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Endovascular

Transluminal Stent-Assisted Coil Embolization of a Vertebral Confluence Aneurysm: Technique Report

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BACKGROUND
Recent advances in stent technology have allowed for negotiation of often tortuous posterior circulation intracranial vasculature. Stent-assisted coil embolization is a novel treatment for complex wide-necked aneurysms, as stents provide a buttress that allows for coil deposition while preventing coil herniation into the parent vessel lumen. We describe a case of stent-assisted coil embolization of a complex wide-necked vertebral confluence aneurysm.

CASE DESCRIPTION
A 61-year-old woman presented with a Hunt–Hess III, Fisher Grade III subarachnoid hemorrhage secondary to a ruptured vertebral confluence aneurysm demonstrated on angiography. The patient underwent emergent angiography and attempted coiling of a vertebral confluence aneurysm. Because of the aneurysm's complex wide neck and the presence of subclavian steal syndrome, the coils repeatedly herniated into the left vertebral and basilar artery lumina. A flexible coronary stent was deployed across the aneurysm neck, preventing coil herniation and allowing for greater coil deposition. The patient tolerated the procedure and underwent repeat coiling 2 months postoperatively because of mild coil compaction. This resulted in 100% occlusion and the patient is neurologically normal except for a sixth nerve palsy which had been present after the hemorrhage.

CONCLUSION
Recent advances in stent technology allow negotiation of the tortuous posterior circulation vasculature. Stent-assisted coil embolization of complex, wide-necked vertebral confluence aneurysms may be an alternative intervention for these surgically challenging lesions.

KEY WORDS
Coil embolization, endovascular therapy, GDC, stents, vertebrobasilar.

Ruptured intracranial vertebral confluence (VA) aneurysms often present therapeutic challenges. Though surgical intervention is often feasible, it is technically difficult and accompanied by significant risks [6]. Similarly, coil embolization with Guglielmi detachable coils (GDCs; Target Therapeutics/Boston Scientific, Fremont, CA) of vertebral confluence aneurysms is difficult because of their complex wide necks or irregular shapes. Aneurysm coiling can result in parent vessel occlusion secondary to coil herniation. Recent advances in coronary stent technology have provided endovascular surgeons with flexible devices capable of negotiating the tortuous intracranial posterior arterial vasculature. Placement of such stents across a wide-necked aneurysm diverts blood from the aneurysm inflow tract, often resulting in aneurysm thrombosis [2,6,10,11]. Additionally, stents provide a rigid scaffold that allows improved coil deposition with reduced risk of coil herniation into the parent vessel lumen. We describe the technique of stent-assisted coil embolization of a ruptured vertebral confluence aneurysm in a patient with subclavian steal syndrome.

Methods

Presentation

A 61-year-old woman presented with a severe headache, nausea, vomiting, and progressive lethargy. On examination, she was drowsy but arousable

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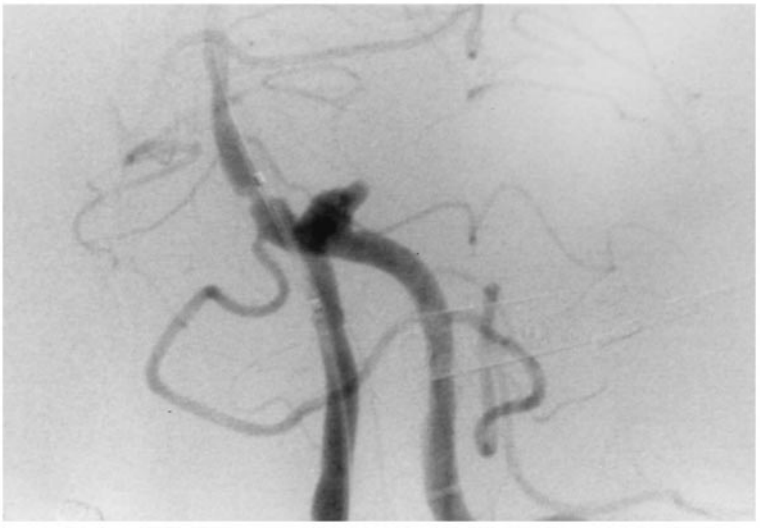


