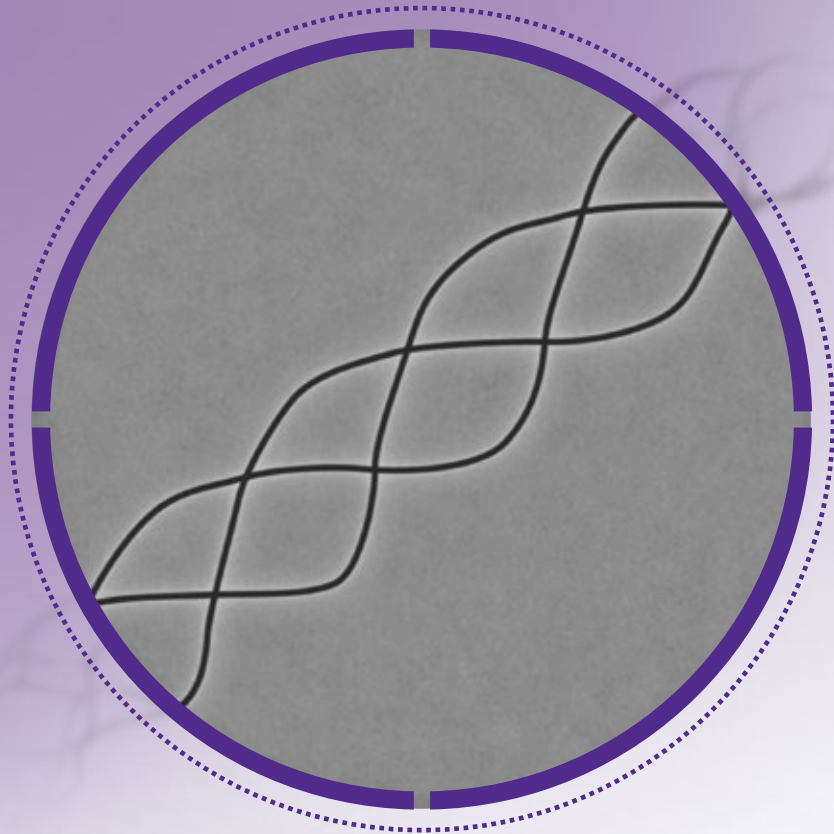




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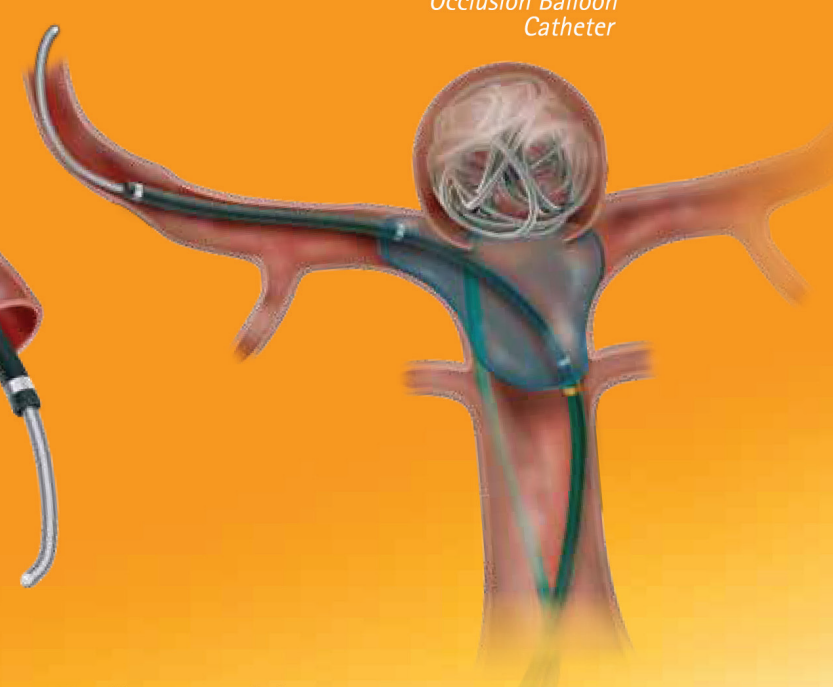
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2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회

08:00-08:30 Registration

08:30-08:40 Opening Remarks

정용구 (대한신경외과학회 이사장), 권오기 (대한뇌혈관내수술학회 회장)

Free Paper I

좌 장: 김범태 (순천향대 부천병원), 유도성 (가톨릭대 의정부성모병원)

08:40-09:20 Free Paper I-I Intracranial Aneurysm-Clinical Aspect

Endovascular treatment for superior cerebellar artery aneurysms 김창현 (서울대병원) / 3

Endovascular treatment of ruptured pericallosal artery aneurysms: report of a single center experience 고준경 (부산대 양산병원) / 4

Treatment of blood blister-like aneurysm of the internal carotid artery that experienced rapid growth with stent-assisted coil embolization 최규선 (한양대병원) / 5

Endovascular treatment of distal posterior inferior cerebellar artery aneurysms - report on 4 cases: clinical characteristics and strategy for treatment 홍대영 (에스포항병원) / 6

09:20-10:00 Free Paper I-II Ischemia

Procedure-related complications of balloon angioplasty and stenting with Wingspan stent in treating intracranial artery stenosis 신희섭 (강동경희대병원) / 7

Is the intolerance inevitable consideration in the use of proximal balloon occlusion embolic protection system for carotid arterial stenting? 유승훈 (울산대 강릉아산병원) / 8

Blood pressure lowering effect of carotid artery stenting in patients with symptomatic carotid artery stenosis 정준호 (연세대 강남세브란스병원) / 9

Clinical analysis of carotid artery stenting with using filter-protected device and proximal flow blockage device: preliminary result 정승영 (대전을지대병원) / 10

Clinical outcomes after carotid stenting in octogenarians with symptomatic carotid stenoses 김성림 (가톨릭대 부천성모병원) / 11

10:00-10:20 Coffee Break

Special Lecture I 해외연자 초청강연

좌 장: 권오기 (분당서울대병원)

10:20-11:00 Onyx experience in EVT of brain AVM

Dong-Lei Song (Deji Hospital & Shanghai Neuromedical Center) / 15



좌 장: 백민우 (가톨릭대 부천성모병원)

11:00-12:00	Endovascular treatment of large or giant aneurysm	권순찬 (울산대병원) / 21
	Endovascular treatment for large and giant aneurysm	김영우 (가톨릭대 부천성모병원) / 25
	Endovascular treatment for large and giant aneurysms	황교준 (분당서울대병원) / 29
12:00-13:30	<i>Lunch & General Assembly</i>	



Special Lecture II 해외연자 초청강연

좌 장: 신용삼 (가톨릭대 서울성모병원)

13:30-14:10 Onyx experience in EVT of dural AVF

Dong-Lei Song (Deji Hospital & Shanghai Neuromedical Center) / 33



Symposium II 해외연수보고

좌 장: 권도훈 (울산대 서울아산병원)

14:10-15:10	Umass memorial hospital Dr. Ajay K. Wakhloo	권현조 (충남대병원) / 39
	Pipeline embolization device for large or giant intracranial aneurysms: comparing the angiographic and clinical outcomes between PED and conventional methods	장인복 (한림대 평촌성심병원) / 48
	해외연수보고	권기훈 (부천세종병원) / 52
15:10-15:30	Coffee Break	



Free Paper II

좌 장: 이창영 (계명대 동산의료원), 조재훈 (대구가톨릭대병원)

15:30-16:15	Free Paper II-I Intracranial Aneurysm-Procedural Aspect	
	Single center experience with balloon-assisted coil embolization of cerebral aneurysm	윤석만 (순천향대 천안병원) / 57
	Modified waffle cone technique for complex cerebral aneurysms	정진영 (동의의료원) / 58
	Endovascular treatment of wide-neck intracranial aneurysms using minimal supporting devices: double-catheter technique	허 준 (가톨릭대 성빈센트병원) / 59
	Modified double microcatheter technique for wide-necked posterior communicating artery aneurysm with daughter sac	신동성 (순천향대 부천병원) / 60
	Endovascular management for retreatment of postsurgical intracranial aneurysms	조영대 (서울대병원) / 61



2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회

16:15-17:00 **Free Paper II-II** Endovascular Neurointervention-Others

The impact of stent design on the structural mechanics of the crossing
Y-stent: an in vitro study 이창영 (계명대병원) / 62

MR-DWI positive lesions and its relationship with symptomatic ischemic
complications after coiling of unruptured intracranial aneurysms 강동훈 (경북대병원) / 63

Early experience of transluminal balloon angioplasty using dual lumen
balloon catheter for angiographic cerebral vasospasm after subarachnoid hemorrhage 신승훈 (한림대 동탄성심병원) / 64

Covered stents for the endovascular treatment of a direct carotid cavernous
fistula: single center experiences with 10 cases 조영대 (서울대병원) / 65

Intracranial venous sinus stenosing for idiopathic intracranial
hypertension (IIH) 장경술 (가톨릭대 인천성모병원) / 66

17:00-17:10 *Closing Remarks*

권오기 (대한뇌혈관내수술학회 회장)



Free Paper I

좌 장: 김범태 (순천향대 부천병원), 유도성 (가톨릭대 의정부성모병원)

2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회



Endovascular Treatment for Superior Cerebellar Artery Aneurysms

Chang-Hun Kim, Seung Chai Jung, Jun Hyong Ahn, Young Dae Cho, Hyun-Seung Kang, Moon Hee Han

Department of Neurosurgery & Radiology, Seoul National University Hospital, Seoul, Korea

Objective: Superior cerebellar artery (SCA) aneurysms have distinctive morphological configuration and vascular source. We evaluated angio-architectural characteristics of SCA aneurysms and outcome of endovascular treatment.

Methods: Data accruing prospectively from January 2002 to September 2013 yielded, 53 patients harboring 53 SCA aneurysms, each classified as basilar type, basilar-SCA type, and SCA type based on the SCA incorporation degree by the aneurysm. Clinical outcome of the patients and morphological outcome of the aneurysms were assessed, with emphasis on technical aspects of treatment.

Result: Angle between SCA and PCA on the side of SCA aneurysm was more obtuse ($124.8 \pm 29.1^\circ$) than that on the opposite side unrelated to the aneurysm ($44.8 \pm 22.0^\circ$). Basilar-SCA type was the most common (66.0%), followed by SCA type (20.8%) and basilar type (13.2%). Steam-shaped “S” microcatheters (n=16) facilitated aneurysmal selection in the cases with approach via the contralateral VA of the aneurysm (n=28), while preshaped 45/90/J microcatheter (n=21) were mainly used in ipsilateral side approach (n=25). Single microcatheter technique (52.8%) was the most commonly applied, followed by double microcatheter (34.0%). Stent (9.4%) and microcatheter protection technique (3.8%) was mostly used in half SCA-involved type. Successful aneurysmal occlusion could be achieved in 82.1%, with no procedure-related morbidity and mortality. During a mean follow up of 25.8 (± 24.4) months (n=46), stable aneurysmal occlusion was sustained in 89.1%.

Conclusion: Coil embolization of SCA aneurysms is a safe and effective treatment modality by customized procedural strategy to accommodate distinctive angio-anatomical configurations.

Key Words: Aneurysm, Superior cerebellar artery, Coil embolization.



Endovascular Treatment of Ruptured Pericallosal Artery Aneurysms: Report of a Single Center Experience

Jun Kyeong Ko,¹ Eun Young Yun,³ Chang Hwa Choi,¹ Jae Il Lee,¹ Sang Weon Lee,⁴ Tae Hong Lee²

¹Departments of Neurosurgery, ²Diagnostic Radiology, ³Biostatistics, Medical Research Institute, Pusan National University Hospital, Busan, Korea

⁴Department of Neurosurgery, Medical Research Institute, Pusan National University Yangsan Hospital, Yangsan, Korea

Objective: Aneurysms arising from pericallosal artery (PA) are uncommon and challenging to treat. The aim of this study was to report our experience with endovascular treatment of ruptured PA aneurysms.

Methods: From September 2003 through May 2012, 30 ruptured PA aneurysms in 30 patients were treated at our institution via endovascular approach. Procedural data, clinical and angiographic results were reviewed retrospectively.

Result: All of the aneurysms were successfully treated with endovascular treatment. The immediate angiographic control showed complete occlusion in 21 (70.0%) patients and near-complete occlusion in 9 (30.0%). Procedure-related complication occurred, including procedure-related rebleeding in six and thromboembolic event in two. Preoperative contrast retention was most strongly associated with a increased risk of procedure-related rebleeding. At the end of the observational period, 18 patients were independent with a mRS score of 0-2, while the other 12 were dependent or dead (mRS score, 3-6). Adjacent hematoma was associated with a increased risk of poor clinical outcome. No neurologic deterioration or bleeding was seen during the follow-up period (mean, 32.7 months) in all survived patients. Seventeen of 23 surviving patients underwent follow-up conventional angiography (mean, 16.5 months). The result showed stable occlusion in 14 (82.4%), minor recanalization in two (11.8%), and major recanalization in one (5.9%), who had required recoiling.

Conclusion: Our preliminary experience demonstrates that endovascular treatment for ruptured PA aneurysms is feasible and effective. Procedure-related rebleedings occur far more often (20.0%) than has been generally suspected in other locations and were associated with a preoperative contrast retention. An existing adjacent hematoma was a predictor of poor clinical outcome.

Key Words: Intracranial aneurysm, Pericallosal artery, Endovascular treatment.



Treatment of Blood Blister-Like Aneurysm of the Internal Carotid Artery That Experienced Rapid Growth with Stent-Assisted Coil Embolization

Kyu-Sun Choi, Hyeong-Joong Yi

Department of Neurosurgery, Hanyang University Medical Center, Seoul, Korea

Objective: Blood-blister-like aneurysms (BBAs) are rare but challenging to treat owing to their fragile, thin walls and poorly defined necks. Here we report our experience of successful treatment with the use of stent-assisted, repeated coil embolization in the treatment of ruptured BBAs of the ICA that experienced rapid growth.

Methods: Six ruptured BBAs in 6 consecutive patients (3 men and 3 women; mean age 48 years, range 39-57 years) were treated using stent-assisted endovascular coil embolization in single center between August 2011 and September 2013. The angiographic findings, treatment strategies, and follow up results were retrospectively analyzed.

Result: All six BBAs were located in C6 or C7 segment of internal carotid artery. Four BBAs had rapid growth of aneurysm size before treatment. Coil embolization with stent-within-a-stent technique as primary treatment were performed in three patient. There were no recanalization during follow up. However, Three BBAs were needed additional embolization due to neck recanalization during follow up period in two stent-assisted coil embolization and one double stent. All six patients had no re-bleeding or neurologic deficits at last follow up.

Conclusion: Stent-assisted coiling of a ruptured BBA is technically challenging but can be done with favorable results. However, it needs to take a close observation for rapid growth before treatment or early re-growth after treatment. Repeated angiographic follow-up with questioning attitude is mandated so that accurate diagnosis and additional treatment can be performed.

Key Words: Blood-blister-like aneurysm, Endovascular treatment.



Endovascular Treatment of Distal Posterior Inferior Cerebellar Artery Aneurysms - Report on 4 Cases: Clinical Characteristics and Strategy for Treatment

Dae-Young Hong,¹ Young-Jin Lee,¹ Se-Jin Oh,² Beom-Jin Choi,¹ Hae-Wook Pyun,³
Yen-Koo Kang,¹ Mun-Chul Kim¹

¹Departments of Neurosurgery, ²Neurology, ³Radiology, S Neurosurgery Specialty Hospital, Pohang, Korea

Objective: Aneurysms located at the distal portion of the posterior inferior cerebellar artery (PICA) are rare, and their clinical features are not fully understood. We report 4 cases and analyze their clinical characteristics and outcomes from three different treatment strategies

Methods: We retrospectively reviewed 4 cases with a distal posterior inferior cerebellar artery (PICA) aneurysm among 368 cases of intracranial aneurysms rupture that were surgically treated during the period from November 2008 to October 2013. The following data were analyzed: age, sex, aneurysm size, Hunt-Hess grade at presentation, angiographic characteristics, and clinical treatment outcome determined by Glasgow outcome scores (GOS). Treatments performed included 2 endovascular sacrificing the parent arteries of the aneurysms, 1 selective coiling, and 1 clipping after failure of endovascular treatment.

