Occipital artery aneurysm from mimicking scalp mass

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Extracranial carotid artery aneurysm are rare, and occurred due to many etiologies. Among them, occipital artery aneurysm can often look like subcutaneous mass of scalp.

A 55-year-old woman presented with a pulsatile scalp mass on the right suboccipital area, with intermittent pain and tenderness from 1 week before. She had no history of head trauma, cranial surgery, infectious or autoimmune disease. Enhanced brain magnetic resonance image and conventional angiography were showed fusiform aneurysm like vessel, 11 X 24mm in diameter. The proximal and distal of occipital artery aneurysm were ligated after carefully dissection, And then, aneurysm was surgically excised. Gross specimen was smooth and black-brown color. Microscopic examination showed thrombosed and dilatated artery, it was concluded as aneurysm. The patient was recovered after 1 month without any surgical complication, and relieved from pain.

Aneurysms of distal branches from extracranial carotid artery are rare. They can developed after blunt or penetrating trauma, infection, post surgical. These etiologies are likely to cause pseudo aneurysm. In particular, occipital artery near the nuchal line may be vulnerable to trauma. Alternatively, arterosclerosis or hemodynamic stress of distal arterial vessel may cause true aneurysm.

We report a rare case of idiopathic aneurysm of occipital artery. The patient complained of pain and tenderness, but it was well controlled by surgical resection.
P-02

Single stage endovascular treatment for bilateral intracranial vertebral artery dissection presenting subarachnoid hemorrhage

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Background
Treatment strategy for bilateral spontaneous vertebral artery dissection (VAD) with subarachnoid hemorrhage (SAH) is controversial because deconstructive technique increases hemodynamic stress on contralateral VA and leads to enlargement and rupture of the VAD. We report our experience of bilateral VAD with SAH treated by single stage endovascular treatment.

Case 1
A 52-year-old man was admitted to our hospital with a sudden headache. Computed tomography (CT) revealed a SAH in the basal cistern and posterior fossa with no laterality. Three-dimensional rotational angiography (3D-CTA) demonstrated bilateral VAD. Rt. Posterior inferior cerebellar artery (PICA) was originated from VAD segment. Lt. PICA was originated from distal to VAD. We performed endovascular treatment. For rt. VAD, Neuroform Atlas stent was placed from rt. PICA to distal part of rt. VA, and rt. VA was occluded at the portion of VAD. In the same session, stent assisted coiling was performed for lt. VAD sparing antegrade flow. The patient was mRS 1 at discharge.

Case 2
A 66-year-old woman was admitted to our hospital with a loss of consciousness. CT revealed SAH in the posterior fossa and intraventricular hemorrhage with obstructive hydrocephalus. 3D-CTA demonstrated bilateral VAD. Rt. PICA was originated from distal to VAD. Lt. PICA was originated from proximal to VAD. We perform endovascular treatment. For rt. VA, parent artery occlusion was performed. In the same session, stent assisted coiling was performed sparing antegrade flow. Conscious level was improved after treatment.

Conclusion
Single stage endovascular treatment is useful for bilateral VAD presenting SAH.
P-03

Long-term results and follow-up examinations after endovascular embolization for unruptured cerebral aneurysm

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Background and Purpose - The appropriate period of follow-up examinations after endovascular embolization for cerebral aneurysm is not well known. We investigated retrospectively long-term results after endovascular embolization for unruptured cerebral aneurysms, and evaluated the periods from embolization to recanalization and retreatment. Methods - Between April 2006 and March 2011, in a total of 170 embolized aneurysms (148 unruptured and 22 ruptured aneurysms) at the Osaka University Hospital, we investigated 118 unruptured, which were followed up for more than 5 years. Time-of-flight magnetic resonance angiogram was performed at post procedure day 1, 3 - 6 month, 1 year and every 1 year. Digital subtraction angiogram was performed at 1 year for monitoring of embolized aneurysm. Results - Mean follow-up periods were 7±1.0 years. The recanalization was observed in 19 aneurysms (16.1%) within 2 years. Among them, retreatment for the recanalization was performed in 8 aneurysms (6.8%). No recanalization was detected in the aneurysms that had been stable in the first 2 years after embolization. Larger maximum size of aneurysm was significantly correlated with the recanalization (P=0.021). Conclusion - If recanalization is not observed within 2 years after endovascular embolization for the unruptured cerebral aneurysm, annual follow-up imaging study might not be essential after that.
Recanalization with normal vertebral artery configuration treated internal trapping of ruptured vertebral artery dissection aneurysm: a case report

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Background: Intracranial vertebral artery dissecting aneurysms are rare lesions that are considered an important cause of spontaneous subarachnoid hemorrhage. We report a patient with ruptured vertebral artery dissection aneurysm treated by internal trapping and recanalization with normal vertebral artery configuration later 6 months.

Methods: A 51-year-old woman without past medical history was admitted to our hospital. Initial CT and CT angiography revealed diffuse subarachnoid hemorrhage and dissecting aneurysm arising from the right vertebral artery distal to the origin of the posterior inferior cerebellar artery (PICA). Endovascular treatment by internal tapping with triple microcatheter technique via both vertebral artery was performed. On final angiography, the dissecting aneurysm and dissecting site was completely occluded with detachable coils. The patient was fully recovered at discharge.

Results: A follow-up angiography performed 6 months after embolization and revealed recanalization with normal vertebral artery configuration with inferior deviated coil mass. We suggest that the true lumen was occluded by coil mass on false lumen.

Conclusion: We report a rare case of recanalization with normal vertebral artery configuration treated internal trapping of ruptured vertebral artery dissection aneurysm. Vertebral artery dissecting aneurysm should be considered recanalization and performed careful follow-up angiography.
P-05

Trans-carotid approach of basilar artery aneurysm in patient with internal carotid artery occlusion

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In treatment of aneurism at basilar artery, surgical approaches have several limitations and neurosurgeons tend to choose endovascular management. However, Despite of technical development of endovascular management, surgical treatment is sometimes still required in the case of wide neck or origin of PCA from aneurysmal dome. The most familiar and common approach to neurosurgeons is the transsylvian approach. Also we use three routes to get to basilar apex in trans-sylvian approach such as optico-carotid, carotid-oculomotor and supracarotid triangle. However, it has limitations in inspection of distal aspect of clip blade, clipping of direct anteriorly or posteriorly projecting aneurysm. To overcome these limitations, we perform the retraction of carotid artery and oculomotor nerve, and removal of anterior and posterior clinoid processes to expand surgical view. Despite of these efforts, we have difficulty in treating aneurysms at high position ( > 1cm from mid-sellar). We will describe unique surgical technique for special cases via two case reports. The special point of our two cases is previous occlusion of distal ICA. Although it is rare, if the patient with basilar artery aneurysm is associated with the occlusion of carotid artery with good collaterals, it is possible to cut the occluded ICA in order to get more wide surgical field. We performed orbitozygomatic approach with ACP removal for clipping of basilar apex aneurysm via resection of occluded ICA. The resection of occluded ICA provided us wide operation field and convenience for clipping of aneurysm.
P-06

Intra-aneurysmal rupture of atheroma during clipping of a large, atherosclerotic aneurysm of the middle cerebral artery: a case report

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- Background and importance Ischemic complications, including silent or symptomatic events, are known to occur during clipping of intracranial aneurysms, although the rate is lower than that seen with endovascular treatment. Atherosclerotic changes in intracranial vessels, or within the aneurysm wall or neck, are often seen during surgery and are a significant risk factor for post-operative ischemic sequelae. - Clinical presentation We present a case of intra-aneurysmal rupture after permanent clipping of a large atherosclerotic aneurysm of the middle cerebral artery. After intensive clipping of the severely atherosclerotic aneurysm, a supplementary clip was applied to the atherosclerotic area of the aneurysmal sac. Subsequent squeezing of the intra-aneurysmal atheroma led to leakage into the sub-adventitial layer of the aneurysmal sac. - Conclusions This case report highlights the potential for embolic shower during aneurysmal clipping surgery. A thorough pre-operative review of high-quality imaging would facilitate decision-making regarding treatment approach, and special surgical techniques for atherosclerotic or calcified aneurysms should be considered to minimize ischemic complications.
Objective: Cerebral De Novo aneurysms rarely occur and many aspects of them are not well understood. In general, the incidence of de novo aneurysms is uncertain and the development time course is unclear. We would like describe two cases of de novo aneurysms found at different time intervals after the first aneurysms were detected.

Case presentation: Case 1: A 47-year-old male visited the emergency room due to changes in consciousness. On brain CT and 3D CT angiography, an aneurysm was found in the left M1 and no abnormality was observed in other blood vessels. An aneurysm clipping was performed for this lesion under a pterional approach. After 8 days, the patient's consciousness changed suddenly. Brain CT revealed a newly developed intracerebral hemorrhage in the right frontal area. An aneurysm was observed in the anterior communicating artery that was not previously observed when conventional angiography was performed. For this lesion, coil embolization was performed.

Case 2: A 55 - year - old female visited the emergency room due to change in consciousness. Brain CT showed subarachnoid hemorrhage (SAH) in the basal cistern. This patient had undergone aneurysm clipping surgery because of SAH due to anterior communicating artery aneurysm rupture 12 years ago in our hospital. Concomitant angiography was performed and an aneurysm was found in the right posterior communicating artery that was not previously observed. We performed coil embolization.

Conclusion: We suggest that an appropriate follow-up imaging study is recommended, although the occurrence of De novo aneurysms is rare.
Vertebral artery dissecting aneurysms (VADAs) are rare and many debates are present about treatment options. We review types and efficacy of our endovascular treatments and establish a safe endovascular therapeutic strategy in regard to the angio-architecture of VADAs.

Between July 2008 and December 2017, we treated 22 patients with symptomatic VADAs. Fifteen patients presented with subarachnoid hemorrhage from the ruptured VADAs, digital subtraction angiography and magnetic resonance image confirmed the diagnosis and endovascular treatments were followed as their angio-architecture.

Among the three different endovascular treatments, 12 patients (80%) were treated with VA coil trapping, 2 patients (13%) with stent-assisted coil embolization, and 1 (6%) patient with stent insertion alone. Clinical results were good in 13 patients (86.7%), and there were no technical problems during endovascular procedures. The other 2 patients with poor prognosis showed severe neurological deficits at the initial evaluation. There were no radiologic cure in one patient with stent insertion alone, but the patient had no significant clinical symptoms either.

Endovascular treatments are safe and effective treatment option for managing VADAs and can be the first treatment of choice for most patients. Selecting proper endovascular treatment according to the angio-architecture of VADAs can reduce the risk of the treatment.
Possibility for preoperative diagnosis of cerebral aneurysm walls based on hemodynamics using computational fluid dynamics (CFD)

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[Background and purposes]
Red-thin regions of aneurysm wall has a potential risk of rupture, which is equivalent to destructive remodeling (DR) caused by adverse effect of hemodynamics. However, neuroradiological imaging is not able to diagnose DR for decision-making of cerebral aneurysms. Therefore, we investigate the possibility of computational fluid dynamics (CFD) to predict DR.

[Material and Methods]
Twenty cerebral aneurysms were investigated using CFD and intraoperative video recording. DR and non-remodeling (NR) regions were defined by quantitative colorimetry using L*a*b* color space. In addition, hemodynamic parameters including wall shear stress (WSS), WSS gradient (WSSG), oscillatory shear index (OSI), aneurysm formation indicator (AFI), gradient oscillatory number (GON) and standardized pressure difference (SPD) were calculated and compared between DR and NR regions.

[Results]
DR regions had statistically high SPD compared with NR regions. In contrast, there was no significant difference in WSS, WSSG, OSI, AFI, GON. Inter-correlations between each parameter that had a significant difference with univariate analyses and red color intensity were examined and SPD had significantly high correlation with red color intensity.

[Conclusions]
SPD could be the most valuable predictor to distinguish DR regions and it was related with the degree of redness in cerebral aneurysms.
P-10

Pseudo-subarchnoid hemorrhage: Chronic subudral hematoma with an-unruptured aneurysm for subarachnoid hemorrhage

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Appearance of hyperdensity in the basal cistern and subarachnoid space on computed tomography (CT) scan is typical finding of suabarchnoid hemorrhage (SAH). However, pseudo-subarachnoid hemorrhage (pseudo-SAH) also can appear in several conditions such as anoxic-ischemic encephalopathy with brain swelling, prominent supratentorial mass effect, purulent meningitis, and venous sinus thrombosis. These increased densities may be a result from compression and effacement of subarachnoid spaces including congested vascular components.

42-year-old male patient was visited to our emergency room presenting of headache for a week. Brain CT showed right chronic subdural hematoma and hyperdensity of basal cistern. Because his previous brain magnetic resonance angiography revealed unruptured right middle cerebral artery aneurysm, surgical clipping of aneurysm and removal of chronic subdural hematoma was performed, under diagnosis of aneurysmal subarachnoid hemorrhage.

After removal of subdural hematoma, xanthochromic membrane look like old SAH was confirmed and it was adhered to dura mater. However, we could not find the evidence of SAH during sylvian dissection.

