대한뇌혈관내수술학회
SKEN
Society of Korean Endovascular Neurosurgeons

2015년도 대한뇌혈관내수술학회 정기학술대회 및 총회

Changes from the *"Cure"* to the *"Care"* in Neurointerventional Surgery Era

일 시 | 2015년 12월 5일 토요일

장 소 | 그랜드 하얏트 인천호텔 그랜드볼룸

주 최 | 대한뇌혈관내수술학회

주 관 | 대한신경외과학연구재단

모시는 글

존경하는 대한뇌혈관내수술학회 회원 여러분, 그간 안녕하셨는지요?

최근 뇌혈관질환 치료 패러다임은 환자는 물론이고 회원 여러분들께 변화를 가져오고 있습니다. 특히 뇌혈관내수술 술기의 발전은 뇌졸중 환자 치료를 넘어 무증상 환자의 예방적 수술로 그 영역을 확장시켜 왔습니다. 이에 발 맞추어 뇌혈관내수술의 궁극적인 임무 또한 환자를 "치료" 한다는 개념에서 수술 전후로부터 평생에 걸쳐 포괄적으로 "관리" 하는 개념으로 변화되어야만 할 것입니다. 따라서 치료합병증을 줄이는 것은 물론이고 환자뿐만 아니라 가족들에 대해 더욱 세심한 관심과 배려를 기울여야 하는 시대에 이르렀습니다.

지난 2013년부터 적용되었던 뇌혈관내수술 인증의제도는 치료결과의 향상을 도모했을 뿐만 아니라 국내 뇌혈관내수술의 현주소를 파악하는데 기여를 하고 있습니다. 최근 2년간 뇌혈관내수술학회 인증의 대상으로 조사된 뇌혈관조영술과 뇌혈관내수술 통계를 살펴보면 급성기 뇌졸중의 혈전제거술, 파열뇌동맥류 코일색전술 그리고 뇌동정맥기형 색전술 등에서 많은 증가 추세를 보이고 있습니다. 이는 최근 발표되는 논문에서 새로운 기구의 치료성적이 근거의학적으로 입증된 후, 각 기관에서 이를 준용한 치료 경험과 영역이 확대되었기 때문으로 사료됩니다. 그러나 새로운 기구의 적용이 자칫하면 좋지 않은 치료결과를 초래 할 수 있다는 점 또한 항상 주지하여 선택에 신중을 기해야 할 것입니다.

금번 학회에서는 한일 양국 젊은 의사들간의 학문적 모임을 마련했습니다. 참석한 일본 뇌혈관내수술학회 회원들 모두 우수한 인재들로 인정받고 있습니다. 우리 젊은 회원들께서 이들과 학문적인 교류와 더불어 문화적 그리고 인간적 교감까지 나누신다면, 향후 진정한 학문적 동반자로서 함께 발전할 수 있는 기회가 될 것입니다.

끝으로, 저는 지난 2년간 회장직을 수행했음을 자랑스럽게 생각합니다. 그러나 여력이 부족하여 여러 회원님들을 만족 시켜드리지 못한 점 송구스럽습니다. 향후 회원님들의 관심과 노력으로 더욱 발전된 학회가 될 것을 믿어 의심치 아니하며, 여러분 모두의 건강과 건승을 기원하겠습니다.

2015년 12월

대한뇌혈관내수술학회 회장 **김 범 태**

2014~2015년 대한뇌혈관내수술학회 임원

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2014~2015년 대한뇌혈관내수술학회 임원

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	손영제	서울대학교 보라매병원
	강동훈	경북대학교병원
	정영진	영남대학교의료원
간사	신동성	순천향대학교 부천병원
학회 사무국	정효경	대한뇌혈관내수술학회

프로그램

08:30~08:45 Registration

08:45~09:00 Opening remarks — **Bum-Tae Kim** (President of SKEN)

Congratulatory address — **Young Jin Lim** (President of The Korean Neurosurgical Society)

09:00-10:30 **Free paper I. Aneurysm**

Chairs : **Do Hoon Kwon** (Ulsan university), **Tae Sun Kim** (Chonnam National University)

09:00-09:10 Thrombus remnant despite intra-arterial thrombolysis for thrombus formation during endovascular treatment of ruptured cerebral aneurysms: is it safe? _17
Hyo Sub Jun (Hallym University Sacred Heart Hospital)

09:10-09:20 Is coil embolization of cerebral aneurysm really safe procedure? _18
Jae-sang Oh (Soonchunhyang university Cheonan Hospital)

09:20-09:30 Fate of coiled aneurysms with minor recanalization at 6 months: rate of progression to further recanalization and related risk factors _19
Young Dae Cho (Seoul National University Hospital)

09:30-09:40 Coil embolization of remnant or recurred aneurysm after surgical treatment and prognosis of the aneurysm _20
Sung Tae Kim (Busan Paik Hospital)

09:40-09:50 The effect of fetal type posterior communicating artery in compaction of endovascular coil embolization _21
Jaewoo Chung (Hanyang University Medical Center)

09:50-10:00 Coil embolization followed by stereotactic aspiration for intracerebral hematomas associated with the ruptured cerebral aneurysm _22
Tae Gon Kim (CHA Bundang Medical Center)

10:00-10:10 Combination of Multicatheter Plus Stent or Balloon for Treatment of Complex Aneurysms _23
Hongjun Jeon (Hallym University Kangdong Sacred Heart Hospital)

10:10-10:20 Aneurysm coil embolization assisted by very-asymmetrically deployed stents; techniques and results _24
Hyon-Jo Kwon (Chungnam National University Hospital)

10:20-10:30 Semi-jailing technique with a Neuroform3 stent for coiling of wide-necked intracranial aneurysms _25
Jun Kyeung Ko (Pusan National University Hospital)

10:30-10:50 ***Coffee break & Poster view***

10:50-11:10 **Presidential address**

Chairs : **Ho Kook Lee** (Hallym University)

Changes from the "*Cure*" to the "*Care*" in Neurointerventional Surgery Era

Bum-Tae Kim (President of SKEN)

일 시 | 2015년 12월 5일 토요일
장 소 | 그랜드 하얏트 인천호텔 그랜드볼룸

11:10-12:10 **Free paper II. Ischemia**

Chairs : **Yong Sam Shin** (Catholic University), **Hee In Kang** (Eulji University)

11:10-11:20 Clinical availability of perfusion-related parameters derived from perfusion CT in acute ischemic stroke — **Dong Seong Shin** (Soonchunhyang University Bucheon Hospital) _31

11:20-11:30 Endovascular treatment of acute ischemic stroke with extracranial cervical carotid artery occlusion — **Hee Sup Shin** (Kyung Hee University Hospital at Gangdong) _32

11:30-11:40 Stent-based recanalization after failed first-line mechanical thrombectomy for Hyperacute Ischemic Stroke — **Ji Hyun Shin** (Bundang Jesaeng Hospital) _33

11:40-11:50 Treatment results of in-hospital acute ischemic stroke with endovascular method: single center experience — **Hee Sup Shin** (Kyung Hee University Hospital at Gangdong) _34

11:50-12:00 A Protocol-based decision for choosing a proper surgical treatment option for carotid artery stenosis — **Joonho Chung** (Gangnam Severance Hospital) _35

12:00-12:10 Angioplasty Balloon Size and Clinical Outcome of Carotid Stenting without Post-stenting Balloon Dilatation — **Kang Min Kim** (Kangwon National University Hospital) _36

12:10-13:10 **Luncheon seminar**

Chairs : **Min Woo Baik** (New Korea Hospital), **Hyeong-Joong Yi** (Hanyang University)

"Endovascular treatment of direct CCF"

1) Anatomical consideration — **Joonho Chung** (Gangnam Severance Hospital) _39

2) Transarterial coil embolization — **Dae Won Kim** (Wonkwang University Hospital) _40

3) Covered stent graft — **Hyun-Seung Kang** (Seoul National University Hospital) _46

13:10-13:30 **General assembly** — **Jae Hoon Sung** (Secretary)

13:30-15:00 **Free paper III. Others**

Chairs : **Hyeon-Song Koh** (Chungnam National University), **Oki Kwon** (Seoul National University)

13:30-13:40 Onyx Embolization for Isolated Dural Arteriovenous Fistula Using a Dual-lumen Balloon Catheter — **Byung Moon Kim** (Severance Hospital) _51

13:40-13:50 Endovascular treatment of bilateral cavernous sinus dural arteriovenous fistula: single center experience with 8 patients — **Jong Kook Rhim** (Seoul National University Hospital) _52

13:50-14:00 Transvenous microguidewire looping technique for breach of ipsilateral inferior petrosal sinus occlusions en route to cavernous sinus dural arteriovenous fistulas — **Young Dae Cho** (Seoul National University Hospital) _53

14:00-14:10 Direct superior ophthalmic vein access for dural arteriovenous fistula embolization — **Jong Min Choi** (Kyung Hee University School of Medicine) _54

14:10-14:20 Safety of Preprocedural Antiplatelet medication in Coil embolization of SAH — **Jung Hyun Park** (Hallym University Dongtan Sacred Heart Hospital) _55

프로그램

14:20-14:30	Long-term outcomes after endovascular treatment of vertebrobasilar junction aneurysms associated with fenestration **Kyu-Sun Choi** (Asan Medical Center)	_56
14:30-14:40	Isolated posterior inferior cerebellar artery dissection **Sung Ho Lee** (Kyung Hee University School of Medicine)	_57
14:40-14:50	Association of engorged perforating artery of basilar top with Non-aneurysmal Perimesencephalic Subarachnoid Hemorrhage **Byung Hoo Moon** (Catholic University Incheon St. Mary's Hospital)	_58
14:50-15:00	Endovascular Coil Embolization of Intracranial Aneurysms in Octogenarian Patients **Seong-Rim Kim** (Catholic University Bucheon St. Mary's Hospital)	_59
15:00-15:20	***Coffee break & Poster view***	
15:20-17:20	**Korean Japanese Scientific Endovascular Conference** Chairs : **Seok-Mann Yoon** (Soonchunhyang University), **Jun Seok Koh** (Kyung Hee University)	
15:20-15:33	Dual catheter technique for intracranial aneurysm **Naoto Kimura** (Iwate prefectural central hospital)	_63
15:33-15:43	Optimal P2Y12 Reaction Units Criterion for High on-Treatment Platelet Reactivity in Coil Embolization for Unruptured Intracranial Aneurysm: a Prospective Validation Study **Chang Hyeun Kim** (Seoul National University Bundang Hospital)	_64
15:43-15:56	Initial experience of enterprise 2 for aneurysmal coil embolization **Keisuke Sato** (Niigata University)	_65
15:56-16:06	Clinical implications of crossover (clip and then coil or vice versa) treatment in cerebral aneurysm **Jae Hoon Sung** (Catholic University St Vincent's Hospital)	_66
16:06-16:19	Usefulness of the metal artifact reduction algorithm on the cone-beam CT images of cerebral aneurysms treated by coil embolization using intracranial stent **Masafumi Hiramatsu** (Okayama University Graduate School of Medicine)	_67
16:19-16:29	Chronological histopathologic healing response following treatment with flow diverter in the canine side-wall aneurysm model **Jong Young Lee** (Hallym University Kangdong Sacred Heart Hospital)	_68
16:29-16:42	Intracranial hemorrhagic complication after acute thrombectomy: the effect of tortuosity of the target vessels **Manabu Shirakawa** (Hyogo Medical University)	_69
16:42-16:52	Result of Stent-Angioplasty with Wingspan Stent for Symptomatic Intracranial Stenosis **Seung-Hoon You** (Gangneung Asan Hospital)	_70
16:52-17:05	Safety and Time Course of Drip-and-ship **Hideyuki Ishihara** (Yamaguchi University)	_71
17:20-17:25	Closing remarks **Bum-Tae Kim** (President of SKEN)	
17:25-18:00	Poster Chairs : **Seok-Mann Yoon** (Soonchunhyang University)	
18:00	***Official dinner*** Academic award ceremony	

일 시 | 2015년 12월 5일 토요일
장 소 | 그랜드 하얏트 인천호텔 그랜드볼룸

Poster session Chairs : **Seok-Mann Yoon** (Soonchunhyang University)

Invited speakers

Curriculum Vitae

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1994-2000	Medical Education in Akita University
2000-2003	Regident in Iwate prefecture Hospital
2003-	Belong to department of Neurosurgery, Tohoku university
2009-2013	Belong to Department of Neurosurgery, National Hospital Organization, Sendai Medical Center
2010	Graduate school of Tohoku University (Ph.D)
2013-	Belong to Department of Neurosurgery, Iwate Prefectural Central Hospital

≫ Certification

Japanese board of Neurosurgery, 2008
Japanese board of Neuroendovascular, 2009
Japanese board of Stroke, 2009

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Residency: 2009-2011, Niigata City General Hospital, Niigata, Japan
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≫ Medical licensure

Medical license (Japan) # ----

≫ Board certification

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≫ Present position

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≫ Professional and society memberships

2011 The Japan Neurosurgical Society
2011 The Japanese Society for Neuroendovascular Therapy

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Okayama University Medical School (premedical and medical) from April 1999 to March 2005.

