Superior cerebellar artery aneurysms treated using the sole stenting approach

Technical note

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Endovascular treatment of intracranial aneurysms has evolved since the introduction of detachable coils. Sole stenting is a brand-new technique that has recently emerged as a definitive treatment for saccular or fusiform aneurysms at particular locations. Superior cerebellar artery aneurysms are rare, and few treated cases have been reported. Most of them have been treated surgically, and endovascular cases usually have been managed with occlusion of the parent vessel. The authors report on the first two endovascularly treated cases with complete cure of the aneurysm as well as preservation of the parent vessel and distal circulation via the sole stenting technique. The results together with several aspects of the technique, such as the correction of the angle of the vessel and modification of the shear stress, are discussed. (DOI: 10.3171/JNS-07/10/0860)

KEY WORDS • endovascular management • intracranial aneurysm • stent • superior cerebellar artery

Poster ior circulation aneurysms barely represent 4 to 10% of all intracranial aneurysms.1,3,6 Basilar tip aneurysms are the most common in this group, followed by lesions of the lateral aspect of the artery including those arising from the SCA–basilar artery trunk junction. Otherwise, distal aneurysms originating from the SCA itself are rare, with an incidence as low as 0.2%.1,13,14,19,23,36

Trapping the lesion via occlusion of the parent vessel has been adopted in most reported cases. Of course, surgical strategies differ according to the affected vessel segment. Nevertheless, these lesions still represent a technical challenge to most neurosurgeons.2 Endovascular coil embolization of intracranial aneurysms has been widely adopted, even as the first choice in posterior circulation lesions because of its efficacy and safety.

Intracranial stenting recently has been incorporated into the endovascular armamentarium, and the concept of sole stenting endovascular bypass, in particular, was introduced by us in a paper published in 2005.37 In that article, we hypothesized that the ability of the stent to change the helical flow into a noncoherent pattern (turbulence) could induce thrombosis. The changes in intraaneurysm hemodynamics seem to prevent further rupture of the lesions.3,37

In the present study, we describe two aneurysms of the APMS of the SCA, which were successfully occluded via the sole stenting technique.

Illustrative Cases

Case 1

History and Examination. This 35-year-old man presented at the emergency room with a sudden headache, dizziness, dysmetria, and gait ataxia. Initial assessment included CT scanning, whose results disclosed intraparenchymal bleeding in the left cerebellar hemisphere and an SAH in the pre-pontine and ambient cisterns with intraventricular bleeding and extension into the fourth ventricle. A DS angiogram showed a 3.0 × 3.5-mm saccular aneurysm located at the anterior pontomesencephalic segment. CT = computed tomography; DS = digital subtraction; SAH = subarachnoid hemorrhage; SCA = superior cerebellar artery.
Sole stenting for superior cerebellar artery aneurysms

distal part of the APMS of the SCA, at the junction with the ambient segment. At this portion of the artery, the main trunk is angled (Fig. 1A). During two previous surgical attempts at another institution, the lesion could not be reached, once because of brain swelling.

Treatment. We inserted a 6-F guiding catheter (Envoy, Cordis) in the distal portion of the right V3 segment via a transfemoral approach while the patient was under general anesthesia. Superselective catheterization was performed using a 1.9-F × 150-cm microcatheter (Excel, Boston Scientific) and a 0.014-in × 205-cm microguidewire (Transend, Boston Scientific). Heparinization was performed with a 3000-IU bolus followed by 800 IU/hour during the procedure. Initially, we had scheduled the patient for coil embolization; however, the coils protruded into the parent vessel, risking migration and occlusion. Therefore, we deemed stent placement as mandatory. Using an exchange technique, we placed the tip of the microcatheter in the ambient segment and navigated a 2.25-mm technique, we placed the tip of the microcatheter in the stent at the neck of the aneurysm. A poststenting run showed correct apposition of the device to the wall and no filling of the aneurysm (Fig. 1B). No clinical or technical complications occurred during the procedure.

Postoperative Course. Antiplatelet drugs were administered after stent placement as follows: a 300-mg loading dose of clopidogrel and 100 mg of acetylsalicylic acid. In the days following treatment, the patient exhibited slight improvement in the cerebellar symptoms. Control angiograms obtained 1 and 6 months after treatment showed no residual aneurysm and overexpansion of the stented segment (Fig. 1C). At the clinical assessment, the patient’s modified Rankin Scale score was 0.

Case 2

History and Examination. This 37-year-old man presented with suddenly blurred vision, loss of consciousness, and generalized seizures. When he regained consciousness, he reported headache, photophobia, and phonophobia. Otherwise, a neurological examination was unremarkable except for nuchal rigidity. Note that an evaluation at another hospital had revealed subarachnoid bleeding in the basal cisterns (pontine, peduncular, and ambient) on unenhanced CT scanning. We first assessed the patient 3 weeks later, and he was asymptomatic at that time.