We present a case of pseudo-SAH, initially diagnosed as subarachnoid hemorrhage accompanied with chronic subdural hematoma.
A case of pseudoaneurysm formation after repetitive suction thrombectomy using a suction catheter

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With the recent development of various suction catheters, which can be delivered to distal tortuous vessels, the use of manual aspiration thrombectomy (MAT) for patients with acute ischemic stroke with large vessel occlusion has increased. Although contrast leakage and subarachnoid hemorrhage have been reported during MAT procedures, pseudoaneurysm formation due to vessel injury by suction catheters has not been. We present the case of a 60-year-old woman who presented to our emergency center with dysarthria and left-sided weakness. She underwent suction thrombectomy 5 times for acute middle cerebral artery (MCA) occlusion and significant contrast leakage occurred during the procedure. On follow-up angiogram on post-operative day 15, we noticed a pseudoaneurysm, which was treated with detachable coil embolization. Neurosurgeons who perform suction thrombectomy should keep in mind the possibility of vessel injury that results in the formation of a pseudoaneurysm, especially at the branching site or tortuous segments.
Efficacy of Target Coiling to Prevent Premature Rupture of Large MCA Aneurysm with High Risk of Intraoperative Rupture

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Aneurysm surgery is performed using different strategies and tactics according to the aneurysm location. Middle cerebral artery (MCA) aneurysms are as one of the most common aneurysm locations for surgery. During surgery for a ruptured MCA aneurysm, intraoperative premature rupture of the aneurysm is an unpredictable danger and stressful situation leading to an unfavorable outcome. Aneurysm approximation to sphenoidal ridge, accompanying intracerebral hemorrhage, and short M1 segment are well-known risk factors for premature rupture of MCA aneurysms. To reduce the risk of premature rupture of the aneurysm during surgery, we performed simple coiling in a very short time with an aneurysm suspected as a rupture point during diagnostic angiography. A 59-year-old man was admitted to our hospital with a history of decreased consciousness and left hemiplegia. A CT and CT angiography demonstrated subarachnoid hemorrhage, right temporal lobe intracerebral hemorrhage and 18 mm sized, lateral projected right MCA aneurysm approximation to sphenoid ridge. We conclude that the risk of premature rupture during surgery is very high. Therefore we performed target coiling using the two catheter technique at the same time as the diagnostic angiography, followed by craniotomy and aneurysm neck clipping. In the treatment of large-sized cerebral artery aneurysms with a high risk of premature rupture, pre-operative target coiling can be performed in a short period of time, effectively preventing premature rupture during surgery.
Effect of direct evaluation on outcomes during treatment of unruptured intracranial aneurysms under local anesthesia

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Background and Purpose: It is widely known that the greatest advantage of local anesthesia (LA) in endovascular treatment (EVT) of unruptured intracranial aneurysms (UIAs) is that direct evaluation can be performed during the procedure, unlike with general anesthesia (GA). However, it has not been established how useful such direct evaluation is. The authors attempted to assess the effects of direct evaluation by identifying the causes, management, and outcomes of intraprocedural symptoms and procedure-related events in EVT under LA.

Methods: We retrospectively evaluated the medical and radiologic data of 1015 UIAs (1000 patients) who had undergone coil embolization under LA from 2008 to 2016.

Results: Intraprocedural symptoms were identified in 62 patients (6.2%). The symptoms improved during the procedure in 27 (44%) and after the procedure in another 28 (45%). Consequently, 55 patients (89%) had good outcomes and seven (11%) poor outcomes. Procedure-related events occurred in 67 patients (6.7%); they comprised 39 symptomatic and 28 asymptomatic events. Thirty-five of the 39 symptomatic events (90%) were detected on the basis of intraprocedural symptoms before angiographic changes were apparent and managed promptly. The 28 patients with asymptomatic events were managed safely without further complications before symptoms developed.

Conclusions: In EVT of UIAs under LA, direct evaluation enables the earliest possible detection of symptomatic events and facilitates recovery before irreversible changes have occurred. Asymptomatic events can also be managed safely. The morbidity rate of EVT of UIAs under local anesthesia can be reduced by appropriate management of intraprocedural symptoms and procedure-related events.
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Hemodynamics analysis by MRFD before and after parent artery occlusion for the internal carotid artery large aneurysm

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【Purpose】
Parent artery occlusion (PAO) for large ICA aneurysm is concern that stress is applied to other blood vessels due to hemodynamics change after PAO. The objective was to clarify how much the hemodynamics and wall shear stress (WSS) changes in to other blood vessels before and after PAO and how long it will continue.

【Materials and methods】
Magnetic resonance fluid dynamics (MRFD) using time-resolved three-dimensional phase-contrast MRI (4D-Flow) at 3.0T was performed on the cases of PAO. Four patients who underwent MRFD before PAO and within 10 months after PAO and two patients who underwent MRFD for more than 4 years from PAO were enrolled in this study.

We measured the flow volume of both sides ICA and BA and the maximum value of WSS in systolic phase of healthy side ICA C1 part before and after PAO by MRFD analysis.

【Result】
Post PAO, the flow volume average of the healthy side ICA increased by 1.29 times, the flow volume average of BA increased by 1.43 times. The maximum WSS in the healthy side ICA C1 part systolic period after PAO increased by an average 1.2 times from 9.3 Pa to 11.1 Pa. Similarly, the maximum WSS in the healthy side ICA C1 part systolic phase was as high as 12 Pa, 23.6 Pa in two cases over 4 years after PAO.

【Conclusion】
Post PAO, the rise in WSS in the healthy side ICA C1 part was observed due to the increase in flow volume, suggesting that the change would continue in the long term.
Supraorbital Keyhole Approach for Clipping Ruptured Distal Anterior Cerebral Artery Aneurysm: Technical Note with Review of Literature

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BACKGROUND: Supraorbital keyhole approach has been using for the clipping of nearly all anterior circulation aneurysms. However, the minimally invasive approach to distal anterior cerebral artery (DACA) aneurysms or high position A-com aneurysms has not gained much acceptance due to difficulties associated with forehead, hair line. It requires bicoronal scalp incision necessitates extensive dissection of soft tissues. We describe a minimally invasive supraorbital craniotomy including orbital osteotomy with an interhemispheric approach for clipping a ruptured DACA aneurysm.

METHODS: A 57 year-old patient presented with subarachnoid hemorrhage. Computed tomography angiography revealed a DACA aneurysm. The surgical technique involved a keyhole craniotomy made via an eyebrow incision, including the orbital rim and roof, cross the supraorbital notch, to extend to the anterior cranial fossa. The dura was opened and interhemispheric dissection was carried out, adequate proximal control was obtained, and the aneurysm neck was dissected and clipped. A relevant review of the literature was carried out.

RESULTS: The patient recovered well, with no residual aneurysm with good cosmesis. Compared with the previously bicoronal scalp incision and interhemispheric approaches, our technique has absolutely less soft tissue dissection, minimal disruption and exposure of normal brain tissue, and an excellent postoperative cosmetic result.

CONCLUSION: The supraorbital keyhole approach with orbital craniotomy is a minimally invasive technique sufficient for clipping some DACA aneurysms, with easier access, better proximal control, and good cosmesis.
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Combined Anterior-temporal approach and Trans-Cavernous Sinus Approach as a strategy for Unruptured BA-SCA Aneurysm : technical case report.

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Introduction
Microsurgical clipping for distal basilar aneurysm is difficult because its narrow and deep operative field and surrounding important structures. Approach should be modified by the height of the aneurysm and the area of the retro-carotid space. We describe surgical steps of anterior temporal approach (ATA) for BA-SCA aneurysm and how to modified it in case of height and width of the operative field is not sufficient.

Case Presentation
74y.o. female was incidentally diagnosed Lt.BA-SCA aneurysm of 4mm diameter. The height from the clinoid-line were 4.4mm and aneurysm was located in anterior to the cerebral peduncle. ATA without zygomatic osteotomy was selected.

Surgical intervention
ATA following orbital skeletonization was performed. The aneurysm was exposed safely. However, retrocarotid space was narrow because of downward shift of ICA. Clip head interfered the anterior choroidal artery (AChA) because of limited apply-angle due to narrow retrocarotid triangle. To avoid accidental occlusion of AChA, retrocarotid space enlargement with mobilizing ICA by circumferential detachment of distal dural ring after anterior clinoidectomy was performed. Simultaneously, mobilization of oculomotor nerve by opening oculomotor foramen via the trans-cavernous approach was performed. Apply-angle of the clip could be changed by those additional dissection. Finally, complete neck clipping was achieved without interfering AChA.

Conclusion
It is important to know the extended ATA approach with skull base technique. Additional extradural anterior clinoidectomy with opening distal dural ring and oculomotor foramen by trans-cavernous approach was useful to widen the retrocarotid triangle.
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Difficulties of endovascular coiling at very small basilar artery bifurcation aneurysm which is ruptured

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Purpose

Very small basilar artery bifurcation aneurysm ruptured cases reported, not a few. These cases have some difficulties of endovascular coiling. We described two cases of intraprocedural ruptured very small basilar artery bifurcation aneurysm during coiling.

Case presentation

A 56-year-old man presented with severe headache due to subarachnoid hemorrhage. The patient underwent endovascular coiling in emergency. In the procedure, the aneurysm was ruptured during 2nd coil insertion. We continued more coil insertion. Three coils are inserted without stent.

A 78-year-old woman presented with moderate headache due to subarachnoid hemorrhage. In the coiling procedure, stent (Enterprise stent 4/23 assisted coiling was performed in jail technique. Intraprocedural rupture during 1st coil insertion. So we continued to insert three more coils and the aneurysm could be completely obstructed.

Finally, these patients discharged without neurologic deficit.

Conclusion

There are several reasons that very small aneurysm ruptured SAH coiling is difficult. First, Protrusion to parent artery during coiling often occur due to that very small aneurysm has relatively wide neck. And during coiling, very small space in aneurysm increases friction against aneurysm wall. So, Intraprocedural rupture rate is higher than other aneurysm.

Strategy of very small ruptured aneurysm in coiling is necessary. There are considering of more soft and shortest coil (reshape), considering stent or balloon assisted(Wide neck, unstable coil position), and location of microcatheter on the aneurysmal neck.
Surgical strategy for A1 aneurysm of Anterior cerebral artery

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Background:
Aneurysms of A1-segment (A1A) are considered to be rare (<1%). They demonstrate unique characteristics with complex morphology. They often occur as multiple aneurysms and pose surgical challenge due to A1-perforators, variability of collateral circulation and fusiform nature. This study aims to set a surgical strategy, based on experience in treating such aneurysms.

Methods:
A total of 16 consecutive patients with A1A were treated in our hospital from April.2013 – January.2018. Clinical data and radiographic results were analyzed with emphasis on aneurysm location (proximal, distal), collateral circulation and clinical outcome, using modified Rankin Scale (mRS).

Results:
From a total of 16 cases with A1A, 6 (37.5%) were located proximal and 10 (62.5%) appeared distal (Acom junction). 4 A1As (25%) were multiple aneurysm cases and 2 (12.5%) were ruptured.
In unruptured cases outcome was excellent in 13 cases (92.9%) with 1 case with visual field deficit (mRS1) after 90 days. 1 ruptured A1A (H&K II°) showed a favourable outcome (mRS0), where the other case (H&K III°) had a poor one (mRS4).

Discussion:
Analysis of surgical method and outcome helped setting an algorithmic strategy when facing A1As. In cases of proximal A1A with sufficient collateral flow, simple trapping is feasible. In case of hypoplastic or aplastic contralateral A1 portion, EC-IC bypass to either side of A2 or A3 segment is needed in order to protect bilateral ACA territory. If A1A involves anterior communicating artery, A3-A3 side-to-side bypass is needed instead of sacrificed anterior communicating artery by trapping A1A. Additionally, in case of poor superficial temporal artery, radial artery short graft between superficial temporal artery trunk and anterior cerebral artery as EC-IC bypass or in between proximal A1 segment and A2 segment distal to the aneurysm as IC-IC bypass will be needed.
Conclusion:
The strategy to treat A1A safely should be considered by the location of the A1A whether anterior communicating artery is involved or not, size of contralateral A1 segment, and superficial temporal artery.
Rupture of arteriovenous malformation is associated with increased maximum nidus velocity

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Little is known about intra-nidal microhemodynamics in arteriovenous malformations (AVMs). Using phase-contrast magnetic resonance angiography (PCMRA)-based flow quantification technique, we examined 23 unruptured and 7 ruptured AVMs (mean volume, 4.7 ml) to elucidate the relationship between the intra-nidal velocity and (i) the baseline characteristics and (ii) rupture of AVMs. PCMRA was acquired using a three-tesla MR system (encoding velocity: 100 cm/s; spatial resolution: 0.6 × 0.6 × 1.0 mm). Using a three-dimensional reconstruction software (Avizo), PCMRA data was merged with time-of-flight imaging, with which niduses were labeled and segmented. The PCMRA data just at the segmented nidus were extracted and resampled, allowing the spatial resolution to be 0.3 × 0.3 × 0.5 mm. Three-dimensional vector data was then created, and intra-nidal flow was quantified as a scalar value of the vector in each voxel. The mean (± SD) values of mean and maximum intra-nidal velocities were 9.6 (± 2.8) cm/s and 66.7 (± 26.2) cm/s, respectively. The presence of deep drainage (p = 0.007), larger volume (> 5 ml, p = 0.002), and younger age (≤ 40 years, p = 0.010) were associated with increased maximum velocity. Maximum velocity > 90 cm/s was significantly associated with AVM rupture via the univariate logistic regression analysis (p = 0.009), though the significance was marginal via the multivariate analysis (p = 0.053). In conclusion, larger AVMs with deep drainage in younger patients are likely to exhibit an increased maximum intra-nidal velocity. PCMRA-based velocimetry is a potential tool to predict AVM rupture.
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Treatment of dural arteriovenous fistula induced schizophrenia: case report

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Purpose:
Cortical venous drainage and venous hypertension are important factors in determining the treatment of dural arteriovenous fistula (DAVF). Schizophrenia is one of the very rare symptoms of DAVF. We experienced DAVF with schizophrenia and performed endovascular and surgical treatment.

Materials and Methods:
A 51-year-old female patient who had been suffering from schizophrenia for 11 years visited our hospital with visual disturbance. She had inadequate emotional expressions and delusions. Brain magnetic resonance imaging (MRI) revealed localized T2 high signal change in the left occipital area and irregular enlarged high flow vessels in the both cerebral hemisphere. It had multiple fistulous channels, distal branches of both middle meningeal arteries (MMAs), superficial temporal arteries (STAs), occipital arteries (OAs) and left posterior auricular artery (PAA).

Results:
The patient underwent endovascular treatment and surgical treatment step by step. First, Onyx embolization was performed on the left distal MMA branches. Surgical ligation of both distal STA channels was performed. Second, partial embolization using onyx for left PAA was done. Then, surgical ligations of the remnant arterial channels and dilatated draining veins were performed. In the brain MRI taken 10 days after the last operation, abnormally engorged vessels in the both cerebral hemisphere were disappeared. One month after the last operation, the patient’s schizophrenia symptoms improved to the point of not taking the psychiatric drug.

