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Case Report

Endovascular Coiling for a Wide-neck Bifurcated Aneurysm with Anterograde Horizontal Stenting via Microcatheter Looping: A Technical Case Report

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Technical advances with devices such as catheters, balloons, and stents have widened the indications for endovascular coiling for unfavorable aneurysms. The authors report two cases of coil embolization for a wide-neck bifurcated aneurysm with anterograde horizontal stenting via microcatheter looping. Two women, aged 56 and 38 years, respectively, had an undertall- and overwide-neck aneurysm with bifurcated branches at the basilar bifurcation and middle cerebral bifurcation, respectively. The delivery microcatheter was steamed so that it could be looped deliberately to the opposite vessel. The enterprise stent was first anchored to the vessel of the posterior cerebral artery on one side. The remaining portion was spanned into a looped microcatheter to the opposite branch while pushing the stent. The Neuroform Atlas stent was passed directly through the looped segment of the microcatheter at the M2 branch and spanned horizontally by unsheathing. Under horizontal stenting, complete coil embolization was achieved without immediate or delayed complications in both cases. This novel technique presents a viable option for stent-assisted coiling within an optimal anatomy.

Keywords Intervention, Intracranial aneurysm, Stent, Catheter

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INTRODUCTION

The advent of an era of aneurysm coiling has substantially covered a wide spectrum of intracranial ruptured or unruptured aneurysms. The rapid development of additional devices and techniques for endovascular coiling has practically allowed treatment of more complex aneurysms that seem to have unfavorable anatomies.[4)9)10)14)] However, wide-neck bifurcated aneurysms cannot be favorably protected by an additional device such as a balloon or stent and a multi-catheter. Although Y-stenting or waffle cone stent-assisted coiling has been precisely developed to cover a whole range of aneurysm neck, it has an increased risk of thromboembolism or reduced completeness of occlusion.[7)13)] We report two consecutive cases of wide-neck bifurcated aneurysm for which a stent was horizontally deployed via catheter looping. To our knowledge, anterograde manipulation has not been demonstrated yet.

CASE REPORT

Case 1

A 56-year-old woman visited our hospital to undergo treatment for a basilar bifurcation (BABIF) aneurysm detected on magnetic resonance angiography. She had a family history of subarachnoid hemorrhage and feared the risk from her aneurysm. Cerebral angiography revealed an undertall- and overwide-neck aneurysm (aspect/height-to-neck ratio, 1.0; dome-to-neck ratio [DNR], 1.1) with both limbs of the posterior cerebellar arteries. Under general anesthesia, a 6-F Envoy guiding catheter (Cordis Neurovascular, Miami Lakes, FL, USA) was positioned in the left distal vertebral artery with continuous infusion of 3,000 U of heparin per 1,000 mL of saline. An Excelsior SL-10 microcatheter (Target Therapeutics, Fremont, CA, USA) was navigated into the aneurysm, and a partial frame was made by the first coil. A Prowler Plus microcatheter (Cordis Neurovascular) was intentionally steamed to bend it into a slight curve at its distal portion, enough to cover the neck. The stent was pushed for a good apposition, and a portion of the delivery microcatheter was spontaneously moved to the contralateral P1 trunk via the catheter looping. The stent was horizontally deployed to cover the whole aneurysm neck with jailing of another microcatheter. Several types of coils were subsequently inserted to make a complete packing for the aneurysm without coil herniation. A total of 3,000 IU of heparin was used