A saccular aneurysm had formed on the APMS of the left SCA, which was verified on both CT angiography and DS angiography. The dimensions of the aneurysm were 3.0 × 3.5 mm, with a neck of 2.5 mm. As in the patient in Case 1, the aneurysm emerged at a curved portion of the SCA (Fig. 2A).

Treatment. A sole stenting bypass procedure was chosen as the aneurysm treatment. Antiplatelet medication was administered as follows: a loading dose of 300 mg clopidogrel and 100 mg of acetylsalicylic acid 2 hours before the procedure. Heparinization was performed with a 3000-IU bolus followed by 800 IU/hour during the procedure.

A transfemoral approach allowed catheterization of the right vertebral artery, at the distal portion of the V3 segment. Superselective catheterization was performed using a 1.9-F × 150-cm microcatheter (Excel, Boston Scientific) and a 0.010-in × 200-cm microguidewire (Silver Speed, MicroTherapeutics); the tip of the microcatheter was placed in the ambient segment. An exchange maneuver with a 0.014-in × 300-cm guidewire allowed us to navigate a 2 × 8-mm stent (Multi-Link Pixel, Guidant Corp.) across the lesion. The stent was then activated at the neck of the aneurysm by inflating the balloon. Angiograms obtained at the end of the procedure confirmed sufficient activation of the stent, some residual filling of the aneurysm, and preservation of the distal flow of the main artery (Fig. 2B).

Posttreatment Course. The procedure was uneventful, and the results of CT angiography performed 3 days later showed a decrease in the aneurysm volume. The patient was discharged 4 days later with a double antiplatelet regimen of aspirin 100 mg and clopidogrel 75 mg/24 hours.

Fig. 1. Case 1. Digital subtraction angiograms demonstrating the basilar trunk and its branches. A: Oblique view showing a saccular aneurysm (black arrow) at the distal portion of APMS. Notice that the aneurysm stands at an angled portion of the artery (hollow arrow). B: Anteroposterior view of a run performed at the end of the stent placement procedure. The diseased portion of the artery has undergone several modifications: the angle has been corrected (straightening of the artery), the aneurysm is resolved, and the stented segment has been slightly overexpanded (hollow arrow). Preservation of the distal vessels is clearly distinguished. C: Six-month follow-up angiogram (oblique view) showing no residual aneurysm and persisting overexpansion with normal opacification of the distal circulation.
The follow-up in this case has involved clinical as well as neuroimaging assessments. At 1 month posttreatment, a CT angiogram revealed complete resolution of the lesion and normal distal flow. At 6 months posttreatment, a selective DS angiogram (Fig. 2C) confirmed closure of the aneurysm, preservation of the distal flow, and a branch emerging from the diseased segment, which had never been visualized (rostral branch of the SCA). We propose two reasons for the unnoticed presence of this trunk during diagnostic and therapeutic endovascular procedures. First, at the time of the procedure, vasospasm may have caused nonfilling of the vessel on angiography. Second, the initial and posttreatment DS angiograms were obtained using two different systems. The posttreatment angiograms were obtained on a flat-panel biplane system (3D Axiom Artis, InSpace 3D, Siemens) with high-resolution imaging (Fig. 2C and D). The initial images were obtained on an older system (KXO-200/DFP-60A, Toshiba) with low-resolution imaging (Fig. 2B). In fact, this vessel can be seen in most anatomical specimens (Fig. 2C).

**Discussion**

**Therapeutic Options for Aneurysms of the SCA**

As already mentioned, lesions arising from the posterior circulation scarcely represent 10% of all intracranial aneurysms. Lesions originating from the SCA–basilar artery trunk junction are not uncommon and are erroneously named “SCA aneurysms” by some authors. We agree with other authors who call them by the distinctive term of “laterobasilar aneurysms,” as they are not strictly aneurysms of the SCA itself.

Aneurysms arising from one of the SCA segments are...
Sole stenting for superior cerebellar artery aneurysms

utterly rare, accounting for only 0.2% of the total.\textsuperscript{14,23,36} Among a series of 2349 ruptured aneurysms described by Locksley,\textsuperscript{14} only six involved the SCA; and in the study by Allocco,\textsuperscript{1} only eight lesions affected the SCA. A meticulous search of the reported literature revealed only 70 cases of SCA aneurysms,\textsuperscript{1-6,8,11-14,16-19,21-36} and although many of these lesions were saccular, fusiform, and dissecting aneurysms were not unusual.\textsuperscript{1,27} Some cases were associated with arteriovenous malformations,\textsuperscript{8} and a history of trauma could be traced in other cases.\textsuperscript{22,28} Despite being distal aneurysms, a mycotic origin has seldom been proven.\textsuperscript{11,16}