Conclusion:
Patients with DAVF who present with atypical symptoms can be expected to improve symptoms through active treatment. In order to improve the symptoms of DAVF patients, various treatment modalities should be considered.
The endovascular management of vein of galen dilatation caused by a dural arteriovenous fistula in adult

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Vein of Galen malformation is an uncommon intracranial vascular abnormality, and this malformation is caused by the persistence of a cerebral arteriovenous fistula of the median prosencephalic vein—a precursor of the vein of Galen at 6–11 weeks gestational age. Most of the cases are found during the neonatal or childhood period; in contrast, it is rarely found in adult patients. The clinical manifestations include headache, seizure, hydrocephalus, calcified pineal mass, and subarachnoid or intracerebral hemorrhage. We described a case of dural arteriovenous fistula with vein of galen dilatation by endovascular embolization that patient with headache that presented vein of galen dilatation in imaging study. A 49-year-old woman presented with headache and nausea during 1 month. She had no significant medical illness history. No neurologic deficit was found. The brain CT angiography showed mass like lesion around third ventricle and the presence of a large dilated vein of galen involving with multiple feeder on both side. Conventional cerebral angiography showed arteriovenous fistula around vein of galen supplied by both internal and external carotid artery and right vertebral artery drained to straight sinus. Vein of galen was presented early arterial phase in dilatated appearance. We treated with Onyx embolization through left superficial temporal artery. Total 3cc injected. Then, post-operative conventional angiography was not showed arteriovenous fistula and arterial phase venous structure. She had not any clinical symptom after procedure. Endovascular embolization has considerably improved outcomes in patients with dural arteriovenous fistula(dAVF). For successful treatment, there were considered to be exact diagnosis.
P-22

Endovascular management of a traumatic carotid cavernous fistula accompanied by a pseudoaneurysm: A case report

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Objective Carotid cavernous fistula (CCF) accompanied by a pseudoaneurysm is a rare life-threatening condition that requires emergency treatment. Herein, we report a case of traumatic CCF accompanied by a pseudoaneurysmal intracranial hemorrhage from the intradural internal carotid artery. Case A man aged 29 years developed a traumatic intracranial hemorrhage after a motor vehicle accident. Cerebral computed tomography (CT) showed an acute subdural hematoma on the left frontal and temporal lobes. There was also an intracranial hemorrhage in the left inferior frontal lobe and a diffuse subarachnoid hemorrhage involving the prepontine cistern, basal cistern, bilateral sylvian fissure, and interhemispheric fissure. Decompressive craniectomy was immediately performed. In a follow-up CT, contrast extravasation in the left inferior frontal lobe with simultaneous venous filling in the left cavernous sinus was detected, concomitant with a high-flow CCF. Cerebral angiography showed that a CCF developed in the left internal carotid artery and a pseudoaneurysm was also detected above the CCF. The fistula was occluded through coil embolization and the pathologic lesions were covered with stents resulting in the disappearance of the fistula and pseudoaneurysm. Conclusion Endovascular stent-assisted coil embolization can be successfully performed in this rare fatal disease without complications. Key words: caroticocavernous fistula, endovascular treatment, pseudoaneurysm
P-23

Management of both intracranial aneurysm and arteriovenous malformation presenting with hemorrhage: Which one of the lesions have led to bleed?

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Purpose: The combination of arteriovenous malformations (AVMs) and intracranial aneurysms (IAs) is associated with higher hemorrhage rate. It presented with hemorrhage is treated more aggressively. We report a case of diffuse SAH patient with both AVM and IA treated in an order of IA first and AVM later.

Result: A 69-male patient presented with sudden mentality deterioration. The diffuse thick SAH was identified and left temporal AVM with prenidal aneurysm at left MCA bifurcation also discovered from series of image study. Although there was locally confined hemorrhage around the AVM, we concluded the diffuse SAH is from ruptured aneurysm. Then we proceeded with aneurysm clip. 2 weeks later, we planned on AVM removal entailing firstly the embolization of AVM to obliterate as much feeders as possible. One week thereafter, we removed the total AVM lesion. The operation was successful.

Discussion: There are some clues of AVMs laden IAs about which one is the bleeder. The patient present with isolated SAH, the aneurysm is the culprit and treatment should be directed at it. A patient present with ICH or IVH around the AVM, the AVM or intranidal aneurysm could be the culprits. In case that cannot be reliably determined which one is the bled lesion, the treatment should be directed toward the aneurysm first because of its higher rupture risk.

Conclusion: The treatment of an AVM combined IA presenting with hemorrhage should be well planned to obliterate both lesions simultaneously or to obliterate ruptured lesion first.
Occipital artery - anterior cerebral artery bypass for severe stenosis at the internal carotid artery bifurcation: a case report

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Background: Superficial temporal artery (STA)-middle cerebral artery (MCA) bypass and STA-anterior cerebral artery (ACA) bypass is a treatment option for selected ischemic cases. However, STA is not always available because of the congenital hypoplasia, posttraumatic change, or previous operation. In such cases, other cutaneous arteries can be an alternative donors to improve cerebral perfusion.

Case presentation: A 59-year-old right-handed man suddenly developed aphasia and paralysis on the right. The symptoms resolved in 90 minutes since the onset. A magnetic resonance imaging demonstrated the stenosis of the left internal carotid artery without any findings of acute infarction. Angiogram confirmed severe left internal carotid artery stenosis and showed delayed perfusion in the left ACA region. Single-photon emission computed tomography revealed poor cerebrovascular reserve capacity categorized as stage two by Powers’ classification in the ACA and MCA areas. Dual antiplatelet therapy failed to prevent recurrent transient ischemic attacks of aphasia and weakness of right lower extremity, indicating the need of revascularization in both ACA and MCA territories. As the ipsilateral STA was terminated at the bifurcation probably due to previous trauma, we performed occipital artery (OA)-ACA bypass with posterior auricular artery (PAA)-MCA bypass. Postoperative angiogram showed good patency of both bypasses, and the patient has had no more ischemic attacks.

Conclusions: OA can reach even to ACA. This OA-ACA bypass can be combined with PAA-MCA bypass. Even if STA is not available, combining OA and PAA may have the potential to re-vascularize cerebrum in both MCA and ACA areas.
P-25

Analysis of the patients with moyamoya disease who needed to be performed multiple revascularization surgery in a cerebral hemisphere

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Purpose: Moyamoya disease is a chronic progressive occlusive disease and often requires multiple surgeries according to the cerebral ischemic area. We examined the characteristics of cases required multiple surgeries on a cerebral hemisphere.

Methods: This study included 54 patients, 74 hemispheres, with moyamoya disease who underwent surgery at Saga University from January 2009 to December 2017. Among them, 5 patients, 9 hemispheres (12.2%), performed 2 or more revascularization surgeries in a cerebral hemisphere. Various clinical data were examined for this group.

Results: All 5 cases were pediatric onset. The period from initial surgery to additional surgery was 8 months to 8 years. Among the 9 cerebral hemispheres, additional surgeries were performed due to the progress of the cerebral artery stenosis in the 6 hemispheres and were performed due to insufficient angiogenesis in the 3 hemispheres. One out of 3 hemispheres, the initial surgery was performed indirect procedure. The remaining 2 hemispheres were performed direct and indirect procedures. After additional surgery, symptoms were improved in all cases.

Discussion: Some reports indicate that angiogenesis is insufficient in 10 to 20% of indirect procedures. In this report, 5% of the indirect procedures required additional surgery, and it was considered to be a relatively good result. Furthermore, it was thought that the indirect procedure could obtain almost the same results as the direct procedure.

Conclusion: Based on the advantages and disadvantages of direct and indirect procedures, it is necessary to select revascularization procedure according to each cases.
Hemodynamic Changes after Unilateral Revascularization for Moyamoya Disease: Serial Assessment by Quantitative Magnetic Resonance Angiography

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BACKGROUND: Ultrasonic flowmeters and quantitative magnetic resonance angiography quantitatively assess flow during hemodynamic evaluation of cerebral ischemia. Although their reliability and reproducibility have been verified, their clinical impact in moyamoya disease has rarely been reported.

OBJECTIVE: To investigate flow measurement outcomes in moyamoya disease patients pre- and postoperatively through a retrospective observational study.

METHODS: We evaluated 41 patients undergoing their first revascularization surgery who were followed ≥ 6 mo. Hemodynamic parameters were recorded preoperatively, at 1 and 6 mo postoperatively, and at the last follow-up. Demographic factors, Suzuki stage, and stroke development were also analyzed.

RESULTS: Patients’ median age was 37 yr (interquartile range [IQR], 27-43), and 16 (39.0%) patients were men. During follow-up, 9 (22.0%) patients experienced postoperative stroke (4 major strokes). Hemodynamic status was improved in 34 (82.9%) patients at the 6-mo follow-up. Median intraoperative flow was 41mL/min (IQR, 25-59). Bypass flow peaked at 6 mo (median, 67 mL/min; IQR, 35-99). At the 1- and 6-mo follow-ups, ipsilateral hemispheric flow was significantly increased. The median proportion of posterior circulation at 6 mo was 44.4%, significantly lower than the preoperative proportion (50.1%). Abundant intraoperative bypass flow was associated with hemodynamic improvement, while low contralateral hemispheric flow was related with immediate postoperative ischemic stroke.

CONCLUSION: Ipsilateral hemispheric flow was increased during 6-mo follow-up, and posterior circulation flow burden was diminished. Abundant intraoperative bypass flow was associated with postoperative hemodynamic improvement. Low preoperative contralateral hemispheric flow was related with immediate postoperative ischemic stroke.
STA-Saphenous Vein-MCA Bypass as a Rescue Surgery in Acute Cerebral Infarction

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A 75-year-old woman with acute cerebral infarction in the left proximal M1 portion of MCA. The patient’s consciousness level at the time of admission to the emergency room was Stupor with right hemiparesis motor grade 1. The interval between the patient’s last normal time and emergency room visit time was 50 minutes. We planned IA thrombolysis and performed emergency procedures. Suction thrombectomy was done and M1 was recanalized. 5 minutes later, occlusion occurred again in-situ. We tried thrombectomy with Trevo stent. But M1 occlusion occurred again. Finally, angioplasty using wingspan was planned, But during the procedure, ruptured distal ICA occurred and ICA total occlusion was performed with coils. Additional treatment was considered necessary. We determined bypass surgery was necessary and STA stump-saphenous vein-MCA bypass surgery was done. Thrombectomy was considered to be quite difficult because of the wingspan stent deployed from the distal ICA to M1. So, the saphenous vein anastomosis to the m2 portion of the MCA and the operation was terminated. Brain CT angiography showed flow patent in STA-saphenous vein-M2 and MCA cortical flow was observed. MCA cortical flow was more clearly observed in CT angiography taken one week later and the patients is currently recovering. If we simply performed decompressive craniectomy or low flow bypass, the patient’s progress may have worsened. We believe that because of the high flow bypass, MCA distal blood flow was improved and therefore the patient’s clinical status improved. In this case, high-flow bypass seems to have been a good treatment option.
P-28

Surgical microanatomy of occipital artery for suboccipital muscle dissection and intracranial artery reconstruction

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Introduction
The occipital artery (OA) is an important donor artery for posterior fossa revascularization. Harvesting the OA is not easy compared to superficial temporal artery because OA runs between suboccipital muscles. Hence, the anatomical knowledge of suboccipital muscles and OA is essential. Present study analyzed running pattern of OA and its anatomic variations by using intraoperative and preoperative findings.

Method
From April 2012 to March 2018, we surgically treated 162 patients with suboccipital muscle dissection with OA dissection for the treatment of intracranial aneurysm or tumor or MVD. The running pattern and relationship between suboccipital muscles and OA was retrospectively analyzed in operation video and preoperative enhanced computed tomography (CT).

Result
The anatomic variation of running pattern of OA were identified around the longissimus capitis muscle. The running pattern of OA was classified in two types, such as running lateral to the longissimus capitis muscle and running medial. The medial pattern were observed in 107 (66%) and lateral pattern were observed in 54 (33.3%). One (0.6%) showed running between longissimus capitis muscles.

There were no difference between intraoperative findings and preoperative CT findings.

Discussion
Present study revealed the effectiveness of the preoperative CT to determine the running course of the OA. To know the running pattern of the OA preoperatively is important to harvesting OA safely. Because there are risk of OA injury in case of lateral pattern during splenius capitis muscle elevation. In addition, this is the first report that the OA rarely running in between longissimus capitis muscles.
P-29

Postoperative countermeasure against the operative 10-0 needle which has been lost during the STA-MCA bypass surgery

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[Purpose] The intraoperative needle loss is an accident that we surgeon must certainly avoid. We can recognize the size of 4-0 needle easily, so we rarely leave them in the surgical field. However we may sometimes have difficulty in confirming 10-0 needles under the microscope. We experienced two cases that we lost 10-0 needle in operation, and identified and removed it based on postoperative CT/MRI image. We report about future prevention policies.

[Object] From April, 2012 to June, 2018, we perform 1435 craniotomy surgery and perform 139 bypass operations above all. Of these, in two cases that the loss of the needle in the operative field was doubted during operation, we could point out the needles on postoperative CT/MRI image. Subsequent removal surgeries were done for both patients, and there was not the new complication associated with the residual needles.

