT) in these patients are increasing. We retrospectively analyzed about perioperative complication and prognosis of NEVT patients with ESRF.

**Method:** Retrospective analysis was conducted for consecutive 10 patients on hemodialysis (HD) with ESRF who received NEVT between August 2009 and February 2016 at our institution.

**Results:** There were 6 carotid artery stenting(CAS) cases, 3 aneurysmal coil embolization cases and 1 trans arterial embolization (TAE) for cerebral arterovenous malformation (AVM). Technical success achieved in 9 cases but in one CAS case, we could not deliver stent to the lesion because of severe tortuous access route, which resulted only balloon angioplasty. There was no complication on 9 cases, except for one perioperative small cerebral infarction in AVM case. There were no change of HD or ESRF condition after NEVT. 5 patients are still alive, 5 patients died within several years after NEVT without any neurological event and one could achieve the average life expectancy of ESRF patients.

**Conclusion:** NEVT for patients with ESRF was performed safely without affecting natural course of ESRF. Although presence of ESRF should not be the reason to avoid NEVT, indication of NEVT for ESRF patients must be decided carefully considering average life expectancy of ESRF patients.

**P594**

**The efficacy of angioscopy for plaque protrusion into the stent after carotid artery stenting**

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**Purpose:** The plaque protrusion into the stent is one of the ischemic risk factors after carotid artery stenting (CAS). Several devices, such as digital subtracted angiography (DSA), intravascular ultrasound (IVUS), and Optical Coherence Tomography (OCT), can be used to detect the plaque protrusion during CAS. In this study, we evaluated the plaque protrusion into the stent using angioscopy during carotid artery stenting.

**Materials and Methods:** Eleven consecutive patients including 2 cases performed CAS for bilateral lesions were enrolled in the study. Angioscopy were performed two times before and after stent deployment. We observed the plaque protrusion into the stent using angioscopy and compared these findings using IVUS.

**Result:** There were no cases with neurological worsening after CAS. All observations of 13 lesions were acquired clear view after stent deployment.
Among the 13 lesions, 8 showed plaque protrusions into the stent using angioscopy but only 1 of these 8 lesions showed plaque protrusion using IVUS. The newly ischemic change with diffusion weighted imaging after CAS were seen in 3 of these 8 lesions, but were not seen in all 5 without plaque protrusion using angiography.

Conclusion: Angioscopy is more useful for detecting plaque protrusion into the stent than IVUS. And the finding of plaque protrusion using angioscopy becomes the predictive factor for ischemic event after CAS.

P595

How to manage bilateral severe carotid stenosis? Which one is the first?

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When we encounter a patient with bilateral significant carotid stenosis, it’s very important for decision making about which side must treat first session? In our department, we had many cases of bilateral carotid stenosis, we selected the side of carotid for treating the first time treatment according to: symptomatic stenosis vs asymptomatic stenosis, morphology of plaque, ulcerative plaque vs nonulcerative plaque, dissecting stenosis, right hand vs left hand, severity of stenosis, assessment of ANT-COM or POST-COM, collateral flow, isolated MCA, poor access vs good access of artery.

P596

Treatment strategy and outcome of ruptured vertebral artery dissecting aneurysms

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Objective: The therapeutic outcome of ruptured vertebral artery dissecting aneurysms (VADAs) remains unclear. The purpose of this study is to develop a strategy for treating such aneurysms.

Methods: Among 77 patients with VADA during last 20 years, 28 patients presented with subarachnoid hemorrhage. 26 of 28 patients underwent surgical intervention. We performed retrospective analysis of these 26 patients.

Results: All 26 ruptured VADAs demonstrated arterial enlargement; aneurysmal dilatation in 16 and pearl and string sign in 10. Internal trapping with endovascular coiling were performed for VADAs without involvement of the origin of the posterior inferior cerebellar artery (PICA) in 20 cases, occipital artery (OA)-PICA bypass followed by proximal parent artery and PICA origin clipping were performed for PICA involved VADAs in 4 cases, and coil embolization with stent assist were performed for VADAs with contralateral VA occlusion in 2 cases. Treatment outcome includes good recovery in 13, moderate disability in 7, severe disability in 1 and death in 5. 18 of 26 patients (69%) were severe condition (Hunt and Kosnik grade on admission, but 11 of 18 severe cases (61%) have recovered. Perioperative complications manifested in 3 cases: branch infarction (one case) in internal trapping group, rerupture in 1, occlusion of basilar artery in one in stent assisted coil embolization group. Other 3 cases experienced symptomatic cerebral vasospasm.

Conclusion: Even for severe ruptured VADAs, aggressive treatment should be performed because more than half of serious cases would recover. There are some issues such as stent assisted coil embolization and vasospasm control to be solved.

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Comparison of Stent Thrombectomy and Suction Thrombectomy for Treatment in Patients with Acute Ischemic Stroke with Basilar Artery Occlusion: Single Center Experience

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Purpose: Despite advances in efficient thrombectomy technique using stent and suction devices, acute ischemic stroke (AIS) with basilar artery occlusion (BAO) is a devastating neurological condition with a high mortality rate and poor clinical outcomes. We compared our experience about two representative thrombectomy technique-stent and suction thrombectomy in patients with AIS with BAO.

Materials and Methods: Between March 2009 and March 2017, 55 patients with BAO within 8 hours from stroke onset were treated with endovascular treatment (EVT) using stent or suction devices. Acute ischemic stroke (AIS) with basilar artery occlusion (BAO) is a devastating neurological condition with a high mortality rate and poor clinical outcomes. We compared the angiographic and clinical outcomes between the each group.

Results: Successful recanalization rates (Thrombolysis in Cerebral Infarction (TICI) score ≥ 2b: 85.0% vs. 91.4%, p = 0.47) and good clinical outcomes (modified Rankin Scale scores ≥ 2 at 3 months: 40.0% vs. 37.1%, p = 0.84) were not different between Stent and Suction group. Use of rescue method for recanalization was less frequent in Stent group than Suction group (20.0% vs. 45.7%, p = 0.06). In a multivariable analysis, age and use of
rescue method were independent predictors for good clinical outcomes.

**Conclusion:** The two thrombectomy techniques were showed with similar recanalization rates and clinical outcomes in AIS with BA0. However, stent thrombectomy technique seemed to more appropriate technique to reduce of rescue method in AIS with BA0.

**P598**

**Subacute endovascular recanalization of symptomatic cerebral artery occlusion**

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**Background:** The interval between the onset of cerebral vessel occlusion and recanalization has been shown to be an independent predictor of poor outcomes. However, endovascular recanalization of symptomatic cerebral vessel occlusion in the subacute period has not been well documented. We investigated the safety and efficacy of subacute recanalization of occluded cerebral vessels in patients with ischemic stroke or transient ischemic attacks (TIAs).

**Methods:** Between 2014 and 2015, 98 patients were admitted to the emergency room for ischemic stroke or TIA with a small infarct core, which was defined as modest early ischemic change on noncontrast-computerized tomography (CT) or overt diffusion-perfusion mismatch. All patients underwent pre-transfemoral cerebral angiography and post-endovascular treatment. The patients were classified according to acute (onset-to-groin puncture time ≤6 h) or subacute (onset-to-groin puncture time >6 h) recanalization. Using propensity score analysis, recipients of acute and subacute recanalization underwent 1:1 matching.

**Results:** Following 1:1 propensity score matching, 32 patients who underwent acute and 32 who underwent subacute intra-arterial thrombolysis were matched. There were no significant differences in National Institutes of Health Stroke Scale at discharge, modified Rankin scale (mRS), the proportion of patients with an mRS value of 0 to 2, mortality at discharge, intracerebral bleeding, post-procedural infarct extension, newly detected infarction, or hyper-intense acute reperfusion marker on follow-up images between the acute and subacute recanalization groups.

**Conclusions:** In selected patients with clinically unstable cerebral artery occlusions, a diffusion-perfusion mismatch, and small CT lesions, subacute and acute recanalization had comparable safety and efficacy rates.

**P599**

**Restenosis after Carotid Artery Stenting without Post-Stenting Angioplasty: Influence of Angioplasty Balloon Size**

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**Purpose:** To evaluate the outcomes of CAS without post-dilatation strategy and compare the effectiveness according to pre-stenting angioplasty balloon size.

**Materials and Methods:** Total of 173 consecutive patients (including 182 stenotic lesions) underwent carotid artery stenting (CAS) without post-dilatation were enrolled from July 2008 to August 2016. The mean age of patients was 71 years and female represented 17%. Symptomatic cases were 74.7% and mean degree of stenosis was 80.6%. The ratio of nominal balloon size to normal distal internal carotid artery ≥1 was classified into optimal angioplasty group (n = 96) and those ratio <1 was classified into suboptimal group (n = 86). The primary endpoint was defined as recurrent ischemic stroke or transient ischemic attack on the ipsilateral side of the CAS during the follow-up. Secondary end-point was composite of recurrent ischemic stroke or transient ischemic attack in other arterial territories. Follow-up imaging was available in 141 cases with mean duration of 43.4 months. Stenosis ≥50% and progression of stenosis ≥20% was defined as in-stent restenosis (ISR). To analyze risk factors of stroke and ISR, univariate (Kaplan-Meier analysis with log rank test) and multivariate (Cox-regression) analysis were performed.

**Results:** There was no statistical difference between the two groups in terms of clinical profiles. Overall 30-days stroke rate was 5.5%, which was not different between two groups. Mean residual stenosis after CAS was 19.7% in the optimal angioplasty group and 30.9% in the suboptimal angioplasty group (p < .001). Estimated rate of ipsilateral stroke 2 years after CAS was 8.5% in the optimal angioplasty group and 10.9% in the suboptimal group (p = 0.26). Estimated rate of ISR 2 years after CAS was 3.6% in the optimal angioplasty group and 18.7% in the suboptimal angioplasty group (p = 0.01). In analysis of predictor for ISR, the suboptimal angioplasty was associated with higher risk of ISR in univariate (HR 4.23, 95% CI 1.54 to 11.65, P = 0.01) and multivariate (HR 3.65, 95% CI 0.66 to 1.33; P = 0.05) analyses. Other factors (age, gender, diabetes, dyslipidemia, presence of symptom prior to CAS, degree of initial stenosis, type of stent, degree of residual stenosis) were not statistically significant predictors of ISR in this study.

**Conclusion:** Our results suggest that the risk of ISR after CAS without post-dilatation strategy is higher in the suboptimal angioplasty group. In strategy of CAS without post-dilatation, the optimal angioplasty prior stenting may helpful in selected patients for long-term durability.
P600
Simultaneous acquisition of dynamic CT angiogram as a by-product of CT perfusion for the evaluation of patients with acute ischemic stroke
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Purpose: Multiphase CT angiography (CTA) is used increasingly for the imaging triage of patients with acute ischemic stroke because CT perfusion (CTP) or diffusion-weighted image (DWI) have limitations in instant image processing or patient selection. Owing to wide coverage of current multidetector CT scanner, dynamic CTA can be obtained simultaneously as a by-product of CTP with a single contrast injection. Therefore, we sought for any benefit of simultaneous acquisition of dynamic CTA and CTP in evaluation of patients with acute ischemic stroke.

Materials and Methods: From October 2015 to November 2016, 84 consecutive patients presenting with acute ischemic stroke undertook CTP for an initial evaluation of acute stroke. CTP data were acquired using 128-section multidetector scanner (SOMATOM Definition Flash, Siemens, Germany) with a protocol as followings; single slap coverage = 8 cm, 80KV, 160mA, CTDIvol = 179mGy, DLP = 2011, contrast volume = 40 cc, injection rate = 5 cc/s, scan cycle = 26, scan interval = 1.5 s, scan time = 39 s. Dynamic CTA as well as CT perfusion maps could be acquired by a single contrast injection. All 84 patients undertook diffusion-weighted image (DWI) at 6 to 24 hours after CT perfusion.

Results: On dynamic CTA, arterial steno-occlusion (positive CTA) could be depicted in 39 of 84 patients (positive circulations in 32 patients, posterior circulation in 7 patients) and the remaining 45 patients had negative CTA. Among the 39 patients with positive CTA, 37 patients had acute infarct on DWI. Among these 37 patients, perfusion abnormality on CTP (positive CTP) was found in 35 patients and negative CTP was found in 2 patients who had small posterior circulation infaracts (pons and thalamus). Among the 45 patients with negative CTA, 25 patients had acute infarct on DWI. Among these 25 patients, positive CTP was found in 16 patients and negative CTP was found in 9 patients who had small posterior circulation infaracts (5 patients) or small cortical infarcts (4 patients). With reference to both CTA and CTP, negative predictive value of infarct was 20/29 (68.9%) and positive predictive value of infarct was 35/37 (94.6%). Despite negative CTA, CTP could depict 16 patients with infarcts which were lacunar infarcts or small cortical infarcts.

Conclusion: Although the dynamic CTA acquisition during CTP has inherent limitation of lower resolution and narrower coverage compared to conventional multiphase CTA, it can help to detect lacunar infarcts or small cortical infarcts which are hard to be detected on conventional multiphase CTA alone.

P602
Carotid-T IS NOT carotid-T IN ISCHEMIC STROKE: outcome after MECHANICAL THROMBECTOMY differs inbetween occlusion types
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Introduction: Acute occlusions of the carotid T are associated with a devastating clinical outcome. IV thrombolysis has a low recanalization rate with only about 10% and the proportion of patients with good outcome. Additionally, MT in Acute carotid-T occlusion results are both low in recanalization rates and poor in outcomes. We investigated clinical outcomes after recanalization in type I, II, and III carotid T occlusions.

Methods: From 2013 to 2016, mechanical thrombectomy was done for 125 patients, where reviewing the data of this patient showed that 44 patients were presented as Carotid T occlusions.

Results: Among the included patients, 23 (52.3%) were classified as having type I, 17 (38.6%) patients as type II and
This study includes 30 patients (male: female after the last ischemic attack. To evaluate the efficacy and safety of CAS within 2 weeks of severe calcification of the lesion (2 cases), intra-plaque hemorrhage (1), or problem of access routes (1).

Urgent revascularization was performed in 5 cases (CAS: CEA = 3:2). Perioperative complication rate of CAS and CEA were 3.3% (ipsilateral ischemic stroke) and 0%, respectively. Good outcome (modified Rankin Scale: 0-2, 90 days after the treatment) of CAS and CEA were 73% and 50%, respectively. CAS can be performed safely for patients with nondisabling stroke in the acute stage, if CAS high risk cases (especially severe calcification of the plaque) are excluded.

P603
Carotid stenting for symptomatic internal carotid stenosis in the acute stage
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After a completed nondisabling stroke caused by carotid stenosis, the risk of stroke was the greatest in the first 2 weeks. Therefore, AHA recommends carotid revascularization surgery (carotid endarterectomy: CEA) within 2 weeks based on several evidences. However, there has been no evidence of revascularization by carotid stenting (CAS) in the acute stage. The purpose of this retrospective study is to evaluate the efficacy and safety of CAS within 2 weeks after the last ischemic attack.