Result: Four patients (4 all females; mean age: 58 years; mean aneurysm size: 4.7 mm) presented at our facility with subarachnoid hemorrhage (SAH) caused by aneurysm rupture. Two patients presented with Hunt-Hess grades 5; two others were in Hunt-Hess grades 2 or 3. The location of the aneurysm was telovelotonsillar in 3 cases and cortical in 1 cases. The angiographic findings were 1 fusiform dissecting aneurysm and 3 saccular aneurysms. One patient with fusiform dissecting aneurysm died because of no procedural related Rt. MCA infarction after endovascular sacrificing the parent arteries. The surviving three patients had GOS of 5.

Conclusion: Treatment decisions were based on the individual clinician's experience, without a standardized approach to treatment. Endovascular sacrificing the parent artery of the distal PICA aneurysm result in permanent occlusion of the lesion. But selective coiling with parent artery preservation can be considered whenever the anatomy allowed the coils to be retained in the aneurysm sac. The type of parent artery and particularly the collateralization of its distal part should be considered as an essential factor to take into consideration when choosing a treatment strategy.

Key Words: Distal posterior inferior cerebellar artery (PICA) aneurysm, Endovascular sacrificing the parent artery, Selective coiling with parent artery preservation.



Procedure-Related Complications of Balloon Angioplasty and Stenting with Wingspan Stent in Treating Intracranial Artery Stenosis

Hee Sup Shin, Jun Seok Koh, Chang Woo Ryu

Neurointervention Unit, Kyung Hee University Hospital at Gangdong, Kyung Hee University School of Medicine, Seoul, Korea

Objective: Intracranial angioplasty and stenting using Wingspan stent is one of valuable treatments of symptomatic intracranial stenosis. But its periprocedural rates of stroke and death, that could be associated with complications occurred during procedures, remain debatable. We evaluated procedure-related complications of intracranial artery stenosis treated with balloon angioplasty and stenting with Wingspan stents in a single center experience.

Methods: From June 2010 to November 2013, 24 intracranial artery stenoses were treated by balloon angioplasty and stenting with Wingspan stent. Clinical manifestations, medical records and radiologic features were reviewed retrospectively.

Result: There were 6 (25%) procedure related complications - 1 subarachnoid hemorrhage (SAH) and 5 (20.8%) acute thrombus formations. SAH was due to arterial perforation during procedure, but the amount of hemorrhage was small and headache was the only symptom. We performed infusion of thrombolytic agent or placement of additional stent as rescue therapies in the cases of acute thrombus formation. Among the 5 patients of acute thrombus formation, 1 patient died due to large territory infarction, and remained 4 patients had no symptomatic cerebral infarction. The acute thrombus formation was occurred after balloon angioplasty in 3 patients and stent placement in 2 patients. In the angiographical variables, the group of acute thrombosis formation had higher ratio of balloon size to minimal lesion diameter than non-thrombus formation group. There were no significant differences of demographical factors including aspirin and clopidogrel resistances between two groups.

Conclusion: Procedure-related complications including acute thrombus formation occurred often during intracranial angioplasty and stenting using Wingspan stent, in this series. Careful procedure and workup could prevent acute thrombus formation during ballooning process.

Key Words: Intracranial stenosis, Wingspan, Complications.

Is the Intolerance Inevitable Consideration in the Use of Proximal Balloon Occlusion Embolic Protection System for Carotid Arterial Stenting?

Seung-Hoon You,¹ Woo-Young Jang,² Moon-Kyu Lee,² Moon-Kyu Kim,¹
Jae-Hong Ahn,³ Kwang-Deog Jo²

¹Departments of Neurosurgery, ²Neurology, ³Radiology, Gangneung Asan Hospital, College of Medicine, Ulsan University, Gangneung, Korea

Objective: The purpose of this study is to assess the factors which influence intolerance in the use of proximal balloon occlusion embolic protection device for carotid artery stenting (CAS).

Methods: From sep. 2012 to Oct. 2013, 27 patients (mean age: 70.3 ± 7.2 years) with proximal internal cerebral artery (pICA) stenosis were treated with proximal balloon occlusion embolic protection system. Fifteen patients presented with acute infarction and the other 12 patients with transient ischemic attacks (TIAs). Mean stenosis rate was $82.3 \pm 6.6\%$ (70-95%). Nine patients had the lesion at the left side (33.3%). Contralateral ICA occlusion or severe stenosis was observed in 12 patients (44.4%). Clinical data, angiographic findings, occlusion time, periprocedural medications including intravenous injection, and procedure-related complications were analyzed according to the presence or absence of intolerance.

Result: All cases were treated successfully and no peri-procedural untoward events occurred. All 3 steps i.e. pre-stent ballooning, stenting, and post-stent ballooning were done in 24 of 27 patients (88.9%) and, in the other 3 patients, only stenting and post-stent ballooning were done. Intolerance was observed in 6 patients (22.2%) and the mean duration of intolerance is 21.7 ± 20.4 seconds (10-60 seconds). There was no statistically significant difference between two dividing groups according to the presence or absence of intolerance in the comparison of clinical and angiographic factors including age, sex, presenting symptoms, stenosis rate, lesion side, occlusion time, and the presence of contralateral occlusion or flow compromising stenosis.

Conclusion: The proximal balloon occlusion embolic protection system seems to be useful in CAS, and the intolerance does not appear to be necessary restrictive consideration even when the patient does not have a eligible collateral system in conventional terms.

Key Words: Carotid artery stenting, Proximal occlusion, Embolic protection, Intolerance.



Blood Pressure Lowering Effect of Carotid Artery Stenting in Patients with Symptomatic Carotid Artery Stenosis

Joonho Chung,¹ Yong Bae Kim,¹ Chang-Ki Hong,¹ Sang Hyun Suh,² Eui-Young Choi,³
Hun Jae Lee,⁴ Yong Cheol Lim,⁵ Yong Sam Shin,⁶ Jin Yang Joo¹

¹Departments of Neurosurgery, ²Radiology, ³Cardiology, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

⁴Department of Social and Preventive Medicine, Inha University School of Medicine, Incheon, Korea

⁵Department of Neurosurgery, Ajou University School of Medicine, Suwon, Korea

⁶Department of Neurosurgery, Seoul St. Mary's Hospital, The Catholic University of Korea College of Medicine, Seoul, Korea

Objective: In patients with symptomatic carotid artery stenosis, long-term effects of carotid artery stenting (CAS) on blood pressure (BP) changes have not been documented well. We evaluated the effects of CAS on BP and found out its predisposing factors in patients with symptomatic carotid artery stenosis.

Methods: Between January 2003 and June 2012, a total of 107 patients were recruited and all subjects met the following inclusion criteria: 1) patients underwent CAS with symptomatic carotid artery stenosis >50%; 2) patients had clinical and radiographic data for at least one year of follow-up after CAS; and 3) patients had BP measurements at four different time points: pretreatment, posttreatment, one-month follow-up, and one-year follow-up. Exclusion criteria were as follows: 1) patients underwent CAS with asymptomatic carotid artery stenosis (n=52); 2) patients who had hypertension had changed their regimen of antihypertensive drugs during follow-up periods (n=38); 3) CAS in patients with acute ischemic stroke in acute period (<2 weeks) (n=26); 4) CAS as retreatment for restenosis of previously treated carotid stenosis (n=7); 5) CAS in patients with traumatic dissection (n=4); and 6) follow-up loss (n=44, due to death in 18 patients). We evaluated the significance of the BP changes between the pretreatment BP and follow-up BPs, and found out its predisposing factors. Paired t-tests were used for the significance of BP changes between the pretreatment BP and the follow-up BPs. Binary logistic regression analysis was performed on variables with an unadjusted effect and a p-value of < 0.10 on univariate analysis in order to determine independent associations of BP-lowering effect with other factors. A p-value of less than 0.05 for a 95% confidence interval was considered to be statistically significant.

Result: Compared to the mean systolic/diastolic BP value (141.0/87.4 mm Hg) at the pretreatment BP, the follow-up BPs were significantly decreased after CAS [120.5/74.5, 126.2/76.9, and 129.2/79.0 mm Hg at the posttreatment, the one-month follow-up, and the one-year follow-up, respectively (p<0.01)]. The location of the stenosis (odds ratio=1.856, 95% confidence interval, 1.388 to 5.589; p=0.003) and hypertension (odds ratio=1.627, 95% confidence interval, 1.101 to 3.757; p=0.014) were independent predisposing factors for BP-lowering effects of CAS on multivariate analysis.

Conclusion: Hypertension and the location of the stenosis were predisposing factors for BP-lowering effects of CAS during the follow-up periods. For patients with symptomatic carotid artery stenosis, CAS might have BP-lowering effect at the one-year follow-up especially in patients with hypertension or the stenosis at body lesions.

Key Words: Blood pressure, Carotid stenosis, Carotid stenting, Hypertension.

Clinical Analysis of Carotid Artery Stenting with Using Filter-Protected Device and Proximal Flow Blockage Device: Preliminary Result

정승영,¹ 윤별희,¹ 김재국,² 박문선,¹ 고영채,² 이수주²

울지대학교 의과대학 신경외과학교실,¹ 신경과학교실²

Objective: Carotid artery stenting을 할 때 cerebral embolization을 줄이기 위해 protection device를 사용하고 있다. 그 중 대표적인 것으로 filter-protected device와 proximal flow blockage device를 널리 사용하고 있다. 본 center에서 이 두 device의 cerebral embolic infarction을 protection 효과를 비교하는 연구를 진행하였다.

Methods: 2012년 1월부터 2013년 11월까지 symptomatic이나 asymptomatic ICA stenosis가 70% 이상 되는 26명의 사람을 대상으로 하였고 filter-protected device를 쓴 21명, proximal flow blockage device를 쓴 5명에서 stent후 신경학적인 증상이 생기는 지를 비교하였으며 Post stent 1일째 diffusion weighted MRI를 찍어서 embolus의 개수를 세서 비교하였다.

Result: Carotid stenting은 총 26명의 환자에서 성공적으로 진행되었다. 이 두 group 모두 사망자 및 새로 신경학적인 증상이 발생한 사람은 없었다. filter-protected device를 사용한 환자군은 평균 나이 68.4세로 평균 83% stenosis를 보였던 환자였으며 이 group에서는 stent insertion 전에 21명 중 10명(47%)의 환자가 infarction이 있었고 proximal flow blockage device는 평균 나이 71.4세로 평균 90% stenosis를 보였던 환자가 대상군이었으며 5명 중 2명(40%)의 환자가 infarction이 시술 전에 있었다. stent후 1일째 diffusion weighted MRI에서 filter-protected device를 사용한 사람은 21명 중 15명의 환자(72%)에서 embolus가 새롭게 발견되었으며 동측에 총 83개 반대측에 총 11개가 생겼다. proximal flow blockage device를 사용한 환자에서는 5명 중 1명의 사람(20%)에서 병변의 동측에 embolus가 6개 발견되었으며 반대측에서는 발견되지 않았다.

Conclusion: Carotid stenting을 시행할 때 아직 case 숫자가 적어서 일반화하기는 힘들지만 proximal flow blockage device가 filter-protected device를 사용하는 것보다 cerebral embolic infarction을 protection하는 효과가 더 좋은 것으로 보아 추후 지속적으로 두 group을 비교하는 전향적인 연구가 필요할 것으로 보인다.

Key Words: Carotid artery stenting, Filter-protected device, Proximal flow blockage device.



Clinical Outcomes After Carotid Stenting in Octogenarians with Symptomatic Carotid Stenoses

Seong-Rim Kim, Hoon Kim, Young-Woo Kim, Ik-Seong Park, Min-Woo Baik

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

Objective: The purpose of this study is to report authors' clinical experience of carotid stenting in octogenarians with symptomatic carotid stenoses.

Methods: From January 2001 to December 2012, 26 consecutive octogenarian patients (20 men and 6 women, mean age of 82 years with a range of 80 to 90) underwent carotid stenting to treat symptomatic carotid stenoses. Anatomic results at follow-up, procedure-related complications, and morbidity and mortality were retrospectively reviewed.

Results: Preoperative stenosis rate was 76% (65-95%). Protective devices were used in 18 cases (69%, 28/26). Stenting procedures were successful in all cases. Postoperative residual stenosis rate was 12% (0-30%). No procedure-related mortality was observed. Procedure-related neurologic morbidity was observed in one patient with unprotected carotid stenting. Procedure-related neurologic morbidity rate was 4% (1/14).

Conclusion: Carotid stenting in symptomatic octogenarians is a safe and effective treatment option. It is desirable to use a protective device to reduce procedure-related morbidity/mortality. More clinical experience is mandatory.



Special Lecture I

해외연자 초청강연

좌 장: 권오기 (분당서울대병원)

Onyx experience in EVT of brain AVM

Dong-Lei Song (Deji Hospital & Shanghai Neuromedical Center)

2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회



Curriculum Vitae

Name Dong-Lei Song
Sex Male
Nationality Chinese
Address Deji Hospital, 378 Gulang Road, Shanghai, China 200331

Academic Qualifications

1998 Doctor of Medicine, Shanghai Medical University

Education

1984-1990 Medical student in the Department of Medicine, Shanghai Medical University
 1993-1998 Postgraduate student for doctor's degree in the Department of Neurosurgery, Huashan Hospital, Shanghai Medical University
 2000 GDC training course, Seoul National University College of Medicine, South Korea
 2002-2003 Neuro-intervention therapy training in Istanbul University, Turkey
 2003 Onyx training course in Sao Paulo, Brazil
 2004 Advanced Onyx training course in Ankara, Turkey
 2013 Clinical observer at Barrow Neurosurgical Institute, Phoenix, USA

Experience

1990-1991 Intern rotating in the various departments of Hua Shan Hospital
 1991-1996 Resident training in the Department of Neurosurgery, Hua Shan Hospital
 1997-2000 Neurosurgeon in the Department of Neurosurgery, Hua Shan Hospital
 2000-2004 Assistant professor in the Department of Neurosurgery, Hua Shan Hospital
 2005-2012 Professor in the Department of Neurosurgery, Hua Shan Hospital
 2013 Director of Cerebral Vascular Center and President, Deji Hospital (Shanghai Neuromedical Center)

Current Studies

My current studies and research are mainly concerned with the experimental and clinical work about cerebrovascular disease, both on microsurgery and endovascular therapy. More than 1000 cases of cerebrovascular disease (brain aneurysms, AVMs, TCCFs, DAVFs, Spinal AVMs, ischemic diseases, etc) were treated successfully by embolization and microsurgery each year.

Since 2003, "the national advanced live training course of neuro-intervention therapy and neurosurgery" has been holding in Huashan hospital each year.

Since 2007, more than 50 doctors from Seoul, Hongkong, Macau and Taiwan have been trained in my "Onyx training course".

Since 2007, "the Huashan international conference on surgery for cerebral & spinal vascular diseases" has been holding in Shanghai every two years.

Since 2013, "cerebrovascular disease treatment live case workshop" will be hold in Deji Hospital (Shanghai Neuromedical Center)



Awards

- 1990 “Excellent Student”, awarded by Shanghai Medical University as a undergraduate student
Rong-Ling Award, for outstanding academic record and research, awarded by Shanghai Medical University
- 1994 Orient Scholarship, for excellent graduate student awarded by Shanghai Medical University
- 1997 “Excellent Resident of Hua Shan Hospital”, awarded by Hua Shan Hospital
“Excellent Student”, awarded by Shanghai Medical University as a graduate student
- 2002 “New Star in Hospital”, awarded by Shanghai board of health

Writings

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Dong-Lei Song, M.D.

Professor of Department of Neurosurgery

Director of Cerebral Vascular Center

President

Deji Hospital & Shanghai Neuromedical Center

378 Gulang Road, Shanghai, China

200331

E-mail: skullbase@tom.com



Symposium I

EVT of Large or Giant Aneurysm

좌 장: 백민우 (가톨릭대 부천성모병원)

2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회



Endovascular Treatment of Large or Giant Aneurysm

Kwon, SoonChan

**Department of Neurosurgery, Ulsan
University Hospital, University of Ulsan
College of Medicine**

Background

- ❖ Not always, but most aneurysms presented with mass effect are in the large and giant size range.