[Consideration, Conclusions] On the bypass surgery, we keep the following things in mind every time. Make the operative field clear basically. Spread out the Gelfoam on the surface around the bypass field for preventing to damage the brain and to lose needles. Every loss of the needle occurs after reopening the bypass flow. Therefore we think that it is related to the situation that blood appears in the operative field, being upset mentally, the left thread with needle is short. It is occasionally impossible to find needles although we make an effort looking for a needle during an operation. However, when we cannot completely deny existence in the skull in operation, we strongly doubt the existence and it is necessary to react as promptly as possible so that secondary complication does not occur.
Assessment of the cortical artery using computed tomography angiography for surgical simulation in moyamoya disease

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Computed tomography angiography (CTA) is often used to assess the vascular status in moyamoya disease. The purpose of the study is to identify the characteristics of cortical arteries (M4) of the moyamoya disease on CTA; the clinical significance of which is also discussed. A total of 38 hemispheric sides of 27 patients with moyamoya disease were included in this study. The number of M4 was visualized on CTA using cortical surface imaging and compared between the moyamoya disease group and the non-moyamoya disease group or control group. Then, the clinical and radiological factors associated with the number of M4, the distribution of M4 and collateral circulation were examined. The number of M4 was lower in moyamoya disease group than in the non-moyamoya disease group and in the control group (P < 0.05). There are few predictive clinical factors of the number of M4 except male sex. The prefrontal artery, precentral artery, central artery, and angular artery had a significantly higher prevalence in moyamoya disease (P < 0.05). The durocortical and perivascular anastomosis had a significantly higher prevalence in moyamoya disease (P < 0.05). The prevalence and distribution pattern of cortical arteries in moyamoya disease differed from that of non-moyamoya disease group, and the distribution patterns of the M4 might be influenced by collateral circulation. It is thus essential to recognize M4 to assess the recipient artery so as to ensure superficial temporal artery-middle cerebral artery bypass.
Long term follow up of patients with moyamoya disease initially treated by unilateral surgery

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Background. We have treated juvenile and adult moyamoya disease (MMD) of ischemic onset mainly using indirect bypass surgery. Basing on hemodynamic measurement such as dynamic susceptibility contrast (DSC)-MRI and/or positron emission tomography (PET), only the symptomatic hemisphere with hemodynamic stress over certain degree have been operated even when vascular lesion is bilateral.

Purpose. We investigated the clinical outcome of patients who received unilateral surgery at the initial treatment to clarify if our strategy can be justified.

Subjects. From June 2003 to December 2011, 50 patients received unilateral indirect bypass surgery (mainly encephalo-duro-arterio-synangiosis (EDAS)) as a maneuver of initial treatment (mean of age, 13.6 y/o (3-51) ). Five of them were unilateral MMD but the others had bilateral vascular region. The hemisphere to be operated was determined by setting the threshold on PET measured oxygen extraction fraction (OEF) and/or DSC-MRI measured mean transit time (MTT), other than clinical symptom. Long term operative result and the rate of additional surgery to the contralateral side was assessed.

Results. Mean post-operative follow-up period was 7.8 years (5.3-13.0). Though two patients (4%) experienced peri-operative infarction (both are adult cases), the others did not present cerebral infarction throughout the follow-up period. Twenty seven cases (54%) underwent contralateral additional surgery. Mean of the interval between two surgery was 24.1 months. Peri-operative complication rate of the second surgery was zero. Seventy one percent of children (<15 y/o) underwent the contralateral surgery, but 81% of elder cases (>=15 y/o) have not been requiring additional surgery. Among 27 cases who required contralateral surgery, 13 (48%) did not present the worsening MRA score, but 11 of such 13 (84.6%) presented the worsening of DSC-MRI measured MTT delay.

Conclusion. Our surgical strategy against MMD could be justified considering rather low subsequent infarction rate after long term follow up period. Considering the discrepancy between the worsening rate of MRA score and that of hemodynamic state, long-term follow-up using DSC-MRI might be a good choice when the patients received unilateral treatment as an initial surgery.
P-32

Carotid endarterectomy in patients on hemodialysis, a comparative cohort

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INTRODUCTION: Although carotid endarterectomy (CEA) is an evidence-based surgical treatment for severe carotid stenosis, there are only a few reports evaluating outcomes in patients on hemodialysis (HD). Here we report outcomes of CEA in HD patients.

METHODS: We retrospectively analyzed the records of 105 patients (including 6 HD patients) who underwent CEA in our hospital from January 2011 to May 2018. During this period, 56 patients were treated by carotid artery stenting (CAS), however none of these were on HD. Clinical variables and outcomes between HD and non-HD group were compared.

RESULT: Among 99 non-hemodialysis patients (87.9% male), mean age was 72.5 years, 49 patients were symptomatic, the mean degree of stenosis was 75.9%, 23 patients were managed in ICU postoperatively. In the HD patient group (n=6, 50% male), the mean age was 76.2 years, 2 patients were symptomatic, the mean degree of stenosis was 88.2%, all patients had severe plaque calcification. Postoperatively all patients were managed in ICU. There was no deterioration of mRS in this group.

CONCLUSION: HD patients tended to be older and have more severe stenosis. Although most of HD patients have medical problems which makes general anesthesia unfavorable, we have to perform CEA due to severe calcification of their plaque. We think surgical tips of CEA for HD patients and postoperative ICU management could avoid surgical complications. In this small cohort, we demonstrate good short-term outcomes, but further investigation should be needed to ensure long-term outcomes of those patients.
Prediction for development of cerebral hyperperfusion after carotid endarterectomy using cerebral oxygen extraction fraction map based on quantitative

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Cerebral hyperperfusion (HP) has been defined as a substantial increase in ipsilateral cerebral blood flow (CBF) over the cerebral metabolic demands following carotid endarterectomy (CEA) in patients with carotid stenosis. It is well-known that hyperperfusion tends to occur when CEA was performed in the state of misery perfusion, which is defined by elevation of cerebral oxygen extraction fraction (OEF). In the previous work by our group, it has been validated that a map based on quantitative susceptibility mapping (QSM) obtained at 7 Tesla ultra-high field magnetic resonance imaging (MRI) system can assess OEF equal to positron emission tomography, which is a gold standard in assessing the cerebral blood flow and metabolism. Thus, the aim of the present study was to validate whether the preoperative OEF map based on QSM at 7T (OEFQSM) could predict the development of postoperative HP after CEA in patients with the unilateral internal carotid artery stenosis. As the results, OEFQSM was significantly higher in the presence group than that in the absence group of HP (p<0.0001). Receiver operating characteristic analysis showed the OEFQSM was a good indicator for predicting the development of HP after CEA when the suitable cut-off value (sensitivity, 90%; specificity, 84%; positive predictive value, 45%; negative predictive value, 98%). Finally, the present study demonstrated that preoperative OEFQSM map at 7T can identify patients at risk for HP after CEA.
Preoperative Cervical Carotid Artery CEUS findings are associated with development of MES on transcranial doppler during CEA.

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Purpose: Emboli from the surgical site during exposure of the carotid arteries cause new cerebral ischemic lesions or neurological deficits after carotid endarterectomy (CEA). The purpose of the present study was to determine whether preoperative contrast enhanced ultrasonography (CEUS) findings of the cervical carotid artery (CCA) are associated with the development of microembolic signals (MES) on transcranial Doppler during exposure of the artery in CEA and to compare the predictive accuracy of CEUS findings with that of gray-scale median (GSM) on the conventional B-mode of ultrasonography.

Methods: 70 patients with the internal carotid artery stenosis (≥70%) preoperatively underwent the ultrasonography with and without the contrast agents at the portion of CCA. CEA was performed under transcranial Doppler monitoring to the ipsilateral middle cerebral artery for detecting MES. Maximal intensity on the time-intensity curves were identified by a curve fitting technique to each 4D CEUS dataset of intraplaque or lumen, and the ratio of two maximal intensities (intraplaque/lumen) was calculated. GSM value of the intraplaque was also calculated.

Results: Multivariate statistical analysis demonstrated that only EIp/EIl was significantly associated with the development of MES (p=0.0002). The area under the receiver operating characteristic curve to discriminate between the presence and absence of MES during exposure of the carotid arteries was significantly greater for EIp/EIl than for GSM (p=0.0108).

Conclusions: Preoperative CEUS findings of the cervical carotid arteries are associated with development of MES on transcranial Doppler during exposure of the artery in CEA, and the predictive accuracy of CEUS is greater than that of GSM.
A case of unruptured ICPC aneurysm which was treated with simultaneous ipsilateral carotid endarterectomy

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[Introduction]
Proximal control during aneurysm clipping is essential. Although in case of severe atherosclerosis of parent artery the exposure of cervical carotid artery is needed, cervical carotid exposure should be carefully performed because a patient with severe atherosclerosis of parent artery has relatively high incidence of cervical carotid atherosclerotic stenosis.

[Case]
67-year-old female with right unruptured ICPC aneurysm.
Preoperative CTA showed severe atherosclerosis with calcification at supraclinoid ICA and ipsilateral cervical ICA stenosis (NASCET: 60 %). Carotid endarterectomy was performed prior to neck clipping for a safe proximal control during clipping aneurysm.

[Surgical procedure]
At first, external carotid, internal and common carotid artery were exposed by cervical dissection. Subsequently, front-temporal craniotomy was performed. After sufficient hemostasis of the epidural space, 3,000 IU heparin was infused and CEA was performed. Afterward, ICPC aneurysm was exposed through transsylvian route as an anterior temporal approach. The aneurysm was clipped safely under proximal control at cervical carotid artery without touching intradural proximal ICA. Patient discharged with mRS 0.

[Discussion]
Coexistence of cerebral aneurysm and ipsilateral cervical ICA stenosis is not common. This is the first report of single-stage cerebral artery aneurysm clipping and ipsilateral CEA. Although the risk of distal embolism can be considered even after carotid endarterectomy during temporary clamping cervical carotid artery, tentative occlusion of cervical carotid artery without endarterectomy may cause more severe distal embolism by plaque rupture.

[Conclusion]
CEA and neck clipping aneurysm could be performed safely with a proper management of hemostasis.
Background: While acute middle cerebral M2 occlusion may result in severe neurological deficits, endovascular thrombectomy (ET) has not been considered as the first-line treatment because of the lack of enough clinical evidence. In this study, we evaluated the efficacy of ET for M2 occlusion from the aspect of the anatomical variation of middle cerebral artery.

Patients and Methods: This study includes 11 consecutive patients with isolated acute M2 occlusion who underwent ET in our institution. Occluded vessel was categorized into the following three based on the supplying area of affected M2: Functional M1 (FM1), Superior branch (SP), and Inferior branch (IF). Clinical features and results of ET in each group were retrospectively analyzed and compared.

Results: Occlusive vessel was determined as follows; 4 (36%) were FM1, 3 (27%) were SP, and 4 (36%) were IF. In FM1 group, in both NIH Stroke Scale (NIHSS) and motor NIHSS were significantly higher than those in other groups (11 vs. 6.1; p<0.05, and 4.8 vs. 1.1; p<0.01, respectively). The rate of successful reperfusion (TICI grades 2B and 3) was highest in FM1 (100%), and lowest in SP occlusion (33%). Favorable clinical outcome (modified Rankin Score 0-2 at 3 months after onset) was obtained in 9 cases (82%).

Conclusions: This study suggested that FM1 occlusion is considered as a good candidate for ET. The efficacy of ET for M2 with limited supplying area is questionable. Further investigation with anatomical consideration is needed to elucidate the efficacy of ET for acute M2 occlusion.
Endovascular mechanical thrombectomy for acute ischemic stroke in patients with implantable continuous-flow ventricular assist device

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Introduction: Thromboembolism is a serious complication in candidates for heart transplantation wearing ventricular assist device (VAD). Acute ischemic stroke with large vessel occlusion (LVO) is one of the most critical complications. The aim of this study is to investigate the efficacy of endovascular treatment for LVO in VAD patients.

Methods: We retrospectively reviewed acute ischemic stroke and endovascular mechanical thrombectomy on patients with continuous-flow VAD between 2011 and 2017 at Osaka University Hospital.

Results: Forty-three patients with 73 ischemic stroke events were identified and 6 consecutive patients with 8 LVO events underwent endovascular treatment. The mean age of 6 was 43.8 years, and there were 4 men (67%). Implanted VAD was EVAHEART in 3 patients and Heartmate II in 3 patients. Ten arterial occlusions were observed in 8 events. The median Alberta Stroke Program Early CT Score was 9. Nobody received intravenous rt-PA therapy and endovascular treatment was performed in 10 arteries. The successful reperfusion (Thrombolysis in Cerebral Infarction ≥ 2b) rate was 80% (contact aspiration: 87% vs. stent retriever: 33%). A favorable outcome at 90 days (modified Rankin scale score ≤ 3 or equal to the pre-stroke score) was observed in 4 (67%) patients. Three (60%) candidates for transplantation could return to the waiting list. Histopathological analysis revealed fibrin-rich thromboses in 4 cases. Periprocedural complications involved one symptomatic intracranial hemorrhage and the mortality within 90 days was 17%.

Conclusions: Endovascular mechanical thrombectomy for VAD patients with LVO is feasible. To achieve early and safe revascularization, the contact aspiration is recommended.
Predictors for Good Functional Outcome after Mechanical Thrombectomy in Acute Cerebral Artery Occlusion

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(Introduction)

Acute occlusion of a major cerebral artery is associated with high mortality and morbidity. Few data about prognostic factors for a good outcome are available, although mechanical thrombectomy has significantly advanced over the last 5 years. The aim of this study is to investigate good prognostic factors for an acute occlusion of a major cerebral artery using mechanical thrombectomy.

(Materials and methods)

A single center retrospective analysis of 37 consecutive patients with acute occlusion of a major cerebral artery treated by mechanical thrombectomy with stent retrievers was conducted. Collaterals were assessed by the Thrombolysis in Myocardial Infarction (TIMI), and recanalization was assessed by the Thrombolysis in Cerebral Infarction (TICI) score. Outcome was assessed by National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale (mRS) at 90 days.

(Results)

Most patients (27/37) demonstrated good recanalization (TICI 2b or 3) after thrombectomy. At the 90-day follow up, 19 patients had good (mRS, 0-2), 14 had moderate (mRS, 3-4) and four had poor outcomes (mRS, 5-6). Early recanalization, high TIMI, and low baseline NIHSS were closely related to 90-day mRS, whereas high TICI was related to both mRS and the decrease in the NIHSS.