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≫ Professional Training and Employment

Resident at Kishiwada Tokushukai Hospital from April 2005 to March 2008
Resident of Neurological Surgery at Okayama University Hospital from April 2008 to March 2009
Resident of Neurological Surgery at Kagawa Rosai Hospital from April 2009 to Spetember 2011
Research Fellow in the Laboratory of Neurological Surgery at Okayama University Medical School from October 2011
Attending staff of Neurological Surgery at Okayama University Hospital from October 2014 to October 2015
Assistant professor of Neurological Surgery at Okayama University Hospital from November 2015

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1999 M.D., Hyogo College of Medicine
1993 Graduated from High School

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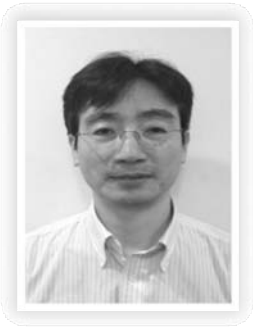
2005-preresent Assistant Professor, Department of Neurosurgery, Hyogo College of Medicine
2005 Clinical Fellow, Department of Neurosurgery, Hyogo College of Medicine
2004-2005 Clinical Fellow, Department of Neurosurgery, Yuaikai Hospital
2002-2004 Clinical Fellow, Department of Neurosurgery, Ishikiriseiki Hospital
2001-2002 Clinical Fellow, Department of Neurosurgery, Shimizu Hospital
1999-2001 Resident, Department of Neurosurgery, Hyogo College of Medicine
1999 Passed the Examination of National Board

≫ Society

The Japan Neurosurgical Society
The Japanese Society for Neuroendovascular Therapy
The Japan Stroke Society
Japanese Society of Neuroendoscopy
Japanese Headache Society

Hideyuki Ishihara



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1996 Postgraduate Course
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≫ Professional Training and Employment

2010-present Lecturer, Department of Neurosurgery Yamaguchi University School of Medicine
2006-2009 Assistant Professor, Department of Neurosurgery Yamaguchi University School of Medicine
2005-2006 Guest doctor, Neuroradiology University Hospital of Geneva
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2002-2004 Assistant Professor, Department of Neurosurgery Yamaguchi University School of Medicine
2001-2002 Staff Neurosurgeon, Department of Neurosurgery Yamaguchi University School of Medicine
1999-2001 Postdoctoral fellow, Department of Neurosurgery Zurichi University Hospital
1998-1999 Staff Neurosurgeon, Department of Neurosurgery Yamaguchi University School of Medicine
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≫ Certification and Licensure

April 1992 Physician's License of Japan
August 1998 Japanese Board of Neurological Surgery

Free paper I. Aneurysm

Chairs: **Do Hoon Kwon** (Ulsan university)
Tae Sun Kim (Chonnam National University)

Thrombus remnant despite intra-arterial thrombolysis for thrombus formation during endovascular treatment of ruptured cerebral aneurysms: is it safe?

Hyo Sub Jun, M.D., Jun Hyong Ahn, M.D., Ji Hee Kim, M.D., Jae Keun Oh, M.D.,
Joon Ho Song, M.D., Ph.D., In Bok Chang, M.D., Ph.D.
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Objective: Thromboembolism is one of the major concerns during endovascular treatment of ruptured intracranial aneurysms. The fate and safety of thrombus remnant despite intra-arterial thrombolysis for unexpected thrombus formation has rarely been reported.

Methods: From January 2010 to May 2015, a total of 131 consecutive patients with ruptured intracranial aneurysms were treated by endovascular methods at our institution. Among them, we identified 9 patients harboring 9 aneurysms who suffered from thrombus remnant despite intra-arterial thrombolysis during endovascular coiling of ruptured intracranial aneurysms. We reviewed the clinical and radiologic outcomes of patients with thrombus remnant as well as intraoperative and postoperative management of thrombus formation.

Results: Thrombus formation occurred near the coiled aneurysm in 8 patients, and distal embolic occlusion was observed in 1 patient. All patients were managed by intra-arterial thrombolysis with tirofiban. Two patients with distal migration of thrombi and 1 patient with persistent embolic occlusion after intra-arterial thrombolysis were additionally treated with stent retriever. One patient with occlusion of parent artery near the coiled aneurysm despite intra-arterial thrombolysis was partially recanalized by permanent deployment of stent retriever. Delayed cerebral angiography showed no increase in size of thrombus remnant without flow stagnation in all patients. After the procedure, thrombus remnant was managed by intravenous infusion of tirofiban. Follow-up CT angiography on the first postoperative day showed stable patency of the involved artery, and thromboembolic events did not occur in all patients. One patient suffered from hemorrhagic complication.

Conclusions: If the patency of parent artery is maintained and the size of thrombus remnant does not increase on delayed angiography after intra-arterial thrombolysis, postoperative thromboembolic events rarely occur.

Keywords: Intracranial ruptured aneurysm, Endovascular treatment, Thromboembolism, Intra-arterial thrombolysis

Is coil embolization of cerebral aneurysm really safe procedure?

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Objective: Coil embolization is recently regarded as a safe and effective treatment for unruptured and ruptured intracranial aneurysm with low rates of procedure-related complications. However, rebleeding or thromboembolic event during the procedure and post-procedure early rebleeding still remains the major concerns of coil embolization for especially young neurosurgeon.

Methods: Between July 2007 and November 2015, 472 aneurysms (UIA 194; SAH 278) were treated using the simple, balloon-assisted, stent-assisted, and multiple microcatheter techniques at our institution. Sixty five (13%) complications were identified from the prospectively collected database. They are categorized as four types: bleeding or aneurysm perforation, thromboembolism, recanalized thromboembolic events, and post-procedure early rebleeding.

Results: The overall incidence of all complications in SAH group was higher than in UIA group (19% vs 6.2%) and the incidence of bleeding as well as thromboembolic events during embolization were higher in SAH group than in UIA group (Bleeding 10% vs 3.6%, thromboembolism 4.3% vs 1.5%). Stent-assisted coil and simple coil embolization were most common method for UIA (78%), and balloon-assisted and simple coil were most common method in SAH (74%). In SAH patients who performed on balloon-assisted coil, there were no mortality and better outcome than non-balloon patients when the intraprocedural rupture or aneurysm perforation occurred. (mean GOS in BAC vs non-BAC : 5 vs 3). Thromboembolic events were not related with the use of balloon or stent during procedure. Post-procedure early rebleeding occurred in 5 SAH patients and 4 of 5 were related with the use of thrombolytic agents during postoperative period and poor outcome.

Conclusions: Balloon-assisted coil embolization became the useful rescue therapy on intraprocedural rupture in both UIA and SAH. Young neurosurgeon should keep in mind the two points: First, balloon-assisted coil embolization could be a safe and feasible options on rupture aneurysm. Second, we should always consider the use of thrombolytic agents carefully on facing the thromboembolic events.

Keywords: intraprocedure rupture, thromboembolism

Fate of coiled aneurysms with minor recanalization at 6 months: rate of progression to further recanalization and related risk factors

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Objective: To monitor coiled aneurysms displaying minor recanalization in imaging studies at 6 months, gauging major recanalization rate and related risk factors through extended follow-up.

Methods: A total of 65 aneurysms (in 65 patients) showing minor recanalization in follow-up imaging at 6 months, were reviewed retrospectively. Medical records and radiologic data accruing during extended monitoring (mean, 24.8±8.2 months) were assessed. Univariate and multivariate analyses were conducted to identify risk factors for progression from minor to major recanalization.

Results: Progression to major recanalization was observed in 24 (36.9%) of the initially qualifying aneurysms during a follow-up period of 112.5 aneurysm-years, for an annual rate of 17.84% per aneurysm-year. Progression was determined chronologically as follows: 14 (58.3%) at 6 months; 8 (33.3%) at 18 months; and 2 (8.4%) at 30 months. Stent deployment significantly decreased the occurrence of major recanalization (OR=0.22; p=0.03), whereas antiplatelet therapy (OR=0.82; p=0.75), posterior location (OR=0.24; p=0.20), and second coiling for recanalized aneurysms (OR=0.96; p=0.96) were unrelated.

Conclusions: Our analysis determined a 36.9% rate of major recanalization during follow-up of 112.5 aneurysm-years in coiled aneurysms showing minor recanalization at 6 months. Stent deployment alone conferred a protective effect, preventing further recanalization without additional treatment. Given the fair probability of late major recanalization, aneurysms showing minor recanalization at 6 months should be monitored diligently, particularly in the absence of stenting.

Keywords: aneurysm, coil, embolization, recanalization, follow up

Coil embolization of remnant or recurred aneurysm after surgical treatment and prognosis of the aneurysm

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Objective: The aim of this study was to review the cases of coil embolization for remnant or recurred aneurysm after surgical treatment in our institute.

Methods: Between May 1999 and November 2014, 1645 cases of coil embolization were performed in two centers. 38 consecutive patients (8 men and 30 women; mean age, 58.3 years) with 38 remnant or recurred aneurysms after surgical treatment underwent coil embolization. Clinical presentation, coiling technique, angiographic and clinical outcome, and prognostic factors were evaluated retrospectively.

Results: 27 aneurysms initially presented with subarachnoid haemorrhage (SAH). The others were unruptured aneurysms. During the coil embolization, 11 aneurysms were symptomatic lesion. The most common location was P-com aneurysm (13 cases, 34.2%). The median interval between surgical treatment and coil embolization was 76.7 months.Immediate post-embolization angiography revealed 18 cases of complete occlusion. Procedure related event was occurred in 3 cases. After coiling, the mean clinical follow-up period was 41.5 months. Good clinical outcome(mRS <3) was checked in 28 cases (74%). Whenever before or after coiling, rupture of aneurysm were statistically related to clinical outcome. Follow-up angiography was possible in 27 patients. major recanalization was detected in 6 cases (22.2%) which had tendency of regrowth. Among them, 5 cases were retreated. Rebleeding event was occurred in 2 patients.

Conclusions: Coil embolization for remnant or recurred aneurysm after clipping seems to be an effective retreatment option. For better results, it requires to pay attention to the image follow-up after endovascular coiling.

Keywords: aneurysm, coiling

The effect of fetal type posterior communicating artery in compaction of endovascular coil embolization

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Objective: The fetal type posterior cerebral artery (fPCA) is a common variant of cerebral circulation. And it can be categorized by two types by relationship with posterior circulation of circle of Willis, which is complete fetal PCA (cfPCA) and partial fetal PCA (pfPCA). As the blood flow via posterior circulation effects the blood flow of PcoA/PCA, the hemodynamics around the PcoA aneurysm can be altered.

Methods: From January 2006 to May 2015, 343 patients underwent aneurysmal coil embolization at our hospital (Hanyang University Medical Center, Department of Neurosurgery). Among those 343 patients, 32 patients were PcoA Aneurysm. From these 32 patients, 18 patients matched the inclusion criteria, which is radiological follow up more than 3 months without PcoA anomaly other than fPCA. Each patient's medical records were reviewed and morphologic parameters from cerebral angiograph were obtained.

Results: Among 18 patients, 9 patients had normal PcoA and 9 patients had fPCA (7 cfPCA, 2 pfPCA). From the blood flow via PcoA/PCA by cerebral angiograph result we regard 11 patients (normal PCA and pfPCA) as low flow group, which posterior circulation altered the blood flow via PcoA/PCA. And 7 patients as high flow group (pfPCA) which there is no communication with posterior circulation. Surprisingly 4 patients among high flow group had compaction of coil embolization, however none had such phenomenon in low flow group. (P=0.011) There were no statistical significance between two groups in medical history and morphologic parameters except the diameter of PCA. (p=0.015) As a result the altered blood flow from posterior circulation might influence the hemodynamics around the PcoA aneurysm, which low flow condition acts like side wall aneurysm, while high flow condition acts as bifurcation aneurysm.

Conclusions: Although there is a limitation that it is done in small group of population, this result could be a shift of perspective view of PcoA aneurysm by considering the posterior circulation. If the patient is confirmed as cfPCA during cerebral angiography or endovascular coil embolization, we can consider as relatively high risk patient for coil compaction, so frequent follow up for coil compaction could be suggested. Further study with large population and computerized hemodynamic study could be considered.

Keywords: Coil compaction, fetal type posterior communicating artery, fetal type posterior cerebral artery

Coil embolization followed by stereotactic aspiration for intracerebral hematomas associated with the ruptured cerebral aneurysm

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Objective: The intracerebral hematomas associated with the ruptured cerebral aneurysms has been known to be one of the poor prognostic factors. There still are controversies about the optimal management for the lesions. We report our experiences that the poor grade patients with the intracerebral hematomas associated with the ruptured cerebral aneurysms have been managed by coil embolization followed by stereotactic aspiration.

Methods: The retrospective analysis was performed in 113 patients with ruptured cerebral aneurysms who have been managed at our institution from Jan. 2013 to Dec. 2014. Of these 113 patients, intracerebral hematomas were associated with the ruptured cerebral aneurysm in 36 patients (31%). The intracerebral hematoma associated with the middle cerebral artery aneurysm occurred most frequently (15 cases; 41.6%) and then with the anterior communicating artery aneurysm (13 cases; 36.1%) and internal carotid artery-posterior communicating artery aneurysm (5 cases; 13.8%).

Results: Among these 36 patients, 16 patients have been managed endovascular coiling (15 patients) or surgical clipping (1 patient) followed by conservative manner and 11 patients by surgical clipping and hematoma evacuation simultaneously. In 9 patients, endovascular coil embolization followed by stereotactic aspiration were performed. The admission World Federation of neurosurgical Societies grades were IV or V in all 9 patients (100%) and the five patients (55.5%) recovered well with GOS scales of 1 or 2. There was no mortality cases.

Conclusions: Coil embolization followed by stereotactic aspiration of hematomas are a less invasive technique and might be an good alternative management for the poor grade patients with the intracerebral hematomas associated with the ruptured cerebral aneurysms.

Keywords: Endovascular coil embolization, Ruptured cerebral aneurysm, Intracerebral hematoma, Stereotactic aspiration

Combination of Multicatheter Plus Stent or Balloon for Treatment of Complex Aneurysms

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Objective: Coiling of complex aneurysms is still difficult even with current adjuvant techniques. This study sought to evaluate the safety and effectiveness of a combination of multicatheter plus stent or balloon for the treatment of complex aneurysms.

Methods: All complex aneurysms that underwent coiling with the combination technique were identified from prospectively maintained neurointerventional data bases. "Complex aneurysm" was defined as a wide-neck aneurysm with branch incorporation into or a deep lobulation of the sac. The clinical and angiographic outcomes were retrospectively analyzed.

Results: Sixty-two complex aneurysms (12 ruptured, 50 unruptured) in 62 patients (mean age, 57 years; male/ female ratio, 12:50) were treated with a combination technique by using a multicatheter plus stent (n 42, 3 ruptured) or balloon (n 20, 9 ruptured). Treatment related morbidity (grade 3 hemiparesis) occurred in 1 patient (1.6%). Except for 1 patient who had treatment-related morbidity, none of the other patients with unruptured aneurysms developed new neurologic symptoms at discharge. Nine of the 12 patients with ruptured aneurysms had good outcomes (Glasgow Outcome Score, 4 or 5) at the latest follow-up (mean, 32 months; range, 6-72 months), and 1patient died from an initial SAH. Posttreatment control angiograms revealed complete occlusion in 27, neck remnant in 34, and incomplete occlusion in 1 aneurysm. At least 1 follow-up catheter or MR angiogram was available in 80.6% (n 50) (mean, 21 months; range, 6-65 months). There were 4 minor and 3 major recurrences (14.0%).

Conclusions: In this case series, the combination technique by using multicatheter plus stent or balloon seemed safe and effective for the treatment of complex aneurysms.

Keywords: Endovascular, Complex, Aneurysm.

