CASE REPORT

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Alpha horizontal stent delivery for coil embolization of a broad-necked large basilar apex aneurysm: a case report

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ABSTRACT

Here we describe a novel technique for single stent horizontal reconstruction and coil embolization for a broad-necked large basilar artery (BA) apex aneurysm. A previously healthy 77-year-old woman presented with a broad-necked large BA apex aneurysm. Due to difficulty accessing the right posterior cerebral artery (PCA), we abandoned the Y-stent technique. Instead, we decided to navigate the stent through the BA to the left PCA making a loop of the stent delivery catheter inside the aneurysm in an "alpha" fashion. The procedure outcome was excellent without any complications. Alpha horizontal stent delivery via an antegrade approach for coil embolization of broad-necked large BA apex aneurysms may provide an effective therapeutic alternative, if other techniques are not feasible.

Key Words: basilar apex aneurysm, coiling, stent placement

INTRODUCTION

Broad-necked aneurysms of the basilar artery (BA) apex are challenging to treat using both microsurgical clipping and endovascular techniques. However, the use of endovascular techniques for coil occlusion of these aneurysms has been dramatically favored over traditional open microsurgical procedures because of the morbidity and mortality associated with such procedures. While various adjunctive techniques, such as balloon neck remodeling, Y-stenting, and waffle cone stenting, have been used to facilitate coil embolization of these lesions,[1-10] these methods cannot be used in all cases. Some authors reported efficacy of stent placement in a horizontal configuration across the neck of the aneurysm, from the internal carotid artery (ICA) via the posterior communicating (Pcom) artery into the contralateral posterior cerebral artery (PCA) proximal segment (P1), in a retrograde fashion.[11-12] Unfortunately, if no retrograde access is available, horizontal stenting cannot be established. To address this problem, we developed a horizontal stent delivery technique via the parent BA of a broad-necked large BA apex aneurysm. The stent delivery system consists of an "alpha" configuration. To the best of our knowledge, this is the first report of an "alpha" horizontal stent delivery technique for coil embolization of broad-necked large BA apex aneurysms.

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CASE PRESENTATION

A large BA apex aneurysm was found during magnetic resonance imaging (MRI) of a previously healthy 77-year-old woman. Diagnostic catheter angiography revealed a large, broad-necked, relatively shallow aneurysm with a maximum diameter of 15.7 mm. The right P1 was 1.1 mm in diameter and the left was 1.5 mm (Figure 1). Neither Pcom artery was observed despite Allcock's tests to determine flow through posterior communicating arteries. The patient was informed in detail about the nature of the unruptured aneurysm, and available surgical and endovascular treatment options. She eventually decided to undergo coil embolization.

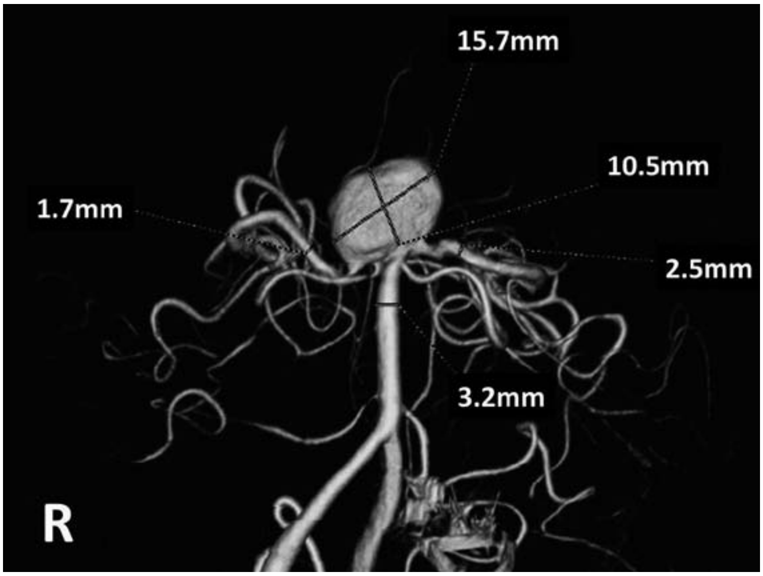

Fig. 1 Three-dimensional digital subtracted angiogram showing a large basilar apex aneurysm with an extremely wide neck.