(Conclusions)

NIHSS decreased markedly when recanalization was successful. A good mRS was related to low initial NIHSS and good collateral and early and successful recanalization.
Current guidelines for mechanical thrombectomy (MT) via stent retriever device, recommend to first place an 8 French (Fr) balloon guide catheter proximal to occlusion site and to place the retriever device through the occlusion distal to the clot by using a guide wire. Balloon guided catheter is used in order to create temporary blood flow arrest to minimize the possibility of further distal occlusion form thrombus fragments while retrieving the thrombus. However, even with such excellent aspects, authors have experienced retrieval failure when the distance between the balloon guidier and occlusion site is remote especially when it is increased due to tortuosity of the vessel. In this study, we present a case of successful MT of an obstruction in acute ischemic stroke by the using an intracranial support catheter advance technique (CATCH), with good angiographic and clinical outcome. CATCH should be considered as a preferable method of treatment for vessel occlusion of acute ischemic stroke.
The objective of this study was to investigate the predictive value of CTA source image ASPECTS in clinical outcome and final infarction extent after endovascular treatment (EVT) in patients with acute ischemic stroke (AIS).

All eligible patients from January 2013 to December 2017 undergoing EVT were retrospectively reviewed. The baseline ASPECTS on initial NCCT and CTA source image was compared with the follow-up MR DWI ASPECTS. Receiver operating characteristic (ROC) curve analysis was used to assess the predictive value of CTA source image ASPECT for prediction of final infarct extent and favorable outcome (mRS ≤ 2). Multivariable logistic regression analysis was performed to identify independent predictors of favorable functional outcome.

Our sample included a total of 122 eligible patients with a median baseline NIHSS score of 12. Baseline ASPECTS on CTA source image correlated with follow-up MR DWI ASPECTS (r=0.84, p for comparison of the 2 coefficients < 0.001) better than NCCT ASPECTS (r=0.45, p < 0.001). ROC curve analysis revealed baseline CTA source image ASPECTS (AUC = 0.738; 95%CI: 0.65-0.83 p<0.001) can better predict favorable functional outcome than NCCT ASPECTS (AUC = 0.640; 95%CI: 0.54-0.74 p=0.008).

Additionally, Baseline NIHSS score <15 (OR 3.01 95%CI: 1.12-8.06, p=0.028), CTA ASPECTS ≥8 (OR 3.15 95%CI: 1.08-9.19, p=0.036) and successful recanalization (OR 5.31 95%CI: 1.81-15.58 p=0.002) were independent predictors of good clinical outcomes.

The ASPECTS on CTA source image provides more information in the prediction of good clinical outcome and final infarction size than NCCT in patients with AIS treated with EVT.
P-41

Predictors for detecting patients who need intravenous tissue plasminogen activator administration and/or endovascular thrombectomy from emergent patients of probable stroke by pre-hospital status

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Purpose:
Acute ischemic stroke (AIS) from large artery occlusion (LAO) can be treated by intra-venous tissue plasminogen activator (IV t-PA) administration and/or endovascular thrombectomy (EVT) if the patient is taken to the hospital at earlier phase from the onset. It is also proved that time to reperfusion is a strong predictor of outcome following EVT, but the comprehensive stroke centers (CSCs) which can provide both IV t-PA and EVT are not so many in each medical area in Japan. When the emergency medical service (EMS) take the eligible patient to the hospital that is not the CSC, the patient needs to be transported again to the CSC. It is loss of time for starting these treatments and the prognosis expected to be worse, so it is important that the eligible patient is properly taken to the CSC first by EMS. There are many differential diagnosis from AIS like intra-cranial hemorrhage, epilepsy, low blood glucose and so on. We aimed to find the predictors for AIS from LAO that requires IV t-PA and/or EVT from the data that are available by EMS.

Materials and Methods:
We retrospectively analyzed our database for patients who had the possibility of AIS between October 2015 and December 2016.

“The possibility of AIS from LAO” is considered as the sudden onset of neurological symptoms that are suspicious of stroke and the onset time is estimated within 6 hours at the time of EMS contact. We retrospectively surveyed their background including past medical history, vital signs and neurological status from the EMS document and checked their diagnosis and treatment also. This cohort was dichotomized into reperfusion therapy group and no reperfusion therapy group and compared the data from two group. Statistical analysis is performed by multivariate analysis with logistic regression model and p<0.05 is considered as significant.

Results:
Among 87 patients, 25 patients (28.7%) have been treated by IV t-PA and/or EVT. The multivariate analysis revealed the significant factors associated with receiving these treatments were female (p<0.01),
irregular heart rhythm (p<0.01), conjugated deviation (p=0.045) and aphasia (p<0.01). When all four factors are positive or negative, prior probability of receiving these treatments are 97.0% and 2.0%, respectively.

Conclusion:
In this study, predictors for receiving IV t-PA and/or EVT are female, irregular heart rhythm, conjugated deviation and aphasia. It may be useful for EMS to make decision of patient transportation to the CSC first or not.
Average mean transit time (MTT) of whole brain predicts the development of cerebral infarction due to delayed cerebral ischemia

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Introduction: Delayed cerebral ischemia (DCI) is a serious complication of aneurysmal subarachnoid hemorrhage (aSAH). We examined whether CT perfusion (CTP) on day 7 (D7) after onset from aSAH could predict development of cerebral infarction (CI) due to DCI.

Methods: In 94 aSAH patients, we performed plain CT, CTP, and CT angiography (CTA) on day 7 (D7) from onset. Region of interest (ROI) was determined in 6 areas of the bilateral anterior cerebral artery, 12 in the middle cerebral artery, and 6 in the posterior cerebral artery, and 2 in the basal ganglia. We measured average MTT of whole brain (wMTT) and territories of each of the 6 major vessels (tMTT). Vessel narrowing >50% was defined as CVS on CTA or digital subtraction angiography (DSA) on D7 or thereafter. We examined CI due to DCI on plain CT after one month from onset.

Results: CVS developed in 74 arteries in 29 patients. CI due to DCI developed in 18 areas in 13 patients. On D7, there were no differences in tMTTs with and without CVS, and with and without CI. On D7, wMTTs in patients with and without CI were 4.97s and 4.11s (p=0.0037), respectively, but there was no difference on D0.

Conclusion:
Not tMTT but wMTT on D7 is useful to predict the development of CI due to DCI.
The usefulness and problem of arterial spin labeling for moyamoya disease

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Background and Purpose: Arterial spin labeling (ASL) allows repeated measurement of estimated cerebral blood flow (CBF) without exogenous contrast. Moyamoya disease is known to demonstrate dynamic CBF changes during perioperative periods. The aim of this study was to explore the value of ASL in the perioperative management of Moyamoya disease.

Methods: Thirteen patients underwent revascularization surgery and CBF was evaluated by using ASL and IMP-SPECT pre- and post-operatively. Imaging included ASL using multiple post labeling delays (PLD, 1.5 and 2.5 sec.) to evaluate operative/nonoperative CBF ratio. Three-dimensional stereotaxic region of interest template was used to compare with CBF ratio of ASL and SPECT.

Results: Preoperatively, CBF ratios of ASL with PLD of 1.5 sec. did not correlate with those of SPECT. In 50% of the patients the side of decreased CBF on SPECT was correctly indicated with ASL (match group), but in the other half of the patients the results was reversed (mismatch group). The mismatch was due to arterial transit artifacts (ATA) in all 5 patients. In mismatch group, the ivy signs were more prominent than in the match group. The localization of the ATAs and the ivy sign were well compatible. Postoperative CBF ratios of ASL with PLD of 1.5 sec. tended to correlate with those of SPECT. ATAs were diminished postoperatively.

Conclusions: Perioperative ASL with PLD of 1.5 sec was useful to evaluate CBF when the ivy sign is not evident. In patients with prominent ivy signs, ASL did not correctly demonstrate CBF due to ATA.
Poster

P-44

Clinical value of arterial spin labeling with acetazolamide for assessing cerebral circulation

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Background and purpose: Arterial spin labeling (ASL) with 3T magnetic resonance imaging (MRI) is non-invasive and an effective method for estimating cerebral blood flow (CBF). In clinical use, CBF and cerebrovascular reactivity (CVR) are needed for screening surgical adaptation and estimating surgical risks. We measured these parameters of cerebral circulation with ASL with acetazolamide (ACZ).

Material and method: Twenty-five patients (male: 20, female: 5, average age: 67.4 years, range: 48-79 years) with unilateral major cerebrovascular stenosis or occlusion underwent CBF measurement with single photon emission computed tomography (SPECT) and ASL. Eight of them assessed CVR with SPECT and ASL using ACZ. MRI was performed with 3Tesla Discovery (GE Healthcare) and the data were collected with dual post-labeling delays (PLDs).

Result: CBF and CVR values were successfully measured with MRI and SPECT. There was a significant correlation between 2 methods in CBF values of lesion side and healthy side (Spearman’s correlation coefficient 0.331, 0.365: p<0.01). CVR values were estimated sufficiently by the differences of dual-PLDs ASL-CBF 10min after ACZ administration (Spearman’s correlation coefficient -0.4062: p<0.0001).

Conclusion: ASL-MRI with ACZ is available for CBF and CVR estimation, and useful for assessing cerebrovascular circulation. This is the first report for CVR measurements by ASL with dual delay time in comparison to those by SPECT in patients with IC stenosis.
P-45

Evaluation of sylvian veins by 3D rotational venography for sylvian fissure dissection

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Background: Dissection of the sylvian fissure is a standard procedure in neurosurgical operations. However, this dissection is complicated by the anatomy and running directions of the sylvian veins. Therefore, we analyzed the sylvian veins by 3D rotational venography for the successful dissection of the sylvian fissure. Methods: We examined five patients with unruptured cerebral aneurysms. We performed cerebral angiography for all the patients before the clipping surgery. During cerebral angiography, 3D rotational venography was also performed. We analyzed the sylvian veins before the operation and compared the preoperative findings with the actual anatomy and running directions of the sylvian veins during the operation. Results: In all the cases, intraoperative findings of the sylvian veins were the same as preoperative findings. Discussion: The anatomy and running directions of the sylvian veins showed various patterns. Occasionally, the veins showed complex running directions and connections; in such cases, the dissection of the fissure was time-consuming. To dissect the sylvian fissure smoothly and successfully, the sylvian veins need to be comprehensively analyzed. Currently, cerebral angiography is not preferred because of its invasiveness and risk. Furthermore, computed tomography angiography does not provide detailed descriptions of the venous structures compared with cerebral angiography. 3D rotational venography can provide more detailed images than those by 2D rotational venography. Additionally, the actual venous conformation can be easily unraveled by 3D rotational venography. Conclusions: The findings of our study showed that a detailed analysis of the sylvian veins by 3D rotational venography is useful for sylvian fissure dissection.
P-46

The prognostic value of CT-angiographic parameters of internal carotid artery terminus occlusion

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The objective of this study was to investigate the prognostic value of computed tomographic angiography (CTA) based on leptomeningeal collateral status and other parameters in acute ischemic stroke (AIS) patients with internal carotid artery (ICA) terminus occlusion treated with endovascular treatment (EVT).

Methods: All eligible patients from January 2013 to December 2017 undergoing EVT were retrospectively reviewed. The regional leptomeningeal score was used to assess the leptomeningeal collaterals (LMC) on baseline CTA. The collateral status measured by the LMC score (0-20) was trichotomized into 3 groups: good (17-20), intermediate (11-16), and poor (0-10).

Results: Our sample included a total of 119 eligible patients (60 males, mean age 73 years) with a median baseline National Institute of Health Stroke Scale (NIHSS) score of 14. Patients with a good LMC score had a lower baseline mean NIHSS score, a higher mean Alberta Stroke Program Early CT score (ASPECTS), and a higher mean clot burden score (CBS). Baseline NIHSS score<15 (OR 3.69 95%CI: 1.32-10.29, p=0.013), CBS>6 (OR 3.97 95%CI: 1.05-14.99, p=0.042), good LMC score (OR 5.14 95%CI: 1.62-16.26, p=0.005) and successful recanalization (OR 11.55 95%CI: 2.72-48.99, p=0.001) were independent predictors of good clinical outcomes.

Conclusion: CTA-based LMC status and CBS are powerful predictors of clinical outcomes in patients with an acute ICA terminus occlusion treated with EVT.
Safety estimating of the preoperative lateral sylvian vein determine method in cerebral aneurysm by using 3D rotational venography

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**Purpose** Sylvian dissection is the most basic and popular technique for aneurysm surgery through pterional approach. There have been many effort to preserve of the lateral sylvian veins. We describe an appropriate sylvian dissection side for unruptured aneurysm to preserve these vein by using 3D rotational venography.

**Materials and Methods** Between January 2017 and December 2017, we performed microsurgical clipping for 75 hemisphere in 74 patients. 33 of them underwent a diagnostic angiogram, and obtained a 3D rotational venography (Zeego Q siemens, Geramany) using Syngo X workplace (Version: VD 11B) software.

**Results** All surgeries were performed without difficulty. We present two cases with using the 3D DSA venography. Case 1 is a case in which 3D DSA venography was helpful in determining the ideal dissection side in multiple lateral sylvian veins. Case 2 is a case in which 3D DSA venography that helpful to determine crossed vein in the sylvian fissure.

**Conclusion** 3D DSA venography is useful define the optimal side of sylvian dissection and determines the crossed vein in sylvian fissure.
Intraoperative Quantitative Blood Flow Assessment by Multiparameter Analysis of Indocyanine Green Video Angiography

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[BACKGROUND]
Measurements of quantitative blood flow are crucial during brain vascular surgery. Indocyanine green video angiography (ICG-VAG) is an accepted method of blood flow visualization; however, quantitative techniques have not yet been established. Thus, the aim of this study was to further develop ICG analysis for visualizing intraoperative flow changes.

[METHODS]
We conducted basic experiments and clinical investigations to establish a relationship between ICG-VAG and measured blood flow. We evaluated several parameters and identified optimal indicators that precisely reflect blood (or fluid) flow. Both in vitro and in vivo studies were performed to calculate the interval between baseline and the intensity peak (Grad) and to measure actual flow rate.

[RESULTS]
Grad and actual flow rate showed good exponential correlation, with R² values of 0.90 in vitro and 0.82 in vivo. In a representative Moyamoya disease operative case, we performed intraoperative flow analysis using FlowInsight, which identified a marked elevation in Grad on the brain surface. We managed postoperative blood pressure carefully.