Aneurysm coil embolization assisted by very-asymmetrically deployed stents; techniques and results

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Objective: During the stent-assisted coil embolization for the cerebral aneurysm, it is advocated to deploy the stent symmetrically and keep at least a 4-mm margin between the ends of the stent and aneurysm neck for good anchoring and stability of the stent. We conducted this study to evaluate the angiographic and clinical results of patients treated with very-asymmetrically-deployed stent-assisted coiling.

Methods: A retrospective review of all patients treated with very asymmetrically deployed stent-assisted coiling between April 2006 and November 2015 was done. Among the 329 aneurysms treated with stent-assisted coiling, 44 aneurysms were embolized with very-asymmetrically-deployed stent assistance by the operators intention. Seven of the aneurysms were ruptured. The technical success of the procedure, procedure related complications, and the angiographic results were documented.

Results: In 42 of 44 aneurysms, initial stent deployment across the neck of the aneurysm was successful. Coiling was performed successfully in all of the 42 aneurysms. Procedure-related mortality did not occur. Adverse events occurred in two patients (4.5%); one case of branch occlusion and one case of intra-operative rupture. No permanent neurologic deficit resulted. Immediate posttreatment angiography showed complete occlusion (48%), neck remnant (40%), or dome filling (12%).

Conclusions: Very asymmetrical deployment of stent for coiling assistance can be one of the option of stent-deployment for the suitable cases.

Keywords: Cerebral Aneurysm, Stent-assisted Coil embolization

Semi-jailing technique using a Neuroform3 stent for coiling of wide-necked intracranial aneurysms

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Objective: 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 the SJT using a Neuroform3 stent for coiling of wide-necked intracranial aneurysms.

Methods: By collecting clinical and radiological data we evaluated from January 2009 to through December 2014, wide-necked aneurysms were 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. Aneurysm size 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 had excellent clinical outcomes (mRS 0), except two (mRS 1 or 2), and seven of 14 patients with subarachnoid hemorrhage remained symptom free (mRS 0).

Conclusions: In this report on 70 aneurysms, SJT using a Neuroform3 stent for coiling of wide-necked intracranial aneurysms showed a good technical safety and favorable clinical and angiographic outcome.

Keywords: Intracranial aneurysm, Coils, Embolization, Stent.

Memo

Presidential address

Changes from the "*Cure*" to the "*Care*" in Neurointerventional Surgery Era

Bum-Tae Kim (President of SKEN)

Chairs: **Ho Kook Lee** (Hallym University)

Free paper II. Ischemia

Chairs: Yong Sam Shin (Catholic University)
Hee In Kang (Eulji University)

Clinical availability of perfusion-related parameters derived from perfusion CT in acute ischemic stroke

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Introduction: CT perfusion imaging yields a set of perfusion related parameters which might be useful to describe the hemodynamic status of the ischemic brain. Several cerebral perfusion parameters have been used for the characterization of ischemic brain area. Recently, their role as fundamental factors of the cerebral hemodynamic status has been stressed by calculating threshold values. We analyzed whether the potential of predicting the tissue outcome could be increased by using a functional perfusion parameters.

Methods: In 15 patients with acute hemispheric ischemic stroke <6 hours after onset, perfusion CT was used to calculate relative cerebral blood flow (rCBF) and relative cerebral blood volume (rCBV) values area of ischemic cortical and subcortical gray matter. The efficiency of parameters to predict tissue outcome was analyzed, according to the findings on endovascular thrombectomy images and follow-up MRI diffusion images.

Results: Initially, perfusion CT was obtained with calculating rCBF and rCBV in all patients. According to picture archiving communication system (PACS) server program, calcuating rCBF and rCBV were converted to "penumbra map" on PACS immediately. After endovascular thrombectomy, MRI diffusion image was obtained within 24 hours. Internal carotid artery occlusion case was 3, middle cerebral artery occlusion was 11 and anterior cerebral artery occlusion was 1. Recanalization failed in 4 cases. Others were obtained recanalization over TICI grade 2a. Ischemic core of penumbra map remained to same location in follow up MRI diffusion images and Penumbra area of penumbra map correlated with recanalization success cases. However, penumbra area changed infarction in cases of recanalization failure or disappear in cases of successful recanalization.

Conclusions: Perfusion CT related parameters derived from perfusion CT may provide valuable information to predict tissue outcome

Endovascular treatment of acute ischemic stroke with extracranial cervical carotid artery occlusion

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Objective: Due to the large clot burden and underlying stenosis, the endovascular treatment for acute ischemic stroke caused by extracranial cervical carotid artery occlusion is highly challenging procedure and requires multiple treatment materials. We report our experiences of treating acute occlusion of cervical carotid artery.

Methods: Between January 2013 and October 2015, we reviewed the cases of acute ischemic stroke treated with endovascular manner. This study enrolled eight patients with cervical carotid artery occlusion.

Results: Four patients who were administered rt-PA intravenously showed transient improvement of neurologic signs during few hours, but endovascular treatment was required due to aggravated symptoms. Five patients had underlying stenosis on proximal cervical internal carotid artery (ICA) and balloon angioplasty with/without stenting was performed in all these patients. Three patients who had atrial fibrillation were treated using multiple endovascular modalities, such as aspiration through balloon tipped guiding catheter, Penumbra aspiration catheter, and stent retrieval method. Although recanalization results were not bad (6 patients showed TICI 2b or 3), 6 patients had poor clinical outcome with ≥ mRS 3.

Conclusions: Good recanalization results were achieved using multimodal endovascular manners in treating acute ischemic stroke caused by extracranial cervical carotid artery occlusion. More enthusiastic and advancing tries were needed for improvement of clinical outcome.

Keywords: acute ischemic stroke, extracranial carotid artery, endovascular

Stent-based recanalization after failed first-line mechanical thrombectomy for Hyperacute Ischemic Stroke

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Bundang Jesaeng Hospital

Objective: To evaluate clinical and radiologic outcomes of stent-based recanalization in hyperacute ischemic stroke.

Methods: From January 2011 through September 2015, A retrospective study was performed in 27 patients who had hyperacute ischemic stroke and were treated by Stent-based recanalization after failed first-line mechanical thrombectomy. We studied radiologic appearance, clinical presentation and follow up outcomes.

Results: Of the 27 patients, 11 patients (40%) showed radiologic and clinical improvement, 5 patients (18%) showed clinical improvement with instent stenosis, 6 patients (22%) had complication with hemorrhagic transformation and 4 patients (14%) failed recanalization or severe stenosis. Number of final solitaire stent were 13 cases (48%) and Enterprise stent in 12 cases (43%). 6 patients (22%) were TICI grade III, 10 patients (37%) were TICI grade IIb, 4 patients (14%) were TICI grade IIa, and 4 patients (14%) were TICI grade I. After 3 month, 15 patients (55%) were below mRS 3 and after 6 month, 18 patients (67%) were below mRS 3.

Conclusions: These results indicate that Stent –based recanalization treatment in acute ischemic stroke can be effective technique in failed mechanical thrombectomy. Further studies are needed to evaluate long-term clinical outcomes and instent stenosis.

Keywords: Hyperacute Ischemic Stroke, Mechanical thrombectomy, Stent-based recanalization

Treatment results of in-hospital acute ischemic stroke with endovascular method: single center experience

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Objective: Because acute ischemic stroke (AIS) is well-known situation that require prompt treatment such as intravenous thrombolysis (IVT) and endovascular treatment (EVT), many hospitals have proper system to manage the patients with AIS at emergency room. However, paradoxically, there are some concerns of unintended delay in treating AIS patients who were in-hospital stay.

Methods: Between June 2012 and October 2015, we reviewed the cases of acute ischemic stroke treated with EVT. There were 9 patients who suffered from AIS during their hospitalization.

Results: Five patients were hospitalized at stroke-related departments - neurology and neurosurgery, and four were at non-stroke-related departments – surgery, orthopedic surgery, pulmonology, and oncology. All 9 patients had clear on-set time and detected immediately to medical staffs. The proper management was started in all patients of neurology and neurosurgery within 2 hours (40-115 minutes). However, in two patients who admitted at non-stroke-related departments, there were significant delays to notify to stroke on-call team (125 minutes and 240 minutes).

Conclusions: Awareness for AIS, proper education for medical staffs, and realignment of system are mandatory for preventing unintended delay in treating in-hospital AIS patients.

Keywords: acute ischemic stroke, in-hospital, endovascular.

A Protocol-based decision for choosing a proper surgical treatment option for carotid artery stenosis

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Objective: There are two established surgical treatment options for carotid artery stenosis. Carotid endarterectomy (CEA) has been accepted as a gold standard for surgical treatment while carotid artery stenting (CAS) has become an alternative option recently. Each treatment option has advantage and disadvantage for the treatment outcomes. We propose a protocol to choose a proper surgical treatment option for carotid artery stenosis

Methods: One hundred ninety-two published articles on management of carotid artery stenosis were reviewed. We selected preoperatively considerable factors which had been repeatedly noted in those articles for the risk/benefits of CEA or CAS. According to those factors, a protocol with four categories was established.

Results: CEA or CAS is indicated when the patient has a symptomatic stenosis $\geq$ 50%, or when the patient has an asymptomatic stenosis $\geq$ 80%. Each treatment option has absolute indications and favorable indications. Each absolute indication is scored with three points, and each favorable indication, one point. Based on the highest scores, a proper treatment option (CEA or CAS) is selected.

Conclusions: We have been treating the patients according to this protocol and evaluating the outcomes of our protocol-based decision because this protocol might be helpful to assess risk/benefit for choosing a proper surgical treatment option in patients with carotid artery stenosis.

Keywords: Carotid artery stenosis, Carotid artery stenting, Carotid endarterectomy, Protocol

Angioplasty Balloon Size and Clinical Outcome of Carotid Stenting without Post-stenting Balloon Dilatation

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Objective: The protocol of carotid angioplasty with stenting (CAS) procedure varies between endovascular neurosurgeons. CAS without post-stenting balloon dilatation has been introduced to reduce the complication rate related post-stenting balloon dilatation. We performed a single-institution retrospective study to evaluate the radiological and clinical outcome of CAS without post-stenting balloon dilatation and the effects of the angioplasty balloon size.

Methods: One hundred-five CAS procedures were performed in 100 patients diagnosed as atherosclerotic carotid stenosis from August 2008 to November 2015. The mean age was 71.3 years and the male to female ratio were 90 to 15. Seventy-seven cases (73.3%) were symptomatic and mean degree of stenosis was 79.5% by the NASCET criteria. Mean follow-up duration was 35 months. All cases were categorized into two groups. In the 'oversize' group, the ratio of angioplasty balloon size to the diameter of the normal distal ICA was $\geq$ 1 and it was < 1 in the 'undersize' group. Follow-up imaging, which was available in 97 patients, was performed with CT angiography (n=93) or carotid Doppler ultrasound (n=4). Stenosis $\geq$ 50% and progression of stenosis $\geq$20% confirmed by conventional angiography was considered as in-stent restenosis (ISR).

Results: There was no statistical difference between the two groups in terms of age (p=0.80), gender (p=0.10), rate of symptomatic cases (p=1.00), atherosclerotic risk factors (diabetes mellitus p=0.85, hypertension p=0.18, dyslipidemia p=1.00, smoking p=0.84) and degree of stenosis prior to CAS (p=0.40). The mean ratio of balloon size to the ICA diameter was 1.17 ± 0.16 in the oversize group and 0.85 ± 0.09 in the undersize group. Only 3 patients underwent post-stenting balloon dilatation due to significant residual stenosis. Mean degree of residual stenosis after CAS was 19.2% in the oversize group and 31.3% in the undersize group (p=0.00). The 30-day stoke rate was 6.1% in the oversize group and 7.1% in the undersize group (p=0.84). The estimated rate of stoke at 2 years after CAS was 8.6% in the oversize group and 14.5% in the undersize group (p=0.33, hazard ratio=1.74). The estimated rate of ISR at 2 years after CAS was 2.9% in the oversize group and 22.1% in the undersize group (p=0.02, hazard ratio=7.37). In Cox-regression analysis, using undersize balloon appeared to be a risk factor of ISR with a marginal statistical significance (p=0.09, hazard ratio=6.33)

Conclusions: CAS without post-stenting balloon dilatation using undersize balloon seems to have a high risk of ISR and it can result in ischemic stroke.

Keywords: Carotid stenting, Balloon.

Luncheon seminar

Chairs: **Min Woo Baik** (New Korea Hospital),
Hyeong-Joong Yi (Hanyang University)

"Endovascular treatment of direct CCF"

1) Anatomical Consideration

Joonho Chung (Gangnam Severance Hospital)

2) Transarterial coil embolization

Dae Won Kim (Wonkwang University Hospital)

3) Covered stent graft

Hyun-Seung Kang (Seoul National University Hospital)

Endovascular Treatment of Direct CCF Anatomical Consideration

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Department of Neurosurgery, Gangnam Severance Hospital, Yonsei University

The carotid-cavernous fistula (CCF) refers to an abnormal communication between the internal carotid artery (ICA) or one of its branches or the external carotid artery (ECA) and the cavernous sinus (CS). From a practical, etiopathogenetic, clinical, and therapeutic point of view, the simplest and most useful classification divides CCFs into direct and indirect. According to angioarchitecture, a direct communication between the ICA and the CS is classified as direct CCF. An overview of the general, arterial, and venous anatomy of the CS as well as the ICA anatomy and its branches are important for the understanding of direct CCF and its treatment.

Endovascular treatment of direct CCF -Transarterial coil embolization-

Dae Won Kim
Wonkwang University Hospital

Introduction

- **Carotid-cavernous fistula (CCF)** are spontaneous or acquired connections between the carotid artery and the cavernous sinus and can be classified as direct or indirect.
- **Direct CCF** may occur as a result of trauma, a ruptured cavernous ICA aneurysm, dissection, or surgical trauma.
- **Indirect CCF** are usually supplied by dural branches of the ECA but can be supplied by dural branches of the ICA.

Introduction

- **Classification of CCF**

◇ Types according to Barrow et al.

A. Intracavernous ICA to cavernous sinus
B. Dural ICA branches to cavernous sinus
C. Dural ECA branches to cavernous sinus
D. Dural ICA and ECA branches to cavernous sinus

◇ Types according to structual situation and etiology

1. Traumatic direct fistula
2. Rupture of preexisting cavernous aneurysm
3. Dural CCF supplied by ECA and ICA
4. A combination of a direct and indirect fistula

Introduction

- Endovascular therapy is treatment of choice for both traumatic and spontaneous fistula.
- Until a recent date, detachable balloons were widely used in endovascular embolization of CCF. Gradually, however, detachable balloons are not available commercially.
- Therefore, detachable coils are used as next treatment options for embolization of the fistula.
- The advantage of the coils is that they can be positioned and deployed inside the cavernous sinus.
- Recently we used GDC coils to obliterate 5 CCF.