The patient was prescribed 75 mg of clopidogrel and 100 mg of aspirin per day, 10 days prior to the intervention. The procedure was performed on a biplane flat-panel angiographic unit (GE Healthcare; Milwaukee, WI, USA) under general anesthesia with systemic heparinization (activated clotting time >250 s). A 4-French short sheath was inserted into the right brachial artery and an 80-cm 4-French guiding catheter was advanced into the right vertebral artery. An SL-10 (Boston Scientific; Natick, MA, USA), configured into a C shape with steam, was navigated into the aneurysm for coil delivery, while a 5-French guiding sheath (Destination; Terumo, Tokyo, Japan) was inserted into the right femoral artery and advanced up to the left vertebral artery as a second guide. A 120-cm 4-French catheter (Fubuki; Asahi Intecc, Nagoya, Japan) and a Prowler Select Plus (Cordis; Miami Lakes, FL, USA) were inserted into the 5-French guiding sheath by means of the coaxial system. The 4-French Fubuki catheter was carefully placed into the body of the BA apex aneurysm. Subsequently, a 0.014 microguidewire (CHIKAI; Asahi Intecc, Nagoya, Japan) was then carefully advanced forward along the inner wall of the aneurysm until it made a loop inside the aneurysm to reach the left P1 segment. A microcatheter (Prowler

Select Plus) was then advanced over the wire and placed distal to the left P1 (Figure 2 and 3). The intra-aneurysmal 4-French catheter played an important role as a stabilizer preventing the "alpha" looped microcatheter from flattening. A 4.5 mm × 22 mm Cordis Enterprise™ vascular reconstruction device (VRD) was delivered into the "alpha" fashioned microcatheter in a horizontal configuration across the base of the broad-necked BA apex aneurysm from the left P1. After insertion of a framing coil (Complex18 9 × 23; Terumo) for anchoring via the right brachial route, the stent was carefully deployed. Successful placement of the stent across the wide aneurysmal neck was confirmed by angiography (Figure 4). Subsequent coil embolization ensued to completion with a total of 30 coils (HydroFrame, HydroSoft; Terumo). There was no

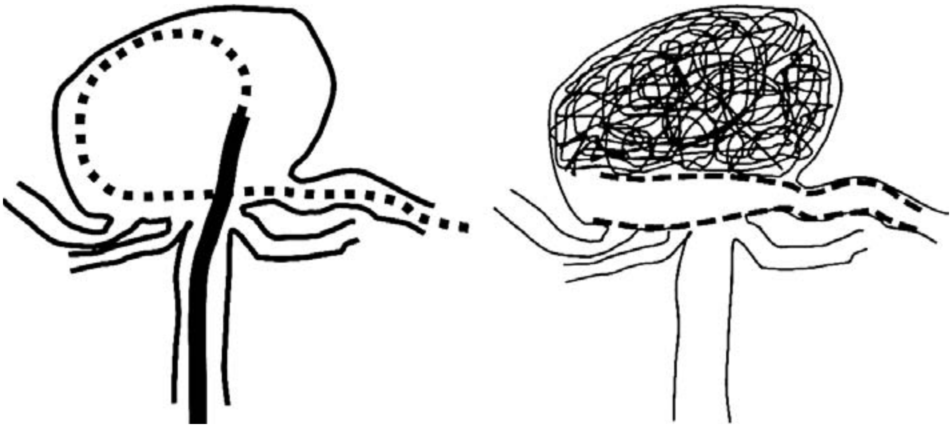

Fig. 2 Strategy for endovascular coil embolization. Left: The 4 Fr. catheter (solid line), and the stent delivery catheter (broken line). Right: The horizontal deployed stent (broken lines), and the coil mass.