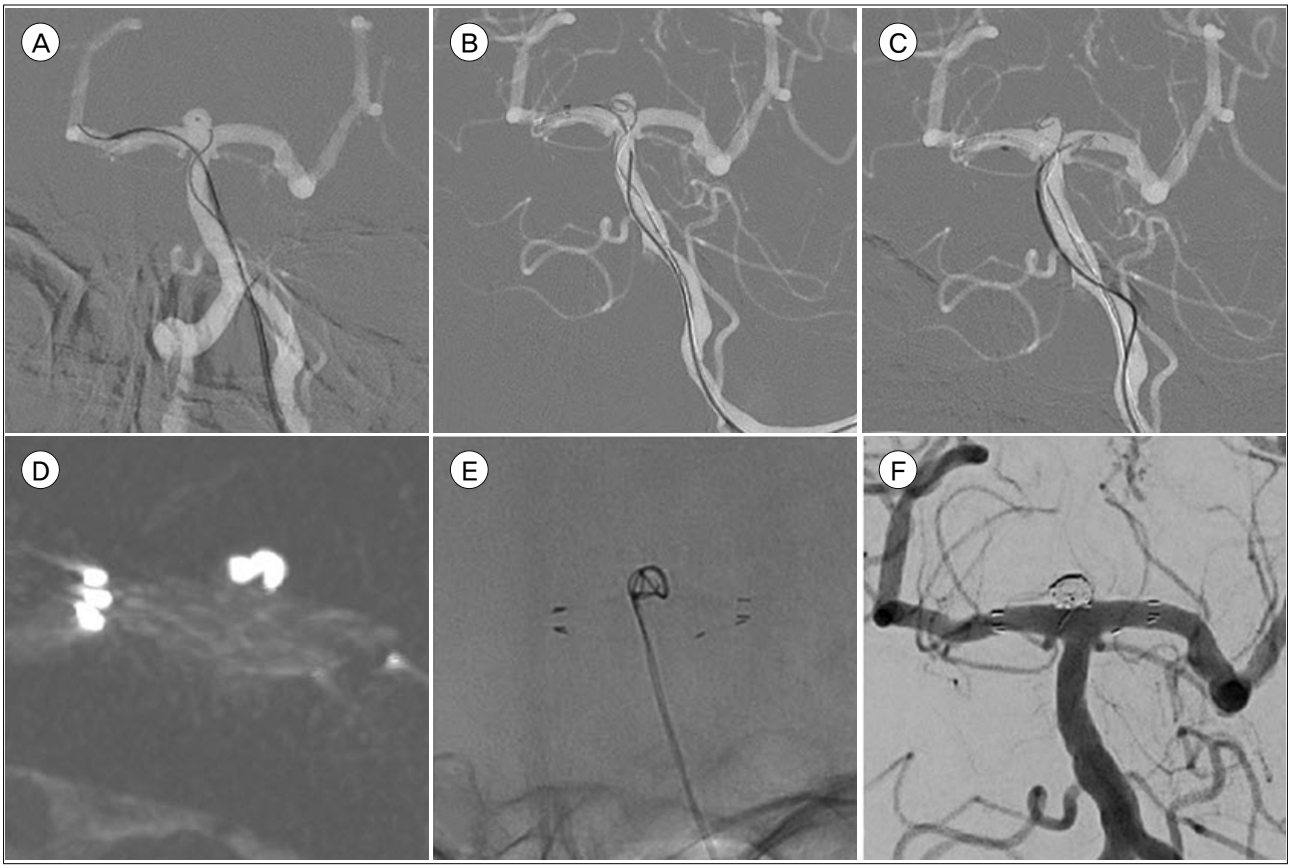

Fig. 1. (A) For a BABIF aneurysm, a microcatheter was selected and a delivery microcatheter was navigated into the right PCA. Note the shape of the undertall- and overwide-neck aneurysm in the anteroposterior plane. (B) Anchoring the proximal portion of the Enterprise stent to the right PCA by microcatheter unsheathing and stent pushing. (C) As the stent is pushed, the steamed curved portion of the delivery microcatheter is moved toward the contralateral PCA, with final deployment by unsheathing. (D) The Vaso-CT image that confirmed the horizontal stenting. (E) Framing achieved with the stent. (F) Complete stent-assisted coil embolization. BABIF = basilar bifurcation; PCA = posterior cerebellar artery; CT = computed tomography.

during the procedure. The patient was discharged without any adverse events after the treatment (Fig. 1).

Case 2

A 38-year-old woman presented with a neck growth that had developed in 2 years after she underwent treatment with endovascular coiling for a ruptured aneurysm at the right middle cerebral bifurcation (MCBIF). The double microcatheter technique was used effectively to fill an initial dumbbell-shaped aneurysm, which measured 5.5 × 2.4 mm. The regrowing portion showed an undertall and overwide shape (aspect ratio, 1.0; DNR, 1.1) with bifurcated branches. Under general anesthesia, a 6-F Envoy guiding catheter was positioned in the right internal carotid artery with continuous infusion of 3,000 U of heparin per 1,000 mL of saline. An Excelsior SL-10 microcatheter was navigated into the aneurysm. Another microcatheter was intentionally looped from the inferior to the superior trunk with an Asahi Chikai microwire (Asahi Intecc, Nagoya, Japan). An Atlas neuroform stent (diameter, 3.75 mm; length, 20 mm; Target Therapeutics) was introduced and deployed, spanning the aneurysm neck and achieving horizontal stent deployment to cover the whole neck. Several types of coil were subsequently inserted for complete packing of the aneurysm without any compromise of the branching vessels. A total of 4,000 IU heparin was used during the procedure. The patient was discharged without any complications after the treatment (Fig. 2).