Clinical presentation by aneurysms with Mass effect

❖ Anterior circulation

- Ophthalmoparesis by compression of the CN III, IV or VI
- Ophthalmoplegia, frequently associated with cavernous sinus & PcomA aneurysms
- Decreased visual acuity & visual field deficits, mostly associated with carotid ophthalmic & superior hypophyseal aneurysms
- Frontal syndrome: giant aneurysms of the AcomA
- Dysphasia: MCA aneurysms

Clinical presentation by aneurysms with Mass effect

❖ Posterior circulation

- Brainstem compression
- CN III palsy: large basilar tip & SCA aneurysms
- Compression of CN V or VII: PICA aneurysms

Background

❖ Surgical treatment options for cerebral aneurysms presented with mass effect

- direct surgical clipping
- thrombectomy with clip reconstruction
- bypass surgery preceding occlusion

: still relatively high risk for complications

Background

❖ Endovascular treatment options for cerebral aneurysms presented with mass effect

- Parent vessels occlusion (PVO)
- Selective endosaccular coil embolization
- endoluminal flow diversion



Background

❖ Endovascular treatment options for cerebral aneurysms presented with mass effect

- Parent vessels occlusion (PVO)
 - : It has been proved to be an effective & safe treatment. However, it is not always possible.
- Selective endosaccular coil embolization
- Endoluminal flow diversion
 - : This has not yet been confirmed.

1. The efficacy of endovascular aneurysms occlusion in alleviating neurological deficits produced by mass effect. (Halbach VV, et al., J Neurosurgery 1994; 80: 659-666)
2. Treatment of large and giant fusiform intracranial aneurysms with Guglielmi detachable coils. (Gobin YP, et al., J Neurosurgery 1996; 84: 55-62)
3. Unruptured aneurysms presenting with mass effect symptoms: response to endosaccular treatment with Guglielmi detachable coils. Part I. Symptoms of cranial nerve dysfunction. (Malish TW, et al., J Neurosurg 1998; 89: 956-961)
4. Clinical and angiographic results of endosaccular coiling treatment of giant and very large intracranial aneurysms: a 7-years, single-center experience. (Gruber A, et al., Neurosurgery 1999; 45: 793-803)
5. Endovascular treatment of distally located giant aneurysms. (Ross IB, et al., Neurosurgery 2000; 47: 1147-1152)
6. Giant aneurysms of the internal carotid artery: endovascular treatment and long-term follow-up. (Lubicz B, et al., Neuroradiology 2003; 45: 650-655)
7. Coiling of very large or giant cerebral aneurysms: long-term clinical and serial angiographic results. (Sluzewski M, et al., AJNR 2003; 24: 257-262)
8. Giant vertebrobasilar aneurysms: endovascular treatment and long-term follow-up. (Lubicz B, et al., Neurosurgery 2004; 55: 316-323)
9. Challenges in the endovascular treatment in giant intracranial aneurysms. (Gonzalez NR, et al., Neurosurgery 2006; 59: S113-124)
10. Unruptured large and giant carotid artery aneurysms presenting with cranial nerve palsy: comparison of clinical recovery after selective aneurysm coiling and therapeutic carotid artery occlusion. (van Rooij WJ, et al., AJNR 2008; 29: 997-1002)
11. Endovascular treatment of largely thrombosed saccular aneurysms: follow-up results in ten patients. (Cho YD, et al., Neuroradiology 2010; 52: 751-758)
12. Partially thrombosed intracranial aneurysms presenting with mass effect: long-term clinical and imaging follow-up after endovascular treatment. (Ferns SP, et al., AJNR 2010; 31: 1197-1205)
13. Clinical analysis of giant intracranial aneurysms with endovascular embolization. (Ha SW, et al., J Cerebrovasc Endovasc Neurosurg 2012; 14: 22-28)

❖ Generally accepted concepts of selective endosaccular coil embolization for aneurysms presented with mass effect

- technically feasible with a low rate of procedural complications
- the good clinical outcome
- rate of (re-)bleeding: very low

❖ Generally accepted concepts of selective endosaccular coil embolization for aneurysms presented with mass effect

- : - coil compaction over time: reopening of the an. lumen
- symptoms related to mass effect

not appropriate or questioned

High possibility of re-canalization

❖ Reported possibility of reopening after selective coiling for large and giant aneurysms during follow-up

: about 70 - 75%, mostly as a result of migration of coils

cf. Reported rate of reopening for coiled aneurysms (Ferns SP, et al., Stroke 2009; 40:523-529)

: 21%

10% of aneurysms were retreated.

High possibility of re-canalization

❖ Why ?

1. These are more often partially thrombosed.
 - : thrombus resolution and coil migration into the thrombus mass is well known to occur frequently.
2. the impossibility of obtaining dense packing with coils
 - : Radiologic dense packing doesn't mean real dense packing.



High possibility of re-canalization

- ❖ New devices for endovascular coiling of large or giant aneurysms
 - New coils
 - Stents
 - ect.

???

Symptoms related to mass effect

- ❖ Resolution of CN III palsy after endovascular coiling compared to clipping group
 - : - already well established concepts
 - due to loss or reduction of aneurysmal pulsatility
 - no statistical difference of CN III palsy recovery in clipping and coiling groups

Symptoms related to mass effect

- ❖ Clinical and angiographic results of endosaccular coiling treatment of giant and very large intracranial aneurysms: a 7-years, single-center experience. (Gruber A, et al. Neurosurgery 1999; 45: 793-803)
 - : total 31 cases
 - Pre-operatively 13 cases had symptoms related to aneurysmal mass effect.
 - 5/13(45.5%): improved mass effect.

Symptoms related to mass effect

- ❖ Resolution of Cranial nerve palsy for large and giant aneurysms after endovascular selective coiling (van Rooij WJ, et al., AJNR 2008; 29: 997-1002)
 - : - 17 large or giant ICA an. with dysfunction of cranial N.
 - resolved in 3
 - improved in 10
 - remained unchanged in 4 ans.
 - ptosis resolved in all pts.
 - compared to a cohort of 31 large or giant Ans. treated with PVO, there were no statistical difference.

Symptoms related to mass effect

- ❖ Endovascular treatment of largely thrombosed saccular aneurysms: follow-up results in ten patients (Cho YD, et al., Neuroradiology 2010; 52: 751-758)
 - : - 4 were symptomatic due to mass effect
 - improved in 3 (75%)

Conclusions

- ❖ PVO is the treatment of choice for aneurysms presented with mass effect because it is effective, safe, definitive, simple to perform, and inexpensive.
- ❖ In case which cannot tolerate therapeutic PVO, alternative treatment, such as selective occlusion with coils or bypass surgery, should be considered.



Symposium I

EVT of Large or Giant Aneurysm

Conclusions

- ❖ The safety of coiling for large and giant aneurysms with mass effect is supported by previous many studies.
- ❖ Symptoms of mass effect, even though large or giant aneurysms, could be alleviated in most patients.
- ❖ Imaging follow-up is mandatory because reopening with time occurs in a substantial proportion of patients with large and giant aneurysms.

**Thank you
for your attention.**



Endovascular Treatment for Large and Giant Aneurysm

Department of Neurosurgery, Bucheon St Mary's Hospital,
The Catholic University of Korea
Young Woo Kim

2013 대한뇌혈관내수술학회 정기 학술 대회 및 총회
(Dec. 7th 2013)

가톨릭대학교 부천성모병원
THE CATHOLIC UNIV. OF KOREA BUCHEON ST. MARY'S HOSPITAL

Annual rupture rate

Author (Year)	Annual rupture rate (%)	Factors affecting rupture
Yassi et al. (1987) ²⁰	2.3	multiplicity
Rinkel et al. (1988) ²¹	1.5 (1.3-2.6)	symptomatic, size, location
ISUIA (1988) ²²	4.5 < 1 cm 0.65 < 1 cm 0.5 > 1 cm	size
Jevola et al. (2000) ²³	0.3	smoking, older age, size
Treatment et al. (2000) ²⁴	2.3	size
Morita et al. (2007) ²⁵	2.7	size, posterior, symptom
Warner et al. (2007) ²⁶	1.2 < 5 yrs 0.6 5-10 yrs 1.3 > 10 yrs	age > 60 yrs, female, location or P/terminal, size > 3 mm, posterior, symptom

an: aneurysms, pt: pat

➤ Morita et al.: 4.37% (10-24mm) / 33.4% (>24mm)

Risk Factor	Hazard Ratio (95% CI)	P Value
Largest dimension of aneurysm	Reference	
3-4 mm		
5-6 mm	1.13 (0.58-2.22)	0.71
7-9 mm	3.35 (1.87-6.00)	<0.001
10-24 mm	9.09 (5.25-15.74)	<0.001
≥25 mm	76.26 (32.76-177.54)	<0.001

Morita A, et al. *Neurol Med Chir* 2010;50:777-87
Morita A, et al. *N Engl J Med* 2012;366:2474-82

Types of Endovascular Treatment for Large and Giant Aneurysms

- 1. Parent vessel occlusion (balloons or coils)
with/without bypass surgery
- 2. Selective coil embolization
 - ✓ Coiling with/without aid of a supporting device (balloon, stent)
 - ✓ Onyx
- 3. Flow diverter: Silk, Pipeline
- 4. Flow disruptor: WEB device

➤ Depends on clinical and anatomic factors:
✓ clinical presentation, aneurysm location, timing of treatment after SAH, the presence of collateral circulation, aneurysm anatomy, and the presence of intra-luminal thrombus.

Reopening and Retreatment

- Systemic review by Ferns et al (46 studies - 8161 coiled An.)
 - ✓ Reopening 20.8%
 - ✓ Retreatment: 10.3%
- Risk factors: large aneurysm size, presence of intraluminal thrombus, low packing density, initial incomplete occlusion, duration of follow-up, ruptured aneurysms, location in the posterior circulation, and a large neck-dome ratio
- Mechanisms: coil compaction, aneurysm growth, coil migration into intraluminal thrombus, or resolution of intra-luminal thrombus

➔ higher retreatment rates with increasing proportion of aneurysms >10 mm (Lesser packing density and Intramural thrombosis)

Ferns SP, et al. *Stroke*. 2009;40:e523-e529
Ferns SP, et al. *Stroke*. 2011;42:1331-1337

Concerns!

- **Parent vessel occlusion**
 - ✓ BTO: high positive and negative predictive value
 - ✓ De novo aneurysm?
- **Selective coil embolization**
 - ✓ recanalization: When? / How many?
 - ✓ angiographic F/U: When first? / How often? / How long?
 - ✓ In-Stent Stenosis after stent-assisted coiling?
- **Pipeline stent**
 - ✓ complications
 - ✓ delayed aneurysm rupture?
 - ✓ Stent migration/shortening?
 - ✓ Late reopening

1. Parent vessel occlusion

- when tolerated, is an appealing technique
- simple to perform, safe, and definitively excludes the aneurysm from the circulation
- **1. ICA occlusion**
 - ✓ for giant and/or fusiform aneurysms of the cavernous and ophthalmic segments of the ICA
 - ✓ In the acute phase of SAH, cannot be recommended
 - ← vasospasm & ischemic events may be aggravated by diminished reserve capacity after occlusion of the carotid artery
 - ← impossible to do PTA



Symposium I

EVT of Large or Giant Aneurysm

BTO (Balloon Test Occlusion)

- Clinical testing during 30 minutes of ICA occlusion
- high positive and negative predictive value
- - Tolerance: synchronous filling of cortical veins in both territories, circulation times are equal
- - Uncertain: filling of cortical veins > 1 sec
- Van Rooij, et al:
 - ✓ angiographic tolerance: 86/122 (70.5%)
 - No early or late permanent neurologic ischemic deficits

1. van Rooij WJ, et al. *AJNR Am J Neuroradiol* 2005;1:175-78
 2. Abdul DG, et al. *AJNR Am J Neuroradiol* 2005;26:2602-09
 3. van Rooij WJ, *AJNR Am J Neuroradiol* 2009;30:12-8

Concern about de novo aneurysm after parent vessel occlusion

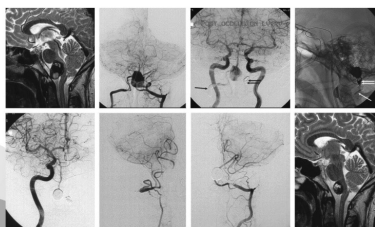
- as a result of hemodynamic alterations in the circle of Willis
- de Gast et al.: 0/26 (42.5 months F/U)
- Van Rooij et al.: 0/76 (midterm MRA F/U)

Therapeutic ICA occlusion is not risk factor
of development of de novo aneurysm !

1. de Gast AN, et al. *AJNR Am J Neuroradiol* 2007;28:508-10
 2. van Rooij WJ, *AJNR Am J Neuroradiol* 2009;30:12-8

1. Parent vessel occlusion – cont.

- 2. VA occlusion
- ✓ Large aneurysms of intradural V4 (between PICA and VBJ) → trapping
- ✓ Aneurysms in BA trunk or VBJ: VA occlusion or prox. BA occlusion



Peluso JP, et al. *AJNR Am J Neuroradiol* 2007;28:1747-51

1. Parent vessel occlusion – cont.

- 3. Occlusion of Vessels Beyond the Circle of Willis
- ✓ Distal to the circle of Willis: on the MCA or PCA
- ✓ fusiform dissecting, dolichoectatic, or serpentine with circumferential involvement of the vessel wall and a separate inflow and outflow tract.
- ✓ Selective BTO of the involved vessel in the awake patient
 - if tolerate → direct endovascular internal trapping with coils
 - if not tolerate → bypass procedures → trapping

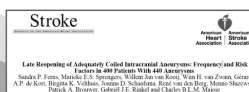
2. Selective Endovascular Treatment of Large and Giant Aneurysm

- 1. Selective Coiling of Large and Giant Aneurysm
 - ✓ most large aneurysms have a wide neck
 - ✓ supporting devices (balloon, stent) are often needed
 - ✓ With time, most aneurysms reopen by coil compaction, coil migration into intraluminal thrombus, or dissolution of intraluminal thrombus resulting in luminal enlargement.
- - Sluzewski M, et al.:
 - ✓ only 13/31 (42%): one coiling as a sole therapy
 - ✓ 58% require repeat coiling, surgery, and/or parent vessel occlusion

Sluzewski M, et al.: *AJNR Am J Neuroradiol* 2003;24:257-62

Late reopening

- Ferns et al: 400 Pts. with 440 aneurysms
 - ✓ Mean duration of F/U: 6 years (4.5 – 12.9)
 - ✓ Late reopening: 11/400 (2.8%)
 - ✓ Retreatment: 3 reopened aneurysms (0.7%)
 - ✓ Independent predictors:
 - aneurysm size ≥ 10 mm (OR 4.7; 95% CI, 1.3–16.3)
 - location on basilar tip (OR 3.9; 95% CI, 1.1–14.6).
 - ✓ No late reopenings in the 143 anterior cerebral artery aneurysms.