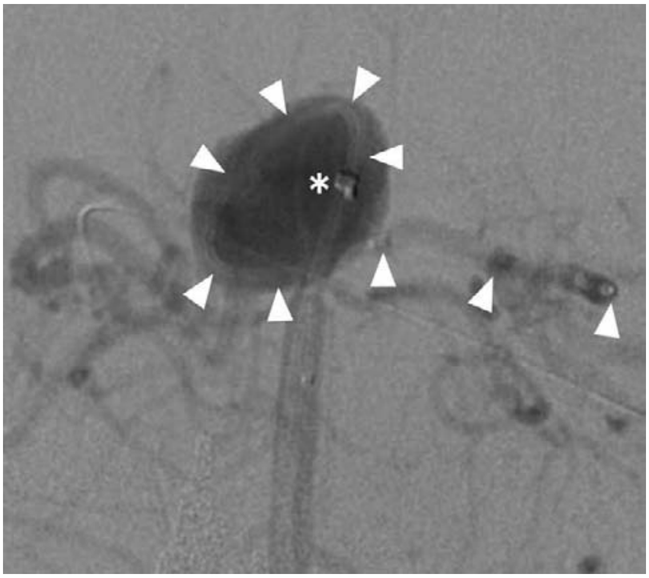

Fig. 3 Angiogram showing the tip of the 4 Fr. catheter (*), and the stent delivery catheter (▲).

evidence of coil protrusion in any of the parent arteries, the BA or bilateral P1. A final angiogram revealed 90% body-filling (Figure 5). The patient demonstrated no neurological deficits and was subsequently discharged seven days after the intervention. MRI at her 12-month follow-up revealed no reperfusion and confirmed patency of both P1 vessels (Figure 6).

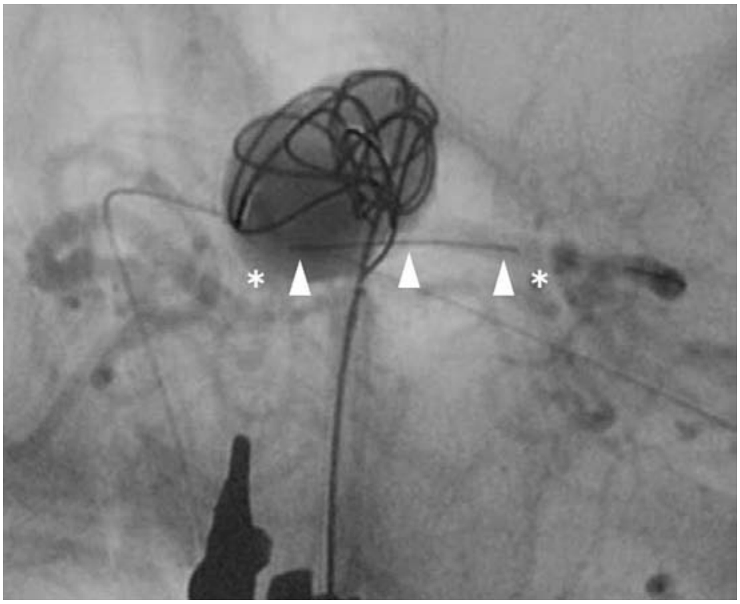

Fig. 4 Angiogram immediately after stent deployment. Both stent tips (*) and the stent positioning marker (▲) have been shown.

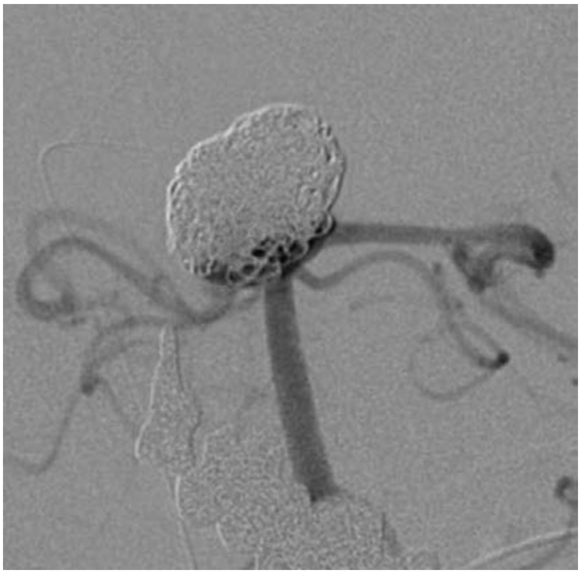

Fig. 5 Final post-procedure image showing successfully re-established arterial flow.