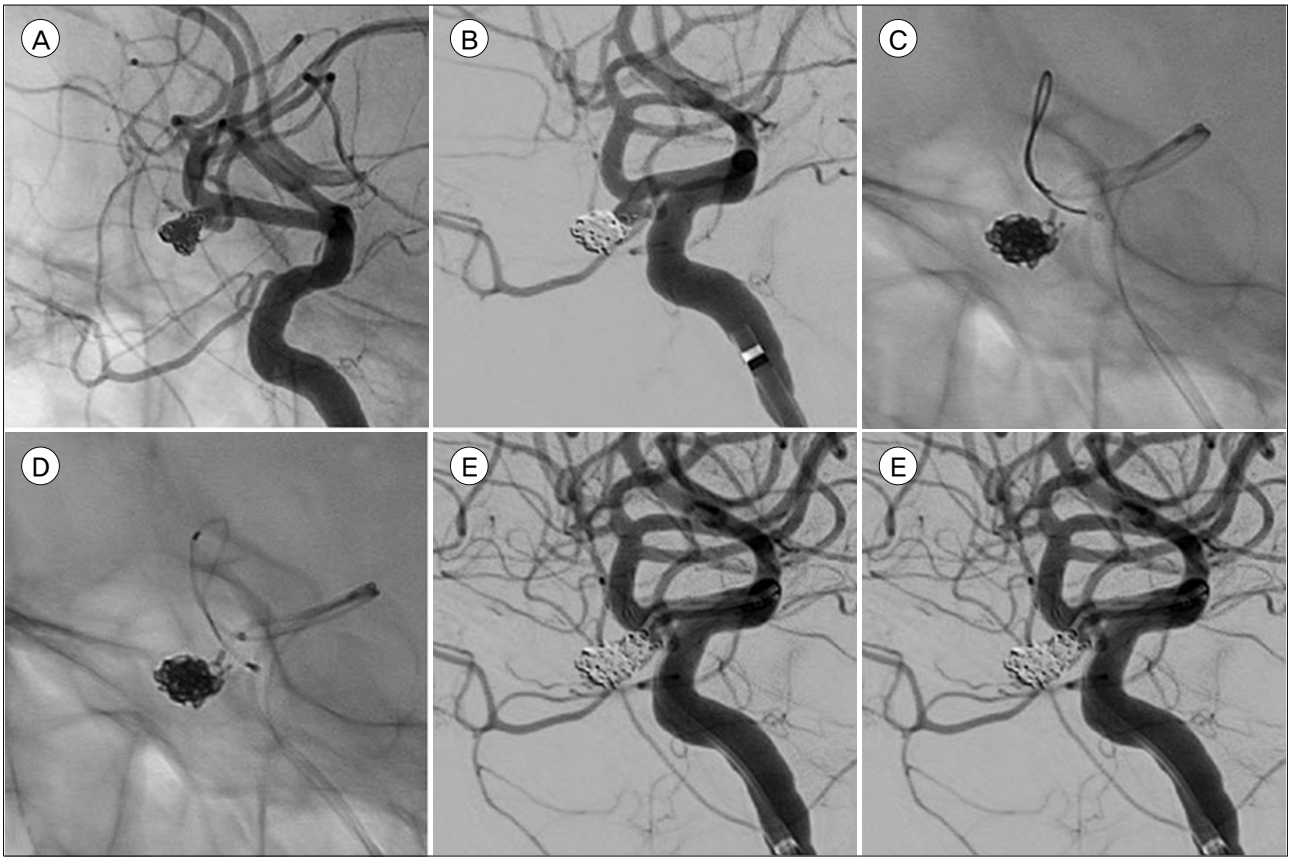

Fig. 2. *(A) Initial ruptured MCBIF aneurysm completely treated with a double microcatheter. (B) Neck growth seen as an undertall- and overwide-neck aneurysm with vessel branches 2 years after the initial treatment. (C) The delivery microcatheter is looped from the inferior to the superior trunk of the MCA. (D) A Neuroform Atlas stent placed directly over the looping segment with control of tension. (E) Complete stent-assisted coil embolization. (F) The Vaso-CT image that confirmed the stenting. MCBIF = middle cerebral bifurcation; MCA = middle cerebral artery; CT = computed tomography.*