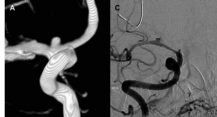


Late Reopening of Adequately Coiled Intracranial Aneurysms: Frequency and Risk Factors in 400 Patients With 440 Aneurysms
 Sander P. Ferns, Mandeep S. S. Sengupta, William J. van Rooij, Wim H. van Rooij, Gert J. A. P. de Kort, Rogier A. Velthuis, Jeroen P. Schoneveld, Eric van der Berg, Armin Shorrock, Patrick A. Brown, Gabriel H. Rinkel and Christel B. M. Majoie

Ferns SP, et al. *Stroke* 2011;42:1331-7

In-Stent Stenosis after Stent-Assisted Coiling

- Fiorella et al: Neuroform only - 9/156 (5.8%)
 - ✓ 2/9 (1.8%): Occlusion and symptomatic
 - ✓ 4/7: Spontaneous resolution
- Range from other studies: 1.3-3%



- Chalouhi N et al: N=435 (Neuroform: 264 / Enterprise: 171)
 - ✓ ISS: 11 Pts. (2.5%) (4.2 Months)
 - ✓ > 50%: 3 Pts. (0.7%)
 - ✓ All asymptomatic
 - ✓ Almost < 6 Mos. (majority within < 3 Mos.)
 - ✓ No difference btw devices

1. Fiorella D, et al. *Neurosurgery*. 2006;59: 34-42
2. Kanaoka H, et al. *Neurosurgery*. 2010;67:1523-1532
3. Micco J, et al. *Neurosurgery*. 2011;69: 908-913
4. Santillan A, et al. *Neurosurgery*. 2012;70:1232-1237
5. Chalouhi N, et al. *Neurosurgery*. 2013;72:390-396

2. Selective Endovascular Treatment of Large and Giant Aneurysm – Cont.

2. Selective Treatment of Large and Giant Aneurysms with Onyx

- ✓ In a multicenter study (CAMEO trial) by Molyneux,
 - in large and giant aneurysms, procedural time was long (~ 6 hours)
 - delayed occlusion of the carotid artery: 9 /100 (9%)
 - complete occlusion at 12 months F/U (large and giant): 38/53 (72%)
 - retreatment was performed in 9 (11%) of 79
 - permanent morbidity: 8.3% (8/97 patients) with 2 procedural deaths

Molyneux AJ, et al. *CAMEO trial. AJNR Am J Neuroradiol* 2004;25:39-51

3. Flow diverter

Comparison of Flow Diversion and Coiling in Large Unruptured Intracranial Saccular Aneurysms

Nohra Chalouhi, MD Ciro Randazzo Lea A. Moukazar		Table 2. Complication and Occlusion Rates Per Aneurysm Size		Fernando Gonzalez, MD; Shingal, MD; Jasal Jabbar, MD	
		Complications		Complete Occlusion	
Background and Purpose The purpose of this study was to compare the efficacy, safety, and clinical outcomes of flow diversion and coiling in large unruptured intracranial saccular aneurysms.		PED		ent of intracranial aneurysms. Strategies in terms of safety, efficacy, and clinical outcomes were compared in a 1:3 fashion with 120 anterior communicating artery aneurysms, and clinical outcomes were compared.	
Methods—Forty patients treated with PEDs and 40 aneurysms were enrolled and analyzed.		Aneurysms 10–19.9 mm 3/32 (9.4%)		23/27 (85.2%)	
		Aneurysms ≥20 mm 0/8		7/8 (87.5%)	
Results—There were no differences in the rate of procedure-related complications between the PED (7.3%) and the coil group (7.5%; $P=1$). At the latest follow-up, a significantly higher proportion of aneurysms treated with PED (86%) achieved complete obliteration compared with coiled aneurysms (41%; $P<0.001$). In multivariable analysis, coiling was an independent predictor of nonocclusion. Retreatment was necessary in fewer patients in the PED group (2.8%) than the coil group (37%; $P<0.001$). A similar proportion of patients attained a favorable outcome (modified Rankin Scale, 0–2) in the PED group (92%) and in the coil group (94%; $P=0.8$).		Coiling			
		Aneurysms 10–19.9 mm 7/94 (7.4%)		33/73 (45.2%)	
		Aneurysms ≥20 mm 2/26 (7.7%)		4/17 (23.5%)	
		PED indicates Pipeline Embolization Device.			
		size, and aneurysm location.			
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		PED indicates Pipeline Embolization Device.</			

Complications

Table 3. Outcomes by Aneurysm Size and Location			
Outcome	Odds Ratio	95% CI	
Ischemic stroke			
Aneurysm size (small/large vs giant)*	0.26	0.07-0.91	
Aneurysm location (anterior vs posterior)*	0.15	0.08-0.27	
SAH			
Aneurysm size (small/large vs giant)*	0.10	0.02-0.42	
Aneurysm location (anterior vs posterior)	1.89	0.43-8.21	
Perforator infarction			
Aneurysm size (small/large vs giant)	0.33	0.09-1.25	
Aneurysm location (anterior vs posterior)*	0.01	0.00-0.08	
Intraparenchymal hemorrhage			
Aneurysm size (small/large vs giant)	0.43	0.11-1.65	
Aneurysm location (anterior vs posterior)	0.48	0.17-1.35	

CI indicates confidence interval; and SAH, subarachnoid hemorrhage.
*Denotes statistically significant results. Odds ratio <1.0 favors the characteristic mentioned first.

Delayed Aneurysm Rupture after Flow-Diversion Treatment

- RADAR study
 - ✓ 14/1421 (1 %): 13 SAH & 1 CCF
 - ✓ > 10 mm: 2.1 %.
 - ✓ Risk factors: symptomatic aneurysm, large and giant aneurysm, large aspect ratio
- Mechanism
 - ✓ Hemodynamic mechanisms: sudden change in flow pattern → increased focal stress within the aneurysm wall that was not previously encountered.
 - ✓ Intra-aneurysmal thrombus: → nonorganized red thrombus (unstable & rich proteolytic enzymes) → weaken aneurysm wall

1. Kulcsar Z, et al. *Retrospective analysis of Delayed Aneurysm Ruptures (RADAR) study. EJMIT*. 2012. <http://www.ejmit.org>
2. Jurkowski B, et al. *Neuroradiology*. 2011;53:37-41

Spontaneous Delayed migration/shortening

- Chalouhi et al.: 5/155 (3.2%)
- Possible mechanisms
 - ✓ “Watermelon-seed effect” by mismatch in arterial diameter between inflow and outflow vessels
 - ✓ “Accordion effect” by foreshortening of device
- To prevent
 - ✓ Complete expansion with optimal vessel wall apposition (accurate sizing!)
 - ✓ Longer PEDs
 - ✓ Avoidance of dragging and stretching
 - ✓ Adjunctive coiling to prevent prolapse of PED

PED migration characteristics			
Patient No.	Length of PED Extending to Aneurysm [mm]	Migration Distance [mm]	Migration of Proximal or Distal End of PED?
1	7	6	Proximal
2	10	16	Distal
3	15	3	Distal
4	10	7	Distal and proximal
5	11	3.5	Distal

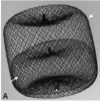
Chalouhi N, et al. *AJNR Am Neuroradiol*. 2013



Symposium I

EVT of Large or Giant Aneurysm

4. Flow disruptor: WEB device

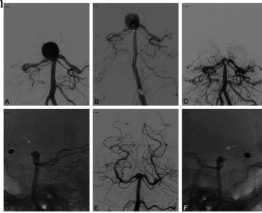



- Lubicz et al: prospective study with 20 wide-neck bifurcation UIA
 - ✓ Immediate: 1 complete occlusion, 13 near-complete, 5 incomplete
 - ✓ At 6 months: 2 complete, 15 near-complete, 2 incomplete
 - ✓ 1 rupture & 1 symptomatic infarction

Table 1. Clinical presentation and aneurysm characteristics in 19 patients with 20 intracranial aneurysms treated by WEB placement

No.	Age (yr)/Sex	Clinical Presentation	Neck (mm)	Width (mm)	Dome (mm)	Location
1	44/F	Incidental	6	5	2	NCA
2	44/M	Incidental	6	5	0.5	Vertebral artery-PICA
3	35/F	Incidental	5.5	4.5	8	NCA
4	57/F	Incidental	10	8	11	Basilar tip
5	42/F	Incidental	1	5.5	4	NCA
6	52/F	Incidental	4.5	7.5	0.5	NCA
7	44/F	Incidental	5	10	15	Basilar tip
8	42/M	Incidental	5.5	8.5	0.5	ICA bifurcation
9	56/M	Revascularization	4	8	9	AcomA
10	42/F	Revascularization	5	4	8	NCA
11	56/F	Incidental	4	4	7	NCA
12	54/F	Revascularization	10	8	18	NCA
13	40/F	Incidental	4.5	8	9	AcomA
14	50/F	Incidental	4.5	5.5	7	NCA
15	56/M	Incidental	4	7	9	NCA
16	70/F	Incidental	4.5	5	4	NCA
17	52/F	Incidental	9	12	12	NCA
18	54/F	Incidental	5	5.5	3.5	NCA
19	44/M	Incidental	5.5	8.5	7	NCA

Note: —AcomA indicates anterior communicating artery.



*Pierot L, et al. AJNR Am J Neuroradiol. 2012;33:1232–1238.
Lubicz B, et al. AJNR Am J Neuroradiol. 2013;34:1209–14*

Conclusions

- **Parent vessel occlusion**
 - ✓ When tolerated, endovascular therapy of choice (except BA trunk aneurysm)
 - ✓ Safe, effective, and definitive
 - ✓ No need of prolonged imaging F/U
 - ✓ No risk for of development of *de novo* aneurysm
 - ✓ Tolerance can be reliably evaluated with angiographic testing, even in patients under general anesthesia.
 - ✓ Clinical balloon test occlusion can be performed in vessels beyond the circle of Willis.

➤ Selective coil embolization

- ✓ a low-risk alternative (when no tolerance)
- ✓ frequent reopening with time → follow-up imaging is mandatory
 - 1st F/U after 3 months in partially thrombosed aneurysms
 - after 6 months in aneurysms without intraluminal thrombus
- ✓ In-stent restenosis after stent-assisted coiling is an uncommon, often transient, and clinically benign.
- ✓ late aneurysm regrowth and reopening may occur (particularly in large BA tip aneurysms)
- ✓ selective aneurysm occlusion with Onyx: no advantages to selective coiling, and higher complication rate

➤ Flow diverter

- ✓ provides higher aneurysm occlusion rate than coiling.
- ✓ but, the risk of procedure-related morbidity and mortality not negligible.
- ✓ keep in mind the occurrence of unexpected complications (delayed aneurysm rupture, ICH and perforator infarction), especially in larger, located posteriorly, and thrombosed aneurysm

➤ Clinical Outcome of EVT of ruptured Large and Giant Aneurysms

- ✓ Primary goal: prevention of short-term recurrent hemorrhage
- ✓ For ruptured intradural *carotid artery aneurysms* in patients in poor clinical condition,
 - primary coiling (even aimed at partial occlusion) is effective to prevent recurrent hemorrhage.
 - In a later stage (after the vasospasm period), more definitive treatment can be considered.
- ✓ For ruptured large aneurysms at *other locations*, parent vessel occlusion, when tolerated, is the therapy of choice.

Thank you





Endovascular Treatment for Large and Giant Aneurysms

황 교 준

분당서울대학교병원

Large 및 giant aneurysm의 치료는 기술적으로 어려우며 시술 관련 합병증도 높은 것으로 알려져 있다. 지난 10년간 본 병원에서는 이런 문제를 해결하기 위해 여러 치료방법 및 전략을 세워 개별환자에 맞춰 시도해왔다. 그 결과를 분석하여 합병증을 줄이고 결과를 향상시키기 위한 치료전략을 모색하고자 한다.

Simple Coiling Without Stent Support

파열성 거대 뇌동맥류나 스텐트가 보편적으로 사용되기 전 치료되었던 비파열성 거대 뇌동맥류에 사용되었다. Multiple microcatheter technique 혹은 balloon supporting하에 시행되었으며, 시술 관련 합병증은 대부분 mass effect에 의한 것이었으며, thromboembolic complication은 적었다. 하지만 장기추적결과는 약 50% 가까운 케이스에서 재발이 발생하였고, 기존에 mass effect가 없었던 환자도 동맥류가 다시 자람에 따라 direct mass effect, coiled aneurysm 주변의 edema, hydrocephalus로 새로 증상이 생겼다. 이런 문제를 줄이기 위해 intrasaccular heparin injection 및 시술 이후 anticoagulation을 사용하였으나 그 효과를 증명하기에는 좀 더 많은 증례가 필요하다.

Stent-Assisted Coiling

스텐트 사용이 보편화 되면서, 많은 수에서 사용되었다. 스텐트 없이 coiling이 가능한 경우도 flow diverting 효과를 얻기 위해 여러 개의 스텐트를 사용하기도 하였다. 하지만 stent없이 치료된 경우와 outcome에 있어서는 비슷하였다. 오히려 시술 중 혹은 이후 일부에서 stent와 관련된 thromboembolic complication이나 perforator infarction이 발생되기도 하였다.

Surgical Treatment

수술이 성공적인 경우 outcome에 있어서는 장기적인 면이나 수술 전 mass effect의 소실에서는 가장 좋았다. 해부학적으로 어렵지 않은 경우 direct surgery가 시도되었으나, proximal control이 현실적으로 가장 어려운 부분으로 파악되었다. 본원에서는 circulation arrest나 hybrid OR의 부재로 endovascular supporting으로 direct clipping이 된 적은 없었다.

대부분의 전방순환계 거대동맥류의 경우, mass effect가 있거나 생길 것으로 예측되는 경우, bypass 후 surgical 혹은 endovascular trapping이 시도되었고, 수술 합병증이나 결과 면에서 가장 효과적 이었다. 후방순환계의 경우 처음부터 시도된 경우는 없었으며, endovascular treatment후에도 계속 성장하는 경우에 대해 시도되었으나 적은 케이스여서 그 결과를 입증하기는 어렵다고 판단되었다. 초기에는 saphenous vein을 주로 graft로 사용하였으나 장기결과 중 폐색된 경우가 있어, 최근에는 radial artery graft를 주로 사용하고 있었으며, trapping후 perfusion defect가 적을 것으로 판단되는 경우 STA-MCA bypass를 사용하였다.

결 론

본원 결과를 분석하였을 때, 거대동맥류의 경우 mass effect가 있거나 없어도 endovascular treatment후 생기는 경우가 많았다. 따라서 전방순환계의 가장 현실적인 치료방법은 trapping with bypass로 판단된다. 후방순환계의 경우, 해부학적



접근이 용이치 않아 endovascular treatment가 우선적으로 시도되어야 하나 그 치료 결과가 만족스럽지는 않은 상태이다. 코일보조용 스텐트는 여러 개를 사용한다 해도 그 결과가 미흡하다. 현재 flow diverter를 국내에서 사용할 수 없기 때문에 정확히는 알 수 없으나 flow diverter의 시술 관련 합병증을 고려해도 giant aneurysm의 예후와 기존치료의 결과를 보았을 때 특히 후방순환계에서는 사용이 불가피해 보인다.



Special Lecture II

해외연자 초청강연

좌 장: 신용삼 (가톨릭대 서울성모병원)

Onyx experience in EVT of dural AVF

Dong-Lei Song (Deji Hospital & Shanghai Neuromedical Center)

2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회



Curriculum Vitae

Name Dong-Lei Song
Sex Male
Nationality Chinese
Address Deji Hospital, 378 Gulang Road, Shanghai, China 200331

Academic Qualifications

1998 Doctor of Medicine, Shanghai Medical University

Education

1984-1990 Medical student in the Department of Medicine, Shanghai Medical University
 1993-1998 Postgraduate student for doctor's degree in the Department of Neurosurgery, Huashan Hospital, Shanghai Medical University
 2000 GDC training course, Seoul National University College of Medicine, South Korea
 2002-2003 Neuro-intervention therapy training in Istanbul University, Turkey
 2003 Onyx training course in Sao Paulo, Brazil
 2004 Advanced Onyx training course in Ankara, Turkey
 2013 Clinical observer at Barrow Neurosurgical Institute, Phoenix, USA

Experience

1990-1991 Intern rotating in the various departments of Hua Shan Hospital
 1991-1996 Resident training in the Department of Neurosurgery, Hua Shan Hospital
 1997-2000 Neurosurgeon in the Department of Neurosurgery, Hua Shan Hospital
 2000-2004 Assistant professor in the Department of Neurosurgery, Hua Shan Hospital
 2005-2012 Professor in the Department of Neurosurgery, Hua Shan Hospital
 2013 Director of Cerebral Vascular Center and President, Deji Hospital (Shanghai Neuromedical Center)

Current Studies

My current studies and research are mainly concerned with the experimental and clinical work about cerebrovascular disease, both on microsurgery and endovascular therapy. More than 1000 cases of cerebrovascular disease (brain aneurysms, AVMs, TCCFs, DAVFs, Spinal AVMs, ischemic diseases, etc) were treated successfully by embolization and microsurgery each year.

Since 2003, "the national advanced live training course of neuro-intervention therapy and neurosurgery" has been holding in Huashan hospital each year.

Since 2007, more than 50 doctors from Seoul, Hongkong, Macau and Taiwan have been trained in my "Onyx training course".