This study includes 30 patients (male: female = 19:11, mean age = 75.3), who underwent carotid revascularization within 2 weeks after the last attack (a transient ischemic attack or an minor stroke) in Nagoya City University Hospital and were followed up more than 3 months between 2013 and 2017. Strong medical treatments (dual antiplatelet and anti-thrombin) also started immediately after the admission. In case of a crescendo TIA, progressing or fluctuating stroke, urgent revascularization (within 48 hours) was performed. Basically, CAS was chosen first, but CEA in case of CAS high risk (severe calcification, etc.).

CAS was performed in 26 of 30 cases. The mean stenotic rate was 85% (NASCET). We applied Carotid Wallstent (Boston Scientific Japan) under proximal balloon protection methods in 25 of 26 cases. The other 4 cases underwent CEA because of severe calcification of the lesion (2 cases), intra-plaque hemorrhage (1), or problem of access routes (1).

Conclusions: Carotid-T occlusions could be classified into 3 types according to the study of robustness of collaterals. In our cohort, type I looks to be the fastest type to be recanalized and the type of occlusion with better outcome and reperfusion rate.

P604
Acute stroke intervention of the over-90 population in South Florida
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Purpose: South Florida is one of the primary destinations of retirees in the United States. With the relatively wealthy and healthy population getting older, the mean age of stroke patients in certain areas far exceed national averages. The purpose of this study was to follow how demographics and treatment results of our hospital’s acute stroke patients evolved in the past 8 years. We believe that our South Florida data can be extrapolated to the future of the western world’s increasingly aging population and provides guidelines for the upcoming decades.

Materials and Methods: A retrospective analysis of all stroke patients was conducted to include patients who were 90 year or older, and who underwent stroke intervention at Holy Cross Hospital. Statistical data was compared to our whole stroke intervention population. Demographics, clot location, groin-to-revascularization times, TICI scoring criteria on post-intervention CT or DWI-MRI when available.

Results: Of the 300 thrombectomies, performed between April 2009 and April 2017, 36 (12%) procedures were done in this very elderly age group. In the consecutive years from 2009 to 2017 the ratios were 0%, 0%, 7.1%, 15.8%, 13.5%, 7.0%, 11.8%, 29.7%, 16%, respectively. TICI 2BC/3 scores were recorded as 3/3 (100%) in 2011, 3/6 (50%) in 2012, 2/5 (40%) in 2013, 2/3 (67%) in 2014, 1/4 (25%) in 2015, 10/11 (91%) in 2016 and 4/4 (100%) in 2017 first 3 months. Overall TICI2BC rate was 25/36 (69%). Overall TICI3 rate was 13/36 (36%). M2-3 or equivalent branches were occluded and treated in 24 of 36 cases (66.7%). Post-intervention ASPECT score evaluation is still ongoing.

Conclusion: For years there has been a controversy over the value of performing thrombectomy on patients over 85. Our data on this even higher age group indicates that the procedure can be successfully done with expectations of good clinical outcomes in technically successful cases. High TICI-2BC and 3 scores can be achieved. Our data show fluctuation but an overall improvement of TICI scores during the past 8 years. Lower number of cases in 2014 and 2015 probably...
reflect the controversy of enrolling this age group into some of the randomized trials. Strong 2016–2017 results suggest that our current technique is appropriate. Difficulties in this age group are related to the unusually tortuous and rigid vessels and the unusually high number of M2, A2 or P2 occlusions. The reason of such high frequency of smaller vessel occlusions is unclear, and should be further evaluated.

P605
Elective carotid artery stenting for high signal lesions on MR black blood images
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Background: Carotid artery lesions with high signal on MR black-blood (BB) images look at high risk for symptomatic embolic complications following carotid artery stenting (CAS).

Purpose: The aim of our study was to investigate the effectiveness of our strategy to prevent symptomatic complications following CAS of MR-BB high-signal lesions.

Methods: We included in our study patients who underwent elective CAS of MR-BB high-signal lesions between Jan 2015 and Aug 2016. Symptomatic patients underwent CAS 30 days or later after their ischemic events. We performed transbrachial CAS as following; introducing the Spider filter device distal to BB-high lesions through the MSK-guide (6Fr Simmonds-type super‐long sheath), dilatation of lesions with a 3 mm‐diameter balloon catheter (Shiden) and deployment of CarotidWallStents without post-CAS balloon dilatation. Patients started to take clopidogrel and cilostazol before CAS and continued to do them after CAS. They took yokukansan (TJ-54, Japanese kampo) and suvorexant during before CAS and continued to do them after CAS. They took yokukansan (TJ-54, Japanese kampo) and suvorexant during peri-CAS periods. We evaluated symptomatic complications.

Results: Twenty-nine patients were analyzed. Their average age was 77 years. They had MR-BB high lesions and their average NASCET stenosis rate of 70%, which were reduced to 34.5% after CAS. Neither symptomatic ischemic complications nor hyperperfusion syndrome occurred during per-CAS periods. We evaluated symptomatic complications.

Conclusion: Our strategy of elective CAS for MR-BB high-signal lesions was effective in preventing symptomatic complications.

P606
Probable preventive effect of in-stent residual stenosis on hyperperfusion syndrome after carotid artery stenting without post-balloon dilatation in patients with an extremely high-grade stenosis
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Purpose: The aim of our retrospective study was to investigate whether or not in-stent residual stenosis after carotid artery stenting (CAS) without post-balloon dilatation (pBD) had relation to prevention of cerebral hyperperfusion syndrome (CHS).

Methods: We included in our study patients with a high-grade carotid stenosis (CS) who underwent elective CAS without pBD from January 2012 to November 2016, defined as an extremely high-grade CS (ex-CS) as a stenosis of more than NASCET 70% which caused delayed filling of contrast media in internal carotid angiograms, and defined a significant in-stent residual stenosis (isRS) as angiographic stenosis of more than NASCET 50% (probably area stenosis of 75%) or peak systolic velocity (PSV) of more than 80 cm/s by Doppler ultrasonography because significant stenosis caused PSV to increase. We evaluated patients’ baseline characteristics, isRS just after CAS and incidence of CHS.

Results: Thirty-six patients were analyzed. Their average age was 73.5 years. Twenty-three patients had symptomatic carotid artery stenosis. Median PSV before and just after CAS was 283 and 75 cm/s. Six patients (16.7%) had angiographic isRS. Thirteen patients (36%) had PSV of more than 80 cm/s. Totally 16 patients (44%) had significant isRS of more than 50% stenosis or of more than 80 cm/s of PSV. No CHS occurred.

Conclusion: CAS without pBD resulted in significant isRS in about half of patients with an ex-CS. It was probably associated with no CHS.

P607
Diagnostic value of dual-energy CT angiography in the assessment of supraaortic in-stent restenotic lesions: comparison with Doppler US findings
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Purpose: The regular follow-up of stented segments in the cervical ICA and proximal supraaortic vessels is routinely performed by Doppler ultrasonography. In case of a suspected high-grade in-stent restenotic lesion, an invasive catheter angiography is required for verification, generating a substantial number of invasive follow-up procedures. Dual-energy CT angiography provides a non-invasive alternative for the follow-up of neurovascular stents, due to its ability to assess the intraluminal space of stented vessel segments, especially when calcification is also present.

Materials and Methods: Supraaortic dual-energy CTA examinations were evaluated retrospectively in 33 patients with 41 supraaortic stents. Stent morphology, contrast filled lumen area, area of neointimal hyperplasia and the presence of metallic artefacts were assessed across different scanning, reconstruction and visualization protocols.
Results: 5 proximal supraaortic and 36 cervical carotid stents were evaluated. The findings of Doppler US and dual-energy CTA were concordant in 71% (29) of the cases, whereas in 29% (12) of the suspected restenotic lesions on the US could not be verified by CTA. The diagnostic value of dual-source CTA was maximal using high concentration (400 mg/ml) contrast media with thin slice, small FOV reconstructions centered on the stented segment.

Conclusion: Dual-energy CT angiography is useful in the follow-up of supraaortic stented segments when US findings are inconclusive or of limited value, mostly due to extensive plaque calcification around the stents. CTA can rule out in-stent restenotic lesions in patients with ambiguous US findings. Proper scanning protocol and individually tailored postprocessing is necessary for reliable assessment.

P608

Treatment outcome of carotid artery stenting in one municipal hospital

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Purpose: Preventing embolism during carotid artery stenting (CAS) is important. The result of a multicenter case study in Japan with tailored CAS including stents and protection devices revealed the safety of CAS in Japan. The aim of this study is to assess tailored CAS result in our hospital.

Material and Methods: We retrospectively observed clinical outcome of CAS. 100 CAS procedures were performed between January 2013 and March 2017, consisting of 13 female and 33 asymptomatic lesions. CAS was performed with 1 distal filter protection, 18 distal balloon protection (including 1 double balloon protection) and 81 proximal + distal balloon protection (67 complete proximal protection).

Results: At thirty-day, one patient had major adverse event (cerebral infarction) and no myocardial infarction was occurred. New postoperative diffusion-weighted imaging (DWI)-positive lesion was detected in 14 of 100 (14.0%) procedures. Asymptomatic hyper-intensities on DWI after CAS were detected in 13 cases. New lesions on postprocedural DWI were significantly more frequent without statin than with statin before CAS. (p = 0.01)

Conclusion: Tailored CAS strategies should be selected based on patient condition and plaque characterization. Whether recent technical and device advances for CAS could reduce ischemic events still remains to be evaluated.

P610

Comparison of venous drainage pattern in hemorrhagic dural arteriovenous fistula

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Intracranial hemorrhage is one of the most serious clinical manifestations of intracranial dural arteriovenous fistulas (DAVFs). In hemorrhagic DAVFs, venous drainage pattern is one of the most concern about treatment strategy. We reviewed the clinical and angiographic features and outcome of patients with intracranial DAVFs who presented with hemorrhage.

Material and Methods: A retrospective study of 26 patients with DAVFs who presented with intracranial hemorrhage. The information reviewed included clinical presentation, type of hemorrhage, location, angiographic features including Cognard classification and venous drainage pattern (sinusual type or nonsinusal type), clinical and radiological outcome.

There were 15 men and 11 women (mean age, 66 years; range, 45–85). The most common symptom was headache (36%). Intraparenchymal hemorrhage was most observed (69%). All DAVFs had a cortical venous drainage and most common location was Transverse-Sigmoid junction (38%). Cognard type was most common (34%). Treatment ranged from TAE (35%) with surgically disconnection (15%), TVE (31%), or TAE with TVE (19%). Complete obliteration was confirmed 22 patients (86%). All patients were not rebleeding after received treatment. TAE was complicated by cerebellar infarction in 1 patient (4%). In comparison of venous drainage pattern, nonsinusal type DAVFs were significant older (64 v.s 70 year) and male dominance (35.7% v.s 83.3%) than sinusal type DAVFs. Despite nonsinusal type DAVFs were lower complete obliteration rate (100% v.s 75%) and higher complication rate (0 v.s 7.6%) than sinusal type DAVFs, there was no significant difference from modified Rankin Scale (1.8 v.s 1.7).

All hemorrhagic DAVFs have cortical venous drainage. The most common type was transverse sigmoid junction. In nonsinusal type DAVFs, There is a male predominance and older than sinusal type. In both cases, good outcomes are achieved with individualized treatment, which includes TAE or TVE or a combined without Onyx in a very low complication rate.
P611

Comprehensive Hybrid Strategy for Carotid Artery Stenosis with “Toyama Carotid 8” rules

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Purpose: We report their preliminary results of carotid endarterectomy (CEA) and carotid artery stenting (CAS) for patients with carotid artery stenosis according to their “Toyama Carotid 8” rules.

Methods: This prospective study included total 104 patients who underwent CEA or CAS for carotid artery stenosis in our hospitals between March 2012 and January 2015. “Toyama Carotid 8” rules primarily recommend CEA for symptomatic and CAS for asymptomatic lesions with crossover between these two modalities for high treatment risk patients in each group. As other rules of “Toyama Carotid 8”, monitoring of platelet functions is quite important prior to CAS. Internal shunting and near infrared spectroscopy monitoring are essential in CEA. Temporary cardiac pacing is mandatory in CAS. The choice of protection device and stent depends on the results of MR plaque imaging. Cerebral blood flow measurement should be always measured before and after CEA/CAS. No age limitation is indicated.

Results: As the results, 52 CEA and 52 CAS were performed for 55 symptomatic and 49 asymptomatic lesions. The cross-over happened in 10 (18%) of 55 symptomatic lesions (CEA to CAS) and 7 (14%) of 49 asymptomatic lesions (CAS to CEA). The 30-day morbidity rate was 1.9% in CEA and 1.9% in CAS group. Postoperative diffusion-weighted imaging detected fresh ischemic lesions in 5 (10%) CEA patients and 9 (18%) CAS patients. Hyperperfusion syndrome occurred in one CEA patient (1.0%). There were no mortalities in each group during perioperative period.

Conclusion: Establishment of in-hospital management rule is useful for medical team to share their opinions and improve the short-term results of CEA/CAS for carotid artery stenosis. Further studies would be warranted to evaluate the long-term outcome.

P612

Bailout use of balloon expandable stents in the endovascular treatment of acute ischemic stroke

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Purpose: Mechanical thrombectomy (MT) and/or aspiration has been proved effective in recanalization of large vessel occlusions (LVO) causing acute ischemic stroke (AIS). In 10–15% of the cases however, both thrombectomy and aspiration fail to recanalize the occluded vessel, due to fixed fibrotic, calcified thrombotic material or a ruptured and thrombosed atherosclerotic plaque at the site of the occlusion. In these cases, bailout application of flexible, high-radial force balloon-mounted stents may be required as a last resort to achieve recanalization. Simultaneous use of intravenous thrombolysis may increase the risk of hemorrhagic complications due to the necessary application of antiplatelet agents. Here we present our experience on the safety and efficacy of the bailout use of balloon-expandable stents in the treatment acute cerebral artery occlusions.

Methods: Out of 380 AIS stroke cases treated with MT, bailout application of balloon-mounted stents following multiple unsuccessful passages of stent-retriever thrombectomy and aspiration was performed in 6 cases (3 MCA and 3 BA) between 2014 and 2017 in our institutions. All patients received IV thrombolysis prior to MT. Balloon-mounted stents were used as bailout in all cases. In 3 cases, patients were kept on anticoagulation with preventive dose of LMWH and daily dose of 100 mg aspirin p.o. in the first 5 days postoperatively in, followed by dual anti-platelet therapy. In the remaining 3 cases, dual antiplatelet therapy was initiated immediately after stent implantation. Procedural success evaluation was based on the extent of reperfusion, the lack of bleeding, and the extent of clinical improvement at 3 months follow up.

Results: Complete recanalization of the occluded vessels (TICI 3) was achieved in all cases (100%) following stent implantation. No bleeding complication occurred despite the application of dual anti-platelet therapy using aspirin and clopidogrel, within the 24-hour time window of the thrombolysis in 3 cases. There was no clinical or imaging evidence of ischemic damage in the area of lenticulo-striatal or brain-stem perforators due to plaque shift or thrombus squeezing. Modified Rankin score at 3 months was 1–2 in 5 cases (83%) and 5 in 1 case (17%).