Materials and methods

- Patients *(Table 1)*
- Eleven patients with CCF treated by GDC coils
- M:F = 5:6 (mean age, 58.6 years)
- Sx: chemosis (*n=8*), audible bruit (*n=8*), proptosis (*n=7*), headache (*n=5*), ptosis/diplopia (*n=1*)
- Seven had history of head trauma.
- Four had no history of any trauma.
- One had fistula associated with persistent primitive trigeminal artery.

Materials and methods

- Endovascular treatment was carried out with patients under general or local anesthesia.
- All patients underwent complete cerebral angiography. These acquisitions were used for analysis of the morphology of CCF and for measurement of CCF to determine the appropriate coil size.
- The fistula was at the C5 segment in 6 and at C4 in 3 and at C4/5 in 2.
- Transarterial approach was carried out in 9 and combined transarterial and transvenous approach in 2.

Table 1. Summary of cases treated with detachable coils

Case No	Major Symptoms	Sex/Age	Cause	Access Route	Treatment
1	Headache Audible bruit Proptosis Chemosis	M/60y	Trauma	ICA	GDC
2	Diplopia/ptosis Chemosis Audible bruit	F/24y	Trauma	ICA	GDC
3	Proptosis Chemosis Audible bruit	M/56y	Trauma	ICA	GDC
4	Headache Chemosis	F/36y	Spontaneous	ICA	GDC
5*	Proptosis Audible bruit Headache	F/40y	Spontaneous	ICA +IPS	GDC

ICA: Internal carotid artery, IPS: Inferior petrosal sinus
** : Associated with persistent primitive trigeminal artery*

Case No	Major Symptoms	Sex/Age	Cause	Access Route	Treatment
6	Auditory bruit Chemosis	M/65	Trauma	ICA	GDC
7	Chemosis Proptosis	M/72	Spontaneous	ICA	GDC
8	Headache Proptosis Auditory bruit	F/69	Trauma	ICA	GDC
9	Chemosis Auditory bruit	F/76	Spontaneous	ICA	GDC
10	Proptosis Chemosis	F/72	Trauma	ICA	GDC
11	Headache Auditory bruit Proptosis	M/75	Trauma	ICA	GDC

Case No	Complications	Angiographic result	Outcome	Clinical folllow-up *(months)*
1	None	Complete CCF occlusion	No symptoms	37
2	None	Incomplete CCF occlusion (Immediately)	No symptoms	18
3	None	Complete CCF occlusion	No symptoms	15
4	None	Complete CCF occlusion	No symptoms	11
5	None	Complete CCF occlusion	Slight III palsy	6

Case No	Complications	Angiographic result	Outcome	Clinical folllow-up *(months)*
6	None	Complete CCF occlusion	No symptoms	20
7	None	Complete CCF occlusion	No symptoms	12
8	None	Complete CCF occlusion	No symptoms	35
9	None	Complete CCF occlusion	No symptoms	8
10	None	Complete CCF occlusion	No symptoms	10
11	None	Complete CCF occlusion	No symptoms	14

Results

- The fistula was occluded successfully in all cases.
- One had small residual fistula immediately, but patient's symptoms resolved completely on 1 month clinical follow-up.
- Bruit, proptosis, and chemosis recovered completely soon after fistula occlusion, but 3rd nerve palsy failed to improve adequately in 1 patient.
- No thromboembolic or hemorrhgic complication.
- No recurrence of fistulas or neurologic deterioration was observed during clinical f/u periods 6-37 months.

Illustrated Cases

Case 1. A 60y-old male with head trauma
(Total 10 GDC coils, 143 cm in length)

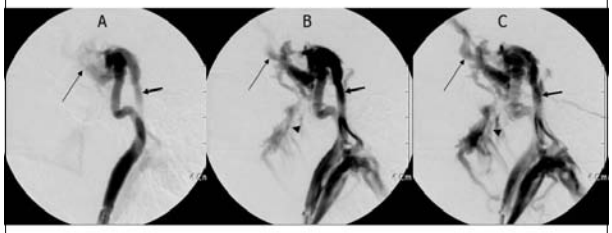


Fig. 1A-C. Right ICA angiograms show type A CCF with no flow of intradural segment of ICA. Note prominent venous drainage into inferior petrosal sinus *(short arrows),* pterygoid plexus *(arrowheads),* and superior ophthalmic vein *(thin arrows).*

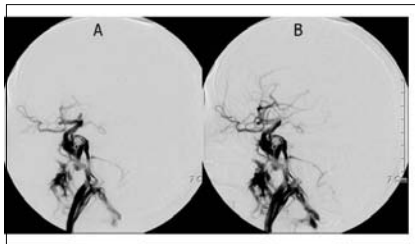


Fig. 2A, B. Subtotal occlusion of CCF is seen after detachment of 4 GDC coils. Note partial intracranial blood flow.

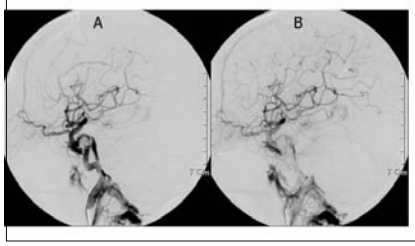


Fig. 3A, B. After placement of additional 2 coils, a moderate residual fistula remains.

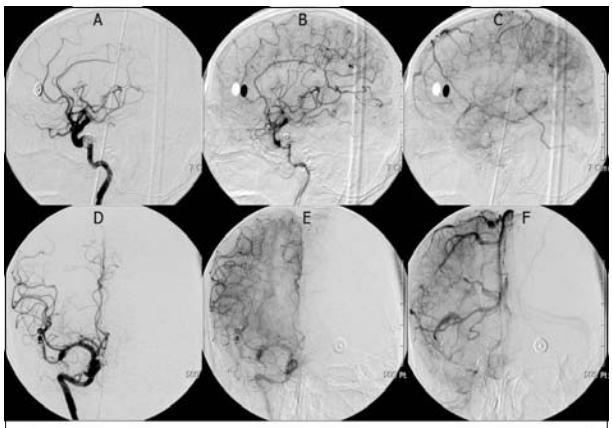


Fig. 4A-F. Complete obliteration of the fistula after additional 4 GDC coils is noted.

Case 2. A 24y-old female with head trauma
(Total 6 GDC coils, 105 cm in length)

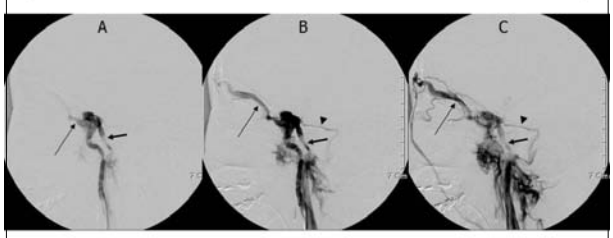


Fig. 5A-C. Right ICA angiograms show type A CCF with no flow of intradural segment of ICA. Note prominent venous drainage into superior ophthalmic vein*(thin arrows),* inferior *(arrows),* and superior petrosal sinus*(arrowheads).*

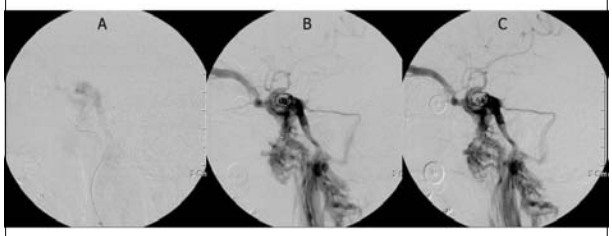


Fig. 6A-C. A microcatheter is inserted into the fistula (A). Note partial flow into intradural ICA and MCA after placement of 2 and 4 GDC coils (B, C. respectively).

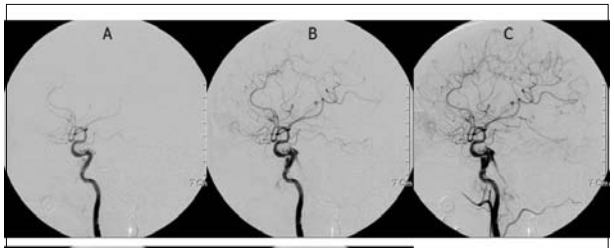


Fig. 7A-E. After placement of additional 2 coils, almost normal intracranial blood flow is seen. Small residual fistula is noted. However, the patient's symptoms are disappeared on 1 month clinical F/U.

Case 3. A 56y-old male with head trauma
(Total 3 GDC coils, 48 cm in length)

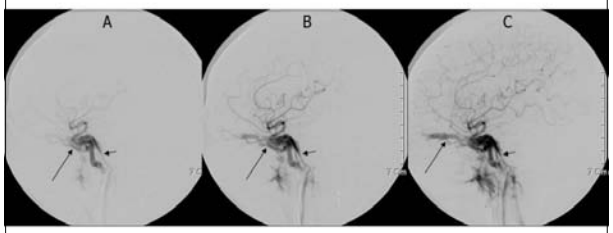


Fig. 8A-C. Right ICA angiograms show type A CCF. Note major venous drainage into IPS *(small arrows)* and superior ophthalmic vein *(long arrows)*.

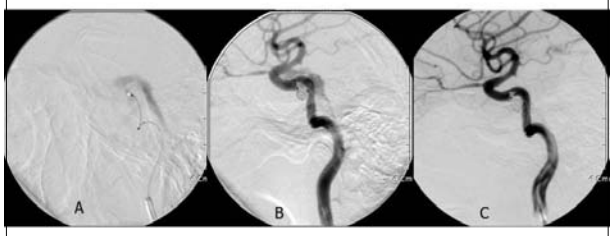


Fig. 9A-C. A microcatheter is inserted into the fistula via C5 segment of ICA (A). Small residual fistula is remained after detachment of 2 coils (B). Note complete obliteration of the fistula after placement of additional 1 GDC coil (C).

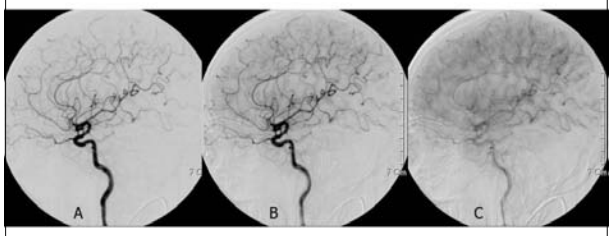
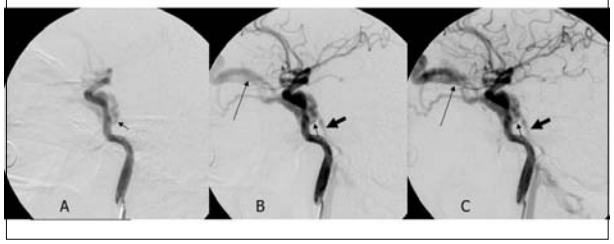


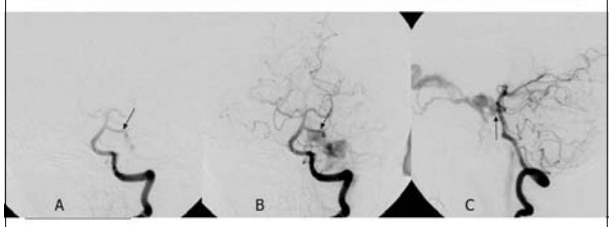
Fig. 10A-C. A follow-up angiograms 5 weeks later shows complete occlusion of the fistula.

Case 5. A 40y-old female without head trauma
(Total 12 GDC coils, 211 cm in length)

- A left carotid angiograms (Fig. 11A-C) demonstrate an abnormal artery *(arrows)* arising from C5 segment and having a fistulous connection with the left cavernous sinus.
- The venous drainage of the fistula is through superior ophthalmic vein *(long arrows)* and inferior petrosal sinus *(thick arrows)*.

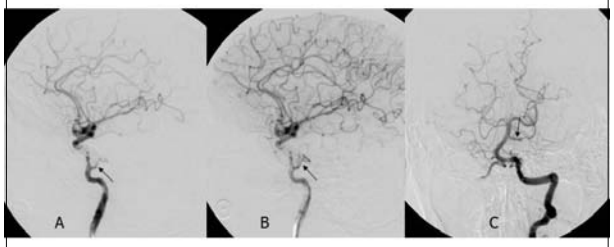


- A left vertebral arteriograms (Fig. 12A-C) depict an abnormal artery *(arrows)* that arises from upper basilar artery, passed laterally and then anteriorly, and finally connected to the fistula.



- These angiographic findings serve to confirm **persistent primitive trigeminal artery (PPTA) - cavernous sinus fistula.**

- Post-embolization left carotid (Fig. 13A, B) and vertebral (C) angiograms show complete occlusion of the fistula and preservation of the ICA and PPTA *(arrows)*.



Discussion

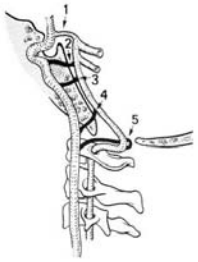
- The goal of treatment of CCF is to eliminate fistulas and maintain the patency of the ICA.
- Transarterial balloon embolization was the treatment of first choice of CCF. However, detachable balloons are not available commercially in now.

Discussion

- In recent studies, the usefulness of transarterial coil embolization for CCF was reported.
- Advantages of using detachable coils are the ability to control their placement and to easily retrieve, reposition, or exchange them, if necessary. It is also technically easier to guide a microcatheter/microwire combination through a small fistula.

Persistent Primitive Trigeminal Artery-Cavernous Sinus Fistula

- Primitive embryonic anastomotic vessels between the anterior and posterior circulation systems occasionally persist into adult life (Fig. 14).



1. Posterior communicating artery
2. Primitive trigeminal artery
3. Otic artery
4. Hypoglossal artery
5. Proatlantal intersegmental artery

- Adapted from Osborn -

- The most commonly found vessel is the persistent primitive trigeminal artery (PPTA) followed by the hypoglossal and proatlantal intersegmental arteries. The primitive otic artery is the rarest of the four anomalous vessels.
- These vessels are usually large and are associated with hypoplasia or aplasia of the normal intracranial anastomotic channels.