Since 2007, "the Huashan international conference on surgery for cerebral & spinal vascular diseases" has been holding in Shanghai every two years.

Since 2013, "cerebrovascular disease treatment live case workshop" will be hold in Deji Hospital (Shanghai Neuromedical Center)



Awards

- 1990 “Excellent Student”, awarded by Shanghai Medical University as a undergraduate student
Rong-Ling Award, for outstanding academic record and research, awarded by Shanghai Medical University
- 1994 Orient Scholarship, for excellent graduate student awarded by Shanghai Medical University
- 1997 “Excellent Resident of Hua Shan Hospital”, awarded by Hua Shan Hospital
“Excellent Student”, awarded by Shanghai Medical University as a graduate student
- 2002 “New Star in Hospital”, awarded by Shanghai board of health

Writings

<In Chinese>

- 1) **Song Dong-Lei**, Zhou Liang-Fu. Comparison of various transpterional approaches in craniotomy. *Acta Academiae Medicine Shanghai*, 1995, 22(suppl.):139.
- 2) **Song Dong-Lei**, Gu Yu-Xiang, Zhou Liang-Fu. Ossifying fibroma of the cranial base. *Chin J Neurosurg*, 1997, 13(4):227.
- 3) **Song Dong-Lei**, Zhou Liang-Fu. Application of brain mapping in the brain operation. *Foreign Medical Sciences Section on Neurology & Neurosurgery*, 1997, 24(1):20.
- 4) **Song Dong-Lei**, Li Shi-Qi, Zhou Liang-Fu. Resection of giant invasive pituitary adenomas via extended subfrontal approach. *Chin J Neurosurg*, 1998, 14(2):87.
- 5) **Dong-lei Song**, Liang-fu Zhou, Shi-qi Li. The long-term follow-up results of the dural reconstruction without bone graft at the anterior skull-base defect. *Chin.J.Nerv.Ment.Dis.*, 1999;25(2):74.
- 6) **Song Donglei**, Zhou Liangfu, Li Shiqi, Ding Zurong. Analysis of the Creep Property of the Dural Mater at Skull Defects. *Acta Academiae Medicine Shanghai*, 1999, 26(3.):60.
- 7) **DongLei Song**, YuXiang Gu, QiWu Xu. Surgical treatment of clival Chordomas. *Chin.J.Clin.Neurosciences*, 2000, 8(1):55.
- 8) **Song DongLei**, Xu QiWu, Gao Xiang, et al. Resection of Giant Clival Chordomas via the Extended Subfrontal Exdural Approach. *Chin.J.Nerv. Ment.Dis.*, 2000;26(6):327.
- 9) **Donglei Song**, Zurong Ding, Liangfu Zhou, et al. Experimental Study of the Protrusion of the Dura Mater at Skull-base Defects. *Chin.J.Clin.Neurosciences*, 2001;9(1):6--8.
- 10) **Song Donglei**, Du Guhong, Bao Weiming. Neuronavigator-guided resection of pituitary microadenoma via transsphenoidal approach in patients with conchiform sphenoidal sinus. *Chin J Clin Neurosurg*, 2001;6(4):204-206.
- 11) **Song Donglei**, Zhou Liangfu, Li Shiqi. The long-term follow-up results of the dural reconstruction without bone graft at the anterior skull-base defects. *Chinese Medical Journal* 2002; 115(4):552-554.
- 12) **Song Donglei**, Leng Bin, Zhang Fayong. The diagnosis and treatment of spinal vascular malformations. *Chinese J Surgery*, 2003, 41(1): 76-77.
- 13) **Song Donglei**. Onyx in the treatment of cerebral vascular diseases. *Chin J Modern Neurodiseases*, 2004, 4(1):15-18.
- 14) **Song Donglei**, Leng Bing, Gu Yuxiang. Endovascular strategy for the treatment of traumatic carotid-cavernous sinus fistula. *Chin J Neurosurgery*, 2004, 20(3):238-241.
- 15) **Song Donglei**, Leng Bing, Gu Yu-xiang. Treatment of Cerebral Arteriovenous Malformations with Onyx. *Chin J Cerebrovasc Dis*, 2004, 1(10): 438-441.
- 16) **Song Donglei**. The treatment of the Cerebral Arteriovenous Malformations. *Chinese Medical Journal*, 2005, 85(43):3092-3093.
- 17) **Song Donglei**, Leng Bing, Xu Bing. A novel liquid embolic agent Onyx in the treatment of intracranial aneurysms: preliminary findings. *Chin J Cerebrovasc Dis*, 2006, 3(3):110-113.
- 18) **Song Donglei**, Leng Bing, Xu Bing. Clinical Experience of 70 Cases of Cerebral Arteriovenous Malformations Embolization with Onyx®, a Novel Liquid Embolic Agent. *Chinese J Surgery*, 2007,45(4):223-225.
- 19) **Song Donglei**, Leng Bing, Xu Bing, Wang Qihon, Chen Gon, Tian Yanlong. Clinical Experience on Intracranial Aneurysm Treatment with Balloon-assisted Coiling Technique. *Chin J Neurosurgery*, 2007,23 (11):826-828.
- 20) **WANG Wei, SONG Dong-lei, LENG Bing, WANG Qi-hon, YANG Chen**. A study of intracranial giant aneurysm treatment by parent arterial occlusion. *Chin J Neurosurgery*, 2007,23(11):833-836.
- 21) **Song Donglei**, Leng Bing, Xu Bing, Wang Qihon, Chen Gon, Tian Yanlong. Preliminary Experience on Balloon-assisted Onyx Embolization of Cerebral Vascular Malformations. *Chin J Cerebrovasc Dis*, 2007,4(12):551-554.
- 22) **Song Donglei**. Focused Tactics in Cerebral Arteriovenous Malformation Embolization with Onyx. *Chin J Cerebrovasc Dis*, 2009,6 (4):320-322.



<In English>

- 1) Xu F, Qin X, Tian Y, Gu Y, Leng B, **Song D**. Endovascular treatment of complex intracranial aneurysms using intra/extra-aneurysmal stent. *Acta Neurochir (Wien)*. 2011;153(4):923-30.
- 2) Chen G, Wang Q, Tian Y, Gu Y, Xu B, Leng B, **Song D**. Dural arteriovenous fistulae at the craniocervical junction: the relation between clinical symptom and pattern of venous drainage. *Acta Neurochir Suppl*. 2011;110(Pt 2):99-104.
- 3) Ni W, Gu YX, **Song DL**, Leng B, Li PL, Mao Y. The relationship between IL-6 in CSF and occurrence of vasospasm after subarachnoid hemorrhage. *Acta Neurochir Suppl*. 2011;110(Pt 1):203-8.
- 4) Wang Q, **Song D**, Chen G. Endovascular treatment of high-flow cervical direct vertebro-vertebral arteriovenous fistula with detachable coils and Onyx liquid embolic agent. *Acta Neurochir (Wien)*. 2011;153(2):347-52.
- 5) Xu F, Ni W, Liao Y, Gu Y, Xu B, Leng B, **Song D**. Onyx embolization for the treatment of brain arteriovenous malformations. *Acta Neurochir (Wien)*. 2011;153(4):869-78.
- 6) Chen G, Leng B, **Song D**, Wang Q. Multiple aneurysms of external and internal carotid arteries. *Acta Neurol Belg*. 2010;110(1):120-1.
- 7) Wang Q, Leng B, **Song D**, Chen G. Fusiform aneurysms of the vertebrobasilar arterial trunk: choice of endovascular methods and therapeutic efficacy. *Acta Neurochir (Wien)*. 2010;152(9):1467-76.
- 8) Wang X, Wang Q, Chen G, Leng B, **Song D**. Endovascular treatment of congenital brain arteriovenous fistula with combination of detachable coils and onyx liquid embolic agent. *Neuroradiology*. 2010;52(12):1121-6.
- 9) Li MH, Leng B, Li YD, Tan HQ, Wang W, **Song DL**, Tian YL. Comparative study of covered stent with coil embolization in the treatment of cranial internal carotid artery aneurysm: a nonrandomized prospective trial. *Eur Radiol* 2010;20(11):2732-9.
- 10) Wang Q, Chen C, **Song D**, Leng B. Transarterial embolization of traumatic carotid-superior hypophyseal arterial cavernous fistula. A case report. *Interv Neuroradiol* 2010;16(3):278-81.
- 11) Chen G, Leng B, **Song D**, Wang Q. Coexistence multiple intracerebral, spinal cavernous angiomas and multiple intracerebral meningiomas. *Neurol India* 2010;58(2):332-3.
- 12) **Song D**, Leng B, Gu Y, Zhu W, Xu B, Chen X, Zhou L. Clinical Analysis of 50 Cases of BAVM Embolization with Onyx, a Novel Liquid Embolic Agent. *Interv Neuroradiol*. 2005;11(Suppl 1):179-84.
- 13) **Song DL**, Leng B, Zhou LF, Gu YX, Chen XC. Onyx in treatment of large and giant cerebral aneurysms and arteriovenous malformations. *Chin Med J (Engl)* 2004;117(12):1869-72.

Dong-Lei Song, M.D.

Professor of Department of Neurosurgery

Director of Cerebral Vascular Center

President

Deji Hospital & Shanghai Neuromedical Center

378 Gulang Road, Shanghai, China

200331

E-mail: skullbase@tom.com



Symposium II

해외연수보고

좌 장: 권도훈 (울산대 서울아산병원)

2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회



해외연수보고

Umass Memorial Hospital
Dr. Ajay K. Wakhloo

충남대병원
권현조

Where

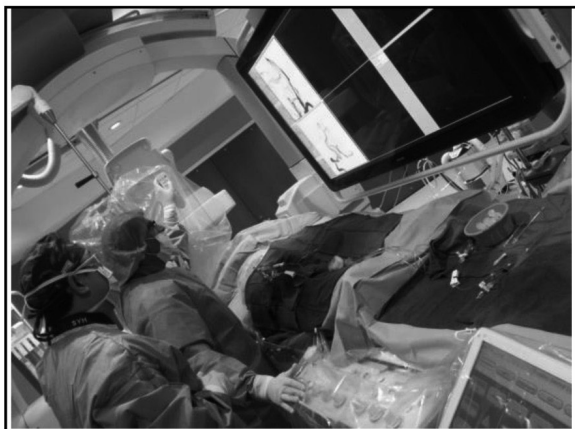
- University of Massachusetts(Umass) medical school, Worcester, MA
- Department of Radiology
- Umass memorial hospital
- NS – no residents
- 4 staffs in Neurointervention team





Angio Suite

- Two Philips Biplanes
- Four Staffs
- 200 aneurysms
- Flow diverter – Pipeline, Surpass
- Thrombectomy – Solitaire FR, Trevo Provue

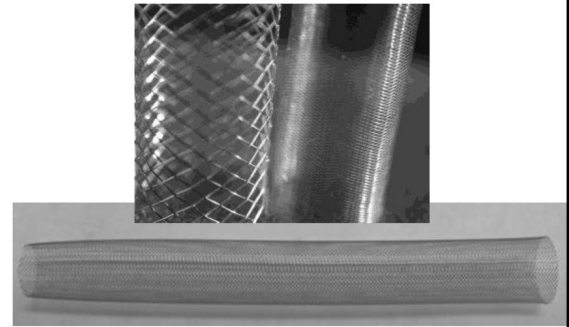


Who #1

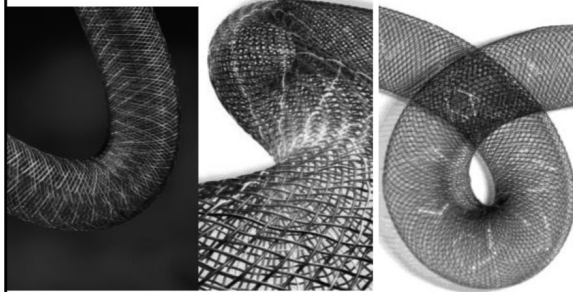
- Dr. Ajay K. Wakhloo
- Surpass – Stryker
- Europe – CE mark
- USA – FDA trial



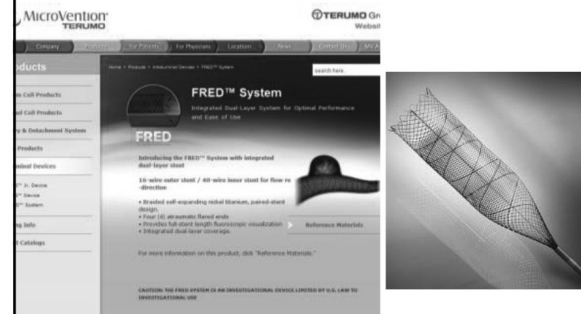
Surpass Flow Diverter



Pipeline vs. Surpass vs. Silk



FRED vs. Derivo



Stryker Corp. to purchase Surpass Medical for \$135 million

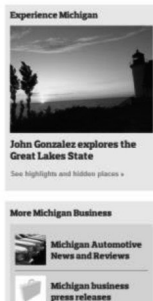
KALAMAZOO, MI – Stryker Corp. has opened its wallet again.

The Kalamazoo-based medical device maker announced Oct. 16 it is purchasing Surpass Medical, Ltd., for \$135 million.

Stryker will pay \$100 million in cash for the privately held company, with up to \$35 million in additional milestone payments.

Surpass, which was founded in 2003 and based in Tel Aviv, Israel, with manufacturing and research and development in Miramar, Fla., is developing a next-generation stent technology using a mesh design and delivery system to divert blood flow. The NeuroEndoCraft family of flow diverters is designed to redirect blood flow away from an aneurysm, allowing a stable clot to be formed.

"The acquisition of Surpass Medical further builds on Stryker's global platform in the fast growing and highly innovative neurovascular market and helps broaden our offering in complete stroke care," said Kevin A. Lobo, president and chief executive officer, in a statement. "We remain committed to furthering care in the interventional neurovascular space by offering products and capabilities differentiated from our competitors."



Who #2

- Matthew Gounis Ph.D.
- New England Center for Stroke Research
- Philips Angiomachine
- 3T MRI
- Device test
- Plastic vascular model

Matthew Gounis PhD



New England Center for Stroke Research

Home
Facilities
Services
Personnel

Facilities

Angiosurgical suite:

The center is built around the angiosurgical suite dedicated to pre-clinical research and home to the latest flat panel detector x-ray system available today (Allura FCB0, Philips Medical Systems, Best, Netherlands). The system offers both cardiac and vascular packages, 3-dimensional reconstruction, angiography (CDSA), 3D post-procedure imaging, and various software packages that are not yet available for clinical use. The suite is fully equipped for aseptic surgical procedures that include medical gases, physiologic monitoring, scrub rooms, OR lights, surgical cameras, and X-ray equipment for procedure documentation. Adjacent to the angiosurgical suite is the animal preoperative room and the Advanced MRI Imaging Center, enabling multimodality image acquisition.



- Allura FCB0
- Surgical physiological monitoring
- Matrix anesthesia machine and ventilator
- Harbormed anesthesia machine
- Omni ventilator (MRI) compatible
- Matrix anesthesia machine (MRI) compatible
- Decidoid OR lighting system with surgical camera and audiovisual
- Medical power injector
- i-STAT hand-held clinical analyzer
- Harvey hydroclave steam sterilizer

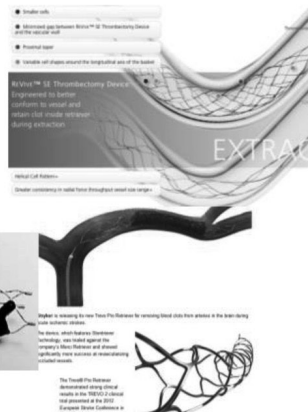
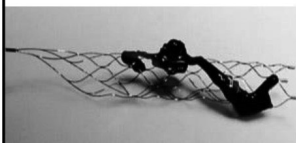
Chemistry and Hemodynamic laboratories:

The center also incorporates a chemistry and hemodynamics laboratories for bench-top, in vitro studies. The chemistry lab is equipped to create true to scale silicone vascular replicas. The models are manufactured by the use of a rapid prototyping system, with the assistance of computer aided design (CAD) software. In the hemodynamics lab, vascular models are connected to a flow loop system designed to mimic the conditions in the body through the use of a cardiac pulse duplicator and data acquisition system. The flow loop system is used to test devices for the treatment of vascular disease.