Conclusion: Based on our limited experience, the bailout use of balloon expandable stents seems to be a safe and effective approach following unsuccessful IV lysis and mechanical thrombectomy or aspiration. Despite our encouraging initial result, larger scale clinical data is needed to determine the optimal use of balloon-mounted stents in this setting.

P613

Histopathological Study of Retrieved Clot in Acute Ischemic Stroke –Correlation with Endovascular Treatment Result

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Materials and Methods: Between 2015 to early 2017 in our institution, 30 patients in acute ischemic stroke were treated with endovascular therapy using stent retriever. Obtained clots were analyzed histopathologically, staining with hematoxylin and eosin. Histology sections were categorized into red blood cell (RBC) dominant, platelet/fibrin dominant and white blood cell rate. These histological findings compared to the clinical outcome in patients of major anterior circulation artery occlusion.

Results: Total 18 patients were included. The mean age was 75.5 years and 72.2% were male. Atrial fibrillation was detected in 10 (55.5%) patients. Of the retrieved clots, 8 (44.4%) were RBC dominant, 10 (55.5%) were platelet/fibrin dominant. Comparing the result of endovascular therapy, poor TICI grade (1-2a) was experienced in 4 patients with cardiac embolism and higher platelet/fibrin rate was found. Higher TICI grade (2b-3) was obtained in 14 patients with RBC dominant patients (mostly non-cardiogenic stroke).

Conclusion: Our results suggest that histological analysis may provide the clue to improve the quality of mechanical thrombectomy in acute stroke patients.

P614
Different Learning Curves between Stent Retrieval and a Direct Aspiration First Pass Technique for Acute Ischemic Stroke

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Purpose: Clinical outcomes of a direct aspiration first pass technique (ADAPT) and stent retriever (SR) were similar in several observational studies. We compared procedural and clinical outcomes of ADAPT and SR in acute ischemic stroke with large artery occlusion.

Materials and Methods: In each specific time period, SR and ADAPT were determined as first-line treatment approach of acute ischemic stroke patients with large artery occlusion at our institution. Baseline characteristics, procedural variables, and functional outcome at 90 days were compared between patients treated with SR and those treated with ADAPT. The two groups were divided into three sequential subgroups to assess the learning curve of endovascular team on procedural variables with each treatment strategy.

Results: Overall, 89 patients were treated. In the SR group, the recanalization rate was higher (86% vs. 65%; p = 0.01) and the procedure time was shorter than in the ADAPT group (42 min vs. 76 min; p = 0.04). By subgroup analysis for learning curve, the SR group showed more rapid improvement on procedure time than ADAPT group (p = 0.01).

Conclusion: In our initial experience, higher recanalization rate and shorter procedure time were achieved with SR than with ADAPT. High recanalization rate with SR was possible with relatively less clinical experience, whereas procedure time dramatically decreased with experience. Thus, SR might be considered as the preferred method for initial endovascular treatment of acute ischemic stroke in relatively small stroke centers.

P615
Intraarterial urokinase injection may ameriolate motor and speech disturbance via urokinase-type plasminogen activator receptor (uPAR) in subacute brain infarction

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Background: Intravenous t-PA and endovascular intervention improves outcomes in ischemic stroke, but the benefit of reperfusion is limited to the first few hours after symptom onset. Original pathological idea of penumbra is not dependent on time but on reduction of cerebral blood flow. In addition, recently urokinase-type plasminogen activator receptor (uPAR) augments brain damage and functional recovery in experimental model of ischemic stroke by the mechanism of regeneration of dendrites or angiogenesis mediated increase in CBF. It is also reported the same in t-PA. We investigated whether intraarterial urokinase improves neurological outcome when administered in the subacute phase of cerebral infarction.

Material and Method: 16 patients with cerebral infarction (age: 60–92 ys; M/F(8/8)) were studied; 4 pontine, 1 subcortical, 2 IC transient occlusion, 1 MC transient occlusion, 2 cortex, 3 in basal ganglia, 3 in other areas. Neurological finding is motor disturbance and speech disturbance. Catheter angiography was performed 2–4 day after symptom onset. Patients did not have a major cerebral arterial occlusion. A microcatheter was introduced of distal IC, distal M1 distal, VA and BA. Motor and speech deficits were assessed evaluated before and after 6–12 x (10,000 U) of intraarterial urokinase injection over 5 minutes. Then Neurological finding and brain CT were evaluated soon, and a few days after the injection. (Results) Motor function improved in 8 of 15 cases and motor aphasia improved in two of three cases. Three patients with perforator occlusions worsened within
24 hours following the IA urokinase relevant motor recovery, second IA of urokinase but showed no effect in all cases. **Conclusion:** These results suggest that IA injection of urokinase may improve neurological function when given after the acute period cerebral artery occlusion. The mechanism remains clarified to administered urokinase may modulate the neuronal function via urokinase-type plasminogen activator receptor (uPAR) augments which is intrinsic system of urokinase in the brain.

**P616**

The association between restenosis after carotid artery stenting and fatty acid

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Purpose: To clarify the effectiveness and problem of the clot aspiration therapy via a balloon guiding catheter (BGC) by manual procedure for acute extra and/or intra cranial carotid artery (ICA) occlusion.

Subject: From 2010 to 2016, we treated 28 acute intra and extra ICA occlusion cases with neuroendovascular therapy with the BGC. After the diagnostic angiography, the the BGC was positioned to affected ICA origin with roadmap. Then the balloon was inflated to get the proximal flow control and manual blood aspiration with a syringe which was connected to the hub of the BGC immediately. Some cases could be retrieved as a total/partial thrombus without any clot retrieving devices. If the clot was not retrieved, further clot retrieving device, such as stentretriever and/or Penumbra aspiration catheter, was administered consecutively.

Results: Eleven of 28 cases (39.3%) achieved manual aspiration clot retrieved. Total clot retrieved with complete recanalization of ICA was achieved in one case, partial clot retrieval without recanalization achieved in 10 cases. The TICI 2B+/3 recanalization rate of 11 cases were 72.7%. The average puncture-to-recanalization time was 60 minutes (range: 15 ~ 114 min.), and the average mRS at discharge was 2.8. Manual clot retrieval was achieved in case with proximal ICA occlusion (from origin to skull base portion), otherwise no clot retrieval was achieved with ICA terminal type occlusion.

Discussion: Clot retrieval therapy for the ICA occlusion cases sometimes is complicated and the procedure time is long due to high amount of clotage. Manual clotage aspiration via a BGC will get the clot reduction, and lead high-recanalization rate with shortened procedure time.

Conclusion: Manual clot aspiration via a BGC is easier and sometimes effective for the acute extra/intra cranial ICA occlusion cases. It is worthwhile to try this procedure before using the stentretriever.

**P617**

Usefulness of Manual blood aspiration via a balloon guiding catheter for acute internal carotid artery occlusion

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Purpose: To clarify the effectiveness and problem of the clot aspiration therapy via a balloon guiding catheter (BGC) by further clot retrieving device, such as stentretriever and/or Penumbra aspiration catheter, was administered consecutively.

Results: Eleven of 28 cases (39.3%) achieved manual aspiration clot retrieved. Total clot retrieved with complete recanalization of ICA was achieved in one case, partial clot retrieval without recanalization achieved in 10 cases. The TICI 2B+/3 recanalization rate of 11 cases were 72.7%. The average puncture-to-recanalization time was 60 minutes (range: 15 ~ 114 min.), and the average mRS at discharge was 2.8. Manual clot retrieval was achieved in case with proximal ICA occlusion (from origin to skull base portion), otherwise no clot retrieval was achieved with ICA terminal type occlusion.

Discussion: Clot retrieval therapy for the ICA occlusion cases sometimes is complicated and the procedure time is long due to high amount of clotage. Manual clotage aspiration via a BGC will get the clot reduction, and lead high-recanalization rate with shortened procedure time.

Conclusion: Manual clot aspiration via a BGC is easier and sometimes effective for the acute extra/intra cranial ICA occlusion cases. It is worthwhile to try this procedure before using the stentretriever.

**P618**

Management of thromboembolic complication after middle cerebral artery aneurysm coiling in a thrombophilic patient

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Purpose: Thromboembolism is considered to be the most common source of morbidity is connected with endovascular treatment of cerebral aneurysms. According to the earlier study thromboembolism occurred 3~10% of the patients. The first treatment to choose in case when thrombus appears within endovascular procerures of intracranial aneurysm is glycoprotein IIB-IIIa inhibitors.

Methods: Few hours after the successful endovascular treatment of the middle cerebral artery aneurysm of a young thrombophilic female patient, the deterioration of her clinical status occurred due to proven progressive thrombus formation of middle cerebral artery.
**Results:** Due to the thrombophilia of the patient, mechanical thrombectomy, aspiration and intraarterial rtPA treatment were applied, and the thrombus was successfully removed and dissolved. As a result of the treatment, the neurological status of the patient rapidly improved and only a mild aphasia remained.

**Conclusion:** It can be concluded that in case of the treatment of the thromboembolism developed during the endovascular aneurysm treatment of a thrombophilic patient, the mechanical thrombectomy and the thrombolysis can be unambiguous alternative of the glycoprotein IIB-IIIa inhibitor treatment.

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**P619**

**Endovascular treatment of patient with acute carotid occlusion after cervical radiation therapy**

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**Purpose:** Patients with malignant head and neck tumors after radiation therapy (RT) harbor a higher risk of carotid stenosis or occlusion. Endovascular therapy has been established for intracranial occlusions, the acute treatment of extracranial carotid artery (ICA) occlusions has not yet been proven in randomized studies.

**Methods:** For the 51-year-old right handed female patient, swallowing complaints and tongue base pain appeared. Contrast enhanced CT proved a neoplasm of 32x26x29 mm on the right side of the oropharynx on the dorsal part of the tongue. Histology proved planocellular carcinoma. The patient received 5x1.8 Gy 6MV. Suddenly left side hemiplegia, moderately severe aphasia and facial paresis appeared. The urgent CTA and DSA proved the occlusion of the initial stage of the right ICA.

**Results:** By mechanical thrombectomy and carotid angioplasty and stenting (CAS), we succeeded to completely recanalize the ICA and as a result, the symptoms of the patient disappeared.

**Conclusion:** As a result of radiation treatment, a late atherosclerosis is formed. An acute stenosis or occlusion is scarcely described in the literature. The acute treatment of extracranial ICA occlusions has not yet been proven in randomized studies. Combination of the thrombectomy and the CAS is a more successful and safer solution than the CAS after pre-dilation. The endovascular treatment of acute extracranial ICA occlusion shall be proven by further multicenter studies.

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**P620**

**The initial results of effective zone for mobile stroke team (EZO trial)**

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**Introduction:** In Japan, endovascular treatment for acute ischemic stroke from large vessel occlusion should be performed by certified neurointerventionists. However, most hospitals in rural area that offer treatment for cerebral vascular disease do not have access to a neurointerventionist; the rural areas are especially affected. Thus, Our University has offered support to institutions without a neurointerventionist, to perform mechanical thrombectomy. The neurointerventionists stationed in other hospitals drive to retrieve the resultant clot since the acute ischemic stroke from large vessel occlusion. We called this the “drive and retrieve system” method, and launched the prospective trial to evaluate the validity and efficacy of this method. Herein, we report the initial results of this trial.

**Methods:** Nine institutes across our affiliated hospitals within a one-hour drive from Sapporo City took part in this trial. Three of these 9 institutes that have a full-time neurointerventionist were registered as the source. When an episode of acute ischemic stroke requiring intervention occurred in the other 6 hospitals, the available neurointerventionist provided treatment based on the drive and retrieve method. The neurointerventionists’ schedules was updated and distributed to all participating units once a week, so that the supported hospitals could immediately make contact when required. We analysis the data of 44 cases in this trial from July 2015 to April 2016.

**Results:** For 41 out of 44 cases (93%), Neurointerventionists were able to respond immediately. The median time from door-to-puncture was 90 min (interquartile range [IQR]: 72–125). The median time from puncture to recanalization was also 76 min (IQR: 57.5–99.5). The recanalization rate (TICI 2b/3) was 77 %. mRS 0–2 was 39%.

**Conclusion:** The drive and retrieve system has the potential to support rural medical institutes that do not have access to a full-time neurointerventionist.
A single center preliminary experience in the treatment of acute ischemic stroke with ADAPT technique with the new Catalyst 6 intermediate aspiration catheter

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Purpose: Over the past years, randomized trials have showed the safety and efficacy of new endovascular strategies for the treatment of patients with acute ischemic stroke (AIS) correlated to emergent large vessel occlusion (ELVO). Thanks to continuous advances in catheters development and to increased operator’s skills the thromboaspiration is finding larger interest. The aim of this study is to evaluate the safety and efficacy of AXS Catalyst 6 distal access catheter in AIS patients with ELVO in the anterior and posterior circulation treated with direct aspiration first-pass technique (ADAPT) as the primary EVT approach.

Materials and Methods: We analyzed prospectively collected data of our comprehensive stroke center. Between March and December 2016, 53 patients underwent primary EVT with ADAPT for anterior or posterior ELVO using the Catalyst 6 (CAT6) catheter. The use of the CAT 6 catheter was at operator’s discretion. Inclusion criteria of EVT were: large occlusion in the anterior or posterior circulation proved by CT angiography, groin puncture initiated within 6 hours of symptoms onset and ASPECT score ≥ 6 at baseline non contrast CT; in most of patients CT perfusion was also performed. Technical endpoints were the ability to reach the thrombus with the CAT6 catheter and successful recanalization defined as TICI ≥ 2b on final angiogram. Clinical endpoint was Modified Rankin Scale (mRS) score ≤ 2 at 90 days follow up. Mortality at 90 days was also analyzed. NIHSS score was evaluated on admission and at discharge.

Results: In all patients but one the thrombus was successfully reached with the CAT6 catheter. TICI ≥ 2b was achieved in 45/53 (84.9%) of all patients. The ADAPT technique with the CAT 6 device alone was successful in 40/53 patients (75.5%). In the 77.5% of this subgroup of patients (31/40) one or two aspiration attempts were successful. In 13/53 (24.5%) patients, additional devices were used, maintaining thrombus aspiration technique or switching to stent retriever devices and successful reperfusion was achieved in 9/13 (69.2%) patients. No complications related to the CAT6 catheter were observed. At 90 days follow up mRS score ≤ 2 was 43.3%.

Conclusions: The Catalyst 6 intermediate catheter is a safe and very effective device for the endovascular treatment of patients with acute ischemic stroke; its superior trackability allows a very easy navigation of intracranial vessels generally over wires, with no need of smaller catheters for coaxial systems. No significant limits of aspiration capability related to the smaller diameter of the CAT6 catheter compared to the other available intermediate aspiration catheters were observed. The high success rate with the ADAPT technique by means of the Stryker Catalyst 6 allows a significant reduction in the overall materials procedure costs that is generally lower than 3.000 euros/patient in the Italian market.