Pathogenesis

PPTA-Cavernous Sinus Fistula

- All cases of CCF associated with PPTA were caused by the rupture of identifiable or unidentifiable aneurysms of the PPTA.
- In our case, an aneurysm was not found by angiography, but the spontaneous development of a fistula and absence of trauma suggest that the ruptured aneurysm may have been present.
- The pathogenesis of the aneurysm is possibly not only the result of congenital defects of the middle layer of the PPTA, but also its hemodynamic stress due to the anatomic location the two major arterial systems.

Summary

- Endovascular embolization with the use of detachable coils and represents a safe and effective method of occluding CCF.
- When the site of the tear in the arterial wall is localized and we are able to navigate the microcatheter through the fistula into the affected cavernous sinus.
- Failure of fistula embolization with loss of access is the most worrisome complication

Conclusion

- The surgeon should strike a balance between packing the sinus enough to occlude the fistula and overpacking, which can cause cranial nerve palsies.
- The author suggested that cranial nerve palsies from overpacking are more common in transvenous approach.

“Endovascular treatment of direct CCF” Covered stent graft

Hyun-Seung Kang
Seoul National University Hospital

Currently detachable balloon is not available in Korea, which makes us select alternative treatment materials in patients with direct carotid cavernous fistula.

Covered stent can be a good option in this situation, especially in patients with a favorable carotid configuration. It can be used as the initial treatment option; otherwise it can be used in incompletely treated patients with coil embolization.

In our experiences, patients could tolerate the procedures well and anatomical healing could be achieved in most of the patients.

In this presentation, exemplary cases will be demonstrated with an emphasis on technical aspects.

General assembly

Jae Hoon Sung (Secretary)

Free paper III. Others

Chairs: **Hyeon-Song Koh** (Chungnam National University)
Oki Kwon (Seoul National University)

Onyx Embolization for Isolated Dural Arteriovenous Fistula Using a Dual-lumen Balloon Catheter

Byung Moon Kim, Jin Woo Kim, Keun Young Park, Dong Joon Kim

Interventional Neuroradiology and Neurosurgery, Severance Hospital, Yonsei University College of Medicine, Seoul, South Korea

Objective: OBJECTIVE: Utilization of dual-lumen balloon may enable Onyx penetration into isolated dural arteriovenous fistula (i-DAVF) more effective. The objective of this study is to compare the results of Onyx embolization using dual-lumen balloon with those using non-balloon catheter for i-DAVF.

Methods: Twenty-nine patients underwent Onyx embolization for i-DAVF using non-balloon (n=14) or dual-lumen balloon catheter (n=15). Since its introduction, dual-lumen balloon catheter has been preferentially used. We compared dual-lumen balloon group with non-balloon catheter group regarding angiographic outcome, treatment-related complications, total procedural and Onyx injection times, and the number of feeders requiring embolization.

Results: Dual-lumen balloon group showed complete occlusion of i-DAVF in 13 and near complete in 2 patients, while non-balloon group showed complete occlusion in 5, near complete in 5, and incomplete in 4 patients ($p < 0.05$). Treatment-related complications occurred in 2 patients, 1 in non-balloon group and 1 in dual-lumen balloon group, respectively. The mean total procedural time was 62 minutes ± 32 minutes in dual-lumen balloon and 171 minutes ± 88 minutes in non-balloon group ($p < 0.05$). The mean Onyx injection time was 10 ± 6 minutes in dual-lumen balloon and 49 ± 32 minutes in non-balloon group ($p < 0.05$). The median number of feeders requiring embolization was 1 (range, 1-3) in dual-lumen balloon and 2 (range, 1-4) in non-balloon group ($p < 0.05$).

Conclusions: Utilization of dual-lumen balloon catheter for Onyx embolization of i-DAVF seemed to significantly increase the immediate complete occlusion rate and decrease total procedural time, Onyx injection time, and number of feeders requiring embolization.

Keywords: onyx, dural arteriovenous fistula, dual-lumen balloon, embolization

Endovascular treatment of bilateral cavernous sinus dural arteriovenous fistula: single center experience with 8 patients

Jong Kook Rhim, Young Dae Cho, Dong Hyun Yoo, Hyun Seung Kang, Moon Hee Han
Seoul National University Hospital

Objective: Although devices and embolic materials have been developed, endovascular treatment of cavernous sinus dural arteriovenous fistula (CSdAVF) is technically not easy. Moreover, bilateral CSdAVF has been reported as a rare case. The purpose of this study is to describe our experiences with the treatment of bilateral CSdAVF.

Methods: All data were obtained in a consecutive series of 125 patients with CSdAVF treated from January 2004 to October 2015. Bilateral CSdAVF in diagnostic angiography was identified in eight patients, who were reviewed retrospectively on clinical and radiologic data.

Results: Most common symptom was ocular manifestation with cranial nerve palsy (n = 5) and bilateral symptoms were presented in two patients. Access via inferior petrosal sinus (IPS) was preferred by transvenous approach in all cases. Bilateral fistulas were occluded through the unilateral IPS (n = 6) and bilateral IPS (n = 2). Among 16 CSdAVF lesions, complete occlusion was achieved in 15 after transvenous embolization, and residual shunt was in 1. Additional transarterial embolization was performed in 2 lesions (1 residual shunt and 1 recurred fistula), and both were cured. Six patients (75%) experienced paradoxical worsening of cranial nerve palsy after the transvenous embolization. During a follow-up period, four patients had made a full recovery while the rest remained permanent deficits.

Conclusions: Our small study suggest that endovascular treatment for bilateral CSdAVF can achieve excellent angiographic occlusion results, similar to unilateral CSdAVF. However, paradoxical aggravation of symptoms after transvenous embolization may occur more commonly in bilateral CSdAVF.

Keywords: dural arteriovenous fistula, cavernous sinus, embolization

Transvenous microguidewire looping technique for breach of ipsilateral inferior petrosal sinus occlusions en route to cavernous sinus dural arteriovenous fistulas

Young Dae Cho, Hyun-Seung Kang, Moon Hee Han

Seoul National University Hospital

Objective: Transarterial access to dural arteriovenous fistulas (dAVFs) has been popularized by device improvements and novel embolic materials. However, this approach is limited in the cavernous sinus (CS) due to related complications and low cure rates. Although a transvenous approach, via ipsilateral inferior petrosal sinus (IPS), may be more suitable for CS-dAVFs, microcatheter delivery is occasionally impeded by ipsilateral IPS occlusion. Described herein is a novel microguidewire looping method to breach such occlusions, thus enabling access to CS lesions.

Methods: microcatheter is initially advanced into IPS orifice, and a microguidewire is passed into occluded IPS. Looping is easily achieved through the resistance met. With greater support of the guiding catheter, the microguidewire (still looped) is then advanced into CS. When nearing CS, the microcatheter is further reinforced, and it is navigated along the microguidewire into CS.

Results: This technique was applied in 10 instances of CS-dAVF with ipsilateral IPS occlusion, enabling ipsilateral access to CS. In 8 cases (80%), microdevice advancement was successful, culminating in effective transvenous coil embolization. Clinical and radiologic outcomes in all patients were excellent, with no delayed post-procedural cranial palsies.

Conclusions: This microguidewire looping technique enables safe and effective entry into CS during transvenous coil embolization of CS-dAVFs with ipsilateral IPS occlusion.

Keywords: dural arteriovenous fistula, cavernous sinus, transvesnous, coil embolization, inferior petrosal sinus

Direct superior ophthalmic vein access for dural arteriovenous fistula embolization

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[1]Department of Neurosurgery, Kyung Hee University School of Medicine, Seoul, Korea; [2]Department of Radiology, Kyung Hee University School of Medicine, Seoul, Korea

Objective: Transvenous approach via inferior petrosal sinus is the most widely used route for endovascular treatment of dural arteriovenous fistula (dAVF) around cavernous sinus or carotid cavernous fistula (CCF). When it is not possible, however, direct access through superior ophthalmic vein (SOV) could be considered alternatively.

Methods: A 72-year-old female admitted to our hospital presenting unilateral orbital pain, exophthalmos and 6th nerve palsy those are aggravating during a month. MR and conventional angiography revealed dAVF that originated from internal maxillary artery leaking into SOV. We attempted using conventional venous approach via femoral vein-external jugular vein and facial vein. However, we failed to proceed microcatheter into left SOV owing to its tortuous and stenotic point.

Results: We chose alternative treatment strategy, surgical exposure of the SOV following linear incision on eyelid and direct cannulation. Two temporary clips (Yasargil mini curved) seized the SOV and FAST Cath for children (4Fr, 8.5cm) was inserted.

Conclusions: We used smaller sheath, which is shorter and softer than conventional endovascular catheter. It was beneficial in SOV puncture and catheter anchoring.

Keywords: surgical exposure, superior ophthalmic vein, dural arteriovenous fistula, embolization.

Safety of Preprocedural Antiplatelet medication in Coil embolization of SAH

Jung Hyun Park, Hyung Sik Hwang, Il Young Shin
Hallym University Dongtan Sacred Heart Hospital

Objective: 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

Methods: Retrospectively reviewed 23 patients who received preprocedural antiplatelet medication that inderwent coil embolization. Total 200mg Aspirin and 150mg Clopidogrel were administered at least 1 hour before coiling. 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.

Conclusions: PReoperative antiplatelet medication leads to a low rate of thromboembolic complications and may have no adverse effect on bleeding complications

Keywords: antiplatelet medication, SAH, coil embolization

Long-term outcomes after endovascular treatment of vertebrobasilar junction aneurysms associated with fenestration

Kyu Sun Choi, Do Hoon Kwon, Jung Cheol Park, Jae Sung Ahn, Byung Duk Kwun

Department of Neurosurgery, University of Ulsan College of Medicine, Asan Medical Center, Seoul, Korea

Objective: Vertebrobasilar junction (VBJ) aneurysms are rare and are often associated with proximal basilar artery fenestration. This complex anatomical variation and location may preclude microsurgical clipping of these aneurysms. Therefore, the endovascular treatment (EVT) is now usually considered as the first-line treatment. The aim of this study is to report the long-term clinical and radiologic results after EVT of VBJ aneurysms associated with fenestration.

Methods: Between January 1996 and January 2013, 1894 aneurysms were treated by EVT in our institution. Fourteen aneurysms in 13 patients were located on the VBJ and 12 aneurysms (0.6 %) in 11 patients were associated with proximal basilar fenestration. There were 5 men and 6 women, ranging from 32 to 67 years of age. Eight patients presented with subarachnoid hemorrhage, and in three of the patients the aneurysms were found incidentally.

Results: Two patients were treated by stent-assisted coil embolization, and nine patients were treated by simple coil embolization. Retreatment of aneurysms was performed in 3 patients. There was no procedure-related mortality. One patient experienced transient 6th cranial nerve palsy and facial hypesthesia. Follow-up angiography more than 1 year after embolization (n =11; mean, 57.2 months; range, 18-144 months) demonstrated stable occlusion in 9 (75.0 %), minor recanalization in 2 (16.6 %), and major recanalization in 1 (8.3 %).

Conclusions: The aneurysms from a fenestrated VBJ are rare, with an incidence of 0.6 % of treated aneurysms by EVT at our institution. The 3D rotational angiography was critical to the understanding of the complex geometry associated with the fenestrated VBJ. EVT seems to be an effective, safe, and durable therapeutic method in treating the fenestrated VBJ aneurysms.

Keywords: Aneurysms, Vertebrobasilar junction, Endovascular treatment, Fenestration

Isolated posterior inferior cerebellar artery dissection

Sung Ho Lee[1], Seok Keun Choi[1], Il ho Kkang[1], Eui Jong Kim[2]

[1]Department of Neurosurgery, Kyung Hee University School of Medicine, Seoul, Korea,

[2]Department of Radiology, Kyung Hee University School of Medicine, Seoul, Korea

Objective: An isolated dissection developed on the posterior inferior cerebellar artery (PICA) requires an intensive treatment owing to its potential fatality. However, the treatment is not well established due to its rarity. We reports clinical manifestations and results of surgical, endovascular and conservative treatment.

Methods: We retrospectively reviewed clinical records of the patients who underwent any treatment of PICA dissecting aneurysm in this hospital during recent 3 years. Nine patients were enrolled (4 males and 5 females, 42 - 74 years old): subarachnoid hemorrhage (SAH) in six cases and PICA territory infarct in the other three cases. Dissection was seen at proximal portion (anterior and lateral medullary segments) in 7 patients, remained 2 patients showed distal PICA dissecting aneurysms.

Results: Among 6 patients with hemorrhage, 5 patients were actively treated (trapping and bypass: 2, clipping: 1, coil embolization: 2). Conservative management was performed in the other patient who showed minimal change of PICA. Among three patients with infarction, two patients received conservative treatment. Endovascular treatment was performed in a patient who showed rapid progression, aneurysm formation and conversion to massive SAH within 10 days after initial attack. Although other patients (7/8) were showed relative good outcome (mRS <2) after 30 days follow-up, the patient of rapid progression died from large amount of SAH.

Conclusions: Given dynamic clinical course and potential fatality of this disease, meticulous evaluation, intensive treatment with variable modalities and proper follow-up are required in patients with PICA dissection for favorable outcomes.

Keywords: cerebral arterial dissection, posterior inferior cerebellar artery, stroke, endovascular intervention, surgery.

Association of engorged perforating artery of basilar top with Non-aneurysmal Perimesencephalic Subarachnoid Hemorrhage

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Department of Neurosurgery, Catholic University of Korea, Incheon St. Mary's Hospital

Objective : Perimesencephalic subarachnoid hemorrhage (PM-SAH) accounts for about 10% of all SAHs, and digital subtraction angiography (DSA) is mostly found to be normal in such patients. The purpose of this study is to investigate the relationship between counts and diameter of engorged perforating artery of basilar top and non-aneurysmal PM-SAH.

Methods: DSA findings of all patients who underwent catheter angiography for evaluation of non-aneurysmal PM-SAH between May 2014 and March 2015 were reviewed. Patients with anterior circulation aneurysms were excluded. PM-SAH and control group were evaluated by DSA 3D reconstruction images. Perforating artery diameters were measured and were counted engorged artery. Non-aneurysmal PM-SAH were identified : (1) center of bleeding located immediately anterior and in contact with the brain stem in the prepontine, interpeduncular, or posterior suprasellar cistern; (2) blood limited to the prepontine, interpeduncular, suprasellar, crural, ambient, and/or quadrigeminal cisterns and/or cisterna magna; (3) no extension of blood into Sylvian or interhemispheric fissures; (4) intraventricular blood limited to incomplete filling of the fourth ventricle and occipital horns of the lateral ventricles (ie, consistent with reflux); (5) no intraparenchymal blood.

