Unusual Intracranial Stent Navigation through the Circle of Willis in a Patient with Recurrent Basilar Tip Aneurysm during Stent-Assisted Coiling

A Case Report

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Summary

We describe a case of unusual Enterprise stent navigation through the Circle of Willis in a patient with a basilar tip aneurysm, left internal carotid artery (ICA) occlusion and previous right ICA stenting. Basilar tip aneurysms are known for their therapeutic challenges, especially when the posterior cerebral arteries (PCAs) are incorporated in the aneurysm neck. This becomes more technically demanding if the vertebral artery does not offer a route for stent navigation.

We undertook stent-assisted coiling using the horizontal stenting of posterior cerebral arteries via both the posterior and anterior communicating artery navigation. This was necessary because the vertebral arteries were very tortuous, hence not suitable for stent navigation due to their small size and stenosis at their origin. Another compounding factor was the anatomy of the aneurysm neck in relation to the T-shaped origin of both P1 PCAs from the basilar artery.

The right ICA was stented previously and the whole navigation was done through this stented artery as the opposite left ICA was occluded at the bifurcation. In addition, there was no visualized posterior communicating artery (PCOM) on the right side, so following navigation through the anterior communicating artery (ACOM) the left PCOM artery was catheterized

to reach the PCAs. After horizontal placement of stent, coiling was performed for the residual aneurysm.

The outcome of this intervention revealed successful placement of the Enterprise stent in bilateral posterior cerebral arteries covering the aneurysm. Further coiling of the basilar artery aneurysm was done with a good result. No complication was seen in the angiography suite or later in the course of action.

Horizontal stent placement in wide-necked basilar aneurysms can be performed via the PCOM and ACOM arteries.

Introduction

Endovascular treatment of basilar tip aneurysms is often preferred, but the geometry of the aneurysm may not be amenable to coil occlusion without adjunctive methods. As novel techniques and new technologies arise, wide-necked basilar tip aneurysms have become amenable to endovascular therapy.

In the case described herein, Enterprise stent (Cordis Endovascular, Miami Lakes, FL), a self-expanding, flexible, nitinol stent designed specifically for the intracranial circulation, was deployed horizontally across the neck of a basilar tip aneurysm via both the ACOM and PCOM arteries through the previously stented cervical right internal carotid artery. Access to

Figure 1 Vertebral angiogram in the lateral (A) and frontal (B) plane show the residual filling of the basilar tip aneurysm with suspicious pseudo-lobule. We can also appreciate part of both posterior cerebral arteries (PCAs) incorporated in the neck of the aneurysm. C) Right internal carotid artery injection (ICA) revealed cross flow into the left side with non flow limiting narrowing at the distal end of the stent (arrow).

the aneurysm sac was then achieved via the right vertebral artery, and the aneurysm was successfully coiled with a microcatheter positioned through the struts within the stent. Although this technique has been described previously via a same side PCOM artery in the past, we describe the stent placement via left PCOM artery from the right ICA with navigation through the ACOM artery, completing almost the full circle through the circle of Willis. This case presents the navigation ability and flexibility of newer intracranial stents like Enterprise stent.

Case Report

History

Our patient is a 49-year-old female who presented to the neurosurgery clinic in February 2005 for recurrent headaches after previous basilar tip aneurysm coiling at an outside institution in 2004. Four vessel cerebral angiography was performed which revealed 20% stenosis of the right ICA at its origin. There was occlusion of the left ICA with filling of the left anterior cerebral artery (ACA) and some branches of the left middle cerebral artery (MCA) via the ACOM artery. In addition, vertebral angiography revealed a residual basilar tip aneurysm.

The patient was made aware of the findings, options for treatment and its prognosis. The patient decided to follow up and another angiography was performed in June 2005 which revealed further progression of right ICA stenosis to 80%. In addition further aneurysm regrowth and coil compaction was also seen. The patient was given the option of endovascular

Figure 2 Road map through the vertebral artery in the frontal (A) and lateral (B) plane revealing the course of the navigation across the circle of Willis. The Prowler plus select microcatheter is visualized extending from right ICA proximally to the right PCA P3 segment distally traversing right anterior cerebral artery, anterior communicating artery, left supraclinoid ICA, left posterior communicating artery, left PCA and basilar tip to reach the target vessel segment. Native image in the frontal (C) and lateral plane (D) revealing the deployed stent across both PCAs and the coil mass following embolization. Arrows point to the stent markers.

and operative treatment by the neurosurgery team, but due to previous coiling experience, the patient chose to undergo operative treatment of the residual aneurysm. However before that the right ICA stenosis was stented in July 2005 at our institution with a good angiographic result and no procedural or follow-up complications.

In September 2005 the patient was admitted

for operative clipping of the residual basilar aneurysm, but during the course of the operation our neurosurgeons found that the thick neck of the aneurysm was not amenable to clipping following previous coil placement. The patient was advised but was lost to follow-up. She was later seen at another institution in March 2008 for headaches and was advised angiography and intervention (Figure 1).

Figure 3 Vertebral angiogram in the lateral (A) and frontal (B) plane revealing the successful horizontal stenting and subsequent coiling. Note the pseudolobule has some coil loops as well.