In most cases (~90%) the aneurysms had ruptured, and patients presented with an SAH, 95% of whom underwent surgical treatment. In a very few endovascular cases, the selected modality was permanent occlusion of the parent vessel,\textsuperscript{2,6,12} imitating the surgical experience, which occludes the aneurysm by surgical trapping. In some cases occlusion of the parent vessel was intentional and in others unintentional, but infarction rarely developed, or the symptoms were limited due to the rich collateral supply of the region.\textsuperscript{2,4,6,24,27,28}

Occlusion of the parent vessel was deemed necessary in the treatment of two aneurysms described by Chaloupka et al.\textsuperscript{2} Established criteria included a localization distal to the APMS and a structure making them wide-necked aneurysms.

In a study of distal intracranial aneurysms treated by occlusion of the parent vessel, Ekard et al.\textsuperscript{6} reported on a far distal aneurysm of the SCA. In this case, as the distal flow could not be easily preserved, sacrifice of the parent vessel was required for resolution of the lesion. We might infer that occlusion of the parent vessel applies in cases of distal aneurysms, as closure of the proximal vessels could cause infarction in the cerebellum, the tegmentum of the pons, the superior cerebellar peduncles, and the dentate nucleus.

It is always suitable to preserve flow in the parent vessel. We emphasize the fact that our cases are the only ones involving both preservation of distal flow and definitive treatment of the aneurysm.

Along with the patients featured in the present report, only 14 other patients harboring an aneurysm in the APMS have been described in the English literature.\textsuperscript{4,14,25,29,30,34}

The surgical management of this segment requires several strategies.\textsuperscript{3} Moreover, any surgical attempt to treat a lesion of the SCA carries some potential morbidity with functional and vital risks.

The endovascular technique is less time-consuming and provides easy access to the first segment of the SCA. As far as we know, the cases herein described represent the only reported instances of treatment via sole stenting, which led to an aneurysm cure together with preservation of the parent vessel, adjacent arteries, and distal flow.

Data from several in vitro and animal studies have shown that stents can induce modification of the flow within an aneurysm, leading to the formation of a stable thrombus and excluding the lesion from the circulation.\textsuperscript{9,37} We have described our experience with the use of sole stenting as the only therapeutic modality for vertebral artery aneurysms, occluding 100% of the lesions.\textsuperscript{37}

We concluded that in selected cases, modifying the angle of the vessel alters the flow within an aneurism, shifts the helical pattern into a noncoherent flow, decreases the shear stress on the vessel wall, and modifies the inflow, and therefore allowing healing of the lesion.

These aforementioned reasons led us to use stents for the treatment of aneurysms of this arterial segment. Moreover, the particular conditions of the lesions also encouraged our technique. Both lesions arose at the tip of angled portions of the SCA; our maneuver straightened the vessel and kept patent the adjacent vessels, leading to progressive thrombosis of the lesion (Fig. 1B and C and Fig. 2C and D). We deliberately chose coronary stents for these cases rather than self-expandable stents given that, in our experience, self-expandable devices are so soft that they do not modify the anatomy of the vessel and that spontaneous thrombosis of the aneurysm via the sole stenting technique seems more difficult to achieve.

Flow in the portion of the vessel distal to the stented segment was preserved and normal. In Case 2, a 3D reconstruction image showed patency of the rostral branch of the SCA, despite its origin from the stented part of the main trunk.

Finally, there are two other issues that we would like to discuss. Concerning in-stent stenosis, it has never been described in intracranial stenting for aneurysms when using a balloon-expandable stent. Only one case of stenosis has involved a self-expandable stent for the treatment of an aneurysm,\textsuperscript{7} and three other cases of atherosclerotic stenoses involved balloon-expandable stents.\textsuperscript{15}

Concerning thrombosis of stents in neurovascular disease, such cases are rare and related to patient noncompliance with his or her antplatelet drug regimen.\textsuperscript{15}

Conclusions

Aneurysms located in the SCA are rare but can develop in any segment of the artery. The risk for these lesions arises from the frequency of SAH and should therefore be rapidly addressed. Many cases in the literature have been controlled by parent vessel occlusion; however, this approach should be avoided as often as possible. A surgical approach to the APMS is tedious and time-consuming and carries an insignificant risk of morbidity. Neurointerventional management with endovascular bypass via sole stenting is an efficacious and safe method of treatment, as it allows preservation of vessel patency, modifies hemodynamic conditions (inflow and outflow), and promotes thrombosis of the lesion.

Additional investigators should confirm our findings by conducting further studies with a larger number of patients and established criteria to predict thrombosis of saccular or fusiform aneurysms by sole stenting. Furthermore, authors of animal and in vitro studies should try to reproduce the anatomical conditions found in intracranial aneurysms in humans to answer to some of the issues raised by our data.

References

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