Results: 4 patients with non-aneurysmal PM-SAH and control group with posterior circulation aneurysms or dissection were identified. In patients with non-aneurysmal PM-SAH, mean diameters and counts of perforating artery were 1.002mm(min-max, 0.85-1.26) and 3.75(min-max, 3-4). In control group, diameters and counts were 0.663mm(min-max, 0.5-1.12) and 2.4(min-max, 1-4).

Conclusions: There is a relationship between PM-SAH and engorged perforating artery counts and diameters. In patients of PM-SAH, there were found increased counts and diameters of perforating artery of basilar top.

Keywords: PMSAH, thalamoperforating artery.

Endovascular Coil Embolization of Intracranial Aneurysms in Octogenarian Patients

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Department of Neurosurgery, Bucheon St. Mary's Hospital, The Catholic University of Korea

Objective: The purpose of this study is to evaluate and report our anatomic and clinical results associated with coil embolization of intracranial aneurysms in octogenarian patients.

Methods: From January 2006 to December 2014, 26 consecutive octogenarian patients (12 with UIA, 14 with SAH) underwent 27 coil embolization procedures (13 with UIA, 14 with SAH). Anatomic results at follow-up, procedure-related complications, and morbidity and mortality were retrospectively reviewed.

Results: Coil embolization procedures were successful in all cases. 30-day mortality was 0% in patients with UIA and 7% (1/14) with SAH. Procedure-related neurologic morbidity was observed in one patient presenting with ruptured distal anterior cerebral artery aneurysm, which was due to intraoperative rupture. In patients with SAH, procedure-related neurologic morbidity rate was 7% (1/14) and, in patients with UIA, 0%. Six-month clinical follow-up was available in 25 patients. Eight patients exhibited favorable clinical outcome (modified Rankin scale score 0~3). In 7 patients with unfavorable clinical outcome (modified Rankin scale score 4 or 5), one was due to intraoperative rupture, two were due to medical complications (sepsis and deep vein thrombosis), and the others were due to poor initial neurologic status (Hunt-Hess grade IV or V).

Conclusions: Coil embolization of intracranial aneurysms in octogenarians is safe and effective treatment option. Procedure-related complication (intraoperative rupture) and initial clinical status were correlated with favorable outcomes. More clinical experience is mandatory.

Keywords: octogenarian, aneurysm, embolization

Memo

Korean Japanese Scientific Endovascular Conference

Chairs: **Seok-Mann Yoon** (Soonchunhyang University)
Jun Seok Koh (Kyung Hee University)

Dual catheter technique for intracranial aneurysm

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Objectives: Intracranial coil embolization is common treatment for intracranial aneurysm. Various adjunctive techniques such as stent assist, balloon remodeling, dual guiding technique is performed to complex aneurysm. Balloon remodeling or stent assist will improve success rate of coil embolization, but increase complication. And further, stent assist technique to ruptured aneurysm is not covered by health insurance in Japan.

Methods: Dual microcatheter technique is safe and effective adjunctive technique and there are several types. Interleaving technique is used for wide neck to stabilize 2 coils. Locking technique is for unstable framing coil. We describe the efficacy of dual catheter technique.

Results: 143 (74 ruptured, 69 unruptured) intracranial aneurysmal embolization was done from October 2013 to October 2015. 35 aneurysm (20 ruptured, 15 unruptured) was treated by dual catheter technique. Major complication was seen in 1 ruptured aneurysm case coil migration.

Conclusions: Dual catheter technique is easy and useful adjunctive technique. However risk of coil migration exists and some cases are difficult to treat only with this technique.

Optimal P2Y12 Reaction Units Criterion for High on-Treatment Platelet Reactivity in Coil Embolization for Unruptured Intracranial Aneurysm: a Prospective Validation Study

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Objective: To identify optimal P2Y12 reaction units (PRU) criterion for high on-treatment platelet reactivity (HTPR) and evaluate clinical validity of tailored antiplatelet preparation based on this criterion in coil embolization for unruptured intracranial aneurysm.

Methods: The institutional review board approved this study and written informed consent was obtained. In a post hoc analysis for our previous prospective study, a ≥220 PRU was identified as the optimal criterion for HTPR. For its validation, 244 patients were prospectively enrolled: according to this criterion, 126 (51.6%) without HTPR and 118 (48.4%) with HTPR received standard and modified preparation before coiling, respectively. From our previous study, 57 patients with HTPR receiving standard preparation were also included. Thromboembolic event within 7 days after coiling was compared among the study groups.

Results: Compared with the patients with HTPR receiving standard preparation (7/57 [12.5%]), the primary outcome rate was significantly low in the patients without HTPR (1/126 [0.8%]; adjusted risk difference, 10.1% [95% confidence interval 1.7, 18.5]; p=0.015), when using ≥220 PRU as the new criterion. The patients with HTPR receiving modified preparation (1/118 [0.9%]) had a similarly low primary outcome rate, compared with the patients without HTPR (1/126 [0.8%]; adjusted risk difference 0.5% [95% confidence interval -2.1, 3.1]; p=0.001 for noninferiority and p=0.699 for superiority), when tailoring antiplatelet preparation based on the new criterion.

Conclusions: A ≥220 PRU was identified as an optimal criterion for HTPR, and tailoring antiplatelet preparation based on this criterion was validated in this prospective study.

Keywords: Aneurysm, coiling, antiplatelet drug.

Initial experience of enterprise 2 for aneurysmal coil embolization

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Objectives: Enterprise VRD 2 (E2) has been launched in Japan for the first time in the world. We introduce initial experimental and clinical experience of this novel stent.
Enterprise VRD (E1) is a closed-cell design intracranial self-expandable stent. There are several reports regarding incomplete stent apposition which makes gap between the stent and the vessel wall.

Methods: To solve such problem, E2 has been developed. The difference between E1 and E2 is expansion diameter from 4.5 to 5.0 mm with increasing the amplitude of the wave pattern. This increase in diameter may improve vessel wall conformability in tortuous anatomy.
We evaluated the stent apposition using endovascular evaluator(EVE) which is in vitro 3D silicon model. We deployed E1 and E2 from right M2 to right M1 in silicone model by two different deployment techniques, simple pull technique and pull & push technique. Comparative evaluation of stent apposition was made by gross appearance as well as by cone-beam CT.

Results: The result of this evaluation showed pull & push technique using E2 achieved the best wall apposition.
As an initial case of E2, we performed coil embolization for 70-year-old female who had a recurrent unruptured aneurysm after clipping at the right A1. Although the angle made by IC and A1 was sharp, we achieved good wall apposition of E2 by pull & push technique and preserved the parent artery.

Conclusions: E2 may provide better wall apposition than E1 by pull & push technique, even in tortuous vessel.

Clinical implications of crossover (clip and then coil or vice versa) treatment in cerebral aneurysm

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Objective: For effective eradication of intra-aneurysmal flow to prevent rupture, complementary treatment between clipping and coiling is the general concept. The crossover treatment [(one treatment modality (clip or coil) followed by the other one (coil or clip)] is helpful in many situations. We evaluated the characteristics of crossover treatment.

Methods: From Jun 2009 to Nov 2015, total 388 cases of endovascular coil embolization were performed. Among them, crossover cases were selected same as follows. 1) clipping over ("old clipping section") or within ("recent clipping section") this time period and then coiling (group 1). 2) coiling followed by clipping within this period (group 2). The characteristics of aneurysm, treatment details, treatment interval and cause of crossover were reviewed using medical record, operation and procedure note.

Results: Among 388 cases of coiling patients, total 17cases of crossover was performed (4.4%). In crossover cases, all patients except one are ruptured aneurysms. The group 1 and group 2 of crossover were 9 (52.9%) and 8 cases (47.1%), respectively. In group 1, the following characteristics could be found. 1) the causes of crossover were 4 partial clip, 3 regrowth and 2 clip giving up. 2) clipping performed by other institute were 3 (33.3%). 3) the mean interval of 4 old clipping section was 111 months and the outcome was excellent. 4) one case of mortality occurred in recent clipping section. In group 2, the following characteristics could be found. 1) the causes of crossover were 3 coil compaction, 2 immediate rebleeding, 2 coil giving up and 1 indication error. 2) one mortality was related to tirofiban infusion after coiling. 3) the main cause of clipping in compacted coil was intolerance to stent and antiplatelet agent.

Conclusions: The crossover treatment was effective in most cases. The main causes of crossover in surgical clipping were clip failures rather than regrowth of aneurysms. Those in endovascular coiling were rebleeding, coil compaction or antiplatelet intolerance. In both types of crossover, the outcomes of delayed cases were more acceptable. In treated aneurysm, despite of modality, regular follow up is essential to find out crossover candidates.

Keywords: aneurysm, clip, coil, crossover, treatment

Usefulness of the metal artifact reduction algorithm on the cone-beam CT images of cerebral aneurysms treated by coil embolization using intracranial stent

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Background: Cone-beam CT has been used for the assessment of stents and vessels after stent assisted coil embolization. However, the metal artifacts from the coil mass is a critical problem to visualize these architectures. We evaluated the usefulness of the metal artifact reduction (MAR) algorithm.

Materials and Methods: We retrospectively reconstructed cone-beam CT data of 13 cerebral aneurysms treated with stent assisted coil embolization between March 2013 and June 2015. Cone-beam CT was acquired as 20 second Dyna CT using Artis zee BA Twin (Siemens Healthcare, GmbH), and data were reconstructed with the MAR algorithm using syngo X-Workplace (Siemens Healthcare, GmbH). We evaluated the degree of image quality improvement and artifact reduction by comparing uncorrected and corrected images.

Results: Mean size of the aneurysms was 14.6mm (range: 3.2-24.0mm). Locations of the aneurysms were ICA (n=6), MCA (n=1), Acom (n=1), VA (n=3), and BA (n=2) respectively. We could identify stent struts with all the aneurysms except ICA aneurysms (mean diameter: 19.6mm). We could visualize perforators in 2 cases by MAR reconsturucted images.

Conclusions: We could visualize the stents and vessels using the MAR algorithm after the coil embolization for cerebral aneurysms. Further studies are expected with advanced algorithm to reduce the metal artifact of ICA and larger aneurysms.

Key words: metal artifact reduction, stent-assisted coil embolization, cone beam CT

Chronological histopathologic healing response following treatment with flow diverter in the canine side-wall aneurysm model

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Objective: To characterize the chronological histopathologic progression of wide-necked, side wall aneurysm following treatment with a flow diverter in a canine aneurysm model.

Methods: With institutional animal care and use committee approval, 21 side wall aneurysms were created in common carotid artery of 8 dogs and treated with two different flow diverters. Angiographic follow-ups were done immediately after placement of the device, after 4 weeks and 12 weeks. At last follow-up, the aneurysm and the device-implanted parent artery were harvested. The aneurysm occlusion rate was assessed by using a 5-point scale. The harvested aneurysm–parent artery complex was fixed with 5% formalin, embedded in methyl-methacrylated, and stained with hematoxilin-eosin stain.

Results: Overall final occlusion rate were noted as grade 0 in 2, grade 1 in 1, Grade 2 in 6, grade 3 in 5, and grade 4 in 7 of 21 aneurysms, respectively. Contrast stagnation in aneurysmal sac after the procedure was not associated with 4-week angiographic outcome (p for trend = 0.029). Histopathologic findings of completely occluded aneurysms showed that multiple-staged, mural thrombus formation was observed in the aneurysmal sac, and neointimal thickening at the mid-segment of aneurysm at 4 weeks after the procedure. Degree of thrombus formation and organization was various among the aneurysms and aneurismal sac was also vary in their size. At 12 weeks, markedly shrunken aneurysmal sac filled with collagenized attenuated connective tissues with collagenized neointima was shown. In a case of incomplete occlusion at 12 weeks, 10-mm sized, wide-necked aneurysm became a small neck aneurysm with contrast stagnation at the venous phase of follow-up angiography. Histopathology of the aneurysm showed thick neointimal formation without any stage of thrombus formation in aneurysmal sac.

Conclusions: After the flow diverter insertion, intra-aneurysmal thrombus formation was progressed gradually according to the degree of flow modification. Depending on degree of thrombus formation and organization, healing process seems to be different in the similar hemodynamic milieu. Neointimal formation seems to be processed independently of intra-aneurysmal thrombus formation. However, it might be interrupted by inflow into aneurysmal sac.

Keywords: flow diverter, histopathology, healing process.

Intracranial hemorrhagic complication after acute thrombectomy: the effect of tortuosity of the target vessels

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Purpose: Intracranial hemorrhagic complications after acute thrombectomy are not rare.
The purpose of this study was to elucidate the effect of tortuosity of the target vessel on the hemorrhagic complication.

Materials and Methods: A total of 80 consecutive patients who underwent mechanical thrombectomy for acute large vessel occlusion between Sep. in 2013 and Augin 2014 were included. The patients were classified into two groups; hemorrhagic group and non-hemorrhagic group, based on the findings on head CT performed 12 to 24 hours after the procedure. Vessel tortuosity was assessed by measuring the distance between the highest and lowest points of M1in the middle cerebral artery (MCA).

Results: Among 80 patients, 29(36%) were classified intohemorrhagic group and 51(64%) were in non-hemorrhagic group. Baseline characteristics were no significant difference in both groups. The distance of highest and lowest points in M1 was significantly larger in hemorrhagic group compared to non-hemorrhagic group (8.8 vs 6.9, p=0.01). The percentage of the favorable outcome (modified Rankin Scale 0-2)on discharge was less in hemorrhagic group compared to non-hemorrhagic group (18% vs 82%, p=0.006).

Conclusions: The results obtained in the present study indicated that the incidence of intracranial hemorrhagic after thrombectomy was significantly correlated with tortuosity of the target vessel.

Result of Stent-Angioplasty with Wingspan Stent for Symptomatic Intracranial Stenosis

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Objective: 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.

Methods: From May. 2010 to May 2015, 76 patients (52 males, 24 females, mean age: 66.6±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: 39 vs. 37) and severe stenosis related to symptoms confirmed with catheter angiography. The numbers of stenotic lesions were 29 cases on ICA, 34 on MCA, and 13 on vertebrobasilar (V-B) artery. All of the used stents for treatment were Wingspan self-expanding stent and Gateway balloon. Mean NIHSS at admission was 1.4±1.9, and mean stenosis rate was 76.8±6.2%. Clinical status (including NIHSS) and angiographic results were assessed retrospectively.