Analysis of CTA collateral status and EVT outcomes in patients with acute internal Carotid artery terminus occlusion

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The objective of the present study is to investigate the prognostic value of baseline collateral status and length of thrombus burden as well as other known parameters in patients with acute ischemic stroke (AIS) involving internal carotid artery (ICA) terminus occlusion treated with endovascular treatment (EVT). All eligible patients from January 2011 to October 2016 undergoing EVT were retrospectively reviewed. Leptomeningeal collateral statuses (LMC) on baseline computed tomographic angiography (CTA) were assessed by use of the regional leptomeningeal score. We identified 100 eligible patients (53 males, mean age 73 years, median baseline National Institute of Health Stroke Scale (NIHSS) score 12). Collateral status by use of the LMC score (0–20) was dichotomized into 3 group: good (17–20), intermediate (11–16), and poor (0–10). Patients with good LMC had lower baseline NIHSS scores, higher Alberta Stroke Program Early CT score (ASPECTS), higher clot burden score (CBS) on baseline CTA. Baseline NIHSS score < 15 (OR 3.22 95%CI: 1.04–9.91 p = 0.042), CBS ≥ 6 (OR 5.33 95%CI: 1.33–21.44 p = 0.018), good LMC (OR 3.73 95%CI: 1.88–7.47 p = 0.001) were independent predictors of good clinical outcome. In conclusion, CTA-based LMC status and CBS were one of the powerful predictor of clinical outcome in patients with acute ICA terminus occlusion treated with EVT.

Key words: Leptomeningeal collaterals, Computed tomographic angiography, Acute ischemic stroke, Endovascular treatment.

Predictors for good functional outcome after mechanical thrombectomy in acute cerebral artery occlusion

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Withdrawn
Introduction: Acute occlusion of a major cerebral artery is associated with high mortality and morbidity. Few data about prognostic factors for a good outcome are available, although mechanical thrombectomy has significantly advanced over the last 5 years. The aim of this study is to investigate good prognostic factors for an acute occlusion of a major cerebral artery using mechanical thrombectomy.

Materials and Methods: A single center retrospective analysis of 37 consecutive patients with acute occlusion of a major cerebral artery treated by mechanical thrombectomy with stent retrievers was conducted. Collaterals were assessed by the Thrombolysis in Myocardial Infarction (TIMI), and recanalization was assessed by the Thrombolysis in Cerebral Infarction (TICI) score. Outcome was assessed by National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale (mRS) at 90 days.

Results: Most patients (27/37) demonstrated good recanalization (TICI 2b or 3) after thrombectomy. At the 90-day follow up, 19 patients had good (mRS, 0–2), 14 had moderate (mRS, 3–4) and four had poor outcomes (mRS, 5–6). Early recanalization, high TIMI, and low baseline NIHSS were closely related to 90-day mRS, whereas high TICI was related to both mRS and the decrease in the NIHSS.

Conclusions: NIHSS decreased markedly when recanalization was successful. A good mRS was related to low initial NIHSS and good collateral and early and successful recanalization.

P624

Extremely rare persistent primitive artery passing through the jugular foramen with symptomatic ipsilateral carotid artery stenosis

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Purpose: Primitive arteries are persistent fetal anastomoses between the carotid and vertebral-basilar circulation. Although rare, several types of persistent primitive arteries can remain at birth. We present an extremely rare case of an unnamed persistent primitive artery passing through the ipsilateral jugular foramen, in which an artery-to-artery embolism to the posterior circulation was observed.

Summary of case: A 73-year-old woman presented with cerebral infarction to the posterior circulation caused by symptomatic common carotid artery stenosis with an unnamed and extremely rare persistent primitive artery. This anomalous vessel branched from the extracranial internal carotid artery and passed through the ipsilateral jugular foramen into the posterior cranial fossa and merged into the basilar artery. Carotid artery stenting was performed using distal single balloon protection.

Conclusion: To our knowledge, this is the first case of a persistent primitive artery passing through the jugular foramen with embolism originating from carotid artery stenosis. We speculate that this anomalous vessel may be a remnant of the PHA that is yet to be defined.

P625

A Comparison of Mechanical Thrombectomy for Large Vessel Occlusion in Acute Ischemic Stroke between Patients with Atrial Fibrillation and without Atrial Fibrillation

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Background: Atrial fibrillation (AF) is associated with poor outcome after ischemic stroke, previous studies suggested that greater ischemic volume leading to higher infarct, more severe hemorrhagic transformation and poor outcome. Only few data compare good outcome (mRS ≤ 2) at 90 days with mechanical thrombectomy in AF and non-AF patient.

Methods: Retrospective chart review of all patients with acute ischemic stroke (AIS) caused by large vessel occlusion (LVO) and remained salvageable tissue from CT perfusion or multiphase CTA undergoing mechanical thrombectomy in Siriraj Hospital between November 2009 and November 2016.

Results: One hundred and thirty-eight acute ischemic stroke patients were treated by endovascular mechanical thrombectomy at Siriraj Hospital between November 2009 and November 2016. Five patients lost of follow up. There were 134 patients enrolled included to this study. Age of AF group patients is older than non-AF group statistically significant (p 0.002), and intracranial atherosclerosis diseases were found less than non-AF group statistically significant (p 0.015). Sex, mean NIHSS, the mean time puncture to recanalization, the mean time onset to recanalization, number of pass of stent, TICI, symptomatic intracranial hemorrhage and good clinical outcome at 90 days and death rate were not different between two group.

Conclusion: No significant difference of good outcome and complication between AF and non-AF patients with AIS from LVO with mechanical thrombectomy.

Keywords: Mechanical thrombectomy, acute ischemic stroke, atrial fibrillation
The results of endovascular and medical treatment of acute ischemic stroke with occlusion of proximal internal carotid artery: single center experience

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Purpose: Proximal internal carotid artery occlusion (ICAO) is associated with large infarcts and with a 3-fold increased likelihood of poor recovery. The purpose of this study was to evaluate for clinical impact of the endovascular treatment (EVT) for acute ischemic stroke (AIS) patients with ICAO.

Materials and Methods: After retrospectively reviewed a registry of patients with AIS who underwent EVT from January 2005 to December 2016, 60 patients with ICAO within 8 hours from stroke onset were enrolled regardless of whether accompanied tandem occlusion or not. Whether a patient was treated with EVT or medical treatment decided after cerebral angiography. We classified two patient groups as an EVT group (n = 46) and medical group (n = 14) according to the treatment methods. We compared the baseline characteristics and clinical outcomes between the groups.

Results: Baseline characteristics including age, sex and arrival time from stroke onset, initial NIHSS score, and stroke risk factors were not significantly different between two groups. The good recanalization (TICI 2b-3) was achieved 63% in EVT group. The good clinical outcome of the modified Rankin Scale score 2 at 3 months was more frequent in the EVT group than in the medical group (52.2% vs. 14.3%; P = 0.001).

Conclusion: This study showed more good clinical outcome after EVT compared with medical treatment in AIS with ICAO. We think that it would be worth attempting EVT for revascularization in AIS with ICAO.

Surgical removal of trapped distal embolic protection device during carotid artery stenting

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A distal embolic protection device is key role for prevention of procedural stroke during CAS. There are several reports that some difficulty in filter retrieval. A 67 years old man presented with Lt hemispheric stroke. Planned CAS was performed. But we can’t removed embolic protection devices due to pusher wire kinking. So we try to surgical removal of trapped distal embolic protection device under general anesthesia. The patient’s neurological status was good and there was no complications during surgery.

Endovascular therapy for acute large vessel occlusion due to atherothrombosis

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Purpose: Our nationwide registry showed that cardiogenic stroke was the main cause (around 60%), but arteriothrombosis was the second cause (around 20%). Here, we report our results of endovascular therapy for acute large vessel occlusion due to atherothrombosis.

Materials and Methods: We examined 38 consecutive patients who underwent acute thrombectomy for atherothrombotic large vessel occlusion in our hospital from September 2013 to January 2017. Patient characteristics, time from onset to recanalization, duration of the procedure, reperfusion score, complications and clinical outcome in the atherothrombotic group (AT group) were compared with those of the cardiogenic group (CG group).

Results: The mean age of patients were 75 years, and 31 (82%) were male in the AT group. Regarding occlusion sites were extracranial internal carotid artery (ICA) in 16 (42%), intracranial ICA to middle cerebral artery in 17 (45%), and vertebro-basilar artery in 5 (13%). Median preoperative NIHSS score was not significantly different (14 in AT vs 18 in CG group, p = 0.5). Significant reperfusion (TICI 2B–3) tended to be less in AT group (84.2% in AT vs 90.1% in CG group, p = 0.31), and duration of the procedure was significantly longer in the AT group (104 min in AT vs 70 min in CG, p = 0.004). However, the rate of favorable outcome was not different in the groups (55.2% in AT vs 38.9% in CG, p = 0.07).

Conclusions: Endovascular therapy for acute atherothrombotic occlusion often requires complex procedure, leading to less reperfusion rate with longer procedure time compared to CG group. However, clinical outcome was not worse in this series.
P629
Impact of baseline DWI lesion location for functional outcome of recanalized acute stroke patients
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Background and Purpose: The summed Alberta Stroke Program Early CT Score (ASPECTS) for Diffusion Weighted Image (DWI) represents the extent of early brain ischemia and has been shown to be useful for predicting stroke outcome and has been an efficient indication for endovascular therapy (EVT), but the ASPECTS itself does not incorporate topological feature which is essential for clinical outcomes. Our aim is to determine the association between infarct topology and outcome of the patients treated with EVT.

Materials and Methods: Among patients with acute anterior circulation occlusions who underwent MRI and EVT between January 2011 and June 2016, successful recanalized patients (TICI ≥ 2b) within 8 hours from onset were extracted. Favorable clinical outcome was defined as modified Rankin scale (mRS) score ≤ 3 at 3 months and unfavorable outcome as mRS ≥ 3. Logistic regression analysis determined independent predictors of unfavorable outcome among location of baseline DWI-ASPECTS.

Results: A total of 54 patients (75 ± 8 years old, 33 males) was included. In baseline characteristics, median NIHSS was 20 (IQR: 17–24) and 35 (69%) patients received intravenous tPA before EVT and median image to recanalization time was 118 (IQR: 102–166) minutes. TICI3 grade recanalization was achieved in 11 patients (20%) and TICI2b in 43 (80%). Unfavorable outcome (mRS ≥ 3) was seen in 29 (54%) patients at 3 months and were associated with high age, higher admission blood pressure, symptomatic intracerebral hemorrhage and lower DWI-ASPECTS on baseline scans. DWI-ASPECTS in right M5 (11% versus 36% p = 0.03), left M1 (0% versus 16% p = 0.03), left M2 (0% versus 28% p < 0.01) and left M5 (0% versus 16% p = 0.03) on baseline scans were associated with unfavorable outcome at 3 months. Logistic regression analysis demonstrated right M5 (OR 14.02 [95%CI: 2.93–97.30], p = 0.01) as the independent predictor.

Conclusions: For patients with anterior circulation large vessel occlusions in hyperacute stage, DWI-ASPECTS in right M5 and left M1, M2 and M5 at baseline can be a predictor for unfavorable outcome even successful recanalization were achieved.

P630
Parenchymal Blood Volume maps of Flat panel Detector Showed Correlation with Cerebral Blood Flow in Patients of Chronic Cerebral Artery Stenosis or Occlusion
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Recent flat panel angiographic detector (FD) systems have the capability to make parenchymal blood volume (PBV) maps. It was recently reported that PBV can estimate cerebral blood volume (CBV) in stroke patients. In patients of chronic cerebral ischemic state as stage in Powers’ classification, the CBF is decreased and the CBV is increased. In this study, we assessed whether PBV shows correlation with cerebral blood flow (CBF) in patients of chronic large artery stenosis or occlusion.

From June 2013 to April 2017, 26 patients with cerebral artery (internal carotid artery (ICA) or middle cerebral artery (MCA)) stenosis or occlusion were included. For assessment of CBF at rest, they underwent [123I]-IMP single-photon emission computed tomography (SPECT) followed by FD-PBV imaging (syngo Neuro PBV IR; Siemens, Erlangen, Germany). In both SPECT and PBV, we selected region of interest (ROI) in MCA territories, and evaluated the ratio of ipsilateral and contralateral side. We defined the ratio of PBV as “rPBV”, and the ratio of SPECT as “rSPECT”. rPBV showed more than 1.0 in 25 patients (range: 1.0 – 1.63, mean : 1.11). rSPECT showed less than 0.8 in 2 patients (range: 0.68–1.0, mean : 0.92). 5 patients increased rPBV more than 1.2. In those 5 patients, rSPECT showed less than 0.90 (P value: 0.04). FD-PBV can detect cerebral ischemic state in chronic cerebral artery stenosis or occlusion.

P631
Predictors for detecting patients who need intravenous tissue plasminogen activator administration and/or endovascular thrombectomy from patients of probable stroke by pre-hospital status
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Purpose: Acute ischemic stroke (AIS) from large artery occlusion (LAO) can be treated by intra-venous tissue plasminogen activator (IV t-PA) administration and/or
Endovascular treatment (EVT) for cerebral artery occlusion associated with acute Stanford type A aortic dissection (AAAD) is rarely treated indication because there is no clear evidence and treatment risk is high. We report a rare case of EVT for bilateral common carotid artery occlusion associated with AAAD in the hyper-acute phase. A 63-year-old woman presented 3 h after stroke onset secondary to a bilateral common carotid artery (CCA) occlusion. Admission National Institutes of Health Stroke Scale (NIHSS) score was 24, with conscious disturbance, right hemiparesis and total aphasia. Her chest computed tomography angiogram (CTA) revealed AAAD. There is a high possibility of bleeding and death unless AAAD treatment is done. However, there is no surgical indication for AAAD when cerebral ischemic prognosis is poor. We successfully performed a carotid artery stenting for left common carotid artery occlusion and she showed remarkable recovery (NIHSS score of 5 at 15 h). Replacement of the ascending aorta was performed on the 2nd day. 90 days after onset, she improved to modified Rankin Scale 2. Only when the ischemic brain injury can be still recovered, it was shown to be a good outcome by challenging treatment.