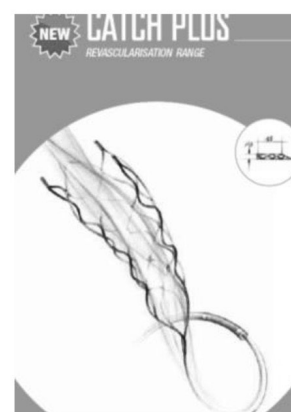
- Olympus AX30 upright microscope
- Prodigy Plus rapid prototyping machine
- Dewetron data acquisition system
- Transonic flow meter
- Comflow 100MRI programmable flow pump (MRI compatible)
- TA XT express enhanced texture analyzer
- VWR vacuum oven
- Eppendorf centrifuge
- Branson S510 ultrasonic cleaner
- Revco -85 freezer



- Solitaire FR, 2
- TREVO Provue
- Revive SE

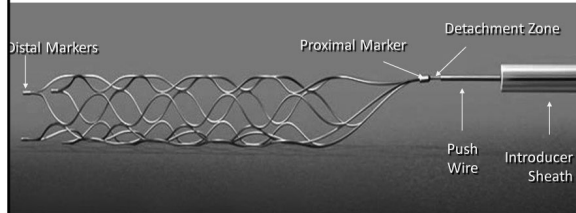


- Catch Plus (BALT)
- ERIC (Microvention)

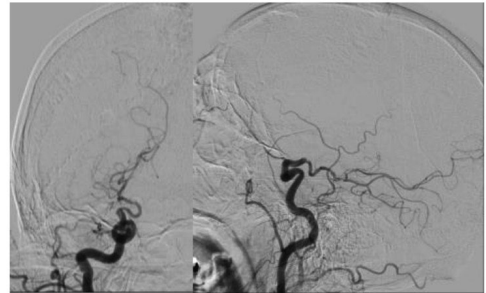




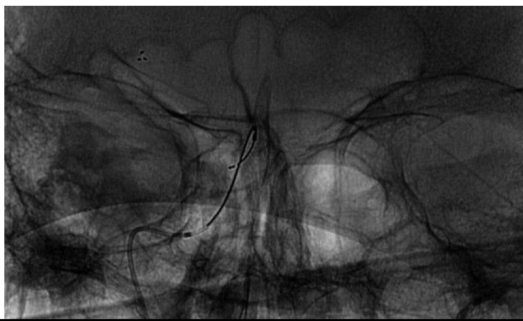
Overview of Solitaire AB/FR



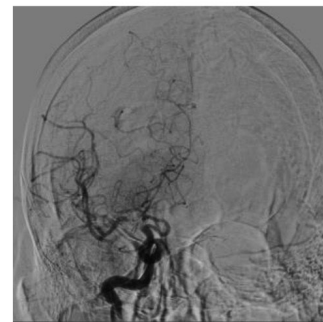
Distal ICA occlusion (72/M)



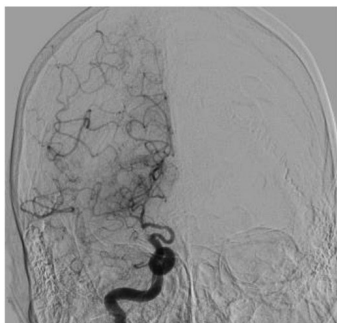
Temporary deployment



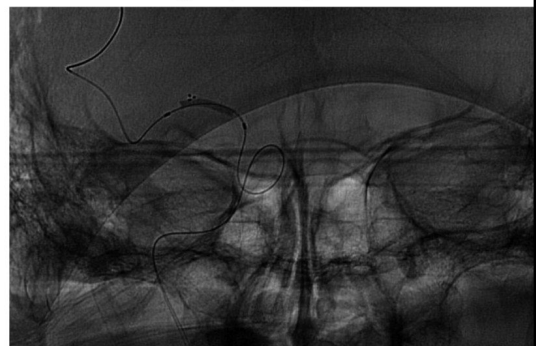
Partial recanalization



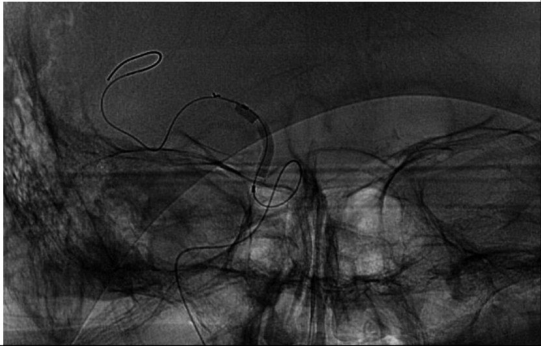
Early detachment during retrieval



Balloon angioplasty for rescue



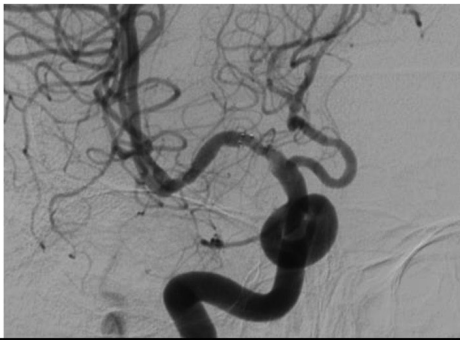
Balloon angioplasty for rescue



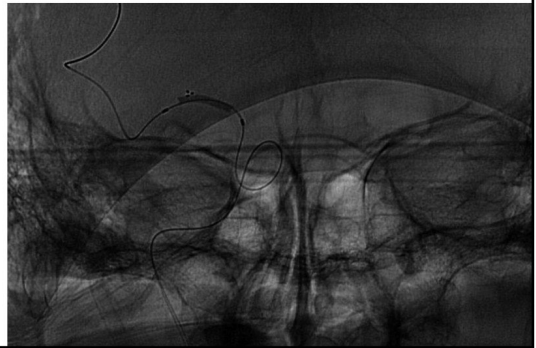
Final



24hrs later



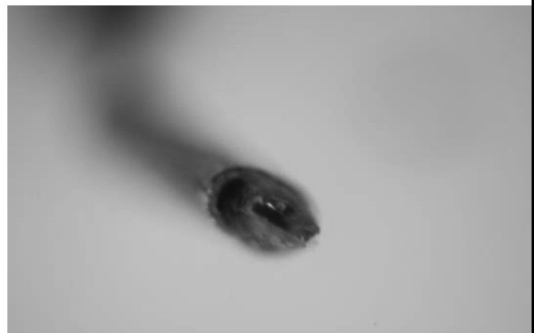
Balloon angioplasty for rescue



Tip of pusher wire

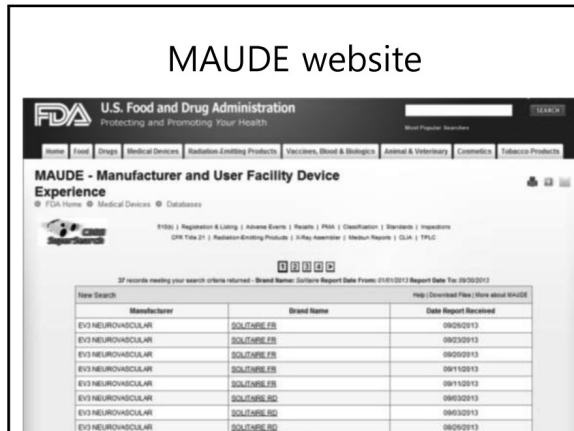


Tip of pusher wire





MAUDE website



Reported cases

	Location of separation	Pass no.	Outcome	Freq.	Description	Risk factors
Nayak et al.	ICA	1	mRS at 30 days 4	1/7	Self-detachment	Extreme tortuosity
Dorn et al.	NA	NA	NA	1/108	Inadvertent detachment	NA
Miteff et al.	MCA	2	mRS at 16 days 3 after recanalization with IA UK	1/26	Detached stent	Tortuosity and large thrombus
SWIFT study	NA	NA	TIMI 3 after rescue with snare	1/58	Device separation	NA
Kang et al.	ICA	1	mRS at 3 months 2 after Surgical removal of retained stent	NA	Detached unexpectedly during retrieval	Tortuous, acutely angled and circumferentially calcified ICA

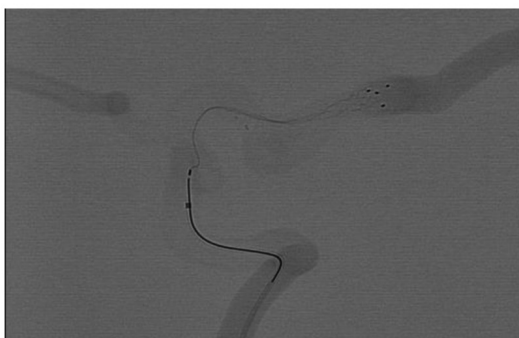
DMA (Dynamic Mechanical Analysis)



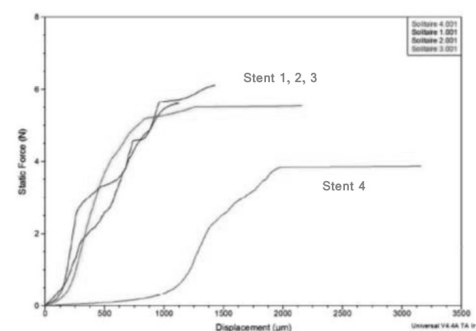
Tested stents

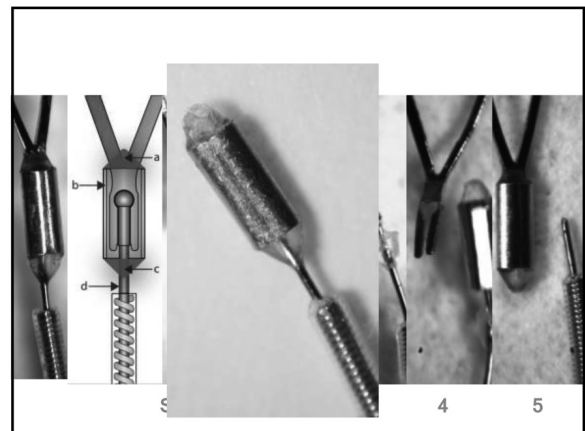
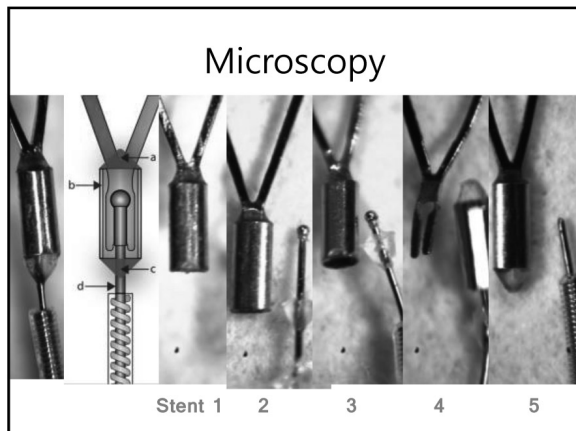
	Stent	Manipulation before DMA test	Re-sheathing during test	Force at break (N)	Main separation point
Stent 1	Solitaire AB 6 x 20	None	No	About 6	Proximal adhesive
Stent 2	Solitaire AB 6 x 20	None	Yes	About 6	Proximal adhesive
Stent 3	Solitaire AB 6 x 30	Deployment and retrieval 3 times in vascular replica	Yes	About 6	Proximal adhesive
Stent 4	Solitaire AB 6 x 30	Deployment and retrieval 1 time in vascular replica with pushing forward to make excessive bending at siphon	No	About 4	Distal adhesive (proximal marker at the end of wire)
Stent 5	Solitaire AB 4 x 20	Manually pulled apart	No	NA	The junction point of the ball-socket joint

Stent 4



Stress-Strain curve





Limitations

- Straight tensile force only at room temperature – adhesive function
- Small number of stents

Conclusion

- Detachment of the Solitaire stent during thrombectomy can be due to abnormal separation around or inside the proximal marker.
- Adhesion to the manufacturer's instructions for use (IFU) of partial resheathing to avoid excessive bending and not using the device for more than two passes might decrease the possibility for such device failure.

Clinical implication

- Partial resheathing



Clinical implication

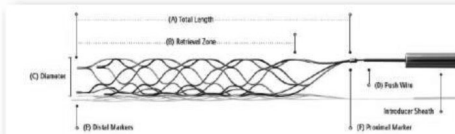
- Partial resheathing - avoid over-bending
- No forward pushing or torqueing
- Only 2 times attempts / Solitaire
- Check the integrity after every pass
- Calcification or severe atherosclerotic stenosis at the thrombosed or proximal segment
- Consider recapture of the device with the original or bigger catheter



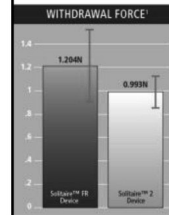
Solitaire 2

Solitaire™ 2 Revascularization Device Overview

Reference Number	Recommended Initial Sheath Diameter (mm)	(A) Total Length (mm)	(B) Retrieval Zone (mm)	(C) Device Diameter (mm)	(D) Push Wire Length (cm)	(E) Distal Markers	(F) Proximal Markers	Distance from Distal Tip to Flow-sensing Marker (cm)	micro-catheter ID (mm)
SFR2-4-15	2.0 - 4.0	26	15	4	180	3	1	<130	.021
SFR2-4-20	2.0 - 4.0	31	20	4	180	3	1	<130	.021
SFR2-6-20	3.0 - 5.5	31	20	6	180	4	1	<130	.027
SFR2-6-30	3.0 - 5.5	42	30	6	180	4	1	<130	.027



Solitaire 2



Improved Retrievability:

With an updated distal pushwire design, the Solitaire™ 2 device offers an **18% reduction in retrieval force** vs. the Solitaire™ FR device improving the ease of device retrieval.¹

*1806/101088, N=32. Testing completed on Solitaire™ 6x30 mm devices



감사합니다.

Pipeline Embolization Device for Large or Giant Intracranial Aneurysms: Comparing the Angiographic and Clinical Outcomes between PED and Conventional Methods

*Department of Neurosurgery
Institute of Neuroscience
Hallym University Medical Center
In Bok Chang, MD*

Challenging aneurysms

- Large or giant aneurysm
- Fusiform aneurysm
- Wide-necked aneurysm

Conventional methods

- Coiling only
- Balloon assisted coiling (BAC)
- Stent assisted coiling (SAC)
- The occlusion rates of large or giant wide-necked aneurysms are 35-71%

Flow diverters

- Paradigm-shifting for the treatment of these aneurysms.
- Pipeline Embolization Device (PED; ev3, Irvine, California, USA)
- SILK flow diverter (SFD, Balt Extrusion, Montmorency, France)
- The PED is the only device approved by the US Food & Drug Administration.
- Approved for aneurysms of the internal carotid artery (ICA) (petrous to superior hypophyseal segment).

