

Stent-Assisted Coil Embolization of a Wide-Neck Aneurysm at the Vertebral Artery Terminus Using a Contralateral Approach: A Technical Report

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Abstract

Background—Aneurysms of the vertebrobasilar junction (VBJ) are especially uncommon but carry a significant risk of hemorrhage and historically have been difficult to treat. In recent years, however, advancements in stent-assisted embolization have allowed better access and stabilization of complicated posterior circulation aneurysms.

Methods—We describe a novel approach in the treatment of a wide-neck aneurysm at the terminus of the left vertebral artery by a contralateral approach in a patient with ipsilateral subclavian artery occlusion.

Results—A complex, wide-neck aneurysm at the vertebrobasilar junction hindered by ipsilateral subclavian occlusion can successfully be treated with stent-assisted coil embolization using a contralateral approach.

Conclusion—Contralateral U-shaped stenting offers a viable endovascular option for patients with complex aneurysms of the vertebral basilar junction but should be reserved for appropriate cases with favorable anatomy when the ipsilateral approach from the subclavian artery is unobtainable.

Keywords

vertebrobasilar aneurysms; stent-assisted coil embolization; wide-neck aneurysms

INTRODUCTION

Posterior circulation aneurysms account for only 8–10% of all intracranial aneurysms but carry the highest risk of hemorrhage and operative complications [1,2]. Aneurysms of the vertebrobasilar junction (VBJ) are especially uncommon and can be extremely difficult to treat. Interventions for intracranial aneurysms include both surgical clipping and endovascular coiling [3]. The proximity of the VBJ to critical vascular and neural structures, however, makes microsurgical intervention less favorable [4]. Moreover, prospective data from the International Subarachnoid Aneurysm Trial (ISAT) suggest patients with subarachnoid hemorrhage (SAH) treated endovascularly have better outcomes than those managed surgically [5]. Complicated cerebrovascular anatomy presents technical challenges that require more innovative thinking about treatment strategies. In turn, new endovascular approaches and techniques in the last five years have

broadened the scope of treatable aneurysms. In particular, advancements in stent-assisted coil embolization have allowed better access and stabilization of complicated wide-neck aneurysms in the posterior circulation [6]. Here, we present a novel approach in the treatment of a complex, wide-necked aneurysm at the left vertebral artery (VA) terminus in a patient who could not undergo antegrade stent placement due to the presence of ipsilateral subclavian artery occlusion. To our knowledge, this represents the first report of an intracranial stent deployed from the contralateral VA to the ipsilateral in a U-shaped configuration for coil embolization.>

TECHNIQUE

A 91-year-old woman with a history of subclavian steal was transferred to our institution with a diagnosis of



Figure 1. AP (a) and lateral (b) projections of a three-dimensional rotational angiogram, showing a wide-neck, bi-lobed aneurysm at the vertebrobasilar junction, principally involving the left vertebral artery

subarachnoid hemorrhage (SAH) and hydrocephalus. On arrival, the patient was alert and following some commands with an National Institutes of Health Stroke Scale (NIHSS) of 10. Within an hour, however, she became progressively obtunded. Following emergent external ventricular drain placement, cerebral angiogram was performed revealing a complex, bi-lobed aneurysm at the vertebrobasilar junction with the neck principally coming off the left vertebral artery. The aneurysm had a wide neck measuring 4.768 mm and a height of 3.34 mm. Lobe 1 had a width of 3.1 mm and lobe 2, 2.1 mm.

Angiography also demonstrated dense calcification and occlusion of the proximal left subclavian artery without flow into any distal branches or the vertebral artery; making an approach through the ipsilateral vertebral impossible.

After loading the patient with 81 mg of aspirin and 600 mg of clopidogrel, a 0.35" glide wire was advanced into the right subclavian and vertebral artery. Guide catheter was positioned at the origin of right vertebral artery. A Prowler Select Plus microcatheter was then introduced into the vertebrobasilar junction. The microwire was

directed from the right vertebral artery, around the junction, and into the left vertebral artery.

A 4.5 × 22 mm Enterprise stent was deployed from the left posterior inferior cerebellar artery (PICA) to the right PICA. After follow-up, angiography confirmed patency and positioning of the stent, the first coil was placed. Immediately following coil #1, the patient became bradycardic, hypotensive, and ICP increased to the 70 s. Follow-up angiography revealed contrast extravasation. The EVD was immediately opened to drain off approximately 15–20 cc of CSF, while protamine and 23.4% hypertonic saline were administered and blood pressure (BP) pharmacologically lowered. Six more coils were deployed in rapid succession; a seventh could not be deployed after the microcatheter herniated out of the aneurysm. Follow-up angiography revealed good exclusion of the aneurysm without any further evidence of extravasation.

There was no evidence of thrombosis or distal artery cutoff. The catheter was removed, and the patient was transferred to the ICU, stable, and intubated. The patient was extubated the following day and by postoperative



Figure 2. CT angiogram revealing proximal occlusion of the left vertebral artery

day 2 was doing well neurologically—alert, verbal without aphasia and was following commands.