[CONCLUSIONS]
Grad is the optimum parameter for estimating flow conditions. Although ICG-VAG provides only visual profiles of blood circulation in the brain, this procedure has the potential to be widely used in clinical situations. ICG-based flow measurement can be used to identify normal and abnormal blood flow conditions, such as graft flow and vascular pathology. The novelty of this technique is that the fluorescence intensity of Grad enables surgeons to quantitatively measure real blood flow.
P-49

**Treatment of complex neurovascular diseases in a hybrid OS: A 10-year survey and future prospects**

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This study was designed to evaluate feasibility, safety and impact on treatment of hybrid operating suite (OS) for combined endovascular and surgical treatment in selected patients with complex neurovascular diseases.

Between April 2007 and September 2017, 143 patients with complex neurovascular diseases (92 with cerebral AVM, highly-selected 42 with cerebral large/giant aneurysms, and 9 with dural AVF) underwent combined microsurgical and endovascular treatment in a single session in our hybrid OS. Intraoperative microcatheter 3D-angiography, ICG videoangiography, Doppler sonography, electrophysiological monitoring were routinely used.

Among 92 patients with AVM, endovascular embolization were conducted in 28 cases (30.4%) before microsurgical procedures. Total elimination of AV shunt was angiographically confirmed in 91 cases (98.9%) before dural closure.

Among 42 patients with large/giant aneurysms, 18 (42.9%) were clipped with the aid of endovascular suction decompression, 9 (21.4%) were successfully coiled after microsurgical neck plasty. Intraoperatively, complete obliteration of the aneurysms was confirmed in 37 patients (88.1%).

The hybrid suite is useful setup which allowed for unconstrained combined microsurgical and neuroradiological workflow. This presentation will assess the role of advanced technology in the surgical treatment of complex neurovascular diseases.
Comparison of transradial and transfemoral approach in cerebral angiography.

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Cerebral catheter angiography is gold standard method for cerebrovascular disease. The standard for cerebral angiography is the transfemoral and transradial approaches. The aim of this study is to retrospectively compare the single center results and complications of radial vs. femoral approach.

We reviewed the medical records of 1058 consecutive angiographic studies. Between January 2014 and December 2016, 528 angiographies were conducted via the radial artery while 530 were via femoral artery. The decision of approach whether transradial or transfemoral was on the operator’s discretion. The success rate of examinations, complications, and the time required for angiography were analyzed.

The success rate of angiography was similar (99.3 % in transradial vs 99.5% in trasfemoral). The complication rate is slightly high in transradial group (3.5 % vs 2.7 %). However, the severity of complication was worse in transfemoral group. Most of complications in transradial group were transient arm pain (n=35) or wound problems (n=12) which were recovered in a few days. Most of complications of transfemoral were femoral hematoma (n=27) and cerebral infarct (n=6) which need bed rest for a few days or permanent sequelae. The time required for angiography were significantly shorter in transradial group (17.22 min) than transfemoral group (28.35) group (p=0.02).

Transradial approach is useful method for simple cerebral angiography with fewer severe complication and shorter time demand.
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A comparison between MRA and CTA to evaluate the access route before endovascular treatment

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【Purpose】
Assessment of access route before endovascular treatment is now essential

While Computed tomography angiography (CTA) can be obtained high resolution, it may lead to burden and can occur various complications. In addition to that, it is hard to use for patients with renal dysfunction. On the other hand, although Magnetic resonance angiography (MRA) is lower in resolution than CTA, it is a device that can be performed safely and less complications than CTA.

This study aim to compare MRA with CTA to evaluate the efficacy of MRA before endovascular treatment.

【Materials and Methods】
Patients who underwent CTA and MRA before endovascular treatment were retrospectively studied from October 2015 to August 2016. 10 subjects were included and evaluated.

The blood vessels from common carotid artery to femoral artery was evaluated by CTA and MRA.

We evaluated Quality score, Vascular property, Stenosis, Aorta type classification, presence / absence of aneurysm, meandering degree.

【Result】
For Stenosis, reader 1 was 100% in sensitivity, specificity, positive predictive value, negative predictive value, reader 2 was 75%, 100%, 100%, 85.7%. Diagnosis quality score and blood vessel meandering were the same as CTA.
【Conclusion】
The evaluation of access route by using MRA was useful. The possibility of a less invasive access route evaluation method was suggested based on MRA as screening, and CTA only when detailed examination is required. Even with renal impairment, there is a possibility that it may be a substitute for CTA.
Opening of mPTP and NMDAR silencing is associated with mitochondrial KATP channel mediated ischemic postconditioning

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[Background] Cerebral ischemic postconditioning (IPoC) has been shown to reduce infarction volume in cerebral ischemia/reperfusion (I/R) injury and association of a mitochondrial ATP-dependent potassium (mK+ ATP) channel has been extensively described. Recently, some reports have demonstrated that N-methyl-D-aspartate receptor (NMDAR) silencing induced by mild opening of the mitochondrial permeability transition pore (mPTP) was a crucial determinant of neuroprotection. In the present study, we examine the precise mechanisms of IPoC involving mK+ ATP channel through NMDAR silencing and opening of mPTP using electrophysiological approach.

[Methods] C57BL/6J mice hippocampal slices were used in all experiments. We simulated severe neuronal ischemia by exposing slices to nitrogen-contained solution. Reperfusion for 20 minutes was performed after 7.5 minutes of ischemia. For the IPoC study, after 7.5 min of ischemia, 30 seconds of reperfusion and 3 cycles of 15 s of ischemia and 15 s reperfusion. We measured NMDAR currents and intracellular Ca2+ concentration with patch-clump technique and the fluorescent probes fura-2 in mice hippocampal neurons.

[Results] NMDARs and anoxia mediated increase in Ca2+ were silenced during IPoC. (P<0.05) And mK+ ATP channel opener diazoxide prevented the anoxia-mediated increase in Ca2+ and reduction in NMDAR currents. (P<0.05) The mPTP blocker cyclosporine A prevented the IPoC effect that NMDAR currents reduced. (P<0.05)

[Conclusion] The present study indicates that mitochondria play a pivotal role for neuroprotection of IPoC induced by opening of mK+ ATP channels through NMDAR current silencing by releasing Ca2+ through a cyclosporine A sensitive mPTP.
Compromised cerebral hemodynamics in moyamoya disease is associated with Blood-Brain Barrier dysfunction

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Background: Blood-brain barrier (BBB) dysfunction has been described in patients with chronic cerebral ischemia. It has been suggested to play also a role in moyamoya disease (MMD). The aim of this study was to evaluate a possible association between BBB function and cerebral hemodynamics in MMD.

Methods: In 14 adult MMD patients (5 women, 17-69 years), preoperative evaluation of cerebral hemodynamics was performed by perfusion single photon emission computed tomography (SPECT) with Tc-99m-HMPAO (n=5) or by perfusion positron emission tomography (PET) with O-15-water (n=9). BBB function was characterized by a 3-score of extravasation of sodium fluorescein (FLNa) to brain parenchyma in a predefined region of interest (ROI) in the frontal lobe during craniotomy surgery. FLNa extravasation was tested for association with relative cerebral blood flow (rCBF) and cerebral vascular reserve capacity (CVRC) in the same ROI.

Results: FLNa extravasation was observed in 9/14 patients (64.3%, mild extravasation in 3 patients, strong extravasation in 6 patients). Resting rCBF was significantly smaller in these patients compared to patients without extravasation (0.68±0.12 versus 0.79±0.08, Mann-Whitney U-test p=0.042). In addition, there was a tendency towards smaller CVRC in patients with FLNa extravasation (18.1±12.3% versus 33.0±17.4%, p=0.083).

Conclusion: We demonstrate cerebrovascular disintegration and impaired blood brain barrier characteristics in MMD patients in vivo. And we suggest that compromised cerebral hemodynamics in MMD is associated with increased BBB vulnerability.
RNA sequencing analysis revealed a distinct motor cortex transcriptome in spontaneously-recovered mice after stroke

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Background: Spontaneous recovery can occur after stroke, however, the intrinsic mechanisms driving recovery is unclear. We aimed to elucidate the intrinsic changes in spontaneous recovery after stroke by using RNA sequencing (RNA-seq) transcriptome of primary motor cortex in mice that naturally recovered after stroke.

Methods: Ischemic stroke was induced in C57BL/6J adult male mice by transient MCAO. Behavioral performance was monitored at baseline and post-stroke days 4, 8, and 14. All mice were sacrificed at post-stroke day 15, and a subset of these mice was processed for immunostaining. Infarct size and locations were evaluated either using T2-weighted MRI or histology. Ipsilesional and contralesional primary motor cortices (iM1 and cM1) were dissected and processed for RNA-seq transcriptome analysis.

Results: Cluster analysis of the stroke mice behavior performance revealed two distinct recovery groups: a spontaneously-recovered and a non-recovered group. Lesion mapping analysis showed there was no difference in the lesion size and locations between the groups. RNA-seq transcriptome analysis revealed distinct biological pathways in the spontaneously-recovered stroke mice, in both iM1 and cM1. Correlation analysis revealed that 38 genes in the iM1 were significantly correlated with improved recovery, while 74 genes were correlated in the cM1. In particular, ingress pathway analysis highlighted the cyclic adenosine monophosphate (cAMP) signaling in the cM1.

Conclusions: Our RNA-seq data revealed a panel of recovery-related genes in the motor cortex of spontaneously-recovered stroke mice and highlighted the involvement of contralesional cortex in spontaneous recovery. Developing drugs targeting the cAMP pathway after stroke may provide beneficial recovery outcome.
P-55

The correlation between the degree of stress through hair cortisol level and cerebral aneurysms

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We evaluated the correlation between the degree of stress through hair cortisol level and cerebral aneurysm.

In this study, retrospectively reviewed 105 patients with intracranial aneurysms were included from January 2016 and December 2016. Patients were divided into ruptured group (Group I, 36 patients) and unruptured group (Group II, 69 patients). In both groups, to measure the level of stress immediately before the onset of the disease, approximately 150 strands of hair about 1 to 1.5 cm from the scalp were collected. The collected hair was washed with isopropanol, dried, finely cut and then grinded using a bead beater. Methanol was added and cortisol was extracted using a rotator. After evaporation of methanol at 40 °C using nitrogen gas, cortisol levels were measured using an ELISA and a salivary enzyme immunoassay kit (ALPCO, USA).

There was no significant difference between the two groups regarding the demographics and baseline characteristics. The overall mean cortisol level was 37.48±3.05. In ruptured group I, the mean cortisol level was 49.17±4.18, and in unruptured group II, the level was 32.89±2.30. There is a significant difference between the two groups. (p<0.001)

Based on the results of the hair cortisol study, the patients with ruptured cerebral aneurysm has had higher stress than the patients with unruptured cerebral aneurysm during the recent several months. In the future, this study could be extended to other hemorrhagic or ischemic stroke to evaluate if the stress is related or not.
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Genetic Analysis in Intracranial Atherosclerosis of the Anterior and Posterior

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Background: Intracranial atherosclerosis of the anterior circulation (anterior ICAS) and posterior circulation (posterior ICAS) are thought to involve different pathogeneses and risk factors. Recently, we identified a genetic variant which has a significant association with ICAS. The variant was ring finger protein 213 (RNF213) c.14576G>A which was originally identified as a susceptibility genetic variant for moyamoya disease (MMD). The present study investigated the association of RNF213 c.14576G>A with anterior and posterior ICAS. Methods: A total of 221 study participants (43 with anterior ICAS, 61 with posterior ICAS, 12 with extracranial atherosclerosis (ECAS), 5 with MMD, and 100 control subjects) were recruited from April 2015 to October 2015. Genetic analysis of RNF213 c.14576G>A and association study with these cerebrovascular diseases were performed. Results: RNF213 c.14576G>A was present in 10/43 patients in the anterior ICAS group and 4/5 in the MMD group, but in no patient in the posterior ICAS and ECAS groups. c.14576G>A was found in 2/100 patients in the control group. RNF213 c.14576G>A showed significant association with anterior ICAS (allele count, P=3.9×10^{-5}, odds ratio=13.0, 95% confidence interval=2.8–60.8; prevalence of carriers of c.14576G>A, P=2.6×10^{-5}, odds ratio=14.8, 95% confidence interval=3.1–71.3). However, RNF213 c.14576G>A showed no association with posterior ICAS. RNF213 c.14576G>A also had a significant association with MMD and no association with ECAS. Conclusions: Genetic variant RNF213 c.14576G>A is significantly associated with anterior ICAS but not with posterior ICAS. The present findings may indicate factors involved in the pathogenesis of ICAS-related stroke.
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Combination therapy of regional cold perfusion and hemoglobin-based oxygen carrier in transient cerebral ischemic model

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【Background】
We demonstrated effectiveness of another treatment for ischemia reperfusion injury. One of treatment is regional cold perfusion, and another is artificial oxygen carrier "HemoAct". In this study, we tried to establish most effective therapy by combine these two different approach.

【Materials and Methods】
We used male SD rats that’s body weight was from 250g to 330g. We made right MCAO model using intraluminal suture that was inserted from right ICA. Ischemia time was set to two hours. Two hours later from intraluminal suture was inserted, treatment was performed before reperfusion. We divided into 3 groups depending on the treatment method (①:Control, ②:Room temperature HemoAct intra venous infusion and 10℃ Saline intra arterial infusion, ③:10℃ HemoAct intra arterial infusion). 24 hours after reperfusion, rats were sacrificed to measure infarction volume by TTC staining.

【Result】
The average infarction volume at 24 hours after reperfusion in the groups ① to ③ are as follows: ① 47%, ② 25%, ③ 11%.

【Conclusion】
The combination therapy regional cold perfusion and HemoAct is may work complementarily to cerebral ischemia reperfusion injury and be useful.
A Rare Case of Varicella Vasculopathy presenting with Subarachnoid Hemorrhage

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Reactivated varicella causes herpes zoster especially in elderly or immunocompromised individuals, and rarely accompany cerebral vasculopathy. We report on a rare case of VZV vasculopathy presenting with SAH.