Pipeline embolization device(PED)

- Flexible, tubular device of 48 strands with 25% of platinum and 75% of cobalt-nickel alloy
- Pore size : 0.02-0.05mm²
- Nominal diameter: 2.5-5mm
- 30-35% metal coverage (6.5 – 9.5%, bare metal stent)
- Reduce blood flow into aneurysm sac
- Progressive thrombosis
- Scaffold for neointimal overgrowth



The aims of this study

- Present our experiences of treatment of large or giant intracranial aneurysms with PED
- To compare the angiographic, clinical results and complications between the PED and conventional methods including Coiling alone, BAC and SAC



Materials and methods

- Between November 2007 and December 2012
- 116 large or giant aneurysms of 109 pts
- 38 aneurysms (33%) – ruptured
- 78 aneurysms (67%) – unruptured
- Conventional methods vs PED
- Angiographic results – Raymond class I-III

Follow up angiography

- Performed in 88 aneurysms (76%)
- 6 months – 1 year F/U
- Every 1 or 2 year F/U
- The mean F/U periods:
11.2months (1-57months)

Characteristics of 116 aneurysms of 109 patients treated with PED or conventional methods

	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
Age (years)				
Mean	61.9	60.2	57.6	55.6
Range	32-84	32-86	20-78	20-81
Gender				
Female	22 (95.7%)	21 (72.4%)	23 (76.7%)	29 (85.3%)
Male	1 (4.3%)	8 (27.6%)	7 (23.3%)	5 (14.7%)
Rupture				
Ruptured	11(47.8%)	17 (58.6%)	5 (16.7%)	5 (14.7%)
Unruptured	12 (52.2%)	12 (41.4%)	25 (83.3%)	29 (85.3%)
Initial mRS				
0-2	15 (71.4%)	19 (65.5%)	24 (88.9%)	29 (90.6%)
3-5	6 (28.6%)	10 (34.5%)	3 (11.1)	3 (9.4%)

Characteristics of 116 aneurysms of 109 patients treated with PED or conventional methods

	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
Aneurysm size				
Large	22 (95.7%)	29 (100%)	27 (90%)	29(85.3%)
Giant	1 (4.3%)	0	3 (10%)	5 (14.7%)
Morphology				
Saccular	20 (87%)	28 (87%)	26 (86.6%)	25 (87%)
Fusiform	2 (8.7%)	1 (87%)	2 (6.7%)	8 (8.7%)
Dissecting	1 (4.3%)		2 (6.7%)	1 (4.3%)

Characteristics of 116 aneurysms of 109 patients treated with PED or conventional methods

	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
Aneurysm location				
Cavernous	2 (8.7%)	3 (10.3%)	6 (20%)	15 (44.1%)
Ophthalmic	4 (17.5%)	5 (17.2%)	6 (20%)	10 (29.4%)
Paraclinoid	2 (8.7%)	3 (10.3%)	3 (10%)	4 (11.8%)
PCoA	5 (21.7%)	5 (17.2%)	1 (3.3%)	4 (11.8%)
MCA	2 (8.7%)	5 (17.2%)	4 (13.3%)	1 (2.9%)
ACA	1 (4.3%)	3 (10.3%)	3 (10%)	34 (100%)
Basilar top	5 (21.7%)	4 (13.8%)	3 (10%)	
Others	2 (8.7%)	1 (3.4%)	4 (13.3)	
Total	13 (100%)	29 (100%)	30 (100%)	

Clinical outcomes of 109 patients

	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
Follow-up mRS				
0-2	16 (76.1%)	20 (69%)	26 (96.3%)	29 (90.6%)
3-5	2 (9.6%)	4 (13.8%)	1 (3.7%)	1 (3.1%)
6	3 (14.3%)	5 (17.2%)	0	2 (6.3%)
Total (109)	21 (100%)	29 (100%)	27 (100%)	32 (100%)

Immediate Angiographic results of 116 aneurysms

Angiographic results	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
Raymond 1	15 (65.2%)	18 (62.1%)	21 (70%)	4 (11.8%)
Raymond 2	6 (26.1%)	10 (34.5%)	5 (16.7%)	1 (2.9%)
Raymond 3	2 (8.7%)	1 (3.4%)	4 (13.3%)	29 (85.3%)
Total (116)	23 (100%)	29 (100%)	30 (100%)	34 (100%)

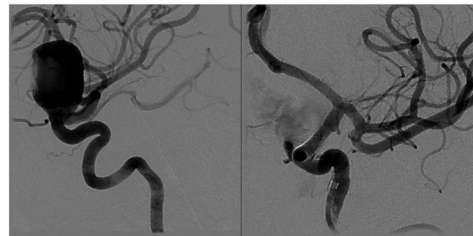
Follow up angiographies of 88 aneurysms

Angiographic results	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
Raymond 1	7 (50%)	12 (60%)	17 (65.4%)	23 (82.1%)
Raymond 2	6 (42.9%)	5 (25%)	7 (26.9%)	3 (10.8%)
Raymond 3	1 (7.1%)	3 (15%)	2 (7.7%)	2 (7.1%)
Total (88)	14(100%)	20 (100%)	26 (100%)	28 (100%)

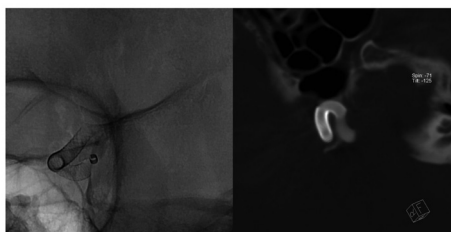
Procedure related complications

	Treatment methods			
	Coiling alone (%)	BAC (%)	SAC (%)	PED (%)
None	20 (87%)	21 (72.4%)	27 (90%)	29 (85.3%)
Thromboembolism	1 (4.3%)	6 (20.7%)	2 (6.7%)	2 (5.9%)
Intraoperative rupture	2 (8.7%)	1 (3.4%)		1 (2.9%)
Others*		1 (3.4%)	1 (3.3%)	2 (5.9%)
Total (116)	23 (100%)	29 (100%)	30 (100%)	34 (100%)

45/F, unruptured giant aneurysm



45/F, unruptured giant aneurysm



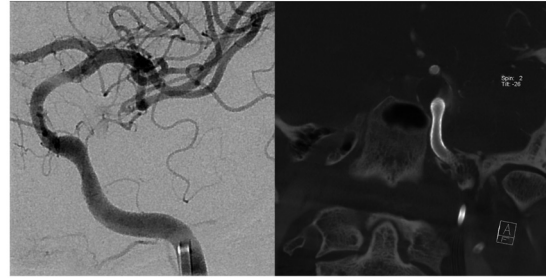
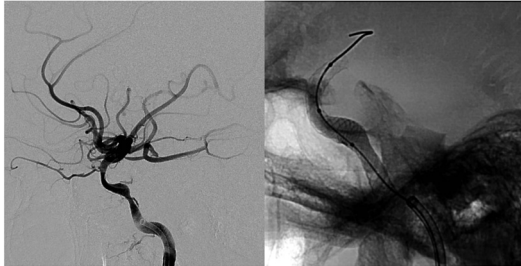
4.75x18, 5.0x18

POD 4 month





51/F, cavernous aneurysm (s/p 2PEDs) Angioplasty with Scepter C balloon



The number of PED

- Single PED: 7 (20.6%)
- Multiple PEDs: 27 (79.4%)
- The mean number: 2.1
- Multiple PEDs:
 - No significant stasis
 - Inadequate apposition
- Complete occlusion
 - 80% - single PED
 - 83.3% - multiple PEDs

Recanalization and Retreatment

- Overall recurrence: 20% (18/88)
- Overall retreatment: 14% (13/88)

	Treatment methods			
	Coiling only	BAC	SAC	PED
Retreatment	1 (14%)	4 (40%)	6 (23%)	2 (7%)
Total (88)	14 (100%)	20 (100%)	26 (100%)	28 (100%)

Conclusions

- The treatment with PED was effective and safe for large or giant intracranial aneurysms.
- Angiographic and clinical outcomes were comparable with conventional methods.
- More long-term and large studies are warranted and will clarify the durability of PED and delayed complications.



- 왜 가는가?
- 어디로 누구에게 가야 하는가?
- 무엇을 배우고 얻어야 하는가?
- 이외의 부수적인 사항(가족, 의식주...)은 현지 해결

- 2012.7.2. ~ 2013.7.18.
- University of California, San Francisco
UCSF Medical Center @ Parnassus Ave.
Dpt. of Neurosurgery
Dpt. of Neurointerventional Radiology



Neurosurgery



Michael Lawton, M.D.

Vascular neurosurgeon

Dr. Michael T. Lawton is the chief of Vascular Neurosurgery and specializes in the surgical treatment of aneurysms, arteriovenous malformations (AVMs), arteriovenous fistulas, cavernous malformations and cerebral revascularization, including carotid endarterectomy. As chief of the busiest vascular neurosurgery service on the West Coast for over 15 years, he has surgically treated over 3,000 brain aneurysms and over 600 AVMs. He is also trained in the endovascular treatment of aneurysms.

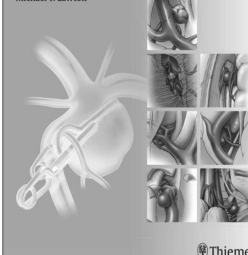
His research at the Center for Neurological Cerebrovascular Research (CCR) investigates the physiology of cerebral circulation and the pathophysiology of vascular malformations. His basic science investigations study the formation, underlying genetics and rupture of brain AVMs, as well as hemodynamics, rupture and computational modeling of brain aneurysms. His clinical investigations study the anatomy of microsurgical approaches to vascular lesions and efficacy of aneurysm, AVM and bypass surgery.

Lawton is the Tong-Po Kan endowed chair, a professor of neurological surgery and vice chairman of the department. He received numerous research awards as a resident and received the Young Neurosurgeon Award from the World Federation of Neurosurgical Societies and the International Congress of Neurological Surgery. Lawton graduated with honors from Brown University with an undergraduate degree in biomedical engineering. He earned a medical degree at the Johns Hopkins University School of Medicine and completed a general surgery internship at Johns Hopkins Hospital. He completed a neurosurgical residency and fellowship in cerebrovascular and skull-base surgery at the Barrow Neurological Institute.

Seven Aneurysms

Tenets and Techniques for Clipping

Michael T. Lawton



Thieme



Neurointerventional Radiology



Randall Higashida, M.D.

Interventional neuroradiologist

A renowned interventional neuroradiologist and expert in the diagnosis and treatment of stroke, Dr. Randall T. Higashida serves as chief of the Division of Interventional Neuroradiology at UCSF Medical Center. Higashida earned his medical

Christopher Dowd, M.D.

Interventional neuroradiologist

Dr. Christopher Dowd is an expert in the field of interventional neuroradiology, with special interests in treating brain aneurysms and vascular malformations using endovascular techniques. After receiving his undergraduate degree in biology from

Heart Association Research
Cardiovascular Radiology
Currently, Higashida has
anesthesiology at UCSF



of the Year award from the
Department of Radiology,
Surgery, Neurology, and



Clinical Faculty Member
professor of radiology, re

Van Halbach, M.D.

Interventional neuroradiologist

Dr. Van Halbach is a leader in interventional neuroradiology, specializing in the endovascular treatment of hemorrhagic and ischemic stroke, dural fistulae and cerebrovascular malformations. He earned a medical degree and completed an internship, residency and fellowship at UCLA Medical Center.

Steven Hetts, M.D.

Neurointerventional radiologist

Dr. Steven Hetts specializes in interventional neuroradiology, the minimally invasive diagnosis and treatment of vascular disorders of the brain and spine, including aneurysms, arteriovenous malformations, arteriovenous fistulas, arteriosclerosis and tumors.

Hetts earned a medical degree at Harvard Medical School and completed a residency in diagnostic radiology and a fellowship in diagnostic and interventional neuroradiology at UCSF. In his research, he studied pediatric brain aneurysms and vascular malformations, spinal vascular malformations and interventional MRI. He also is chief of neuroangiography at San Francisco General Hospital and an assistant professor of radiology at UCSF.

Neurosurgery

- OR
 - Aneurysms clipping by various approaches
 - AVM removal
 - Carvenous malformation
 - Bypass
 - Carotid endarterectomy
 - Spinal AVM, AVF
- Neurovascular conference
- Neurosurgical grand round/Lectures
- AVM Lab.

Interventional Radiology

- Angio suite
 - Aneurysms coil embolization
 - AVM, AVF Onyx embolization
 - Spinal vascular malformation
 - Pipeline embolization for large to giant aneurysms
- Neurovascular conference

도움 주신 분들

- 홍승철 선생님
- 전평, 김건하 선생님
- 김용배, 공두식 선생님



Ana Rodríguez-Hernández
Neurovascular Research Fellow at UCSF Medical Center
San Francisco, California



Michael Oh
Chief Resident at UCSF Medical Center
San Francisco, California



Free Paper II

좌 장: 이창영 (계명대 동산의료원), 조재훈 (대구가톨릭대병원)

2013년도 대한뇌혈관내수술학회

정기학술대회 및 총회



Single Center Experience with Balloon-Assisted Coil Embolization of Cerebral Aneurysm

Seok-Mann Yoon, Jae-Sang Oh, Hack-Gun Bae, Il-Gyu Yun

Department of Neurosurgery, Soonchunhyang University Cheonan Hospital, Cheonan, Korea

Objective: Endovascular coil embolization has become the first line of treatment modality for the cerebral aneurysm. However, aneurysms with broad neck, or unfavorable neck to dome ratio are very difficult to treat without balloon, or stent assistance. Stent assisted coiling is more favored in many centers, but it has some drawbacks such as long term or even life-long medication of postoperative anti-platelet agent, or in SAH patient. However, balloon-assisted coiling (BAC) can be used in SAH patient and no need of pre or postoperative anti-platelet agent. The purpose of this study is to evaluate the outcome and procedure related complication of BAC in a tertiary healthcare center.

Methods: Three hundred fifty aneurysms were coiled during 7 year period by single neurosurgeon, who was trained in both microneurosurgery and endovascular neurosurgery. Of these, BAC was used in 65 aneurysms. Clinical and radiological variables were analyzed in a retrospective manner.

Result: Mean age of the patients was 56 years old. Male to female ratio was 13:52. Thirty nine aneurysms (60%) were ruptured and remaining 26 aneurysms (40%) were unruptured. The location of aneurysms were as follows; 40 ICA aneurysms, 8 ACA aneurysms, 5 MCA aneurysms, 12 post circulation aneurysms. Mean aspect ratio was 1.6 ± 0.8 (0.6-6). The mean aspect ratio was not different between unruptured and ruptured aneurysms (1.6, versus 1.7). The obliteration was complete in 36 (55.4%), neck remnant in 19 (29.2%), and partial in 10 (15.4%) aneurysms. Mean packing density was $37 \pm 11\%$ (ruptured group: 36.8% vs unruptured group: 37%). Procedure related complications occurred in 9 cases (13.8%) (3 intraprocedural rupture without sequale, 5 thromboembolic complications (3 with sequale), and 1 coil migration rescued by surgical removal). One patient re-bleed within 24 hours due to postoperative use of heparin. Permanent morbidity remained in 4 cases (6.1%). No permanent complication was reported in unruptured aneurysms.

Conclusion: BAC is a valuable tool for the treatment of broad based aneurysms, or aneurysms with unfavorable neck to dome ratio. BAC is especially useful when the intra-procedural rupture occurs. Immediate control of bleeding can result in favorable outcome without permanent sequale. However, BAC increases the risk of TE complications. ACT monitoring and full heparinization is recommended before the balloon inflation during the BAC to reduce the TE complication.

Key Words: Balloon assisted coiling, Embolization, Complications.



Modified Waffle Cone Technique for Complex Cerebral Aneurysms

Jin-Young Jung, Byoung-Gook Shin, Hyn-Jun Park, Seong-Yoon Cho

Dong-Eui Medical Center, Pusan, Korea

Objective: To show a novel application of the stent for the embolization of branch incorporated wide-neck cerebral aneurysms that are not amenable to usual neck remodeling technique.

Methods: From March 2012 to October 2013, 6 patients with wide-neck aneurysms were treated with “modified Waffle-cone technique” at our institution. Solitaire AB Remodeling Device was used for this technique and we placing the distal end of the stent into the neck of the aneurysms for purpose of preservation of incorporated branch. The aneurysms were located at the middle cerebral artery bifurcation (n=3), the P-com (n=2) and the basilar-SCA (n=1). Patient demographics, aneurysm morphology, procedures, and clinical and angiographic outcomes were reviewed.

Result: Successful deployment of the stent with preservation of the targeted artery and near complete occlusion was achieved in 5 of 6 patients. One patient with SCA aneurysm, we retrieved the devices and change the treatment plan because of preserving the branch was unsure. No procedure-related complication was occurred in all cases.

Conclusion: The modified waffle-cone technique may enhance the possibilities of the coil embolization of these selected cases. However, its safety and technical feasibility should be further evaluated by larger case series and long-term follow-up is needed.

Key Words: Cerebral aneurysms, Wide-neck, Modified waffle-cone technique.