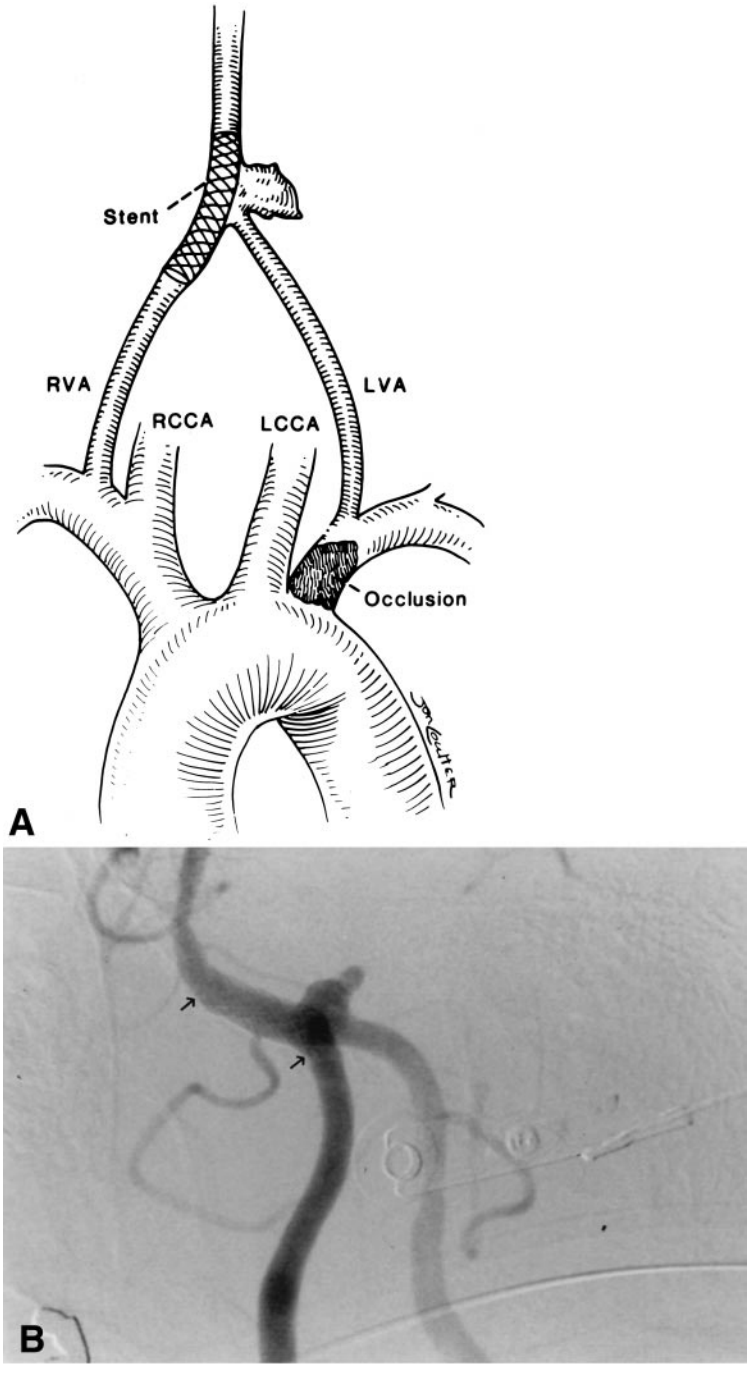
1 Vertebral confluence aneurysm before treatment.

(Hunt–Hess III) with mild limitation of lateral gaze bilaterally but intact vertical gaze. Her medical history was significant for subclavian steal syndrome and sinusitis. Computed tomography (CT) imaging demonstrated Fisher Grade III subarachnoid hemorrhage. Subsequent angiography revealed a multilobular, broad-based vertebral confluence aneurysm (Figure 1) and left subclavian artery occlusion proximal to the vertebral artery origin with retrograde left vertebral artery flow.