A 66-year-old man presented with comatose mentality after fever and dyspepsia for six days. Some rashes were on his abdomen and neck. Brain CT showed diffuse SAH with multiple petechial hemorrhages. Emergent ventriculostomy was performed to relieve ventriculomegaly. Cerebral angiography showed no definite vascular lesions. Since the clinical and radiological features differed from benign non-aneurysmal perimesencephalic SAH, blood and CSF analyses were performed. Initial CSF analysis was nonspecific. Blood analysis showed polynuclear pleocytosis with CRP elevation. Brain MRI demonstrated diffuse cortical/subcortical edema and leptomeningeal enhancement. Intravenous antiviral agent and steroid commenced since CSF PCR for VZV and serum varicella IgG were positive. Despite the intensive care, he expired from respiratory failure due to brain stem edema and pneumonia.

VZV vasculopathy may result in ischemic/hemorrhagic strokes by affecting large and/or small arteries. Abnormalities on cerebral angiogram are depicted in 70%. Characteristic MRI findings are superficial and deep-seated ischemic/hemorrhagic lesions, typically at grey-white matter junctions. A positive result in CSF PCR confirms diagnosis. Intravenous acyclovir is effective treatment, and concurrent steroid therapy may stabilize inflammations. Its diagnosis is often missed because one-third have no preceding rash, one-third have normal CSF, and VZV DNA is often absent in CSF. Furthermore, SAH due to VZV vasculopathy differs from non-aneurysmal SAH in terms of treatment and clinical course. High index of suspicion is required.
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Dose-dependent impact of cilostazol on plasma tenasin-C and delayed cerebral infarction after aneurysmal subarachnoid hemorrhage

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Background: Cilostazol is a selective inhibitor of phosphodiesterase type III that down-regulates tenasin-C, a matricellular protein, which may cause delayed cerebral infarction after aneurysmal subarachnoid hemorrhage (SAH). The authors increased the dosage, and evaluated the dose-dependent effects of cilostazol on delayed cerebral infarction and outcomes in SAH patients.

Methods: This was a single center, retrospective cohort study. One hundred fifty-six consecutive SAH patients who underwent aneurysmal obliteration within 48 hours post-SAH from 2007 to 2017 were analyzed. Cilostazol (0 to 300mg/day) was administered from one day post-clipping or -coiling to day 14 or later. Effects of different dosages of cilostazol on outcome measures including angiographic vasospasm, delayed cerebral infarction, and 3-month outcomes were evaluated using a univariate followed by a multivariate analysis. A propensity score model was generated for non-cilostazol and 300mg/day cilostazol groups, and plasma tenasin-C levels were compared.

Results: Cilostazol treatment decreased delayed cerebral infarction and increased good outcomes in a dose-dependent manner, although cilostazol did not affect other outcome measures. On multivariate analyses, 300mg/day cilostazol independently decreased delayed cerebral infarction and improved 3-month outcomes. Propensity score-matched analyses showed that plasma tenasin-C levels were significantly lower in the 300mg/day cilostazol cohort compared with non-cilostazol cohort during the observation period, associated with a lower incidence of delayed cerebral infarction and poor outcomes.

Conclusion: These results suggested that cilostazol improves post-SAH outcomes by reducing plasma tenasin-C levels and delayed cerebral infarction in a dose-dependent manner, but not vasospasm. 300mg/day cilostazol is effective in the clinical management of SAH.
Experience of Covered Coronary Stent Grafts as Treatment Option for Carotid Cavernous Fistulas with Follow-up results

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INTRODUCTION Endovascular detachable balloon occlusion and coil occlusion have been well-established options for the treatment of carotid cavernous fistulas. In recent years, treatment of CCFs endovascular covered stent grafting is proving an excellent. However, only a few such cases have been reported in the literature while covered coronary stent grafts have been occasionally used in the intracranial vasculature. MATERIALS AND METHODS Four consecutive patients with CCFs underwent the Jostent coronary stent graft (Abbott Vascular, Redwood City, CA) placement alone at our department during 2 years. Two were direct CCFs with a symptom triad and 2 were indirect CCFs with diplopia. These patients had periodic clinical follow-up examinations (at 6-29 months) with all receiving angiographic follow-up examination (at 5-15 months). RESULTS Covered stent placement was technically successful in all patients. Immediate post-procedural complete exclusion of the fistula was achieved in 3 and near complete exclusion with small endoleak was observed in 1 after stent placement. ICA patency was preserved in all. Symptoms related to CCFs regressed within 1-14 days in all patients after treatment without thromboembolic events. There was no mortality and no immediate post-procedural morbidity related to the procedure. Final follow-up angiography showed complete exclusion of all CCFs and revealed good stent patency of the ICA without intra-stent stenosis. CONCLUSION Graft-stents should be considered as an alternative option of treating CCFs and preserving the parent artery by arterial wall reconstruction especially in patients with a fistula that cannot be successfully occluded with detachable balloons or coils.
Posttraumatic hemorrhagic infarction of basal ganglia: a case report

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Posttraumatic hemorrhagic infarction in the basal ganglia is extremely rare. We recently encountered a patient presenting with unilateral basal ganglia hemorrhagic infarction after a motorcycle accident. A 25 year old female was admitted to our trauma department with complaints of pain of right leg, left wrist, and left hand after motorcycle traffic accident. She was diagnosed right femur shaft open fracture, left ulnar and radius fracture, left scaphoid and left hamate fracture. On neurological examination she demonstrated alert mentality, right leg immobility due to fracture, and left hand numbness. Brain computed tomography performed two hours later after traffic accident demonstrated right basal ganglia hemorrhage. Magnetic resonance (MR) images on next day showed hemorrhagic infarction in right basal ganglia. MR angiography on three days later after trauma demonstrated suspicious luminal irregularity of the middle cerebral artery. High resolution vessel wall MR image on three days later after traffic accident demonstrated neither definite evidence of dissecting hematoma nor wall enhancement in the right M1 and right A1 segment. We think that hemorrhagic infarction of right basal ganglia was developed from lenticulostrate perforating artery damage. Clinicians should suspect traumatic origin for hemorrhagic infarction in basal ganglia detected after traffic accident. Keywords : Head trauma, Basal ganglia, Infarction, MR image
Prevalence and anatomy of aberrant right subclavian artery evaluated by computed tomographic angiography at a single institution in Korea

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Purpose Aberrant right subclavian artery (ARSA) is a rare anatomical variant of the origin of the right subclavian artery. ARSA is defined as the right subclavian artery originating as the final branch of the aortic arch. The purpose of this study is to determine the prevalence and the anatomy of ARSA evaluated with computed tomography (CT) angiography. Methods CT angiography was performed in 3460 patients between March 1, 2014 and November 30, 2015 and the results were analyzed. The origin of the ARSA, course of the vessel, possible inadvertent ARSA puncture site during subclavian vein catheterization, Kommerell diverticula, and associated vascular anomalies were evaluated. We used the literature to review the clinical importance of ARSA. Results Seventeen in 3460 patients had ARSA. All ARSAs in 17 patients originated from the posterior aspect of the aortic arch and traveled along a retroesophageal course to the right thoracic outlet. All 17 ARSAs were located in the anterior portion from first to fourth thoracic vertebral bodies and were located near the right subclavian vein at the medial third of the clavicle. Only one of 17 patients presented with dysphagia. Conclusions It is important to be aware ARSA before surgical approaches to upper thoracic vertebrae in order to avoid complications and effect proper treatment. In patients with a known ARSA, a right transradial approach for aortography or cerebral angiography should be changed to a left radial artery or transfemoral approach. Key words Aberrant subclavian artery · Computed tomography angiography · Clinical · Complication
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Risk of brain herniation after craniotomy with lumbar spinal drainage for aneurysmal subarachnoid hemorrhage: a propensity score analysis

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OBJECTIVE: The pathology of brain herniation associated with lumbar spinal drainage (LSD) has become known recently. The objective of this study was to determine the risk of postoperative brain herniation after craniotomy with LSD for ruptured aneurysmal subarachnoid hemorrhage (SAH).

METHODS: Included were 123 patients who underwent craniotomy with LSD for aneurysmal SAH between 2007 and 2016. The authors performed propensity score matching to establish a proper control group taken from among 288 patients who met the inclusion criteria. The incidences of postoperative brain herniation between the patients who underwent craniotomy with LSD (group A, n=123) and the matched patients without LSD (group B, n=123) were compared.

RESULTS: Brain herniation was observed in 16 in group A and 6 in group B (OR 2.9, 95%CI 1.03-9.4, p=0.04). Of the 16 patients, 9 had uncal herniation, 6 had central herniation, and 1 had uncal and subfalcine herniation. In 4 patients, brain herniation proceeded even after external decompression (ED).

Cox regression analysis revealed that the risk of brain herniation related to LSD increased with ED (hazard ratio 2.7, 95%CI 1.04-6.9, p=0.04).

CONCLUSION: Brain herniation to the tentorial hiatus is more likely to occur after craniotomy with LSD for aneurysmal SAH. Additional ED would aggravate brain herniation after LSD. The risk of brain herniation after craniotomy with LSD must be considered even when LSD is essential, especially in the case with MCA aneurysm expected to undergo ED.
Hematochezia occurring in patient with absolute bed rest state during treatment for intracranial lesion: 4 Case report

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Purpose: When neurosurgeons treat patients with intracranial lesion and infection, they are more likely to overlook gastro-intestinal symptom. We investigated four patients with brain disease and hematochezia.

MATERIALS AND METHODS: A 72-year-old woman was treated in ICU, because of brain swelling and septic condition after trauma. On the post-admission days (PAD) 16, hematochezia occurred. Because of active bleeding, she underwent embolization. However, hematochezia recurred, and she underwent total colectomy.

A 35-year-old man (HIV infected) was admitted with a subarachnoid hemorrhage of unknown origin and Thoracic 11-12 IDEM tumor. TFCA revealed no aneurysm. At PAD 49, hematochezia occurred. Sigmoidoscopy revealed ulcerative lesions. He recovered after conservative therapy.

A 58-year-old man with ruptured A-com aneurysm underwent clipping. 10 days later, coil embolization was performed because of pseudoaneurysm, and then dual antiplatelet agents were administered. Hematochezia was observed at PAD 20. Sigmoidoscopy showed erosion. After 2 weeks of NPO and stop taking antiplatelet agents, she recovered.

A 74-year-old woman with A-com aneurysm rupture underwent clipping. In ICU, she was treated with antibiotics due to septic shock. At PAD 13, hematochezia occurred, and abdominal CT showed small bowel infarction. She underwent intestinal resection.

Results: We had 4 cases of multiple colitis with hematochezia for 2 years. Two patients underwent intestinal resection.

Conclusion: Regeneration of GI tract is reduced in the stress condition, and when this situation worsens, severe colitis and ulceration may occur. In stress situations, it is necessary to carefully observe the changes in condition of patient and actively cope with it.
Development of support robot for neuroendovascular intervention

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[Purpose] The robotic technology is rapidly developing in the medical field particularly contributing to support endoscopic surgery using da Vinci. Robotics also enables the telesurgery with remote control. In our neuroendovascular intervention robot surgery has been strongly desired to reduce the radiation of surgeons. We developed a prototype of support robot for neuroendovascular therapy.

[Materials and Methods] Our robot has two independent slaves manipulating catheter and guidewire connected with the remote master driver with two joysticks. This design can realize the usual catheterization with both hands. Slave manipulator has the sufficient output power more than 1 newton to reproduce the exact master intervention without slip and delay. This machine has a unique function to indicate the reaction force of the resistance on wire stuck using the sensor system. This system is useful to prevent over-action of the machine.

[Results] We checked the controllability, safety and reproducibility of our machine on the in-vivo silicone vascular model. Although the operator’s motion could be well reproduced in the simple model, it was difficult to realize the exact correspondence against the rapid action or in the acutely curved vessel. This machine was also available for delivery coils.

[Conclusion] The endovascular support machine on the market is applied for clinical use of coronary intervention. It is available only for monorail device and has no feedback alarm system for the resistance on maneuver. Neuroendovascular intervention requires the delicate power adjustment with fine finger control. Our robot may realize neurointerventions without human operators in the angiosuite.
Comprehensive genetic analysis of RNF213 in moyamoya disease (MMD) and intracranial artery stenosis (ICS)

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Background - RNF213 p.R4859K (rs112735431) was identified as a founder variant for moyamoya disease (MMD) and more recently also as an associated variant for intracranial artery stenosis (ICS) in East Asian population, but the disease susceptibility of the other RNF213 variants have not been fully clarified. This study investigated MMD- and ICS-associated RNF213 variants other than p.R4859K.

Methods - All coding exons of RNF213 were sequenced in 95 MMD, 168 ICS, and 141 control subjects. Association studies were performed between patients and controls for nonsynonymous variants detected in the subjects. Previously reported RNF213 rare variants in MMD patients were reviewed and compared with rare variants detected in our patients without p.R4859K.

Results - Ninety-four missense variants and 58 silent variants were detected in our subjects. The association studies revealed p.R4859K was most significantly associated with both MMD and ICS (p=7.47×10^{-31} and 1.37×10^{-8} respectively). One rare variant (p.T3365I) in our MMD patients and 2 rare variants (p.C167R and p.L2405F) in our ICS patients were consistent with previously reported rare variants in MMD patients. Variants in MMD patients were clustered in the C-terminal region of RNF213 gene, and variants in ICS patients were in contrast distributed closer to the N-terminal.

Conclusions - Association studies showed the importance of RNF213 p.R4859K. We detected 3 candidate rare variants associated with MMD and ICS. The location of variants in RNF213 might be associated with the phenotype of the intracranial artery stenosis. Validation study in a larger cohort and molecularbiological functional analysis are necessary in future.
Preventive effect of four factors-prothrombin complex concentrates on hematoma expansion of anticoagulants associated intracerebral hemorrhage

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There is no standard protocol for anticoagulation reversal in anticoagulant-associated intracerebral hemorrhage (aaICH). We examined whether the introduction of a prothrombin complex concentrate (PCC)-based reversal protocol can benefit patients with aaICH.

A total of 39 treated patients with aaICH participated in the study; 32 patients were taking warfarin and 7 patients were taking a direct oral anticoagulant (DOAC). In the middle of the study period, a prothrombin time-international normalized ratio (PT-INR)-based algorithm was started. Consequently, during the study period, twenty cases received PCC (PCC group), and 19 cases did not receive PCC (non-PCC group). The PCC and non-PCC groups were compared by retrospectively reviewing the clinical, laboratory, and neuroradiological parameters.