Endovascular Treatment of Wide-Neck Intracranial Aneurysms Using Minimal Supporting Devices: Double-Catheter Technique

Joon Huh, Jae Hoon Sung, Moon Suk Kim, Chul Bum Cho, Seung Ho Yang,
Il Sup Kim, Jae Taek Hong, Sang Won Lee

Departement of Neurosurgery, St. Vincent's Hospital, The Catholic University of Korea College of Medicine, Suwon, Korea

Objective: Despite the rapid advancement of endovascular technology, wide-neck or complex shaped intracranial aneurysms are still challenging tasks. Stents are available as supporting devices to ease the burden but the complication of antiplatelet therapy makes it difficult to decide especially in ruptured cases. This study reviewed cases of wide-neck and complex shaped aneurysms treated with minimal supporting devices using double-catheter technique (DCT) and ascertained its reliability.

Methods: Between April 2012 and November 2013, total of 29 patients were treated using DCT. The dome-to-neck ratio (maximum dome width/maximum neck width) was calculated using their 2-dimentional distal subtraction angiography. Those with dome-to-neck ratio below 1.2 were reviewed for their degree of aneurysm obliteration and complications such as coil protrusion, coil herniation, parent artery occlusion, or ascending branch occlusion.

Result: Among 29 patients, total of 33 aneurysms were treated using DCT and 11 aneurysms among 11 patients had the dome-to-neck ratio of below 1.2. 8 were females and 2 were males. The age ranged from 39 to 83 with the mean age of 62.3. 10 patient presented with subarachnoid hemorrhage and 1 patients found her aneurysm incidentally. The aneurysm locations were 4 were located at the posterior communicating artery, 4 at anterior communicating artery, 1 at middle cerebral artery, and 1 at basilar artery. After reviewing their immediate post-procedural and follow-up angiography, 9 aneurysms resulted in complete obliteration and 2 resulted with minimal neck remnant. In terms of complications, there was one small coil protrusion, and one ascending branch occlusion which was re-canalized by administering intra-arterial antithrombotic agent.

Conclusion: Wide-neck intracranial aneurysms are difficult to treat with endovascular technique and often require assisting devices. With minimal complication risk, double-catheter technique can be a reliable method to treat wide-neck and complex shaped aneurysms.

Key Words: Wide-neck aneurysm, Double-catheter technique.



Modified Double Microcatheter Technique for Wide-Necked Posterior Communicating Artery Aneurysm with Daughter Sac

Dong-Seong Shin, Bum-Tae Kim

Department of Neurosurgery, Soonchunhyang University Bucheon Hospital, Bucheon, Korea

Objective: Double catheter technique is effective technique for large, wide neck aneurysm. We describe a special technique used to treat large, wide-necked the posterior communicating (Pcom) artery aneurysm with daughter sac.

Methods: After locating two micro catheters, one at distal dome nearby daughter sac and other at proximal neck, two coils was delivered subsequently through each microcatheter. Proximal supporting frame was made using one microcatheter and preserved the internal carotid artery, and then deposited subsequent packing coils at the distal dome region using other microcatheter. The proximal frame coil didn't detach until distal dome was pack satisfactory through the distally located microcatheter. The procedure was finished if proximal frame coil shape changed or bulging to parent artery minimally. If there were any evidence to advanced change or migration of proximal frame coil, it is possible to withdrawn of proximal coil. 3 patients of Pcom aneurysm were treated with modified double microcatheter technique. All of patient's age was over 70 and female. Ruptured aneurysm cases were in 2 cases, other was unruptured with 3rd nerve palsy. Pcom artery origin belonged to aneurysm neck in 2 cases. 70-year-old female had spontaneous subarachnoid hemorrhage with ruptured left Pcom aneurysm. Aneurysm neck was 7.9 mm and dome size was 8.2×10.8 mm. Aneurysm was successful eliminated using above mentioned method without coil impingement on the parent vessel and remained remnant neck. 75-year-old female had spontaneous subarachnoid hemorrhage with ruptured right Pcom aneurysm. Aneurysm neck was 3.8 mm and dome size was 10.0×6.0 mm with well-defined daughter sac. Pcom artery origin belonged to aneurysm neck. Coil embolization was done successfully with preserved Pcom artery and remained remnant neck. 79-year-old female suffered 3rd nerve accidently on right eye. Catheter angiography was shown right Pcom aneurysm with daughter sac. Neck size was 7.4 mm and dome size was 8.7×8.7 mm with 3.0×3.2 mm sized daughter sac. Pcom artery origin belonged to aneurysm neck. partial Coil embolization was done successfully with preserved Pcom artery. 3rd nerve palsy was recovered during six months fallow up period.

Result: Partial occlusion was achieved one case, others were remnant neck. There were no procedural complication and parent vessel impingement after coil embolization.

Conclusion: This modified double catheter technique may treat safe and effective to Pcom artery aneurysm with daughter sac.

Key Words: Double microcatheter technique, Posterior communicating artery aneurysm, Daughter sac.



Endovascular Management for Retreatment of Postsurgical Intracranial Aneurysms

Young Dae Cho, Hyun-Seung Kang, Jeong Eun Kim, Moon Hee Han

Department of Neurosurgery & Radiology, Seoul National University Hospital, Seoul, Korea

Objective: Incomplete surgical treatment of intracranial aneurysms and recurrent postsurgical aneurysms are associated with a risk of rebleeding, and additional treatment is generally recommended. Surgical retreatment may carry a risk of procedural complications due to technical difficulty. We present here our experience with the endovascular approach for the retreatment of intracranial aneurysms that were initially treated with open surgery.

Methods: From January 2002 through January 2013, a total of 43 patients with 43 post-surgical index aneurysms were identified and underwent subsequent endovascular treatment. Clinical and radiological data were retrospectively reviewed.

Result: Thirty-one patients were surgically clipped before endovascular coiling and 12 patients were non-clipped, which included wrapping. Hemorrhagic presentation occurred in 21 patients prior to coiling. The interval between the initial surgical treatment and coiling varied from 0 days to 264 months (median, 9 months). Endovascular coiling resulted in the successful occlusion of 36 aneurysms (84%). Procedure-related complications included asymptomatic thrombus formation in 6 patients, symptomatic cerebral infarction in 2 patients, and retroperitoneal hemorrhage in 1 patient. Delayed cerebral infarction occurred in 2 patients with a deployed stent. The procedure-related permanent morbidity and mortality rates were 6.9% and 0%, respectively. Radiological follow-up evaluations beyond 6 months were available in 26 patients (60%), which revealed major recanalization in 3 patients (11.5%). There was no rebleeding during the follow-up period, which ranged from 3 to 115 months (mean, 34.5 months).

Conclusion: Endovascular embolization may serve as a safe, efficacious and durable treatment option in the management of postsurgical intracranial aneurysms.

Key Words: Aneurysm, Postsurgical, Coil, Embolization.



The Impact of Stent Design On the Structural Mechanics of the Crossing Y-Stent: An in Vitro Study

Chang-Young Lee, Chang-Hyun Kim

Department of Neurosurgery, Keimyung University School of Medicine, Daegu, Korea

Objective: Crossing Y-stent technique is a valid therapeutic option for endovascular treatment of wide-necked bifurcation aneurysms. Two main designs of self-expanding stents, the open- and closed-cell, have been used in combinations for a crossing Y-stent construct. However, no study has been conducted to identify the optimal combination using these two stent designs to establish a crossing Y-stent construct. The purpose of this in vitro study was to assess the mechanical characteristics of each stent-combination and to suggest an optimal combination for clinical practice.

Methods: Using two different stent designs, four different Y-stent combinations, including double closed-cell (CCS-CCS), open-cell followed by closed-cell (OCS-CCS), closed-cell followed by open-cell (CCS-OCS) and double open-cell design stents (OCS-OCS) were established and tested in a bifurcation aneurysm model. Images of the model were obtained by digital subtraction angiography (DSA) to compare and assess morphological changes of the Y-stent construct caused by the interaction of the two stents in each combination.

Result: The Y-stent construct using the OCS-OCS combination showed the best stent apposition to the model branches and no collapse of the second stent at the intersection of the two devices. In contrast, Y-stent combinations using a CCS as the second stent showed a tubular collapse of the second stent at the crossing section and along its distal portion. These combinations revealed an unsatisfactory apposition to the model branch in which the second stent was deployed. The most significant narrowing of the second stent was noted in the CCS-CCS construct, resulting in the worst stent apposition.

Conclusion: Based on a simple in vitro experiment, the use of OCS-OCS combination for a Y-stent construct is suggested to be the optimal combination for achieving best possible stent-wall apposition. Using a closed-cell stent as the second stent for a crossing Y-stent may increase the risk for thromboembolic complications due to poor stent-wall apposition.

Key Words: Cerebral aneurysm, Coiling; endovascular treatment, Stent design, Y-stent.



MR-DWI Positive Lesions and Its Relationship with Symptomatic Ischemic Complications After Coiling of Unruptured Intracranial Aneurysms

Dong-Hun Kang,¹ Jaechan Park, Yong-Sun Kim,² Byung Moon Kim, Dong Joon Kim, Sang Hyun Suh, Dong Ik Kim, Yong Bae Kim, Seung Kon Huh

¹Department of Neurosurgery & Radiology, Kyungpook National University, College of Medicine, Daegu, Korea

²Department of Neurosurgery & Radiology, Yonsei University, College of Medicine, Seoul, Korea

Objective: The aims of this study are to evaluate the risk factors for symptomatic ischemic complication (symptomatic ischemic complication [SIC], transient ischemic attack, or stroke) and microembolisms detected as MR diffusion-weighted imaging (MR-DWI)-positive (DWI(+)) lesions, and the relationship between DWI(+) and SIC after coiling of unruptured intracranial aneurysm.

Methods: Between March 2009 and November 2011, 382 unruptured intracranial aneurysms in 343 patients underwent both coiling and posttreatment MR-DWI. The incidence of and risk factors for SIC and DWI(+), and the relationship between DWI(+) and SIC were retrospectively analyzed.

Result: The incidence of SIC was 4.1%. The incidence of DWI(+) was 54.5%. The number of DWI(+) lesions was significantly larger in the SIC group, than in the asymptomatic one (12.1 ± 10.4 versus 5.0 ± 8.7 , $p < 0.00$). The cutoff value of DWI(+) for predicting SIC was ≥ 6 (sensitivity 85.7%, specificity 70.7%). The patients with DWI(+) ≥ 6 was 28.6%. Of the patients with SIC, the patients with DWI(+) ≥ 6 was 78.6%. Patients aged ≥ 65 years had a trend for SIC, and it was the only independent risk factor for DWI(+) $\geq$ cutoff ($n=6$; 95%CI, 1.167-3.083).

Conclusion: The number of DWI(+) lesions was significantly larger in the SIC group than in the asymptomatic one after coiling of unruptured intracranial aneurysm. Patients aged ≥ 65 had a trend for SIC, and it was the only independent risk factor for the number of DWI(+) $\geq$ cutoff value ($n=6$) for predicting SIC.

Key Words: Coils, DWI, Intracranial aneurysms, Ischemic complications, Outcomes.



Early Experience of Transluminal Balloon Angioplasty Using Dual Lumen Balloon Catheter for Angiographic Cerebral Vasospasm after Subarachnoid Hemorrhage

Seung Hun Sheen, Sang Gun Lee, Ho Jun Yi, Hyung Sik Hwang

Department of Neurosurgery, Dongtan Sacred Heart Hospital, College of Medicine, Hallym University, Hwaseong, Korea

Objective: Endovascular treatment options of cerebral vasospasm due to aneurysmal subarachnoid hemorrhage are still variable. Recently new dual lumen balloon catheter was emerged for neuroendovascular interventional field. We introduce our early experience of transluminal balloon angioplasty for cerebral vasospasm after aneurysmal subarachnoid hemorrhage.

Materials & Methods: Three cases were treated with new dual lumen balloon catheter for cerebral vasospasm after aneurysmal subarachnoid hemorrhage.

Result: Angiographic outcomes after transluminal balloon angioplasty using dual lumen balloon catheter could be achieved in all excellently. Clinical outcome was also quite excellent for these three patients. There were no procedure-related complications. There was no re-development of angiographic or clinical vasospasm during follow-up period.

Conclusion: Newly developed dual lumen balloon catheter can be a useful and safe tool for transluminal balloon angioplasty after subarachnoid hemorrhage, especially if conventional endovascular treatment is failed or not available.

Key Words: Angioplasty, Dual Lumen Balloon Catheter, Vasospasm, Subarachnoid Hemorrhage.



Covered Stents for the Endovascular Treatment of a Direct Carotid Cavernous Fistula: Single Center Experiences with 10 Cases

Young Dae Cho, Hyun-Seung Kang, Jeong Eun Kim, Moon Hee Han

Department of Neurosurgery & Radiology, Seoul National University Hospital, Seoul, Korea

Objective: Covered stent has been recently reported as an effective alternative treatment for direct carotid cavernous fistulas (DCCF). The purpose of this study is to describe our experiences with the treatment of DCCF with covered stents and to evaluate whether a covered stent has a potential to be used as the first choice in selected cases.

Methods: From February 2009 through July 2013, 10 patients underwent covered stent placement for a DCCF occlusion. Clinical and angiographic data were retrospectively reviewed.

Result: Covered stent placement was performed for five patients primarily as the first choice and in the other five as an alternative option. Access and deployment of a covered stent was successful in all patients (100%) and total occlusion of the fistula was achieved in nine (90%). Complete occlusion immediately after the procedure was obtained in five patients (50%). Endoleak persisted in five patients and the fistulae were found to be completely occluded by one month control angiography in four. The other patient underwent additional coil embolization by a transvenous approach. Balloon inflation-related arterial dissection during the procedure was noted in two cases; healing was noted at follow-up angiography. One patient suffered an asymptomatic internal carotid artery occlusion noted seven months post-treatment.

Conclusion: Although endoleak is currently a common roadblock, our experience demonstrates that a covered stent has the potential to be used as the first choice in DCCF; this potential is likely to increase as experience with this device accumulates and the materials continue to improve.

Key Words: Carotid cavernous fistula, Covered stent, Endovascular treatment.



Intracranial Venous Sinus Stenting for Idiopathic Intracranial Hypertension (IIH)

장경술,¹ Aquilla S Turk,² Raymond D Turner,² Imran Chaudry,² 신승훈³

가톨릭대학교 인천성모병원,¹ Medical University of South Carolina, USA,² 한림대 동탄성심병원³

Objective: The cause of pseudotumor cerebri, or idiopathic intracranial hypertension (IIH), is controversial. We report our results from 13 cases of venous sinus stenting.

Methods: A retrospective chart review of patients with medically refractory IIH, who underwent intracranial venous sinus stenting from March 2008 to June 2011, was performed.

Result: 13 patients have a focal stenosis at the Intracranial venous sinus with a pressure gradient ≥ 10 mm Hg (mean -16.9 mm Hg, range 10-26 mm Hg). The mean age of the patients was 38.3 years. All patients reported headaches, visual symptoms and had abnormal ophthalmological examination with evidence of papilledema and/or visual field or visual acuity deficits. The mean duration of symptoms was 5.7 years. All patients had failed medical management. All patients underwent intracranial venous sinus stenting. The pressure gradient across the stenosis resolved immediately after stent placement. No periprocedural complications were noted in this study. The mean follow-up was 12 months. 10 of 13 patients reported improvement in their symptoms.

Conclusion: These findings indicate a role for transverse sinus stent placement in the management of selected patients with IIH.

Key Words: Idiopathic intracranial hypertension, Pseudotumor cerebri, Venous sinus, Stenting.

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정기학술대회 및 총회

인 쇄 2013년 12월 3일

발 행 2013년 12월 7일

발행처 대한뇌혈관내수술학회

제 작 (주) 엠엘커뮤니케이션
140-846 서울시 용산구 원효로 89길 18-8 중앙빌딩
Tel : 02-717-5511(rep.) / Fax : 02-717-5515
E-mail : mk@smileml.com



SIEMENS

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지멘스 CARE 소프트웨어는 방사선 피폭량을 줄이면서
보다 우수한 진단·시술결과를 제공해 드립니다.

www.siemens.co.kr/healthcare

환자를 방사선 노출로부터 보호하려면 어떻게 해야 할까요?
혁신적인 선량감소 기술을 바탕으로 한 진단, 시술 영상, 종합적 연구 및 최첨단 기술과 기법에 이르기까지 -
지멘스 CARE 표준형 소프트웨어는 방사선 피폭량을 최소화하면서 환자의 생명을 지켜드립니다.

Answers for life.