Results: Stents were successfully deployed at first trial in almost all cases except only two cases due to tortuous ICA course (97.4%), and in one case successful stenting was done at second trial (98.7%). Periprocedural complications occurred in 11 cases (14.5%), and symptomatic cases were only 6 (7.9%, transient vs. permanent: 4 vs. 2 (5.3% vs. 2.6%)). Of 76 cases 67 were followed clinically over 6 months (88.2%) and the mean follow-up period was 25.8±20.0 months). Angiographic follow-up was performed in 57 cases (75.0%. 13.9±11.8 months). The mean NIHSS after stent-angioplasty was 0.8±1.7 and 0.5±1.7 at last clinical follow-up day. Post-stenting residual stenosis was 8.7±13.0%, and 14.8±25.3% at last angiographic follow up. In-stent restenosis over 50% occurred in 7 cases (7/57, 12.3%), and 6 cases were retreated successfully with Gateway balloon (3) or Drug-eluting balloon (3). Symptomatic infarctions were occurred in 4 of 76 (5.3%) patients during the clinical follow-up period.

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

Keywords: Intracranial stenosis, Stent-angioplasty, Wingspan stent, Self-expanding stent, Gateway balloon, Drug-eluting balloon, Endovascular surgery

Safety and Time Course of Drip-and-ship

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Background: The drip-and-ship approach for treating acute ischemic stroke (AIS) patients makes adjuvant endovascular treatment (EVT) possible in cases in which intravenous tissue plasminogen activator (IV t-PA) has failed to achieve recanalization.

Objective: The safety of the drip-and-ship approach and time course of patients were compared to those of patients treated directly at our stroke center.

Methods: A retrospective chart review of blood pressure, systemic complications, and neurological complications was performed in 43 AIS patients treated with the drip-and-ship approach (drip-and-ship group). The time course of drip-and-ship patients was compared to that of patients receiving IV t-PA and EVT following direct admission to our hospital (direct admission group).

Results: Thirty-one and 12 patients in the drip-and-ship group were transferred by ambulance and by helicopter, respectively. One of the patients transferred by ambulance suffered hemorrhagic infarction during transportation. The change in mean blood pressure (mBP) was lower in patients transferred by helicopter, and their mean change in mBP was less than 5 mmHg, while that in patients transported by ambulance was 12.2 mmHg. The mean onset to needle time was 75 minutes in the drip-and-ship group and 72 minutes in the direct admission group. Although the mean transportation time from the primary stroke hospital to our hospital was 27 minutes, the mean needle to departure from the primary stroke hospital time was 50 minutes. Thereafter, there was an average delay of 71 minutes in mean onset to groin puncture time in the drip-and-ship group compared with the direct admission group.

Conclusions: The drip-and-ship approach was relatively safe in this small series. Transportation by helicopter seemed to minimize stress in AIS patients. Reduction of needle to departure from primary stoke hospital time is important to decrease the time to treatment.

Memo

Poster

Chairs: Seok-Mann Yoon (Soonchunhyang University)

Fusion three-dimensional angiography of both internal carotid arteries in the evaluation of anterior communicating artery aneurysms

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Object: To determine whether 'fusion 3D angiography' of both internal carotid arteries (ICAs) can better disclose vascular details in patients diagnosed with anterior communicating artery (ACoA) aneurysms by computed tomography angiography (CTA) or magnetic resonance angiography (MRA).

Methods: Thirty-nine patients diagnosed with ACoA aneurysms by CTA or MRA were evaluated by the new post-processing feature, fusion 3D angiography, with results individually interpreted by four experts. Advantages and disadvantages of the fusion imaging were evaluated. Patients who showed any disadvantages with this additional feature were classified as group I; those with no advantages as group II; those with one or two advantages as group III; and those with three or more advantages as group IV. Radiological and clinical results were also evaluated.

Results: Of the 39 patients, 33 (85%) benefited from fusion 3D angiography, including 17 in group III and 16 in group IV; of the remaining patients, one was classified as group I and five as group II. Representative five categories of advantage to fusion angiography were found and summarized by the four experts. All 33 patients showed defining the exact anatomy of the ACoA and 22 (67%) showed full angiographic features of A2 or A3, including branches.

Conclusions: Fusion 3D angiography can significantly contribute to a better understanding of the complex anatomy of the ACA-ACoA complex, which is essential for successful treatment planning for ACoA aneurysms.

Preliminary experience of self-expanding closed-cell stents placement in small arteries less than 2 mm in diameter for the treatment of intracranial aneurysms

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Object: The purpose of this study was to report the author's preliminary experience using selfexpanding closed-cell stents deployed in small arteries (< 2 mm in diameter) to treat intracranial aneurysms.

Methods: A total of 31 patients were studied. All subjects met the following criteria: (1) they received an Enterprise stent for a wide-necked aneurysm or a dissecting aneurysm or as part of a stent-salvage procedure; and (2) they had an Enterprise stent deployed in a small parent artery (< 2 mm in diameter) that had no atherosclerotic stenosis. Procedure-related complications and follow-up sizes of the parent arteries were evaluated for safety and patency.

Results: There were 16 ruptured aneurysms and 15 unruptured aneurysms. Three (9.7%) of the 31 patients experienced procedure-related complications, and they all were asymptomatic. Follow-up angiography was performed in 27 patients (87.1%) (at a mean 15.5 months after surgery). Parent arteries with 2 acute angles (n=4) were occluded in 3 cases (75.0%), and those with no acute angle (n=13) or 1 acute angle (n=6) showed 100% patency on follow-up angiography. There was a significant difference between the follow-up sizes (mean 1.72 ± 0.30 mm) of parent arteries and their sizes (mean 1.59 ± 0.26 mm) before treatment (95% CI, -0.254 to -0.009 mm; p=0.037, paired samples t-test).

Conclusions: In the current series the deployment of self-expanding closed-cell stents in small arteries was safe and resulted in good patency, especially when stents were deployed in segments of the parent artery with no acute angle or only 1 acute angle.

Safety and efficacy of intravenous Tirofiban as antiplatelet premedication for stent-assisted coiling in acutely ruptured intracranial aneurysms

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Introduction: Thromboembolic complications are one of the major concern in stent-assisted coiling of intracranial aneurysms. Therefore, preoperative antiplatelet therapy with optimal anticoagulation during the procedures are mandatory. However, in the setting of acutely ruptured wide-necked aneurysms, the use of stent is not anticipated, the patients are not pretreated with antiplatelet agents such as aspirin and clopidogrel. Furthermore, there are also concerns about the use of high dose antiplatelet agents in the post-rupture period may increase the risk of rebleeding or periprocedural complication related to further invasive surgical treatment such as ventriculostomy.

Tirofiban (Aggrastat) is one of the new antiplatelet agents which act as a reversible antagonist of fibrinogen, binding to the glycoprotein IIb/IIIa receptor of platelets and the safety and efficacy has been well established in acute coronary syndromes. However, for neuro-endovascular prodedures, there are very limited data pertaining to the use of tirofiban in endovascular aneurysm treatment.

The objective of our study was to evaluate the safety, feasibility and outcome of patients who were treated with intravenous tirofiban injection as a prophylactic treatment for thromboembolic events during stent assisted coil embolization in ruptured intracranial aneurysms.

Material and methods: We conducted a retrospective review of a prospectively collected neurointerventional database containing a consecutive series of patients who underwent stent-assisted coil embolization of ruptured intracranial aneurysms from 2011 to 2015.

During the research period, intravenous tirofiban was infused intra-operatively in all patients with the same protocol as a prophylactic treatment instead of treatment with loading doses of both aspirin and clopidogrel prior to stent assisted coil embolization of ruptured intracranial aneurysms.

We analyzed rates of periprocedural intracerebral hemorrhage with thromboembolic event, tirofibanrelated morbidity and mortality, and evaluated any possible systemic complications related with tirofiban such as retroperitoneal, gastrointestinal, genitourinary bleeding and thrombocytopenia.

Results: A total of 55 patients underwent stent-assisted coiling of ruptured wide necked aneurysms with prophylactic intravenous tirofiban infusion. Six patients (11%) showed worsening of hemorrhage in post procedural computed tomography. Among them, 2 patients (3.6%) showed clinical worsening and the other 4 patient's clinical status did not change (subclinical worsening). There were 2 episodes of intraoperative rupture. However, the patients recovered completely without persistent neurologic deficit.

Ten patients presented hydrocephalus or Hunt and Hess grade $\geq$ III and required a ventriculostomy before or after endovascular coil embolization and there was one case of hemorrhagic complication related to ventriculostomy but the patient was asymptomatic. No immediate or delayed thromboembolic events occurred in patients who received prophylactic tirofiban. There was no systemic complications such as

retroperitoneal, gastrointerstinal, genitourinary bleeding and thrombocytopenia.
Overall, the respective rates of tirofiban-related morbidity and mortality were 3.6%.

Conclusions: Our findings suggest that stent-assisted coiling with prophylactic intravenous tirofiban infusion for prevention of thromboembolic events is a viable option in the management of ruptured wide- necked aneurysms.

Pitfalls of endovascular coiling of aneurysm ; missed diagnosis of ruptured lenticulostriate artery in polycystic kidney patient

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Introduction: Careful examination and review of CT & angiography is essential for treatment of tricky cerebrovascular disease. In most cases, this approach can reveal the causative lesions and can devote to choose appropriate treatment. We report a case of unusual subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH) with vague causative lesion.

Review of case: A 50-year-old female patient was transferred to our emergency center with stuporous mentality. Initial CT showed diffuse SAH at the basal cistern with slightly left predominance. The follow up CT scan at our center revealed rebled ICH around left sylvian fissure. We performed emergency catheter angiography and it confirmed two abnormal vascular lesions. One was small, but lobulated saccular aneurysm at anterior communicating artery (Acom) and the other was wide triangular dissecting or fusiform aneurysm at communicating segment of left internal carotid artery (ICA).

Treatment results: Under the impression of ruptured and unruptured aneurysms, endovascular treatment of simple coiling of Acom aneurysm and stent assist coiling of ICA aneurysm was performed. The loading of clopidogrel was done before stent deployment. Despite of uneventful coiling procedure, the follow up CT showed marked increase of ICH. Despite of decompressive craniectomy, she expired 4 days after operation. Careful re-examination of magnified angiography revealed ruptured dissection of left lenticulostriate artery, more prominent at clopidogrel loaded final angiography. She suffered from polycystic kidney (PCK) and her suggestive diagnosis was PCK induced dissecting rupture of lenticulostriate artery with two unruptured aneurysms. Clopidogrel loading is extremely harmful prescription.

Conclusions: The PCK induced dissection is one of the pitfall-cause of intracranial bleeding. In ruptured aneurysm, stent assist coiling should be done with convincing evidences of rupture point.

Outcomes of Retrievable Solitaire Stent-Assisted Coil Embolization of Wide-Necked Intracranial Aneurysms

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Purpose: To report clinical outcome and immediate and long-term angiographic results of Solitare stentassisted coil embolization

Methods: From January 2011 to September 2014, a total of 156 patients harboring 162 aneurysms were treated with Solitaire stent-assisted coiling. 35 patients (22.4%) presented with acute subarachnoid hemorrhage (SAH). Stent was removed after the procedure in 36 patients (23.1%). Bailout stenting was performed in 27 patients (17.3%) and repositioned during and after the procedure in 8 patients (5.1%)

Results: Of 121 patients with an unruptured aneurysm, two thromboembolic complications and three periprocedural cerebral hemorrahges occurred; 119 patients (98.3%) showed good recovery and two (1.7%) had severe disability 3 months after. Of 35 patients with ruptured aneurysms, 22 patients (62.9%) had a favorable outcome with two cerebral hemorrhage and one thromboembolic complication. Overall, the rate of procedure-related complications was 5.1% (8/156).

Immediate angiographic results of 162 coiled aneurysms were complete occlusion in 106 aneurysms (65.4%), neck remnant in 52 (32.1%), and aneurysm remnant in 4 (2.5%). Follow-up angiography more than 1 year after the coil embolization was obtained in 42 patients with 43 aneurysms (34 with catheter angiography and 8 with MR angiography). Of these, recanalization was observed in 5 aneurysms (11.6%) and they didn't have re-coiling due to the small neck recanalization. 34 aneurysms (79.1%) unchanged, and 4 aneurysms (9.3%) had complete occlusion due to a progressive thrombosis.

Conclusions: Solitaire stent reposition and removal make it possible to prevent the stent thrombosis and make the procedure faster and easier in selected patients. I believe the Solitaire stent-assisted coil embolization enabling stent removal and reposition is safe and effective in the treatment of wide-neck intracranial aneurysms.

MRI analysis of intraprocedural emboli during carotid artery stenting using filter-protected device or proximal flow blockage device

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Objective: The main concern regarding transfemoral carotid artery stenting (CAS) is the possible dislodgement of cerebral emboli during the procedure. CAS with endovascular proximal flow blockage (PFB) is deemed able to reduce the cerebral embolization observed during filter-protected CAS. We evaluated clinical outcome and intraoperative embolization rates in a series of patients undergoing CAS with filter-protected device (FPD) and PFB.

Method: During 4 year, a series of 58 consecutive patients with symptomatic or asymptomatic internal carotid artery stenosis ≥70% were included to undergo CAS with FPD and PFB, obtained with the MoMa system. The FPD in 21 patients and PFB in 30 ones were used during CAS. All patients underwent diffusion weighted magnetic resonance image (DW-MRI) before and after CAS, in order to detect new ischemic lesions. We compared clinical outcome and postoperative embolization rates in each.

Results: CAS was successfully performed in all 38 patients. No deaths or neurological events occurred in the postoperative period with FPD and PFB. The FPD in 21 patients were successfully used during CAS (technical success: 96.6%). Mean age was 70.9 year old and mean stenosis was 83%. Symptomatic was 43%. DW-MRI disclosed 96 new ischemic lesions in 20 patients (71.4%). Twenty four lesions in 7 patients were contralateral to the treated carotid artery. Whereas, the PFB was successfully used in 30 patients (technical success: 93.8%). Mean age was 70.6 year old and mean stenosis was 86%. Symptomatic was 60%. No fail of intolerance to balloon occlusion was observed. DW-MRI disclosed 45 new ischemic lesions in 17 patients (57%). Three lesions in 3 patients were contralateral to the treated carotid artery. The number of ischemic lesion, per patient when present, was lower in the PFB compared to FPD ($p=0.028$, Mann-Whitney U test). Symptomatic or asymptomatic and cell type of stent had statically no significant between the PFB and FPD.

Conclusions: Transfemoral CAS with PFB achieves good technical and clinical results. The use of PFB might be effective to reduce cerebral embolic load during CAS compared to FPD. Further studies, directly comparing the results of DW-MRI after CAS with FPD and PFB, are needed to confirm this result.