Technical notes

Two patients were pretreated with aspirin (100 mg/day) and clopidogrel (75 mg/day) for 1 week before stent-assisted coiling. Thereafter, a dual antiplatelet medication was planned for 9 months and a mono-medication (aspirin or clopidogrel) was prescribed indefinitely. To cover the whole neck through a horizontal stent, the delivery microcatheter is steamed to slightly curve the approximate point of its distal portion that could be long enough to pass the aneurysm neck. Once the microcatheter is navigated into the targeted side of the efferent vessels, a large profile stent such as Enteprise has to be anchored against one side of the efferent vessels by unsheathing and pushing the stent. Then, the remnant portion is pushed until the pre-bended part of the delivery microcatheter is moved to the opposite side of the efferent vessels via looping. As the microcatheter is removed, the stent is simultaneously spanned into the contralateral side. In contrast, when the use of a low-profile stent such as Neuroform Atlas is planned, the steamed curved part of the delivery microcatheter is prepositioned on the opposite side of the efferent vessel via looping. While the stent is pushed, it can directly pass over the looped segment of the delivery microcatheter, and anterograde stent deployment is achieved by unsheathing the microcatheter (Fig. 3).

DISCUSSION

Endovascular coil embolization in wide-neck bifurcated aneurysms is still a challenge because of concerns regarding coil herniation and subsequent occlusion of the main branches due to complex geo-