Fig. 6 MR angiogram at her 12-month follow-up reveals no reperfusion and confirms patency of both P1 vessels. The white arrow indicates the distal tip of the stent.

DISCUSSION

Despite recent developments in endovascular techniques and technology for coil embolization of intracranial aneurysms, one of the fundamental problems is the treatment of broad-necked aneurysms, particularly those originating from vessel bifurcations. Balloon-assisted coil embolization relies on the ability of the compliant balloons to remodel the shape of the aneurysm, specifically around the aneurysmal neck. Unfortunately, these balloons neither provide a permanent barrier against coil herniation nor do they help divert blood flow away from the aneurysm. Therefore, protrusion of coils into the parent artery or distal vessels can occur, as well as coil compaction or reperfusion. However, the more recent generation of self-expandable stents, such as the Enterprise VRD (Cordis), designed specifically for intracranial delivery, offer a new dimension of flexibility and thereby can be navigated to most typical intracranial aneurysm locations. In the majority of broad-necked BA apex aneurysms, it is sufficient to deploy the stent in such a way that it emanates from the BA and ends in one P1 segment. Unfortunately, deployment of a single stent may allow coil herniation based on limited coverage of the aneurysmal neck. The two-stent technique has the added advantage of diverting blood flow away from the aneurysm and into the bilateral PCAs if deployed in a Y-configuration at the BA apex,2,9,13) however, this maneuver also requires widening of the stent struts and thus some mechanical damage to the stent itself. Furthermore, using two stents increases the cost of the procedure as well as the risks of thromboembolic events, including brainstem infarction. Heller RS *et al.* reported that incomplete stent apposition, highly prevalent in closed-cell design stents used to assist coil embolization of aneurysms, is detectable with 3-tesla MR angiography as a crescent sign.14) Incomplete stent apposition was also associated with periprocedural ipsilateral hyperintense lesions on diffusion-weighted imaging. Therefore, an “I”-stent configuration provides better apposition than an “L” or “V”-stent, particularly using the Enterprise VRD.

One of the most recent trends reported in the treatment of broad-necked BA apex aneurysms is a horizontal stent placement technique.[11-12] This technique requires catheterization from one ICA via the Pcom artery into the contralateral P1 segment in a retrograde fashion. Once horizontal stent placement across the aneurysmal neck is achieved, this single stent technique is preferable to the Y-configuration stent because it causes less flow disturbance at the aneurysmal neck and may decrease the risk of thromboembolic events as a result of using fewer stents without covering the BA trunk. However, needless to say, this approach is strictly limited by individual anatomical features.

In the present case, because both Pcom arteries were not available, we had to navigate a stent into the P1 via an antegrade approach. Moreover, the narrow right P1 originated from the aneurysmal dome with a reversed sharp angle. We abandoned the Y-stent technique as well as the waffle cone stent technique because the neck of the aneurysm was very broad. Some authors have recently reported that the waffle cone technique is not sufficiently reliable to support coils over the long term.[15-17] In our search for a more dependable procedure, we came across the "balloon-assisted neck bypass technique" reported by Cekirge SH *et al.*[18] This technique involves navigating a balloon along the inner wall of the aneurysm until it makes a loop inside the aneurysm to reach the outflow in the parent artery. We used this approach to navigate a stent delivery microcatheter with a 0.014 microguidewire by advancing it carefully into the aneurysm and pushing it forward along the inner wall making an "alpha" loop inside the aneurysm to reach the left P1 orifice. An intra-aneurysmal 4-French catheter was used to stabilize the system and prevent flattening of the "alpha" looped microcatheter during stent deployment. Furthermore, prior to stent deployment, we inserted a framing coil into the aneurysm to prevent stent migration into the aneurysm. This coil remained undetached until the stent was placed as a controllable scaffold. The procedure result was favorable proving that coil embolization of a very broad-necked large BA apex aneurysm could be achieved by using the "alpha" stent delivery technique.

CONCLUSION

The treatment of broad-necked aneurysms remains a significant therapeutic challenge, despite the use of balloon- or stent-assist techniques. On the basis of our experience, we believe that our "alpha" horizontal stent delivery technique via an antegrade approach is particularly suitable for treatment of broad-necked large BA apex aneurysms.

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