Tracheo-Innominate Artery Fistula Treated with Covered Stent

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Purpose: Tracheo-innominate artery fistula (TIF) is a rare but fatal complication after tracheostomy. The morbidity and mortality rates are extremely high even though prompt surgical repair owing to the difficulty in controlling hemorrhage and infection during perioperative period. Authors present a case of TIF successfully treated with covered stent.

Case: 17-year-old male patient who had undergone craniectomy after motorcycle traffic accident, and undergone tracheostomy due to aspiration pneumonia. He has tracheal partial obstruction due to granulation tissue on tracheal tube tip and obstruction rate is about 50%. We changed more large-sized tracheal tube and then symptom relieved.

In six months after the tracheostomy, sudden massive hemoptysis from the tracheostomy site occurred and vital signs became unstable. The cuff was inflated immediately and bleeding ceased simultaneously. The patient was transferred to ICU and considered open surgery for TIF. Because of poor general condition of patient, we changed the treatment plan to perform the interventional procedure. Unexpectedly, there was not only button hole-shaped lesion which is presumed to be TIF but also a tiny branch from the innominate artery proximal to the lesion on angiography.

Pushable coils (Tornado 4/2 mm, 3/2mm) were packed into the branch of innominate artery to prevent 'endoleak'. After then the covered stent (Jostent 6-12/28mm) was deployed over the TIF site. The lesion disappeared on final angiography.

Tracheal bleeding was stopped when we deflated the cuff just after the procedures. In two days, he underwent bronchoscopy which showed tracheal ulceration without active bleeding. To prevent of infection of covered stent, antibiotics were used for 2 weeks and antiplatelet medication was also performed. One month later, authors checked angioCT to confirm the patency of the lumen.

Discussion: TIF is rare, but it has a poor prognosis. There is defining our response to do immediately in active bleeding due to TIF, that is inflating tracheal tube balloon. Ballooning of tracheal tube may be compression the TIF site, but the rate is very low. And if only we were succeed compression TIF, we have to do fistula repair. There is a method for vascular suture surgery TIF site to open surgery, but the prognosis is poor because of risk and complexity in open chest surgery. We believe that endovascular procedure should help to improve prognosis of patients in TIF.

Conclusions: We believed that our patient was treated immediate ballooning on acute hematemesis, and was undergone endovascular procedure successfully. After endovascular procedure, he was stable, and no more bleeding. We believe that endovascular procedure should help to improve prognosis of patients in TIF.

Morphological assessment of cadaveric radial, brachial, and subclavian arteries: A neurointerventional approach

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Objective: The transradial approach is becoming widespread, primarily for neurointerventions. Therefore, the evaluation of radial artery puncture in clinical practice and a better understanding of the anatomy are important to improve the safety of neuroendovascular surgery.

Methods: Ten formalin-fixed adult Korean cadavers were dissected to expose radial artery (RA), brachial artery (BrA) and subclvian artery (ScA), bilaterally. Vessel lengths and diameters were meaured using a caliper and distance between the specific point of vessels and the anatomical landmarks including the radial styloid process, the medial epicondyle of the humerus, the sternoclavicular joint, and the vertebral artery orifice were also measured.

Results: The average length between the radial (RAPS) and the BrA puncture sites (BrAPS) and between the vertebral artery orifice (VAO) and the BrA bifurcation (BrAB) did not differ between sides ($p>0.05$). The average length between the radial styloid process (RSP) and the RAPS was 13.41 ± 2.19 mm, and the RSP was 26.85± 2.47 mm from the median nerve (MN).
The mean length between the medial epicondyle (ME) and the BrAPS as 44.23 ± 5.47 mm, whereas the distance between the ME and the MN was 42.23 ± 4.77 mm. The average VAO-ScA angle was 70.94 ± 6.12°, and the length between the ScA junction (SCJ) and the VAO was 60.30± 8.48 mm.

Conclusions: This study provides basic anatomical information about the radial artery and the brachial route and can help improving new techniques, selection of size and shape of catheters for TRC. This can help neurointerventionists who adopt a transradial neuroendovascular approach and offers comprehensive and safe care to their patients.

Key words: transradial, neuroendovascular approach, radial artery anatomy.

Transient Disappeared Anterior Communicating Artery Aneurysm during Coil Embolization

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Objective: Spontaneous occlusion of an intracranial aneurysm is known and more commonly seen in giant aneurysms. Many mechanisms for spontaneous occlusion have been discussed, and according to the literature reappearance was relatively rare. We report a case of anterior communicating artery aneurysms which transient disappeared and reappeared on short-interval angiography.

Methods: A 38-year-old man was transferred to our hospital after having a sudden, severe headache. At the time of admission, the neurologic status was classified as grade 2 according to the Hunt-Hess grading system. A CT scan revealed SAH, and cerebral angiography demonstrated a saccular aneurysm arising from anterior communicating artery measuring 3.29 × 2.54 mm.

Results: The patient agreed to coiling 2 hours later. Baseline angiography prior to the coiling revealed same findings of previous angiography. A microcatheter was carefully guided over a microguidewire into the aneurysm and the tip of the catheter was located in the aneurysm sac. When followed angiography was performed, the aneurysm of previous angiography was disappeared. There were no events and no changes of the patient's neurologic status during the procedure. About 30 minutes later, the aneurysm sac was reappeared gradually. The aneurysm was treated with GD coils and final angiogram showed near total occlusion of the aneurysm. The patient is on follow-up.

Conclusions: Transient disappeared aneurysm may be generated during process of coil embolization. Possible causes were thought of as the spontaneous thrombosis due to various mechanisms related to aneurysm sac and blood flow. So, the operators have the possibility of disappeared aneurysm in mind during the procedure of coil embolization.

Keywords: Transient disappeared aneurysm, coil embolization, spontaneous occlusion.

Three case experiences of unintented coil migration treated by endovascular and surgical removal

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Objective: Distal coil migraition during endovascular treatment of intracranial aneurysm occurs in 2~6% of cases. As endovascular coil embolization of aneurysms has become popular, the incidence of intra-procedural coil migration increases. The consequences of coil migration vary significantly from asymptomatic to as severe as large territory cerebral infarction.

Methods: Unintented coil migration occurred in 3 patients among 342 patients treated between Dec 2013 and Oct 2015.

Results: We report two cases of endovascular retrieval performed with snare technique and retrieval stent technique, and one case with microsurgical extrextion.

Conclusions: Migration of coil following embolization of an intracranial aneurysm is extreamly rare but recently the reports of incidences and different results of management has been increasingly reported. This cases illustrate not only the rare complication of coil migration but also two different management methods of endovascular and surgical removal.

Keywords: Coil migration, Endovascular retreival, Microsurgical extrextion, Coil embolization

Delayed ischemic stroke after Flow Diversion of Posterior Communicating Artery Aneurysm

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Objective: For securing large, giant and wide-neck aneurysms, flow-diverting device was developed. In various studies, flow-diverting device has shown excellent outcomes and safety. However, in some cases, the complications such as aneurysm ruptures, intracerebral hemorrhages and ischemic strokes has been reported. In our case, we experienced a delayed ischemic stroke at the territory of anterior choroidal artery which was covered by flow-diverting device.

Methods: A 56 year-old male who had histories of cerebral palsy, craniotomy for head trauma and acute myocardial infarction, visited our hospital for incidentally detected aneurysms. Because of previous cerebral palsy, he already had right hemiparesis, but other neurologic examination was intact. For securing large PcoA aneurysm, we deployed a flow-diverting device without coiling and the procedure was successfully completed. After deployment, he had not a neurologic deficits and discharged with dual antiplatelet medications. However, 25 days after deployment, he presented right hemiparesis and acute ischemic stroke was found in brain MRI.

Results: Numerous single and multicenter studies demonstrated overall rates of adverse complications. Among these studies, ischemic stroke was a major complication responsible for about 2.5 - 13.2% occurrence risk. In overlapping multiple devices, posterior circulation, large and giant aneurysm cases, occurrence risk of ischemic stroke increased more. A delayed ischemic stroke was also reported, but the mechanism was still unclear. We suspect that the tiny thrombus in aneurysm sac was crossed through the pores of pipeline device. Another possibility is a gradual occlusion of AChA during the endothelial remodeling process.

Conclusions: The flow-diverting device is an innovative technique to allow more effective and safety endovascular treatment of previously untreatable aneurysms and the outcomes of PED are also considerably better than the coil embolization. However, there are still unexpected complications. Therefore, when we use the flow-diverting devices, we should remind the possibility of delayed ischemic stroke.

Keywords: delayed ischemic stroke, flow-diverting devices, pipeline device

The benefit of NavienTM Intracranial Support Catheter in Endovascular treatment

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Objective: Endovascular treatment need to provide safety and stable accessment catheter cavity. The catheter for endovascular treatment have to flexible and at least 0.027 inches of inner diameter. The NavienTM Intracranial Support Catheter provide 0.058 inches inner diameter at 5 franch catheter. And it is important to maintain round shape without change ovium shape. It would french more stable environmant to endovascular treatment

Methods: We reviewed 21 cases of Endovascular treatment with NavienTM Intracranial Support Catheter. The patient under supine position, arterial puncture at left femoral area. The NavienTM Intracranial Support Catheter enter vessel through femoral artery and placed in beyond the clinoidal internal carotid artery or third segment of the vertebral artery. The patients had various shape of intracranial artery include tortuous vessels.

Results: The NavienTM Intracranial Support Catheter was used 21 cases of endovascular treatment. We had 16 cases of Guglielmi detachable coil embolization at unruptured aneurysms and 5 cases of Guglielmi detachable coil embolization at ruptured aneurysms. Unruptured aneurysms site on anterior communicating artery, middle cerebral artery, posterior communicating artery, distal vertebral artery, middle cerebral artery bifurcation, internal carotid artery. Ruptured aneurysms site on posterior communicating artery, basilar top, anterior choroidal artery. The treatment was successful and no complications.

Conclusions: The NavienTM Intracranial Support Catheter is one of most important compornent of endovascular treatment. It provide enough cavity of endovascular treatment devices. And it is enough flexible to approach tortuous vessel. It is useful for endovascular treatment.

Keywords: NavienTM Intracranial Support Catheter, Endovascular treatment.

Intracranial Hemorrhage due to rupture of an posterior communicating artery aneurysm in a patient with pituitary adenoma

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Objective: The presence of a cerebral aneurysm in patients with pituitary adenoma is a rare, with an incidence of 0.5% to 7.4%. Generally, it is believed that the incidence of cerebral aneurysm among pituitary adenoma patients is higher than the prevalence of cerebral aneurysm among the general patient population. We present a pituitary adenoma patient with intracranial hemorrhage due to rupture of an posterior communicating artery aneurysm.

Methods: A 53-year-old woman with a history of invasive pituitary macroadenoma was complained of headache and decreased visual acuity. She was submitted to a partial transsphenoidal resection at 11 years ago and transcranial resection at 2 years ago in our department. Magnetic resonance imaging (MRI) showed pituitary macroadenoma with necrotic change and intracranial hematoma on left frontal and temporal base. Thus, first impression was tumor bleeding to exclude vascular lesion, computed tomography angiogram (CTA) was performed, which demonstrated a ruptured posterior communicating artery aneurysm with a 3.6-mm width, and 4-mm height.

Results: After cerebral angiography, the aneurysm was managed by coil embolization with good patency of the parent artery. And then, transsphenoidal resection was performed to resection of the pituitary adnoma. The patient presented a good progression, without additional neurologic deficits.

Conclusions: In conclusion, the coexistence of pituitary adenoma and cerebral aneurysm is extremely rare. But it has been observed that the occurrence of cerebral aneurysms in patients with pituitary adenomas is larger than that in the general population. So, we suggest brain MRI together with CTA or three dimensional TOF MR angiogram should be used routinely for the preoperative assessments of pituitary adenoma.

Keywords: cerebral aneurysm, intracranial hemorrhage, Pituitary adenoma, posterior communicating artery aneurysm

A Case of Coil Embolization of Wide-Neck Basilar Tip Aneurysm by Triple Catheter Technique

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Objective: We describe a case of coil embolization of a wide-neck basilar tip unruptured aneurysm via a triple catheter technique.

Methods: A 69-year-old female with a medical history of arrhythmia, hypertension, and spinal stenosis at lumbar area, presented with headache and severe back pain. Magnetic resonance angiography and cerebral angiography revealed a wide-neck basilar tip unruptured aneurysm. At first, she was planned for spinal surgery for lumbar stenosis due to severe back pain. However, the initial attempt by endovascular coil embolization for basilar tip aneurysm performed, because that postembolization antiplatelet medication (intracranial stent) in interventional approach makes spinal surgery difficult.

Results: The aneurysm was successfully treated by triple catheter technique without intracranial stent. The patient recovered favorably without any further neurological deficit.

Conclusions: The triple catheter technique is a viable approach for endovascular aneurysm coil embolization in cases with a postembolization antiplatelet medication in interventional approach is contraindicated.

Keywords: basilar tip aneurysm, triple catheter technique, coil embolization

An old age patient with Contrast Induced Nephrotoxicity

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Objective: Nowadays, the usage of contrast media is increased because of the develop of radiographic inspection and treatment. Contrast media has various toxicity to persons.

Methods: There are many kinds of contrast media side effect. One of them, the contrast induced nephrotoxicity is common and very important.

Results: We report an old patient who was stented cerebral artery and the next day he occurred acute renal failure.

Conclusions: Contrast Induced Nephrotoxicity is common. But we want to keep in mind the important of contrast induced nephrotoxicity.

Keywords: Contrast media, Acute renal failure, Nephrotoxicity, Acidosis.

Cerebral infarction in Young woman with contraception

Sung-Hoon, Min, M.D., Chang-Yeong, Kwon, M.D., Dong-Gyu, Shin, M.D., Tae-Sik, Kong, M.D., Hyo-Jun, Kim, M.D., Woo-Ram, Shin, M.D., Yong-Woo, Lee, M.D.

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Objective: The oral contraceptive is most common method of hormone contraception. Almost of oral contraceptives are safe to woman and benefit to increase of bone density, reduce of ectopic pregnancy, ovarian cancer.

Methods: But overusing oral contraceptive has side effect like as cerebral infarction, myocardiac infarction, pulmonary thromboembolism.

Results: We report cerebral infarction patient who had taken oral contraceptives more than 10 years.

Conclusions: .

Keywords: Oral contraceptive, Cerebral infarction, Thrombosis

Memo

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