P633
Treatment of Large Cerebral Artery Stenosis by Angioplasty and Stenting Result of 120 Cases
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Objectives: To analyze the result of endovascular treatment for severe and symptomatic cerebral arteries stenosis by angioplasty and stenting at University Medical Center HCM city.
Population: the research population is including patients who have extra or intracranial cerebral artery stenosis: carotid artery, middle cerebral artery M1 segment, vertebral artery, basilar artery, anterior cerebral artery A1 segment. The level of arterial stenosis is at least 70% and arterial diameter from 2 mm with related symptoms: ischemic stroke, repeated TIA (transient ischemic attack) which failure of medical management.
Methods: This is the case series report study. The clinical symptoms before and after treatment will be analyzed, long term follow up symptoms including new stroke or TIA which is related to the interventional artery. Endovascular procedure will be performed with reopen up the vessel by angioplasty (dilation with the balloon) and stenting (implant of Stent device). After carotid stenting follow up protocol will be applied by Doppler Ultrasound after 1 month, 6 months and 1 year. While intracranial stenosis stenting will be followed up by clinical examination, MRI, MRA after 6 month. Cerebral Digital Subtraction Angiography (DSA) follow up will be indicated when the patient has symptoms (stroke or TIA) which are related to treated vessel.
Results: From 2006 to June 2015 at University Medical Center HCM, we had performed 120 cases with extra or
intracranial cerebral artery stenosis by angioplasty dilation and stent deployment. Among this series, carotid stenosis is 49%, middle cerebral artery M1 segment 28%, origin of vertebral artery 9%, basilar artery 11%, and anterior cerebral artery A1 segment in 2%. Endovascular procedure technical success in 98%. Restenosis rate after carotid stenting detected by Doppler Ultrasound is 4%, mostly no symptoms and can be re-dilated by balloon in severe cases. The longest follow up time is more than 4 years there is no repeated stroke case. The severe complication rate after procedure is 6% including cerebral bleeding after stenting suggested by hyper reperfusion syndrome in 3%, mortality rate is 3%.

Conclusions: Endovascular treatment for severe and symptomatic cerebral arteries stenosis by angioplasty and stenting has indicated that this is quite safe and effective procedure for prevention of repeated stroke caused by large extra or intracranial cerebral artery stenosis with low restenosis rate.

P634
Transvenous aspiration thrombectomy followed by continuous local infusion of thrombolytics for extensive cerebral venous sinus thrombosis
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Purpose: Cerebral venous sinus thrombosis is an uncommon cause of stroke with severe complications including venous infarction, intracranial hemorrhage, and extensive cerebral edema which lead to high mortality. Endovascular thrombolysis with various devices had been proposed as a salvage treatment when standard treatment with systemic anticoagulation was ineffective, especially in extensive long segment dural sinus thrombosis. We describe our technique of transvenous endovascular aspiration thrombectomy with large bore thrombectomy catheters, followed by placement of microcatheter for local thrombolytic infusion at the site of thrombosis. The angiographic and clinical outcome was reviewed.

Materials and Methods: From January 2014 to March 2017, 4 patients with acute complicated cerebral dural venous sinus thrombosis not responsive to systemic anticoagulation were treated with endovascular thrombectomy. All patients were treated by transvenous aspiration thrombectomy with 5Max ACE catheters. If residual thrombus was occluding a segment of the dural venous sinus or cortical vein, a microcatheter was left in-situ locally at the occlusion site for post-procedural continuous urokinase infusion for thrombolysis. A retrospective review of the clinical records, angiographs was performed.

Results: All but one patients developed spontaneous extensive cerebral dural venous sinus thrombosis, one patient had symptomatic sigmoid sinus thrombosis following excision of a tentorial meningioma. 3 patients were complicated with intracerebral hemorrhage. All patients developed progressive neurological deterioration in consciousness and had worsening of cerebral edema of venous hemorrhage despite systemic anticoagulation. Partial or near total recanalization was achieved with aspiration thrombectomy, and all patients had re-establishing antegrade dural venous sinus flow and improved venous stasis. Continuous thrombolytic infusion was given for 2 days with interval CT angiogram confirming reopening of critical cortical veins or further regain of the dural venous sinus lumen. There were no procedural-related complication and no progression of hemorrhage. One patient required decompressive craniectomy for diffuse cerebral edema. All patients recovered to mRS 1 at last follow up.

Conclusion: Endovascular aspiration thrombectomy followed by continuous local infusion of thrombolytic agent appeared to be a safe and efficacious treatment for cerebral dural venous sinus thrombosis refractory to medical treatment.

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Experience of staged angioplasty for carotid artery stenosis to avoid hyperperfusion syndrome
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Objective: Hyperperfusion syndrome after carotid artery stenting (CAS) is a condition which may lead to serious complications such as intracranial hemorrhage. We have previously reported staged angioplasty for avoidance of hyperperfusion syndrome after CAS, Here we report our treatment results and discuss the issues regarding this procedure.

Subjects: The study included 55 cases of patients in whom preoperative single photon emission CT (SPECT) showed severely impaired cerebral blood flow (CBF), for which SAP was subsequently performed. The analyzed subjects are as follows: 49 males and 6 females, or 34 symptomatic and 21 asymptomatic lesions with mean age of 74±8.2 years old.

Methods: Staged angioplasty was performed in patients in whom SPECT had provided the ratio of the CBF of the affected to unaffected hemisphere (asymmetry index) of <0.8 with its cerebrovascular reactivity of less than 10%. First, balloon angioplasty was performed using an undersized (2.0–2.5 mm) balloon, and then finished once when 2 mm or more dilatation was confirmed by intravascular ultrasound. Subsequent approximately two weeks after the initial treatment, CAS was performed. Just after that quantitative SPECT was conducted to confirm the presence or absence of radiologic hyperperfusion. In the case of inadequate dilatation or extensive dissection, stent placement was performed just after the initial balloon angioplasty.

Results: In 48 of 55 cases (87%), staged angioplasty was successfully completed in avoiding hyperperfusion syndrome. But 3 (6%) inadequate dilatations and 4 (7%) vascular dissections shifted into immediate CAS. Among them,
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Endovascular treatment for acute ischemic stroke with intracranial atherosclerotic occlusive disease

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Background: Treatment strategy for acute ischemic stroke with intracranial atherosclerotic disease remains unknown. The aims are to evaluate whether revascularization rates, procedural complications, functional outcomes in patients with emergent endovascular treatment for intracranial atherosclerotic occlusive disease.

Methods: A retrospective review of emergent endovascular treatment from 2003 to 2016 was carried out for acute ischemic stroke patients who had intracranial atherosclerotic occlusion or severe stenosis. Patients were underwent endovascular treatment which included intra-arterial thrombolysis, balloon angioplasty and stenting. Intracranial atherosclerotic disease was defined as significant focal stenosis at the occlusion site, which was evident on final angiographic assessment or observed during endovascular treatment.

Results: A total of 58 consecutive patients were identified. Forty-five were male (78%) and the mean age was 68 years. Atherosclerotic arteries were 24 in middle cerebral artery, 8 in internal carotid artery, 22 in basilar artery, and 4 in vertebral artery. Successful recanalization (TICI 2b and 3) was observed in 45 patients (78%). Intra-arterial thrombolysis, balloon angioplasty without stenting, and balloon angioplasty with stenting by coronary stents were performed in 31 patients (53%), in 45 patients (78%), and in 19 patients (33%), respectively. Acute in-stent thrombosis was observed in 4 patients. Stent retriever and Penumbra system were used in 5 patients and 9 patients, respectively. The postprocedural hemorrhagic complication was observed in 5 patients (8.6%). The incidence of good outcome (90-day modified Rankin scale ≤2) were 68% in anterior circulation and 38% in posterior circulation.

Conclusion: Our data suggest that emergent endovascular treatment for patients with intracranial atherosclerotic occlusive disease is safe and feasible. Particularly, balloon angioplasty with or without stenting have a high rate of recanalization and favorable outcome.

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MRI imaging of vessel wall enhancement in a case of varicella vasculitis

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Background and Purpose: Vasculitis can cause wall thickening and enhancement of the intracranial arteries, which can be detected with high resolution black blood T1-weighted MR imaging. We demonstrate a case of varicella vasculitis where MR imaging contributed to determine the etiology of stroke.

Materials and Methods: A 7 year old girl having had a chickenpox infection a few months before experienced a sudden onset of TIA-like left hemiparesis and subsequently diagnosed of ischaemic stroke at another hospital was referred to our Institute. We performed MRI with vasculitis protocol: 3T high resolution SET1-weighted images with a 2 cm thick volume block covering the basal arteries with 2 mm slice thickness and no gap without contrast in the coronal plane and with contrast and fat suppression in all three orthogonal planes.

Summary: The first MRI at another hospital acquired without vasculitis protocol showed narrowing of the right-sided supraclinoid internal carotid artery (ICA), the M1 and A1 segments. No prominent lenticulostriate arteries were detected. At this stage, differential diagnosis included unilateral early moyamoya disease and vasculitis. One month later, our MRI with vasculitis protocol revealed that the narrowing of the right-sided supraclinoid ICA, the M1 and A1 segments was secondary to concentric wall thickening and enhancement and the A1 stenosis showed progression. Persistent lack of prominent lenticulostriate perforators and the relative fast progression suggested rather vasculitis which was also supported by blood tests suggesting a varicella origin of the vasculitis. The patient was treated with steroid.

Follow up MRI in two moths showed somewhat less intense vessel wall enhancement with no major change of luminal narrowing. Next MRI in three months revealed significant reduction of ICA and M1 stenosis with complete resolution of vessel wall enhancement. The right A1 segment showed no wall enhancement but flow signal could not be detected either, presumably due to occlusion. The girl became symptom free.

Altogether, the clinical history, blood tests and the course of changes on MRI, ie. first fairly fast progression and then continuous regression and finally resolution of vessel narrowing and wall enhancement favoured the diagnosis of
varicella vasculitis over unilateral moyamoya disease. Vessel wall MRI imaging can be used to detect vasculitis and may aid in the differential diagnosis a vessel stenosis.

**P638**

**Results of treatment strategy with 2 mm balloon for symptomatic intracranial arterial stenosis**

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Intravascular treatment for symptomatic intracranial artery stenosis, it has not been proved as evidence of SAMMPRIS study etc. We report on our past experience about it in our departments.

**Material and Method:** Twenty-one patients (22 subjects) who performed intravascular treatment without acute thrombectomy from 2008. First, we used a Gateway balloon diameter of 2 mm and then with another wider diameter balloon or stent in the following condition. The treatment procedure, results, and prognosis were compared with articles.

**Result:** The observation period was median 33 months. The 67% of initial balloon size was 2 mm diameter, and the average number of inflation times was 2.3 ± 1.1 times. In chronic phase, one case needed stent treatment after 23 months later in basilar artery. Only one case of chronic phase appeared perforator infarction (5.6%). No bleeding complications. In the acute phase treatment, two of three cases were reocclusion within 24 hours and reestablishment using stent again. Both of them decreased the mRS. There was no recurrence of ipsilateral cerebral infarction. One patient developed cerebral infarction on the opposite side 22 months later. One case in the observed blood flow evaluation showed improvement in resting blood flow, and no case of hyperperfusion was observed.

**Discussion:** The results of the active medical treatment group of the SAMMPRIS trial showed 12.2% major event incidence in 1 year, stroke / death: 5.8% within 30 days, 13 cases (6%) of stroke related to stenotic sites after 30 days, and our result was good as compared with this.

**Conclusion:** Obviously the prognosis of symptomatic intracranial arterial stenosis is severe. In Japan, it is now possible to use Wingspan stent as an insurance medical treatment with rescue. Japanese blood vessel size may be smaller than western people, but we think that in chronic phase, the treatment strategy for moderate improvement with a 2 mm balloon is effective.

**P639**

**Prophylactic Dual Catheter Technique to Prevent Side Branch Snowplowing Complications during Angioplasty and Stenting**

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**Objective:** Angioplasty and Stenting of intracranial atherosclerotic lesions have a higher complication rate and a large proportion of this is attributable to side branch arterial occlusion from forceful displacement of the atheroma into the ostia or snowplowing effect. This can result in severe disabilities when it result in small infarcts involving eloquent areas in the posterior circulation or the motor tracts.

**Materials and Methods:** We present a series of 6 cases utilizing a new dual catheter technique for maintaining the patency of at-risk vessels during angioplasty and stenting. There are several methods previously described to help reduce the incidence of stroke but because they do not have a physical presence in the ostia to protect it, they are unable to guarantee the patency of the vessel.

**Results:** All 6 patients underwent angioplasty and stenting with the technique. The patients were assessed for complications with post-procedure magnetic resonance imaging and no complications were found.

**Conclusion:** In this preliminary series, the dual catheter technique appears to safe and effective in preventing occlusion of the adjacent branch arteries. This technique may facilitate the use of the Wingspan stent in the treatment of intracranial atherosclerotic stenotic segments by reducing the risk of peri-procedural stroke.

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**Crab claw sign predicts successful recanalization in acute mechanical thrombectomy**

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**Purpose:** Mechanical thrombectomy (MT) is often performed for patients with acute ischemic stroke. While the rate of successful recanalization (thrombolysis in cerebral infarction; TICI score ≥ 2b) is getting better, some cases cannot be recanalized successfully. To find the good predictors for successful recanalization, we retrospectively investigated the patients’ data including angiographic findings.

**Materials and Methods:** We performed MT during January 2014 and March 2017 for 80 patients. We extracted patients with distal artery occlusion (further than the M2 portion of middle cerebral artery, and occlusion of post cerebral artery).
We defined crab claw sign as an angiographic thrombotic shadow which proximally protrude more than half of the blood vessel diameter. We divided our patients into 2 groups (with successful recanalization [TICI score ≥ 2b]; group 1, non-successful recanalization [TICI score < 2b]; group 2). We compared the presence of crab claw sign, and other clinical and radiological data between the groups.

Results: We included 57 patients in this study (34 men, mean age 74.4 ± 11.1 years). There was no difference in the patients’ baseline characteristics (age, sex, presence of hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, and smoking), baseline National Institute of Health Stroke Scale (NIHSS), presence of intravenous tissue plasminogen activator, and stroke subtypes between group 1 (44 patients) and group 2 (13 patients). Although there was no difference in occlusion site and diffusion weighted imaging Alberta Stroke Program Early CT Score (DWI-ASPECTS), the presence of crab claw sign was significantly different between the groups (43.2% vs. 7.7%, p < 0.05). About patients’ outcome, although there was no difference in the modified Rankin Scale score at 3 months, NIHSS at discharge was also significantly different between the groups (9.6 ± 11.5 vs. 16.2 ± 12.9, p < 0.05).

Conclusion: The presence of crab claw sign was higher in group 1. Craw crab sign may be useful for predicting successful recanalization in patients with MT for acute major vessel occlusion.

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Intravenous tPA before stroke thrombectomy is associated with prolonged admission times

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Purpose: The role of intravenous tPA in stroke with large artery occlusion is currently being debated. What is certain is the increased intracranial bleeding risk associated with tPA as well as other possible complications such as allergic reactions or femoral haematomas. We undertook a study to determine if IV tPA for stroke treatment is associated with increased complications or admission.

Methods: We prospectively studied a cohort of acute stroke patients treated with the Embotrap Revascularisation device from 2013 to 2016. We collected the time from femoral sheath removal to discharge (SRTD) time for all patients and analyzed factors that could be associated with prolonged times (defined as). Including age, gender, type of sheath, presence of IV tPA, heparin, IIIB/IIIA inhibitors or the presence of intra- or extracranial stents requiring immediate antiplatelet treatment.