PROCEDURE

Under general endotracheal anesthesia, an indwelling sheath and Simmons catheter was used to access the right vertebral artery. An exchange wire was placed and the Simmons catheter was removed. Over the exchange wire a 90-cm Cordis Envoy (Cordis, Miami Lakes, FL) catheter was advanced into the right vertebral artery. Through this catheter a Prowler .014-inch microcatheter (Cordis, Miami Lakes, FL) was advanced over a steerable microwire and the aneurysm was selectively catheterized. Multiple attempts were made to coil the aneurysm with a variety of GDC coils including 3D coils. The coils repeatedly herniated into the basilar artery and the left vertebral artery. Herniation into the left vertebral artery was promoted by the patient's subclavian steal. To help reform the neck, an S670 12-mm long, 4-mm wide coronary stent (Arterial Vascular Engineering, Inc., Santa Rosa, CA) was introduced over an AVE guidewire (Arterial Vascular Engineering, Inc., Santa Rosa, CA) that had been placed through the Prowler catheter into the posterior cerebral artery for stability. The stent was deployed from the right vertebral artery into the basilar artery, thus, reducing the width of the aneurysm neck and inflow tract (Figure 2**A,B**). The aneurysm neck could not be completely covered by the stent because access to the left vertebral artery was not possible from a femoral route given the proximal occlusion. The aneurysm was recatheterized by using the Prowler catheter and once again an attempt was made to coil the aneurysm. Ultimately, successful stent-assisted coiling of the aneurysm using 3D and 1D GDC coils was accomplished. Ten coils were inserted. During placement of the third coil, extravasation of dye from the aneurysm fundus was identified but was immediately controlled with coil deposition. After final coil deposition there was only slight filling of one of the apical blebs. The basilar artery remained open as did both vertebral arteries (Figure 3**A,B**).

The patient was transferred in stable condition to the neurosurgical intensive care unit. Heparin was discontinued and the patient was placed on aspirin 325 mg daily and Plavix 75 mg daily. Follow-up angiography on post-procedure Day 5 revealed aneurysm occlusion. At this time, however, a thrombus appeared to have formed within the distal stent creating a moderate proximal basilar artery stenosis (Figure 4). The patient was restarted on heparin. A repeat angiogram after 2 weeks of antiplatelet and heparin therapy revealed a large amount of residual aneurysm filling. The basilar thrombus had resolved (Figure 5). The patient was discharged home on aspirin alone and brought back for a 2-month follow-up angiogram which revealed mild coil compaction. The patient underwent repeat coiling with 100% occlusion after the procedure (Figure 6).