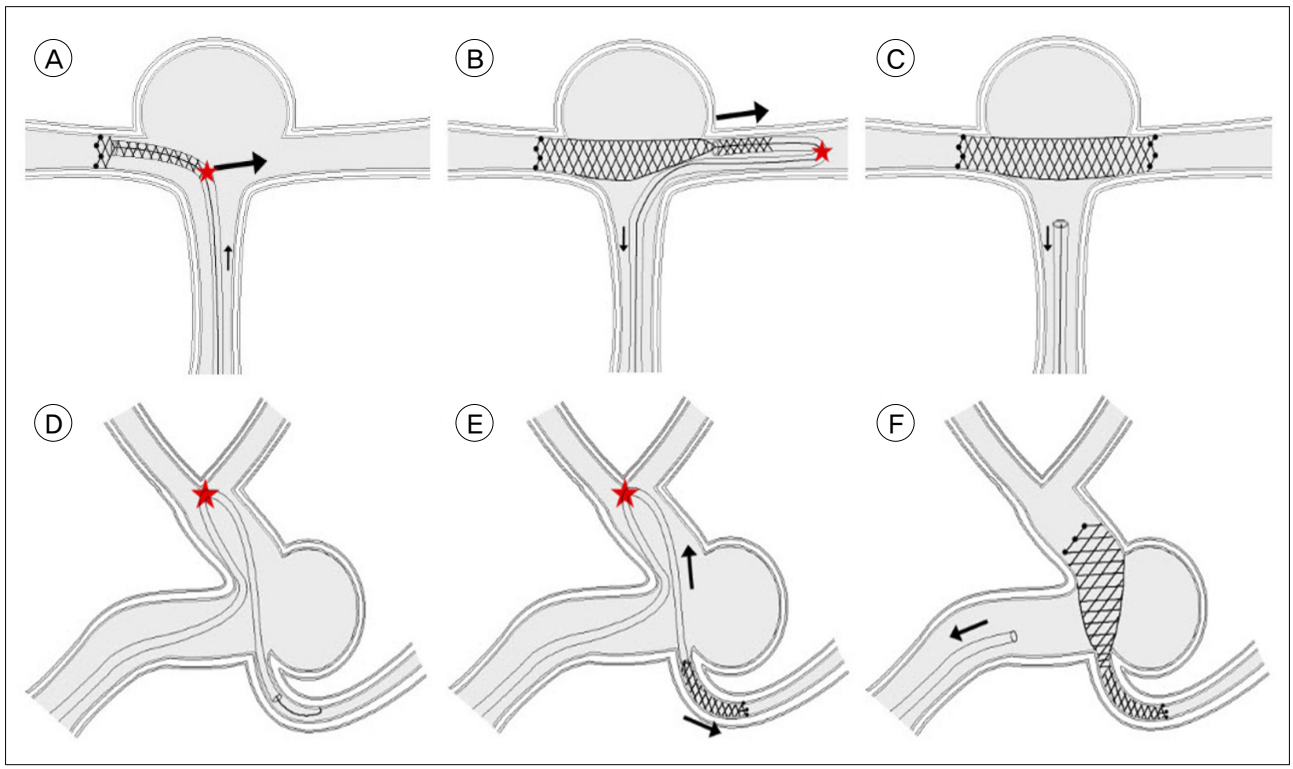

Fig. 3. (A) Initially, the distal segment of Enterprise stent (short size) is expanded to secure the vessel wall via pushing the microcatheter (0.021 inch). (B) As pushed the microcatheter, steamed looped part (asterisk) moves into the contralateral trunk of basilar artery bifurcation. The proximal marker of the stent needs to be positioned below the neck. (C) The horizontal stenting is achieved by unsheathing of microcatheter. (D) The microcatheter (0.0165 inch) is positioned from the superior to the inferior trunk of the middle cerebral artery via steamed looping part (asterisk). (E) As the Neuroform Atlas was pushed, the stent directly passes the looping segment and deploys. (F) The horizontal stenting is achieved by holding the stent delivery wire and unsheathing of microcatheter.

graphical anatomy. Several advanced techniques with a stent, balloon, and multiple microcatheters have been well established with reasonable results.[3)5)17)] However, when both efferent vessels are incorporated into the wide neck of the aneurysm, the balloon can be a limited option, and Y-stenting or Waffle cone stentings may increase the risk of thromboembolic events or decrease the completeness of the coil packing.[1)7)]

The horizontal stenting technique has been described for wide-neck bifurcated aneurysms as able to access another route through the circle of Willis, and a single stent is perpendicularly placed on the long axis of the aneurysm, covering the whole surface of the neck.[2)] In most cases, the technique is indicated for basilar or internal carotid bifurcation aneurysms if they have a patent channel based on the size and tortuosity of the posterior or anterior communicating artery.[2)11)12)] Even if it is possible within the overall anatomy, the profile of the delivery catheter can cause technical difficulty due to the long course of navigation required. It may also induce vessel perforation or dissection during the procedure.[6)] Furthermore, bilateral femoral punctures have to be an option for retrograde access with an additional device. Nevertheless, small case series have demonstrated the benefits of retrograde horizontal stenting in conditions where another competent route is available at the wide-neck bifurcated aneurysms. It can cause less flow disturbance at the aneurysm neck and risk of thromboembolic complications than other multiple stents while securing the complicated aneurysm neck.[2)6)11)]

In the present two cases, we performed coil embolization after horizontal deployment of Enterprise and Neuroform Atlas stents by using an antegrade approach for the BABIF and MCBIF aneurysms via a catheter looping technique.[4)] As a retrograde route is not guaranteed, some important points have to be considered in anterograde stent deployment. First, the diameters of the efferent vessels on both sides should provide sufficient space to enable looping and maneuvering of the delivery microcatheter as noted in previous technical notes.[16)] The stent passes through that point by alleviating tension, completely depending on the vessel diameter. Originally, with the profile of the Enterprise stent, direct passage through the bended segment of a 0.021-in microcatheter is impossible.[8)] Once the distal segment of the stent is fixed to one side of the vessel, while pushing the stent, the microcatheter is looped into the contralateral side, and then the remaining portion of the stent is spanned by unsheathing the microcatheter.[16)] In contrast, the Neuroform Atlas stent fits through small-profile microcatheters (0.0165 in) and provides easier accessibility from its original profile than the Enterprise stent.[15)] Owing to its high flexibility, the stent itself can pass through the looping segment, which is the most resistant part, before deployment. Second, if the stent length is much longer than the expected range of each branch, it creates challenges for the navigation and deployment within a looping catheter. The proximal segment of the stent can be impossible to move toward the looping segment or can induce the folding of some part. The shorter length of the stent reduces friction and tension as the stent moves into the microcatheter and is beneficial for tracking the looping curve.

Even though anterograde horizontal stenting by microcatheter looping is a novel application, the indication for its use has to be precise. Owing to the technical difficulty from the course and geographical anatomy of the efferent vessels, microcatheter looping is not possible, excessive attempts may be troublesome, such as in an unexpected dissection or perforation of branching vessels. Even with looping, depending on the situation, the microcatheter may need to be deployed toward the conventional direction, for example, from one efferent branch to the main parent vessel, because of the stiffness or size of the stent. Some evidence of the usefulness of this approach might be retrospectively or prospectively obtained in large-volume studies conducted to prove its safety and feasibility in technical application in relevant anatomies.

CONCLUSION

The treatment of wide-neck bifurcated aneurysms may be technically challenging despite the use of additional devices. The antegrade horizontal deployment of a stent via catheter looping.

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Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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