Results: 168 consecutive acute stroke patients were included in this study. The mean SRTD time in the whole cohort was 83 hours 8 mins (SD 141 hrs 7 min). Only gender and the presence of IV tPA was significantly associated with prolonged SRTD times. On student-t test there was a significant difference in the SRTD for IV tPA (mean SRTD = 109 hrs 10 mins, SD = 183 hrs 23 min) and no IV tPA (mean SRTD = 65 hrs 58 mins, SD = 57 hrs 21 mins) conditions; t (164) = 2.159, p = 0.033. When we stratified the cohort into the different major discharge destinations, the difference in SRTD between the IV tPA population and the non-IV tPA population remained.

Conclusion: IV tPA is associated with prolonged admissions in our cohort of acute stroke patients. Future cost-benefit analysis studies comparing thrombectomy with and without IV tPA should take into account the additional admission cost.

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Factors for distal embolization during thrombectomy

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Purpose: Movement of the thrombus (MOT) or distal emboli to previously uninvolved vasculature is a feared complication during stroke thrombectomy. We looked at factors which are associated with distal embolisation in a cohort of patients who underwent thrombectomy with the same device.

Methods: We included all patients with acute ischemic stroke who underwent thrombectomy with the same stent-retriever for acute stroke from 2013 to 2016. MOT was defined as any displacement of the thrombus into a previously uninvolved portion of the cerebral vasculature or the presence of thrombotic material further downstream in the affected vessel which has occurred after the initial angiogram. We studied patients’ clinical and technical factors to determine their association with MOT.

Results: 168 consecutive acute stroke patients treated with the Embotrap device were included with a median NIHSS of 15 (range 0–30) and mean age of 66.4 (SD 13.4). 20 (11.9%) patients in our cohort experienced MOT. On univariate analysis, age, intravenous rTPA, posterior circulation occlusions,
and general anaesthesia were associated with MOT. On Multivariate analysis, only posterior circulation occlusions (OR 3.44 95%CI 1.02–11.58, P = 0.46) was significantly associated with MOT. MOT was not significantly associated with worse functional outcomes at 3 months, increased mortality or increased bleeding risk. This may be because many of these patients with MOT undergo further treatment in pursuit of TICI 2c-3 reperfusion in our institution.

Conclusions: Posterior circulation occlusions are significantly associated with distal emboli during thrombectomy, likely due to the lack of distal protection during such procedures. New techniques and devices to counter this should be developed.

P643
Recanalization rate after tissue plasminogen activator administration in patient with larger artery intracranial occlusion disease
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Purpose: Intravenous tissue plasminogen activator (IV-tPA) treatment is the first line and intraarterial thrombolysis (IA-Tx) with retrieval stent is optional treatment method for acute ischemic stroke patients. But recanalization rate of the larger artery occlusion disease (LAI COD) is questionable.

Methods and Methods: 212 patients with anterior circulation stroke patients were included in this analysis. Brain CT-angiography (CTA) was an initial imaging study and acute stroke MRI was immediately following the IV-tPA administration. Recanalization rate and clinical outcomes were analyzed according to the IV-tPA administration and additional IA-Tx.

Results: The overall recanalization rate of LAICOD after IV-tPA was 16.0% (34 patients), favorable outcome was 82.4%. Remaining 178 non-recanalized patients after IV-tPA, 118 were no more treated and 60 were treated additional IA-Tx. Recanalization rate of additional IA-Tx was 80.0% and favorable neurologic outcome was 56.7%, which was better than those patients who were not recanalized after IV-tPA (42.4%, p < 0.05). In additional IA-Tx patients, P/D-mismatching patients showed fewer hemorrhagic complications (p = 0.046) and a more favorable clinical outcome (p = 0.000) than P/D-matching patients.

Conclusion: On our study, initial image study was CT-angiography, and this dynamic imaging requires less than 5 minutes more than non-contrast CT and no additional risk for contrast media usage. From this study, recanalization rate after IV-tPA in acute stroke caused by large artery occlusion is very low. Author would like to propose that dynamic brain CT as initial image study and in a selected patient, IA-Tx might be applied as primary therapy option. Key Words: acute stroke, tissue plasminogen activator, intraarterial therapy, outcomes, recanalization rate, larger artery intracranial occlusive disease.

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Compare the hemorrhagic complication rate after intraarterial thrombolysis with stent retrievers weather tPA infusion or not
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Purpose: Intraarterial thrombolytic therapy (IA-Tx) with stent retriever is accepted as an additional treatment for selected patients. But hemorrhagic complication rate weather intravenous tissue plasminogen administration or not before the IA-Tx with Solitaire device, is not reported yet. Authors tried to find the clinical outcomes according to the IV-TPA before the IA-Tx and perfusion diffusion mismatching (P/D-mismatching).

Materials and Methods: Eighty-one treated IA-Tx with the Solitaire device, diagnosed as anterior circulation larger vessel occlusion were included in this study. CT-angiography was done as an initial diagnostic image and acute stroke MR imaging followed after the IV-tPA. 42 patients were in the tPA group and 39 patients were in the non-tPA group. Recanalization rate, clinically significant hemorrhagic (sICH) and clinical outcomes were recorded according to weather IV-tPA or not.

Results: Recanalization rate was 81.0% in IV-tPA group, and it was 69.2% in non-tPA group (p = 0.017). While sICH were 19.9% and 25.6% respectively (p = 0.328). Neurologic outcomes also did not influence by tPA infusion or not. But according to the P/D-mismatching or not, the recanalization rate and sICH were 91.9% and 16.7% in the mismatched group and 46.7% and 46.7% in the matched group (p = 0.008 & p = 0.019, respectively).

Conclusion: For patients treated with IA-Tx with stent retriever, weather IV-tPA influence or not did not influence on the sICH, recanalization rate and neurologic outcomes. While P/D-mismatching or not was correlated well with sICH, recanalization rate and clinical outcomes.

Keywords: cerebral perfusion pressure, decompressive craniectomy, intracranial pressure, outcome, mean arterial pressure.

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The changes of cerebral perfusion can be estimated only with arterial-spin-labelling MRI during carotid-artery stenting
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Arterial spin labelling (ASL) is a useful modality of cerebral-perfusion analysis, but no reports are available that ASL can be a modality during carotid-artery stenting (CAS).
We report the ASL analysis during CAS, comparing with SPECT. 52 consecutive cases performed CAS were registered. Some of the patients were excluded because of the incomplete study with any reasons. All of the registered cases were performed with ASL and IMP-SPECT. Age, sex, Powers’ stage, and the periprocedural changes of the cerebral perfusion status were analysed. On SPECT, periprocedural regional CBF (rCBF) ratio, which was compared with contralateral side, was calculated. On ASL, ASL perfusion was performed as continuous ASL with 3D FSE in 3T MRI. 20 cases were registered. The average was 75.9 years old (60–90), 18 cases were in male, and 2 were in female. All cases were uneventful during CAS. Powers’ stage were 1 in stage 0, 5 in stage I, and 1 in stage II. No cases were involved in hyperperfusion syndrome. The rCBF changes during CAS were +1.8% increase in stage 0, +2.6% in stage I, and +5.8% in stage II. The changes of ASL were +0.7% in stage 0, +1.7% in stage I, and +3.8% in stage II. It is very important revealing the cerebral perfusion status during CAS because the detection of the high-risk of hyperperfusion syndrome. However, it cannot be done because of the side effect of contrast medium or acetazolamide. ASL needs no tracers, but the metal artefact was the problem during CAS. 3D FSE enables minimizing the metal effect, which leads to the similar perfusion results compared with SPECT. In our small study, ASL perfusion can be a good candidate analysing the cerebral perfusion status during CAS, in spite of its metal artefacts.

STROKE - RESEARCH

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MRI quantitative T2* mapping on thrombus to predict recanalization after endovascular treatment for acute anterior ischemic stroke

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Background: In anterior acute ischemic stroke (AAIS) treated with endovascular treatment (EVT), the susceptibility vessel sign (SVS+ or SVS-) is related to recanalization results (TICI 2b/3) and clinical outcome. However, a binary qualitative assessment of thrombus using SVS does not reflect its complex composition. Our aim was to assess whether a quantitative MRI marker, Thrombus-T2* relaxation time, may be assessable in clinical routine and may to predict early successful recanalization after EVT, defined as a TICI 2b/3 recanalization obtained in 2 attempts or less.

Material and Methods: Thrombus-T2* relaxation time was prospectively obtained from consecutive AAIS patients treated by EVT (concomitant aspiration and stent retriever). Quantitative values were compared between early recanalization and late or unsuccessful recanalization. Results: Thirty patients with AAIS were included and Thrombus-T2* relaxation time was obtainable in all patients. Earlier TICI 2b/3 recanalization were obtained in 22 patients (73%) and was significantly associated with SVS+ (1/8 vs. 16/22, p = 0.01) and a shorter Thrombus-T2* relaxation time (mean ± SD, range: 25 ± 7, 18–50 ms vs. 45 ± 9, 35–60 ms, p < 0.001).

Conclusion: A new quantitative MRI biomarker, the Thrombus-T2* relaxation time is assessable in clinical routine. In a preliminary study of 30 patients, a shorter Thrombus-T2* relaxation time is related to earlier recanalization after EVT using combination of stent retriever and aspiration.

Abbreviations: AAIS = acute anterior ischemic stroke; EVT = endovascular treatment; SVS = susceptibility vessel sign; ICA = internal carotid artery; MCA = middle cerebral artery; Thrombus-T2* = mean T2* MRI relaxation time.

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Iron Toxicity on Advanced MRI in Intracranial Hemorrhage: A Translational Perspective

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Purpose: Intracranial Hemorrhage (ICH) is a devastating disease. No proven therapy improving patient outcome is established yet. Iron mediated neurotoxicity has been shown in the rat & porcine ICH models. We explore the role of detection of perihematomal tissue iron levels on MRI in ICH.

Materials & Methods: We designed an MRI phantom with different iron concentrations and scanned on a 3T MR magnet. The MRI sequence applied was 8 echoes with recorded T2* signal which was then inverted to create R2* maps. Then the R2* value was noted corresponding to various iron concentrations in the MRI phantom. A near linear relationship was obtained between the R2* values and the iron concentration. We then validated this phantom in the 7.4 T small bore animal MR magnet. We then applied the same MRI sequence to the rat ICH model. Then we applied the MRI R2* map creation in 3 human subjects and one control. The contralateral brain hemisphere was used as an internal control.

Results: A near linear relationship was demonstrated between the R2* value and the iron concentration.
Utilizing this method the MRI correctly derived the iron concentration in the periphery of the hematoma in the rat ICH model. The measurements in the human subjects with the same MRI sequence demonstrated iron concentration immediately in the periphery of the hematoma to have a peak of 150 – 200 µg/ml steadily decreasing to 10 – 20 µg/ml remote from the hematoma comparing well with the normal contralateral anatomically identical brain tissue.

**Conclusion:** There is robust animal ICH model correlation of tissue iron levels measured by MRI with tissue iron concentration measured on sacrifice of the animal. R2* Map created from susceptibility weighted MRI sequence can reliably predict the iron concentration in the periphery of the hematoma in an ICH patient. We have been awarded an R 21 grant from NIH to further study this concept to validate a reliable MRI algorithm to assess tissue iron concentration in ICH. Once validated through this grant in 20 patients over 2 years, advanced MRI R2* mapping can be applied to risk stratify ICH patients. Advanced MRI can be an objective surrogate in ICH patients to monitor tissue iron levels following an ICH.

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**Compare the prognostic effects between the intraarterial chemical thrombolysis and mechanical thrombectomy in large arterial occlusive disease**

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**Purpose:** Recent clinical trials concerned, intraarterial thrombolysis (IA-Tx) used retrieval stent (Solitaire or Trevo) in patients who are not recanalized after iv-tPA or not indication for iv-tPA, reported that IA-Tx is effective treatment modality. Authors tried to compare the clinical results between chemical and mechanical IA-Tx.

**Materials and Methods:** Data from 132 patients whom treated IA-Tx, anterior circulation with major vessel occlusion, were analyzed retrospectively. Treatment group were divided into a chemical thrombolysis group (n = 78: Urokinase, Reopro, etc) and mechanical thrombolysis group (n = 54: Solitaire or Trevo devices). And clinical data were analyzed according to the tPA used prior to IA-Tx and perfusion/diffusion mismatch (P/D-mismatching).

**Results:** Recanalization rate was 56.4% in chemical thrombolysis group and 85.2% in the mechanical thrombolysis group (χ2, p < 0.0000). Favorable outcome (modified Rankin Scales score of 0–2), mortality and significant intra-cerebral hemorrhage were similar in the two groups (χ2, p > 0.05). P/D-mismatching checked before the IA-Tx was significant good prognostic indicator for IA-Tx (χ2, p < 0.05).

**Conclusion:** In our study, mechanical thrombolysis shows better recanalization rate compared with chemical thrombolysis group. But clinical outcomes show no difference in both treatment groups. P/D-mismatching was constant significant prognostic indicator in our analysis. Proper combination of the advanced neuroradiologic evaluation and intraarterial treatment might improve the clinical outcomes of the major larger artery intracranial occlusion patients.

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**Optimizing Clinical Outcome Prediction Scores in Acute Ischemic Stroke after Intra-arterial Therapy using collateralization score on CT angiography**

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**Purpose:** to evaluate whether additional use of the collateralization score on CT angiography (CTA) combined with other several outcome prediction scores can increase accuracy of clinical outcome prediction in acute ischemic stroke.

**Materials and Methods:** This retrospective study enrolled patients who underwent pre-procedural CT angiography and stent-retriever thrombectomy for acute ischemic stroke of anterior circulation within 8 hrs. CTA was used to identify occlusion and grade the extent of collateralization vessel in the Sylvian fissure and leptomeningeal convexity. The CTA collateralization score (CTA-CS) classified: 0 = no collateralization filling, 1 = ≤ 50%, 2 = >50% but <100%, and 3 = 100% collateralization filling. We calculated three conventional outcome prediction scores (HIAT-2, SPAN-100, THRIVE) as an independent predictors of clinical outcome. Clinical outcome were assessed with modified Rankin scale (mRS) at discharge and mRS classified as good outcome (mRS 0 ~ 2) and poor outcome (mRS 3 ~ 6). Three prediction scores and these prediction scores with additionally applying CTA-CS were assessed for the predictability of clinical outcome using receiver–operator characteristics (ROC) curve analysis.

**Results:** 68 patients (M:F = 44:24; mean age, 68.5 years) enrolled in this study. Mean symptom to puncture time were 3.8 hrs. 53 cases were middle meningeal artery occlusion and 15 cases were internal carotid artery occlusion. Patients with good outcome were 29 patients (43%) and patients with poor outcome were (n = 39, 57%). The predictability was increased after the added value of CTA-CS over predictive scores than predictive scores alone. AUC value of three predictive scores (HIAT-2, SPAN-100 and THRIVE) alone and added value of CTA-CS over predictive scores were 0.7 vs. 0.73, 0.723 vs. 0.777, and 0.630 vs. 0.682, respectively.

**Conclusion:** the added value of The CTA-CS over conventional clinical outcome scoring system can improve
predictability of clinical outcome after intra-arterial thromboctomy for anterior circulation large artery occlusions, compared with conventional scoring system alone.