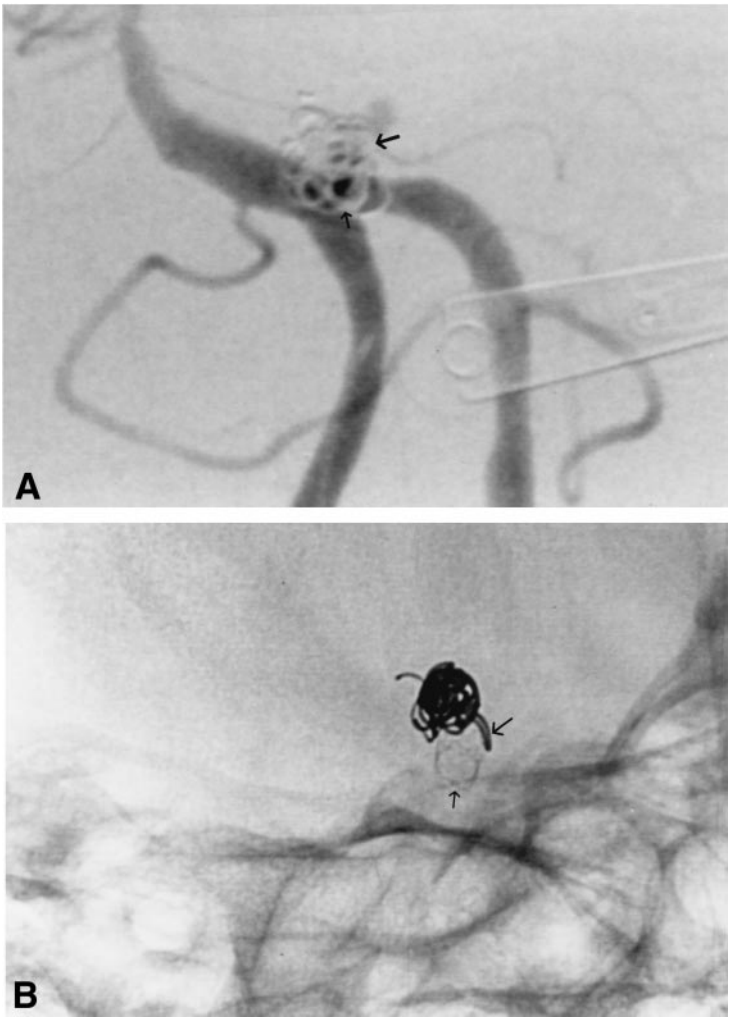


2 (**A**) Diagram showing position of the stent across the aneurysm's neck before coil deposition. (**B**) Oblique view of the aneurysm with the stent across a portion of the neck. Arrows delineate the proximal and distal edges of the stent.

Six months after her hemorrhage, she is neurologically normal except for a mild right sixth nerve paresis, which had been present since her initial hemorrhage.

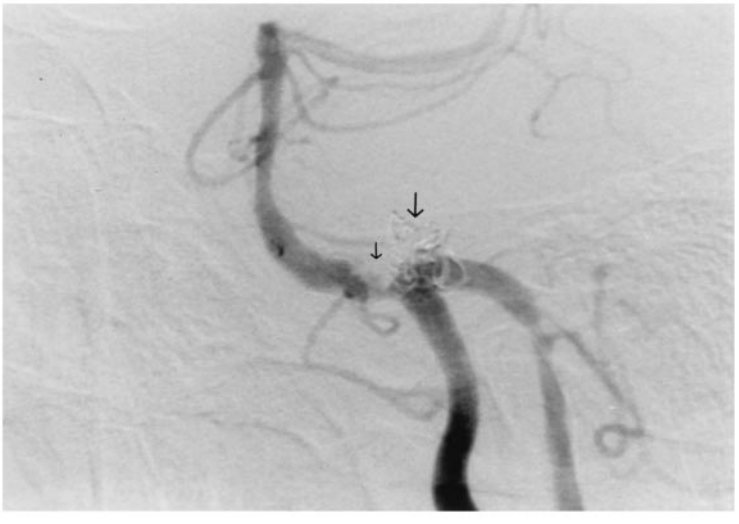
Conclusions

Endovascular treatment of some complex, wide-necked aneurysms has only recently become possible because of advances in coronary stent technology. Higashida et al were among the first to describe stent-assisted coiling for the management of a complex, fusiform basilar aneurysm [4]. Stents help maintain patency of the parent vessel lumen while obstructing the aneurysm inflow tract, potentially resulting in aneurysm thrombosis. The latter has been demonstrated in experimental models where the vorticity within the aneurysm has been reduced after stent placement [7], resulting in stasis and thrombosis [2,10,11]. The use of porous

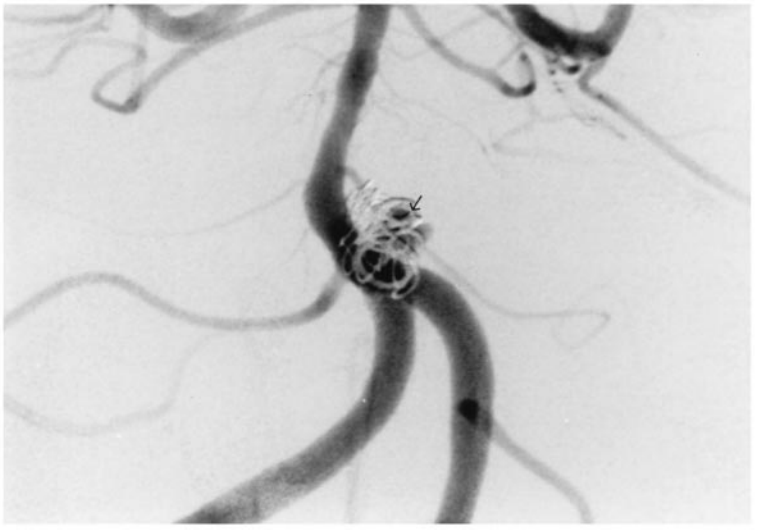


3 Oblique view (**A**) of the aneurysm following initial coiling. One of the apical blebs continues to opacify, as does a small portion of the fundus (large arrow). Although it appears that coils protrude into the parent vessel (small arrow), a submental view (**B**) shows the stent on end (small arrow) with coil wrapped around the stent but not in the vessel lumen (large arrow).

stents in conjunction with anti-platelet therapy reduces the likelihood of aneurysm thrombosis after stent placement, thus necessitating the deposition of coils through the stent into the aneurysm fundus [6]. As demonstrated by Lanzino et al and others, stents provide a buttress that prevents coil herni-



4 Oblique view demonstrating complete aneurysm thrombosis (large arrow) with an intra-stent thrombus within the basilar artery (small arrow).