Hematoma expansion (HE) occurred in 12.8% of all patients. The incidence of HE was significantly lower in both the PCC group receiving conservative treatment (PCC group, 0%; non-PCC group, 46.2%; p = 0.0230) and the PCC group receiving surgical treatment (PCC group, 0%; non-PCC group, 42.9%; p = 0.0135). In operated patients, the time interval between arrival and the start of operation was significantly shorter in the PCC group than in the non-PCC group (PCC, 169.9 minutes; non-PCC, 233.2 minutes; p = 0.0314). There were no significant differences in morbidity and mortality between the two groups.

In conclusion, administration of PCC was associated with a reduced incidence of HE in both the patients receiving conservative treatment and those receiving surgical treatment. This effect seems to be related to a more rapid reversal of anticoagulation.
Artery to artery embolism caused by vertebral artery ostial severe stenosis (five cases report)

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Artery to artery embolism (AAE) due to stenosis of the origin of the vertebral artery has less evidence established. Here we report five cases of symptomatic AAE associated with severe stenosis of vertebral artery ostium. [Material and Method] The age was 61 to 75 years old, all men. Distribution of disseminated cerebral infarction was basilar artery: 1 case, one side PICA: 2 cases, bilateral cerebellum: 1 case, and occipital lobe: 1 case. Three cases were right vertebral artery lesions and two cases were left side lesions. Aplastic contra-lateral vertebral artery was confirmed in only one case. In one case, we removed giant vertebral artery ostium thrombus using endovascular technique, in acute stage. In 4 cases, successful stent placement was performed for stenotic lesions (under intentional subclavian artery steal condition) in sub-acute stage of stroke. [Results] These patients were good clinical course and no recurrence stroke, after endovascular stenting. [Conclusion] The incidence of AAE from VA ostium stenosis is not so low. Endo-vascular stent treatment for symptomatic vertebral artery stenosis is effective and safe.
Subclavian steal syndrome: A case report and review of literatures

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Subclavian steal syndrome is a phenomenon involving flow reversal in a branch of the subclavian artery that results from a hemodynamically significant ipsilateral occlusion or marked stenosis of the proximal subclavian artery. Main symptoms of this disorder are Syncope and left upper arm weakness. We present a case of subclavian steal syndrome successfully diagnosed and treated with stent angioplasty and reviewed wide literatures.
Syndromic Traumatic Internal Carotid Artery Dissection due to Elongated Styloid Process - A Case of Rare Clinical Manifestation of Eagle’s Syndrome

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Background: Carotid artery dissection is a significant cause of juvenile stroke and can be rarely developed due to an elongated styloid process. Eagle’s syndrome is defined by an elongated styloid process that impinges on surrounding structures with a variety of symptoms, including neck pain and very rarely carotid artery dissection. We aimed to discuss about its clinical management.

Case description: A 49-year-old male referred to our hospital with left hemiparesis, right after neck extension when he tried to look up and swallow Japanese traditional sweets. Neurological examination revealed an initial NIHSS score of 4. Diffusion-weighted images demonstrated acute cerebral infarction of the right frontal lobe and MR angiography showed right internal carotid artery (ICA) occlusion due to ICA dissection at the distal cervical segment. Three-dimensional computed tomography angiogram (3D-CTA) revealed the ipsilateral styloid process was elongated as long as 3.1 cm and caused the dissection. He was conservatively treated with antiplatelet agents. After an education not to look up too much to avoid neck over-extension, he recovered without any clinical symptoms and 3D-CTA demonstrated complete luminal recovery at 3 months after the diagnosis.

Conclusions: Carotid artery dissection is one of rare manifestations of Eagle’s syndrome caused by blunt trauma by an elongated styloid process and should be considered as a cause of stroke in case of juvenile stroke. Previous case reports and case series reported and emphasized surgical intervention for this disease entity, but as shown in this case, patient education and conservative therapy can be a choice of management.
Hemorrhagic Trajectories after Stereotactic Aspiration of Spontaneous Intracerebral Hemorrhage in Elderly Patients

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Objective: Spontaneous intracerebral hemorrhage (ICH) is a sudden devastating event, requiring highly intensive care. Stereotactic aspiration is commonly performed in many hospitals. However, hemorrhagic trajectories are sometimes unexpectedly taken place as surgical complications.

In this study, we investigated the variable factors, which may have attributed to the formation of trajectories, in order to prevent unwanted complications.

Methods: During 4 years, we retrospectively studied 125 patients who underwent stereotactic aspiration of spontaneous ICH. They were divided into two groups based on the presence or absence of hemorrhagic trajectories. All patients’ data were analyzed by the parameters such as gender, age, medical history, use of Leksell SurgiPlanR, laboratory findings, hematoma volume, and blood pressure.

Results: Of 125 patients, 33 trajectory events (26%) were observed. 6 out of 40 patients using Leksell SurgiPlanR had hemorrhagic trajectories (15%). However, 27 hemorrhagic trajectories were seen in the patients without using Leksell SurgiPlanR (32%) (p<0.05). 6 out of 11 patients with liver disease history experienced hemorrhagic trajectories (55%). On contrary, trajectories occurred in 27 out of the patients without liver disease history (24%) (p<0.05). Hemorrhagic trajectories were observed in 17 out of 87 patients with normal value of AST/ALT (20%) while they were found in 16 out of 38 patients with high AST/ALT (42%) (p<0.05).

Conclusion: We demonstrated the clinical importance of liver function and its implication in the stereotactic surgical complication. In conclusion, more precautions should be taken in the patients with liver dysfunction. Additionally, the use of Leksell SurgiPlanR is highly recommended to decrease the trajectory incidences post-operatively.
A case of cervical carotid artery pseudo-aneurysm presenting with progressive enlargement

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Introduction: We report a rare case of cervical external carotid artery pseudo-aneurysm which was found by rapid progressive cervical swelling.

Case presentation: A 77-year-old male had been treated with antibiotics for cough, sore throat and fever. Then, right cervical swelling occurred and grew rapidly suggesting acute parotitis. Cervical ultrasonography and computed tomography angiography revealed cervical carotid artery aneurysm larger than 20 mm in diameter. The patient was referred to our hospital for surgical treatment. Progressive enlargement of the aneurysm in short period suggested threatened rupture of aneurysm. Therefore, emergent surgery was performed on the day of admission. After cervical exposure, the aneurysm was resected and carotid artery revascularization was performed. Postoperative CT angiography demonstrated elimination of the aneurysm and good patency of cervical carotid artery. Histopathological examination showed inflammatory change of aneurysm wall with organized thrombosis and other atherosclerotic changes. Postoperative course was uneventful without transient dysphagia, hoarseness and hypoglossal nerve dysfunction.

Discussion: In this case, clinically, infection sign was followed by enlargement of the aneurysm. Furthermore, histopathology showed atherosclerosis with inflammation of aneurysmal wall, suggesting that cervical carotid pseudo-aneurysmal formation was occurred by chronic carotid atherosclerotic changes combined with acute peripheral bacterial infection.
Impact of brain atrophy on 90-day functional outcome after moderate-volume basal ganglia hemorrhage

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This study aimed to evaluate the effect of brain atrophy on the functional outcome of patients with moderate-volume basal ganglia hemorrhage. Of 1003 patients with spontaneous intracerebral hemorrhage, 124 with moderate-volume basal ganglia hemorrhage (hematoma volume of 20-50 mL) were enrolled. The intercaudate distance (ICD) and sylvian fissure ratio (SFR) were used as linear brain atrophy parameters. The patients were divided into groups with favorable and unfavorable outcomes, according to the Glasgow Outcome Scale score, 90 days after symptom onset. Demographic and radiographic features, including the ICD and SFR, were compared between the two groups. Among the 124 patients, 74 (59.7%) exhibited a favorable outcome. The ICD and SFR values were significantly greater for the favorable group than for the unfavorable group. Multivariate analysis indicated that young age, high Glasgow Coma Scale score at admission, small hematoma volume, and increased ICD (odds ratio [OR], 1.207; 95% confidence interval [CI], 1.004-1.451) and SFR (OR, 1.046; 95% CI, 1.007-1.086, per 0.001) values had a beneficial effect on functional outcome. In conclusion, brain atrophy exhibits protective effects in patients with moderate-volume basal ganglia hemorrhage, and is an important factor for predicting functional outcome.
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Endovascular treatment of iatrogenic vertebral artery pseudoaneurysm with basilar artery thrombosis during anterior cervical spine surgery: a case repo

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BACKGROUND DATA: Vertebral artery injuries during anterior cervical spine surgery are rare, with a reported incidence of 0.3% to 0.5%, but serious complications. Without immediate recognition and management, it may have disastrous consequences. The spine surgeon should be aware of the detailed surgical anatomy and be prepared to manage of the vertebral artery injury.

METHODS: A 71-year-old male underwent anterior cervical discectomy and during the surgery right vertebral artery injured and massive bleeding was noted. So, topical hemostatic agent and gauze packing and manual compression was done. Immediate postoperative angiography was performed. The right vertebral artery occlusion and basilar artery thrombosis was noted on 4-vessel angiography. The basilar artery thrombectomy using Solitaire FR revascularization device via left vertebral artery was done. After 3 days the right vertebral artery recanalization and 7mm sized pseudoaneurysm was observed on follow up 4-vessel angiography. And then the patient discharged with anti-platelet medication. After a month the pseudoaneurysm size up to 15mm checked on CT angiography. So, endovascular treatment was done for coil embolization of pseudoaneurysm and right VA trapping.

CONCLUSIONS: In case of vertebral artery injury during anterior cervical spine surgery, the immediate angiography has to be checked. And if necessary, endovascular management was performed. Although bleeding control by hemostatic packing, there remains a risk of delayed hemorrhage from pseudoaneurysm. Postoperative vertebral angiography is helpful to avoid life-threatening complications. Endovascular treatment can be a good treatment of vertebral artery injury.
The role of microsurgical embolectomy for acute ischemic stroke in the endovascular era

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Introduction: Early recanalization of the occluded artery constitutes the fundamental principle in the treatment of acute ischemic stroke (AIS). The object of this paper is to present and discuss our single centre experience in the initial treatment of AIS with emphasis on the role of microsurgical embolectomy (SE) against current endovascular treatment options.

Methods: The retrospective study included all patients, who were treated in our clinic for AIS either by intravenous thrombolysis (IV-tPA), intra-arterial thrombolysis (IAT) or SE. From 2012 to 2016 our treatment paradigm comprised IV-tPA as the first line and SE as a second line therapy. Due to advancements in the endovascular therapy, our policy was later shifted to IV-tPA as the first line, IAT as second and SE as third line therapy.

Results: SE was performed altogether in 41 cases, IAT in 21 cases. The median door-to-recanalization time was 144 and 129 minutes, respectively. TICI scores of 2b+3 (TICI 3) were achieved in 82.9%(80.5%) of the patients in the SE group, and in 59.1%(36.4%) in the IAT group. Excellent outcome (mRS0-2) was achieved in 51.2% vs. 40.9%.

Conclusion: While the rates of recanalization were significantly higher in the SE than in the IAT group, there were no significant differences regarding the clinical outcome. In consideration of medico-economical aspects and the burden on the patient, we therefore recommend IV-tPA and IAT as first and second line therapies for AIS, with SE reserved as an alternative, especially in clinics and regions without endovascular coverage.
Analysis of the outcome and prognostic factors of Decompressive Craniectomy between Young and Elderly Patients for Acute Middle Cerebral Artery Infarction

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We compared the effect of decompressive craniectomy (DC) between patients <65 and ≥65 years age and investigated prognostics factors that may help predict favorable outcome in acute stroke patients undergoing decompressive surgery. 52 patients diagnosed with acute middle cerebral artery (MCA) territory infarction that underwent DC were retrospectively reviewed. The outcome of all patients were evaluated by assessing the GCS, GOS, and mRS six months after the onset of the disease. 21 patients were preoperatively evaluated with a CTA. LMC circulation was graded using CTA by experienced neurosurgeons to assess its prognostic value. The thirty day mortality for patients ≥65 was 35.0% compared to 37.5% in patients <65. There was no significant difference in the clinical and function outcome between the two groups. Mortality was lower with early surgery (within 24 hours) group for both age groups (25% vs. 37.5% in ≥65, 20% vs. 40.7% in < 65). Longer ICU stay time and good collateral supply score were correlated with favorable outcome. Decompressive craniectomy within 24 hours of stroke symptom onset improved survival in both the <65 and ≥65 age groups. There was no significant difference in the functional outcome of both age groups. Unlike previous reports, old age, delayed operation, and multiple of infarct territories were not predictive of poor functional outcome. The presence of good collateral circulation may be a predictor of positive clinical outcome in acute ischemic stroke patients undergoing decompressive craniectomy.

Keywords: Cerebral infarction, Middle cerebral artery, Craniectomy, Cerebral edema, collateral circulation
An interesting case of Unruptured Giant Vertebral Artery Aneurysm

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Giant thrombosed aneurysms in the posterior circulation produce mass effect and associated symptoms in the patient. They are difficult to manage and have a grave natural history. A 50-year-old man with a partially thrombosed giant aneurysm of the vertebral artery (VA) presented with symptoms of giddiness and was treated with coiling, stenting, and eventually endovascular proximal occlusion of the VA with posterior inferior cerebellar artery (PICA) preservation. The patient returned after a year with recurrence of symptoms and the aneurysm was found to be growing in spite of no angiographic evidence of filling of the lumen. Using far lateral approach, aneurysmectomy was performed with coil removal and trapping of the aneurysm and finally improved the patient’s symptoms. During surgery, well-developed vasa vasorum were seen over the aneurysm and there was oozing of blood as soon as the occluded VA. Histologically, the vasa vasorum were found to be enlarged with evidence of inflammatory tissue. This process of neovascularization and growth of vasa vasorum light on the growth mechanisms of a giant thrombosed aneurysm after endovascular treatment. Giant aneurysm growth is come from the role of vasa vasorum. Giant aneurysm growing in spite of coiling, stenting and obliteration of the parent artery has been rarely reported.