P650
Feasibility and Safety of cooling catheter system for combined selective brain hypothermia and thrombectomy in acute ischemic stroke: animal study in temporary MCA occlusion model

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Purpose: Therapeutic hypothermia (TH) represents a promising neuroprotective treatment in acute ischemic stroke. Selective cerebral hypothermia applied early prior and during endovascular mechanical recanalization therapy may be beneficial in the critical phase of reperfusion. Successful selective brain cooling using a new intra-carotid cooling catheter has been recently demonstrated in a sheep model. In this study, we assessed the feasibility and safety of selective TH using a novel cooling catheter system in an animal stroke model of temporary middle cerebral artery occlusion (MCAO) and recanalization.

Methods: 20 adult sheep were examined applying TH \( (n=10) \) and normothermia \( (n=10) \). MCAO was achieved by temporary neurosurgical clipping of MCA M1 segment (3–3.5 hrs. of ischemia). 20 min prior to clip removal, endovascular selective TH was initiated by cooling catheter placement in common carotid artery (CCA) and maintained for 3 hrs (maximum \( \Delta T \) was \( -4.0 \)°C to baseline temperature). In normothermia group, and 8F sheath was inserted into CCA. Systemic and nasal temperatures were monitored continuously, CCA blood flow was assessed on ultrasound and DSA. Infarct volume was quantified on MRI on day 2 and day 30. Functional clinical outcome was assessed daily (until day 30) on dedicated veterinary neurological scale (27 point score). Histopathological quantification of final infarct on brain specimen was performed at day 30. As safety endpoint, histopathological analysis of CCA specimen was performed (day 30; assessed for dissection and thrombi).

Results: The study was still ongoing at time of abstract submission (will be finished in July 2017). Results from pilot experiments with 2 sheep (MCAO with \( n=1 \) and without \( n=1 \) selective TH) showed marked reduction of MCA territory infarct (4.2 ml vs. 21.9 ml) and better neurological outcome (initial assessment at day 1: 7/27 vs. 22/27; final assessment 1/27 vs. 5/27) with MCAO and selective TH compared to normothermia. At the conference we will present a complete report of clinical outcome, infarct volumes on MRI and histopathology, and histopathological CCA safety analysis.

Conclusion: Combined endovascular selective mild hypothermia initiated prior and maintained during and early after recanalization ("cold reperfusion") appears safe and promising to reduce final infarct size and improve clinical outcome in a sheep model of acute ischemic stroke with temporary MCAO.

P651
The use of flow diverter stents in the management of dissecting pseudoaneurysms of cervical part of the internal carotid artery

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Purpose: Flow diverters are flexible self-expanding stents primarily designed for endovascular reconstruction of either fusiform or wide-necked saccular unruptured intra-cranial aneurysms. FDSs mesh in comparison to regular stents has a high metal-surface area coverage, which reduces diverter's mesh porosity and improves laminar flow in the main artery. Reduced porosity in contrary to a standard stent mesh serve as an effective barrier to clot protrusion and protect against distal embolization with a subsequent stroke. This opens new potential applications for these devices in the field of cerebrovascular disease.

Materials and Methods: Clinical data, pre and postoperative DSA, CT and MR images were collected and analyzed.

Results: Two patients (men) 28 and 47 years of age with 4 aneurysms treated with the SILK flow diverter device were included. Pseudo-aneurysm locations were the both right and left ICA. Good clinical outcome was observed in all patients and no new neurological deficits were observed. All pseudo-aneurysm, except one, had a single SILK flow diverter implantation. All patients had follow-up angiographic studies. One aneurysm showed a very small remnant at follow-up. There was no treatment-related complications.

Conclusions: The initial results proves that use of flow diverter stents in the management of dissecting pseudoaneurysms of cervical part of the internal carotid artery is safe and efficiency. This opens new applications for these devices in the field of stroke prevention.
P652

Mechanical Thrombectomy using the new Solitaire™ Platinum stent-retriever with better visibility – reperfusion results, complication rates and early neurological outcome

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Background and Purpose: The technical evolution of the Solitaire™ 2 stent-retriever to the Solitaire™ Platinum stent-retriever, especially the application of radiopaque markers for better visibility during thrombectomy, has the potential to alter the well-known characteristics of the device. It remains uncertain whether the adjustments influence efficacy or safety of the stent-retriever.

Methods: In this retrospective analysis of the stroke databases of a university hospital and a maximum care facility with 24 h / 7 d neurological and neuroradiological attendance we analyzed patients with acute ischemic stroke in the anterior circulation who received mechanical thrombectomy using a Solitaire™ Platinum stent-retriever between Oct 2016 and March 2017. Our investigation was focused on technical and angiographic parameters (time to reperfusion, number of thrombectomy maneuvers), reperfusion results (as per TICI = Thrombolysis In Cerebral Infarction), procedural complications and favorable early neurological recovery (i.e. NIHSS at discharge = 0 or ΔNIHSS ≥ 10).

Results: During the observation period 69 patients (n = 45 female (65.2%); age in years, mean (SD): 75 (13)) were treated using a Solitaire™ Platinum stent-retriever. Median National Institutes of Health Stroke Scale (NIHSS) on admission was 16 (interquartile range (IQR): 10–21). 38 patients (55.1%) received additional i.v. thrombolytics. Most of the patients had a mono-segmental intracranial large vessel (55.1%) received additional i.v. thrombolytics. Most of the patients had a mono-segmental intracranial large vessel occlusion (carotid-T: n = 11 (15.9%), M1: n = 39 (56.5%), M2: n = 14 (20.2%). 5 patients (7.2%) had a tandem lesion with a preceding occlusions of the internal carotid artery (ICA + carotid-T or M2: each n = 1 (1.4%), ICA + M1: n = 3 (4.3%)). Median symptom onset to groin puncture time in minutes was 235 (IQR: 179–365). Median stent-retriever-maneuver count was 2 (range: 1–5). The median time from groin puncture to final angiographic result was 55 minutes (IQR: 40–72). In 63 patients (91.3%) a reperfusion grade TICI 2b–3 was achieved. Early neurological improvement was seen in 32 patients (46.4%). Vasospasms were observed in 7 patients (10.1%) following a stent-retriever maneuver. 2 patients (2.9%) received prophylactic intra-arterial administration of a calcium channel blocker, but most often the vasospasms resolved spontaneously. Emboli into new territories were observed in 3 patients (4.3%) of which one (1.4%) occluded a rather proximal vessel and was subsequently removed without causing any sequelae.

Conclusions: In this retrospective, multicentre series the usage of the Solitaire™ Platinum stent-retriever for mechanical thrombectomy in acute ischemic stroke patients was highly effective and seemed not to be accompanied by an increased procedural complication rate.

P653

Influence of aging on appearance and change of DWI high signal area in revascularization therapy

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Purpose: In AHA guideline, less than 6 points ASPECTS score cases were not recommended undergoing revascularization therapy because its bad outcomes. However, we have experienced that even low ASPECTS score patients tend to get good outcomes in younger patients if it was same treatment time.

As a cause of this phenomenon, it seems that there is a possibility that the high signal appearance in DWI influenced by aging. In this study, we aimed to examine the effect of aging for appearance and change of DWI high signal area on acute revascularization surgery.

Method: From April 2010 to May 2017, among patients who had ICA MCA obstruction due to cardiogenic cerebral embolism, patients who reopened blood flow by revascularization surgery were enrolled.

Patients were classified into three groups of less than 1.5 hours, 1.5 hours to 3.0 hours, 3.0 hours and more, using the time from onset to MRI imaging (onset to MRI).

Furthermore, the vascular occlusion site was classified into five groups of ICA, M1 proximal, M1 intermediate, M1 distal, and M2 using MRI images before surgery.

We measured the volume of the DWI high signal area (DWI volume) at the time of visit, and examined the relationship with age in each group of classification by onset to MRI time and classification by occluded blood vessel site.

Similarly, we examined the change rate of the high signal area after revascularization surgery.

Result: In this study, 62 patients were enrolled. Age <6 points was 15 people, 5 out of these patients showed good outcome. Among good outcome cases, in the younger people also included cases requiring long time to complete the treatment, whereas in elderly people gained good outcome only when treatment was completed in a short time.

In ICA occlusion patients of onset to MRI time <1.5 h groups, As the age is younger, the initial DWI volume tends to increase. Age of DWI volume 50 ml and more cases was younger than less than 50 ml cases (mean(IQR): 81y.o(71–82) vs 83y.o(80–86)).

On the other hand, in these patients, the higher the age, the higher the DWI volume change rate tends to increase within one week. In patients over 80 years of old, the rate of change...
in DWI volume was higher than in patients under 80 years of old (3.71 vs. 1.37). The above tendency was observed in ICA-obstructed case group less than 1.5 hours’ onset, and no significant tendency was observed in other groups.

**Conclusion:** In ICA occlusion cases, MRI performed within 1.5 h from onset, in younger patients tend to revealed larger DWI volume. Whereas, in the elderly, even when the DWI image at the time of visit was small, there was a tendency that the high signal area expands after revascularization therapy. It seems that compared to the elderly, the young person is more likely to have a better outcome than the elderly even in low ASPECTS cases because the DWI image immediately after onset is largely depicted.

### P654

**The Role of Platelet Function Test on In-Stent Thrombus Formation after Carotid Artery Stenting**

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**Purpose:** Stent thrombosis is one of the complications associated with carotid artery stenting, but the mechanism is yet to be clarified. This study aimed to investigate the relationship between platelet function tests and in-stent thrombus formation after carotid artery stenting.

**Methods:** Patients who underwent carotid artery stenting were recruited prospectively. Combination antiplatelet therapy with aspirin 100 mg/day and clopidogrel 75 mg/day was given for a minimum of 7 days preoperatively. Platelet aggregation induced by adenosine diphosphate, collagen, and thrombin receptor-activating peptide was measured by light transmittance aggregometry, and aspirin reaction units, P2Y12 reaction units, and baseline was measured by VerifyNow assay.

**Results:** In-stent thrombus with maximum projection area of ≥1 mm² was detected by optical coherence tomography in 10 of 28 patients (35.7%). Patients with area of in-stent thrombus ≥1 mm² and those with area of in-stent thrombus <1 mm² were compared in terms of characteristics and results of platelet function tests. Baseline characteristics were no significantly different between the 2 groups, but platelet reactivity in the ≥1 mm² group was significantly higher than that in <1 mm² group after stimulation by collagen at 10 μg/ml (42.7 ± 23.1% vs. 63.3 ± 18.4%; p = 0.023) and 20 μg/ml (53.0 ± 24.0% vs. 73.9 ± 16.4%; p = 0.025). Platelet reactivity induced by the other agonists and that measured by VerifyNow assay were not significantly different between the 2 groups.

**Conclusions:** Collagen-induced platelet reactivity was related to in-stent thrombus formation after carotid artery stenting.

### P655

**Efficacy and safety of endovascular treatment in acute ischemic stroke from 2 years experience**

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**Background:** Mechanical thrombectomy in acute stroke was proved from recent positive randomized trials of endovascular therapy about safety and efficacy.

**Objective:** To evaluate the efficacy and safety of endovascular treatment in acute anterior circulation stroke patients from our experience in multicenter in Thailand.

**Method:** This retrospective and descriptive study was analyzed from data of patients from Prasat Neurological Institute and 5 private hospitals in Thailand, between June 2015 and April 2017.

**Results:** Forty acute stroke patients (male 57.1%, Female 42.9%) underwent mechanical thrombectomy with stent retriever (82.5%), aspiration thrombectomy (7.5%) and intra-arterial thrombolysis (5%). The mean age was 68 years old. The lesion of large vessel occlusion were as 31 MCA occlusion (77.5%), 7 tandem occlusion (17.5%) and 2 ICA occlusion (5%). The rt-PA given before sent to endovascular treatment was 25 patients (62.5%). The mean time from onset to groin puncture was about 264 minutes. The mean duration of procedure from groin puncture to recanalization time was 72 minutes. The mean number passes of stent retriever to successful recanalization was 2.8. The good angiographic TICI2b/3 was 30 patients (75%) and poor angiographic outcome (TICI < 2b) was 10 patients (25%). Fifty-two percent of patients was achieved a good functional outcome at 3 months (mRS ≤ 2) that better than MR CLEAN Trial. Six patients were performed craniectomy from reoclusion, non-recanalization, brain swelling and symptomatic ICH (sICH). One patient (2.5%) died from sICH. Two patients (5%) was reoclusion of MCA.

**Conclusions:** Endovascular treatment in acute stroke is safe and high rate recanalization but the clinical outcome depend on multifactors.
STROKE – STROKE CARE ORGANIZATION

P656
Changes in Treatment Results at a Tertiary City Hospital in Pittsburgh

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Purpose: Since 2005, the Comprehensive Stroke Center at Allegheny General Hospital (AGH) has been collecting data on patients who receive acute stroke therapy. Eligible patients can receive IV tPA or mechanical endovascular reperfusion (MER) therapy. The data collected from treated patients include demographic information, time goals, and outcome metrics. The analysis provides important insight into the patient population, the efficiency of therapy, and safety and clinical outcomes.

Materials and Methods: Baseline demographics of patients were collected including sex, age, transfer status, hypertension, atrial fibrillation, HLD(hyperlipidemia), smoking status, DM(diabetes), IV tPA at OSH(outside hospital), IV tPA at AGH, mechanical ventilation, NIHSS, LOS(length of stay), DTN(door to needle) for administration of IV tPA and Emergency Department arrival to skin puncture (goal < 60 minutes) for MER therapy patients are the two most important time goals.

Results: The national standard set by JC for door to needle time (IV tPA) and door to skin puncture (MER). The Joint Commission (JC) published goals for DTN and DTSP. Door to needle time (goal < 60 minutes) for administration of IV tPA and Emergency Department arrival to skin puncture (goal < 90 minutes) for MER therapy patients are the two most important time goals.

Conclusion: We present an analysis of baseline demographics, time goals, utilization of telemedicine, and outcome metrics. This view allows doctors and administrators to make decisions and changes that will lead to more efficient therapy and better patient care and outcomes. The continued maintenance and analysis of data will provide evidence to this effect and is crucial in measuring the success of the Allegheny General Hospital Stroke Program.

P657
Time Metrics Benchmark Analysis of Stroke Intervention between Academic versus Private Community Hospital

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Introduction: Endovascular intervention for large vessel occlusion is now the standard of acute stroke care. One main area of improvement is streamlining the methods of care by speeding up the patient management flow. Our practice provides NeuroInterventional care at a large academic center and a private community hospital. This gives us a unique opportunity to analyze differences between the two hospitals while keeping the same NeuroInterventionalists as a constant. We reviewed organizational differences as well as analyzed time metrics of the management flow in these local stroke care systems.