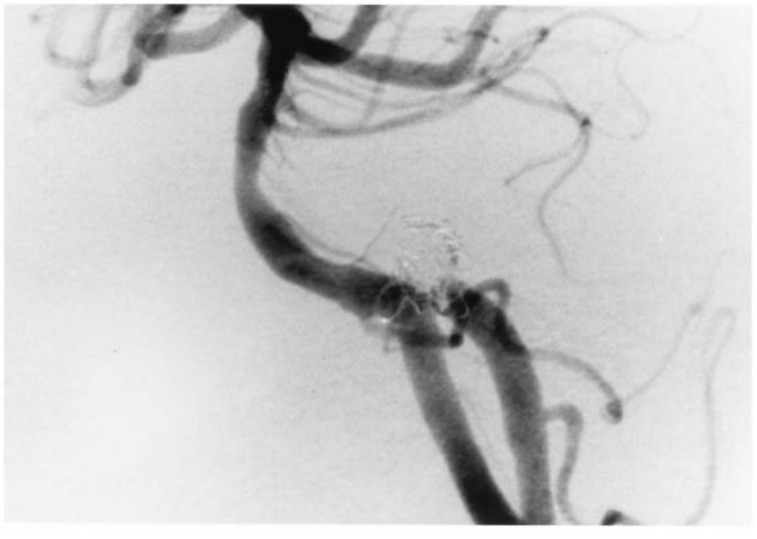


5 Fundal filling (small arrow) after aspirin, heparin, and Plavix therapy. The basilar thrombus is no longer present.

ation into the parent vessel lumen while allowing improved coil deposition [5,6,8,10].

A prior report by Lanzino et al described a series of 10 patients treated with stent-assisted coil embolization. Of these 10 patients, one patient had an intracranial vertebral artery aneurysm and three others had basilar artery aneurysms. The remaining patients had internal carotid artery aneurysms [6]. Short-term clinical follow-up was favorable in all patients, and angiographic follow-up demonstrated only one patient (with a vertebral artery aneurysm) with mild-to-moderate in-stent stenosis [6]. As demonstrated by Lanzino's series and a canine model, perforating vessels remain patent if less than 50% of the ostial diameter is covered by the stent struts [6,11]. Perforating vessel occlusion after stent placement is likely lessened with the use of porous stents and anti-platelet therapy [6].

This case illustrates successful use of stent-assisted coil embolization to treat a complex, wide-necked vertebral confluence aneurysm complicated by left vertebral artery retrograde flow (subclavian steal syndrome). Though this and similar reports demonstrate good short-term results [3,9], larger trials are necessary to adequately assess the efficacy of stent-assisted coil embolization. If stents or other types of aneurysm neck control devices prove to be as effective as they have been in these preliminary reports, we as endovascular surgeons will move one step closer to being able to treat the majority of lesions regardless of neck size and geometry. This will truly represent a quantum leap in



6 Final result after repeat embolization.

aneurysm management of no less importance than Dandy's clip application over a half-century ago [1].

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COMMENTARY

Horowitz et al have elegantly treated this wide-necked vertebrobasilar junction aneurysm with a combination of a stent and coils. It would have been easier to treat the aneurysm with a stent positioned in the distal left vertebral artery, but they did not have access to it because the left subclavian artery was occluded. They could have considered a left brachial approach.

The trend is to combine stents and coils to treat wide-necked aneurysms whenever it is technically possible. It is too early to determine the long-term results of the use of intracerebral stents. The fact that intimal hypertrophy occurs in 20% of the stents must be considered. Improvements in the materials and coating of the stents are expected to greatly decrease this risk.

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Dwell not upon thy weariness, thy strength shall be according to the measure of thy desire.

—ARAB PROVERB