DISCUSSION

Surgical access to an aneurysm at the vertebrobasilar junction is complicated by its proximity to several critical structures, including the brainstem, perforating arteries, and lower cranial nerves. In addition, any direct approach is limited by the petrous bone [4]. However, endovascular approaches to the VBJ are relatively straightforward, and recently, coil occlusion has become the treatment of choice [4]. The advantages of stent-assisted coiling over the use of coiling alone for wide-neck posterior circulation aneurysms has been well documented [1,7–12]. Stenting can help prevent coil extrusion from the aneurysmal sac into the parent artery, facilitate thrombosis of the aneurysm through stasis, and

provide a scaffold for endothelialization across the aneurysmal neck, thus preventing recanalization [13]. Recently, variations of the classic stent model have emerged to tackle some of the most technically challenging aneurysms of the posterior circulation. To manage wide-neck aneurysms at the basilar bifurcation, so-called “Y-stenting” techniques have been adopted that have reshaped our understanding of stent mechanics and peri-aneurysmal flow dynamics [6]. Y-stenting, which involves the passing of one stent through the interstices of another in a Y-configuration, may improve aneurysm occlusion rates through both cerebrovascular remodeling and flow diversion [14]. However, in comparison with most single-stenting techniques, the Y-stent generates more flow disturbance at the aneurysmal neck, may increase the risk of thromboembolic complications with the use of twice the amount of metal work, and results in less precise approximation with the aneurysmal neck [8].

Horizontal stenting has also been used for the management of complicated wide-neck aneurysms of the posterior circulation. Since horizontal stenting was first introduced for wide-necked basilar tip aneurysms, successful P1-P1, P1-SCA, and P1-PCom deployments have been described [9,15,16]. Such a technique allows placement of the stent directly perpendicular to the long axis of the aneurysm and parallel with the efferent vessels, facilitating tighter packing, and reinforcement of the coil mass. The use of a single stent also decreases thromboembolic risk and cost [8].

However, in comparison with the basilar bifurcation, the unique geometry of the vertebrobasilar junction poses additional problems and more limited options of approach. In this case, we felt that with the complexity of the VBJ lesion and its precarious location, endovascular coiling with stent stabilization was the most appropriate intervention. But in the presence of proximal occlusion of the subclavian artery and with the acute angles made by the vertebral arteries at the base of the basilar, a more careful selection of stent device was necessary. In our case, we used the Enterprise stent system. Along with the Prowler Select Plus microcatheter for delivery, the flexibility of this stent system allowed us to negotiate the rather sharp angles of the VBJ to bridge and maintain patency through both vertebral arteries.

However, U-shaped stent-assisted coil embolization is not without its limitations and careful consideration regarding the patient’s clinical picture and cerebrovascular anatomy must be taken into account. The stent serves as a permanent implant and requires subsequent admin-



Figure 3. Digital subtraction angiogram (DSA) demonstrates the approach of the stent delivery system from the contralateral vertebral artery to the ipsilateral

istration of dual antiplatelet therapy, which can complicate the use of ventriculostomy in patients with acute subarachnoid hemorrhage. Additionally, contralateral placement of a U-shaped stent is not applicable to every aneurysm encumbered by proximal occlusion. This approach would require sufficient diameter and a less convoluted course in the contralateral subclavian and vertebral vessels. A more acutely angled junction may also preclude this approach. In the case reported here, the right and left vertebral arteries inserted into the base of the basilar roughly 26° and 21° from the vertical axis, respectively. For successful U-shaped positioning from one vertebral artery to the other, a relatively more obtuse, U-shaped intersection of the two arteries as demonstrated here is ideal. Negotiating a more V-shaped angulation at the base of the basilar artery would prove challenging.

CONCLUSION

The technical challenges of treating complex, wide-neck aneurysms of the posterior circulation continue to

inspire innovative endovascular approaches and techniques. In this technical report, we have demonstrated safe and successful application of U-shaped stent placement and coil occlusion of a complex, wide-neck aneurysm at the terminal portion of the left vertebral artery via a contralateral approach. This technique offers a viable endovascular option for patients with complex aneurysms of the vertebral basilar junction but should be reserved for appropriate cases with favorable anatomy when the ipsilateral approach from the subclavian artery is unobtainable.

ABBREVIATIONS

CSF	cerebrospinal fluid
EVD	external ventricular drain
ICP	intracranial pressure
ICU	intensive care unit



Figure 4. Postdeployment and coil embolization DSA reveals complete occlusion of the vertebrobasilar aneurysm

ISAT	International Subarachnoid Aneurysm Trial
PCoM	posterior communicating artery
PICA	posterior inferior cerebellar artery
SAH	subarachnoid hemorrhage
SCA	superior cerebellar artery
VBJ	vertebrobasilar junction

CONFLICTS OF INTEREST

We have no conflict of interest.

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