Methods: A retrospective review of prospectively collected data from January 1, 2015 to December 31, 2016 from UCLA and Long Beach Memorial (LBM) hospital was performed. Patient management workflow differences, imaging modality preferences as well as time metrics of door-to-image (DtI), image-to-angiosuite (ItA), angiosuite arrival-to-groin puncture (AtG) and overall door-to-groin puncture (DtG) were analyzed. Times between groups were compared with Pearson’s chi-squared tests using Stata software.

Results: We performed in total 109 cases at UCLA and 111 at LBM. The majority of UCLA cases were from direct ER admission 68%, transfers were 24% compared to LBM with equivalent direct ER admissions (46%) and transfers (44%), p = 0.004. A top-down stroke code activation at UCLA vs a linear progression of events at LBM provided similar overall DtG times with UCLA mean of 96 min vs LR 101 min (p = ns). The mean DtI time was 22 min at UCLA and 20 min at LBM (p < 0.001), UCLA ItA was 55 min and 63 min at LBM (p = 0.062), AtG was 22 min at UCLA and 20 min at LBM (p < 0.105). At UCLA 69 (65%) patients got MRI as initial imaging vs. 9 (8%) at LBM, p < 0.001. Each center had 55 cases under the Joint Commission of Health’s (JCOH) target <90 min with UCLA achieving this goal in 51% and LBM in 50% of cases. The Society of Neurointerventional Surgery’s (SNIS) recommendation of <60 min was achieved only in 14 cases at UCLA (12.8%) and in 20 LBM cases (18%, p = 0.29).
At UCLA 55% of the entire DtG time vs 63% at LBM is between start of imaging to angiosuite arrival.

**Conclusion:** Overall mean DtG times between an academic institution versus private community hospital over the past two years performed by the same Neuroradiologist service are equivalent with approximately 50% of cases meeting JCOH recommendations of <90 minutes. Despite of acute stroke CT based imaging at LBM the ITA interval is longer then at UCLA with MR imaging. At both institutions, the majority of the workflow time is spent in the interval between the start of imaging to angiosuite arrival. Further analysis of delays in these individual steps is being done to speed up the workflow.

**SYMPOSIUM FOR NURSES, TECHNICIANS, RADIOGRAPHERS**

**P658**

**Effectiveness of Workflow for Mechanical Thrombectomy in Siriraj Hospital: A comparison of Pre-Post Stroke Workflow Era**

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**Background and Purpose:** The recently clinical trials demonstrated efficacy and safety of endovascular treatment in patients with large vessel occlusion, particularly for anterior circulation. Achieving early reperfusion is the key to a favorable outcome, which reflected by onset to reperfusion time. On November 2015, The Siriraj Guideline for mechanical thrombectomy as stroke workflow (SW) was established, assigned roles and responsibilities of emergency physicians, neurologists, radiologists, neurointerventionists, and anesthesiologists. The patient selection for mechanical thrombectomy was protocolled by using CTA or CTP for anterior circulation, and MRI-core infarction for posterior circulation. The effectiveness of this workflow on periprocedural timings and outcome was assessed.

**Methods:** We retrospectively reviewed 137 acute ischemic stroke patients with large vessel occlusion (anterior and posterior circulation) who underwent endovascular treatment between 2011 and 2016. The following data were recorded: stroke onset to baseline imaging, stroke onset to interventionist consultation, baseline imaging to groin puncture, groin puncture to recanalization, and stroke onset to recanalization. The post-pre effectiveness of SW on periprocedural timing, recanalization, favorable outcome (90-day modified Rankin Score 0–2) and symptomatic intracranial hemorrhage were analyzed.

**Results:** Ninety-eight patients were treated before and 39 after guideline implementation. Time from onset to consultation (median 180 min pre and 129 min post, p = 0.044), groin puncture to recanalization (median 82 min pre and 51 min post, p = 0.004), and stroke onset to recanalization (median 334 min pre and 309 min post, p = 0.034) were significantly reduced. The nonsignificant trend toward shorter time of another periprocedural time intervals after SW introduction was observed: stroke onset to baseline imaging (median 167 min pre and 120 min post), baseline imaging to groin puncture (median 77 min pre and 66 min post). Data from 130 of patients (94%) were available for functional status at 3 months. Median mRS was significantly reduced from 4 to 2 after (p = 0.006) after SW. There was not only patients had significant better favorable outcome after introduction of SW (mRS = 0–2; 30.8% pre and 52.6% post, p = 0.019) but also lower severe disabling stroke or death (mRS = 5–6; 45.1% pre and 21.1% post, p = 0.010). A good recanalization (TICI 2b and 3) was strongly associated with good outcome (p = 0.001), however there was no difference after SW (71.4% versus 82.1%, p = 0.29). Symptomatic intracranial hemorrhage (sICH) (25.5% versus 5.1%, p = 0.007) did significantly differ between pre and post SW. sICH and good recanalization showed effect on favorable outcome at 3 months.

**Conclusion:** The stroke workflow improves outcome of stroke patients with endovascular treatment. Shorter periprocedural time, good recanalization, and lower sICH rate have positive effect on better outcome.

**P659**

**Skin dose to patient in Interventional Neuroradiology (2015–2016) Ramathibodi Hospital, Mahidol University**

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**Introduction:** Nowadays, Interventional Neuroradiology (INR) is more commonly used in the treatment of patients with brain and spinal cord vascular disease. However, each procedure usually takes a long time. Therefore, the amount of skin dose that the patient receives should be considered. The study found that the amount of skin dose to produce deterministic effect is 2000 mSv (2000 mGy), which can cause dermatitis, fatigue and temporary epilation. Therefore, the amount of skin dose that the patient receives is an interesting issue in further study.

**Method:** This study is a 2-year retrospective study (2015–2016) of 838 patients treated with INR by TOSHIBA Infinix-I Biplane x-ray unit with radiation dosimetry Air Kerma and Automatic DAP. (1Gy = 1/J/kg = 1SV)
The study found that the embolization for DAVF has the highest average imaging. The patient received a skin dose at an average of 2,351.33 mGy (2.4 Sv), which is very high when compared to other procedures. It also found that patients with high skin dose were patients who received embolization for BAVM and embolization for aneurysm. However, for the safety of patients from the dose, the level of radiation effects in various procedures must be considered. In general, the x-ray unit gives a dose of 0.02 Gy/min. Therefore, during the procedure, fluoro time can be reduced to control the skin dose to patients appropriately.

**Conclusion:** In our study, there are more DAVF patients come to receive treatment every year. Moreover, this is the disease which patients are most likely to receive high skin dose during treatment as compared to other diseases. Therefore, the INR team has created a protocol that can reduce patient skin dose during the procedure. By the way, if patients are still over-dosed from a long time procedure, INR team will consult and follow-up to get the patient satisfaction.

**P660**

Usefulness of 3D subtraction angiography to identify shunt location in complex dural arteriovenous shunts

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**Background:** Dural arteriovenous shunts (DAVSs) are complex lesions in which arteriovenous shunts exist between meningeal arteries and dural venous sinus or cortical vein. Catheter-based digital subtraction angiography (DSA) is currently the gold standard for assessment and treatment planning. Three-dimensional reconstruction DSA has already known as a useful imaging modality for assessing neurovascular anatomy and disease. We demonstrate combination of using novel technique of image reconstruction for 3D-DSA and multiplanar reconstruction (MPR) to identify the DAVSs location and pathological dural venous sinuses.

**Technique:** In our recent cases of DAVSs with complex venous pathology, the catheter-based 2D DSA, 3D DSA and MPR techniques were used to identify the shunt locations and demonstrate drainage pathways of diseases. Our biplane DSA machine has been GE Innova (GE Medical System, France). The MPR technique was obtained with Innovatile AW Workstation (GE Medical System, France). Rotational 3D angiogram was performed for each arterial feeder. The final reconstructed image was achieved from integrated color code of each sequence. Different colors of different arterial feeders provide more details for shunt evaluation, which is beneficial for planning of approach selection and embolisation materials.

**Conclusion:** Application of new image reconstruction technique, including 3D-DSA as well as advanced MPR images combines with conventional 2D in the routine work, have shown to be advantageous in identifying complex shunts anatomy, number and sites of arterial feeders. This subsequently resulted in more effective embolisation planning, rather than using 2D DSA alone.

**P661**

Evaluation of Cerebral Autoregulation by Application of Apnea Test in Patients with Symptomatic Carotid Stenosis before and after Carotid Andarterectomy

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**Purpose:** To use apnea test, as a noninvasive and safe neu- roultrasonographic method, provides useful information about vasomotor reactivity (VMR) in the indirect evaluation of cerebral autoregulation. The aim of this study was to investigate and analyze changes in carotid hemodynamics in patients with ischemic stroke (IS) or transient ischemic attack (TIA) and symptomatic carotid stenosis in the preoperative and three-month postoperative period as well as the assessment of revascularisation effect of carotid endarterectomy (CEA).

**Materiala and Methods:** The study included 60 hospitalized patients who experienced a first ischemic stroke or TIA in the vasularisation area of anterior cerebral artery (ACA) and middle cerebral artery (MCA), all with carotid stenosis >70% ACI. Patients were hospitalized at the Clinic of Neurology, Clinical Center of Vojvodina, Department of Cardiovascular Surgery, Institute of Cardiovascular Diseases and the Department of Vascular Surgery in Novi Sad. Considering clinical manifestations of stroke, the patients were divided into three groups: patients with TIA and amaurosis fugax, with partial infarction in area ACA or ACM and with lacunar infarct. We analyzed the impact of variable clinical and vascular risk factors on the incidence of ischemic stroke and TIA, but also on VMR, evaluated through Breath Holding Index (BHI) on the ipsilateral and contralateral side from carotid stenosis. We analysed the correlation between the degree of carotid stenosis with preoperative values of BHI, BHI correlation to the sever- ity of clinical findings, the impact of collateral circulation to the VMR, distribution of BHI in certain types of ischemic stroke and TIA as well as comparison of BHI in the pre and postoperative period of 30 and 90 days.
**Results:** The reduced VMR is characteristic of ipsilateral carotid stenosis in preoperative period as well as number of developed collateral characteristics of different types of ipsilateral ischemic stroke and TIA; there is a negative correlation between the degree of carotid stenosis and BHI values. The hypothesis that the greater pathways causes preservation of VMR was not confirmed, while the positive correlation between BHI values in the preoperative and postoperative period was established. Reduced VMR has a negative impact on the degree of clinical picture severity.

**Conclusion:** Recognizing the importance of TCD apnea test method that can be used as a complementary method to other vasoactive tests in monitoring of carotid hemodynamics, is of special importance to the neurologists and vascular surgeons. This would contribute to the further evaluation of mechanism of ischemic stroke, planning of therapeutic approach and determining the prognosis of treated patients.  

**Key words:** Carotid Stenosis; Transcranial Ultrasonography; Vasomotor reactivity; Carotid Endarterectomy
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General Information

CONGRESS VENUE: Pesti Vigadó (address: Vigadó tér 2, Budapest, 1051 Hungary)

CONGRESS LANGUAGE
English is the official language of the Congress

REGISTRATION AND INFORMATION DESK
The registration desk is located in the near vicinity of the Main Entrance, Ground Floor, Congress Centre - Pesti Vigadó.
The Registration Desk - where advanced and on-site registrants may pick up their congress material is operating in the following hours:

- Sunday, 15th October 2017 14:00 pm – 20:00 pm
- Monday, 16th October 2017 06:30 am – 19:00 pm
- Tuesday, 17th October 2017 07:00 am – 19:00 pm
- Wednesday, 18th October 2017 07:00 am – 19:00 pm
- Thursday, 19th October 2017 07:00 am – 16:00 pm

ACCREDITATION AND CERTIFICATE OF ATTENDANCE
“The 14th WFITN Congress has been accredited by the European Accreditation Council for Continuing Medical Education (EACCME®) with 27 European CME credits (ECMEC®’s). Each medical specialist should claim only those hours of credit that he/she actually spent in the educational activity.”

“Through an agreement between the Union Européenne des Médecins Spécialistes and the American Medical Association, physicians may convert EACCME® credits to an equivalent number of AMA PRA Category 1 Credits™. Information on the process to convert EACCME® credit to AMA credit can be found at www.ama-assn.org/go/internationalcme.

“Live educational activities, occurring outside of Canada, recognised by the UEMS-EACCME® for ECMEC®’s are deemed to be Accredited Group Learning Activities (Section 1) as defined by the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada.”

WFITN MEMBERSHIP
The Information Desk of WFITN’s Secretariat will be available throughout the Congress to provide information about WFITN, membership, new applications, INR Journal, payment of membership fee (etc.) during the congress.

SPEAKER READY ROOM
The speaker ready room is located on the 1st level next to Session room 1. All presentations must be uploaded at least two hours before their session. Audiovisual technicians will be at your service to assist with uploading your presentation. Please note that presentation using personal laptops will not be allowed during the sessions!

Operating hours:

- Monday, 16th October 2017 06:30 am – 19:00 pm
- Tuesday, 17th October 2017 07:00 am – 19:00 pm
- Wednesday, 18th October 2017 07:00 am – 19:00 pm
- Thursday, 19th October 2017 07:00 am – 16:00 pm

PLEASE NOTE: in compliance with CME requirements all speakers are requested to include a slide disclosing conflicts of interest at the beginning of their presentation.

For detailed information about instructions for Speakers please visit the website page: http://www.wfitn2017.hu/scientific-program/presentation-information/

POSTER EXHIBITION
E-poster boards are located on the 2nd level in the foyer between Session room 2 and 3. You will be able to consult all the cases selected by the Scientific Committee for poster on the large E-poster displays with touch screen.

CONFERENCE BADGE
Participants will receive a badge upon arrival at the registration desk. Since your personal badge is your entrance ticket to the sessions and exhibition area, please make sure that you wear your badge at all times during all congress activities.
EXHIBITION

The Exhibition is located on the entrance floor.

Opening Hours:

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EXHIBITION MAP

1. BALT
2. STRYKER
3. MEDTRONIC
4. CODMAN-NEURAVI
5. PHENOX
6. PENUMBRA
7. RAPID MEDICAL
8. ACANDIS
9. SIEMENS
10. COOK MEDICAL
11. KANEKA PHARMA
12. BRAINOMIX
13. MICROVENTION
14. WFITN Secretariat
Venue Map

11. Platina and Gold Sponsors’ hands on workshop rooms
10. Session room 4
9. Session room 3
8. Session room 2
7. Session room 1
6. Plenary room
5. Exhibition
4. Cafeteria
3. Cloakroom
2. Main entrance & Registration
1. Board room

1. Entrance level
2. Main entrance & Registration
3. Cloakroom
4. Cafeteria
5. Exhibition
6. Plenary room
7. Session room 1
8. Session room 2
9. Session room 3
10. Session room 4
11. Platina and Gold Sponsors’ hands on workshop rooms

4th level
3rd level
2nd level
1st level
Entrance level

Venue Map
ACKNOWLEDGEMENTS

The Organizing Committee of the 14th Congress of the World Federation of Interventional Neuroradiology is grateful for the endorsement of the Associations and support of Sponsors and Exhibitors.

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KANEKA PHARMA EUROPE N.V.

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Healthineers

COOK
MEDICAL

Brainomix