Therapeutic strategy and endovascular procedure

The patient was placed on 75 mg of Plavix (Bristol-Myers Squibb/ Sanofi Pharmaceuticals, New York, NY) and 325 mg of aspirin five days prior to the date of endovascular treatment. On the day of the procedure, the patient was electively intubated and paralyzed. Right femoral access was obtained and a 6 Fr guiding catheter was advanced into the proximal cervical right ICA which had been previously stented in July 2005. Angiography revealed a patent right ICA with mild non flow limiting narrowing at the distal end of the stent. The right ICA injection revealed filling of the left MCA branches via the ACOM artery. Bilateral vertebral angiography revealed a patent and good sized left PCOM artery.

Left femoral access was obtained and a 6F guide catheter was positioned at the origin of the tortuous but dominant right vertebral artery. This guide catheter was used to obtain a roadmap and for microcatheter access for subsequent coiling. Using a combination of Agility 14 soft (Cordis Endovascular, Miami Lakes, FL) and Transcend EX .014 (Boston Scientific, Fre-

mont, CA) microwires, a Prowler Select Plus (Cordis Endovascular, Miami Lakes, FL) microcatheter was advanced from the guide catheter into the right ICA to the left supraclinoid ICA via the ACOM artery. With further manipulation the microcatheter and microguidewire were advanced into the left PCOM artery and from there to the left PCA and across the neck of the basilar tip aneurysm into the right PCA.

So the catheter and exchange microguidewire was navigated from the right ICA to right PCA as there was no good sized right PCOM artery (Figure 2). Through this microcatheter, a 4.5x22 mm self-expandable stent (Enterprise, Cordis Endovascular) could be advanced without technical difficulties. After positioning across the aneurysm neck, the stent was deployed from the right P2 to the left P2 segment bridging the wide basilar tip aneurysm neck. The small-sized tortuous right vertebral artery was catheterized with the same Prowler Select microcatheter and navigated through the stent struts. Subsequent coil packing resulted in occlusion of the aneurysm without coil herniation into the lumen (Figure 3).

Procedural outcome and patient follow-up

Complete obliteration of the residual aneurysm using three Orbit (Cordis Endovascular) detachable coils 7 x 13 mm, 5 x 15 mm, 3 x 6 mm and a single Hypersoft (Microvention Inc., Aliso Viejo California) detachable coil 2 x 4 mm was achieved. There were no immediate or post procedural complications.

The patient was extubated with no neurological deficits. The patient was kept in the recovery room under close observation. She left the hospital the next day with no new neurological deficit. She was prescribed aspirin for one year and Plavix for three months. Three month follow-up MRA revealed no sign of recanalization.

Discussion

Basilar tip aneurysm endovascular treatment using balloon remodeling technique¹ and Y stent placement² have been described in detail in the past. Balloon remodeling alone may not be adequate to achieve coil stability in the wide-necked aneurysm. Furthermore balloon remodeling does not provide an efficient barrier to prevent coil herniation into the parent artery and therefore cannot prevent coil herniation into the feeding vessel or coil compaction, both of which are common technical problems in the treatment of wide-necked cerebral aneurysms. The Y stent technique involves the placement of two telescoping stents via the vertebrobasilar system. The 'waffle technique' is also one of the described techniques for stent placement in the vertebrobasilar system. We describe horizontal stenting of bilateral PCAs, which removes the need for two stents in the vertebrobasilar system. The deployment of the stent through the internal carotid arteries also offers an alternative route for patients with diseased vertebral arteries.

The introduction of a self-expanding stent designed exclusively for deployment within the intracranial circulation has improved the endovascular therapy of wide neck aneurysms. Stent implantation may result in hemodynamic changes (i.e. "flow remodeling") that theoretically protect the aneurysm from the circulation and may prevent growth of the aneurysm³. Intracranial stent implantation may also prohibit coil compaction of wide-necked aneurysms, which increases the risk of aneurysm recurrence and recurrent rupture.

Figure 4 A magnified view of the end result revealing patent parent arteries and successful occlusion of the recurrent basilar tip aneurysm with stent-coil technique.

This case demonstrates that intracerebral stent implantation with antiplatelet therapy can be safely performed in the setting of extensive navigation around the circle of Willis. Endovascular treatment of this previously ruptured basilar tip aneurysm by a posterior communicating artery and anterior communicating artery approach is feasible with the newer intracranial stent delivery systems. The newer intracranial stents, like Enterprise (Cordis Endovascular) offer more navigation options due to increased flexibility and retrievability. Because previous endovascular and surgical attempts had failed, leaving this wide-necked basilar tip aneurysm unprotected was not an option in the setting of patient's unremitting headaches.

The left ICA occlusion did not help matters with increased demand by the left anterior circulation, further increasing hemodynamic stress on the basilar aneurysm. Conversely, it helped the endovascular navigation by providing adequate blood flow to the left anterior and middle cerebral arteries as increased flow through the posterior communicating artery may have caused a compensatory increase in the caliber, thereby allowing facile access.

The posterior communicating artery approach to basilar tip aneurysms may be advantageous to the Y stent technique because it the-

oretically causes less hemodynamic flow disturbance at the orifice of the aneurysm, fewer thromboembolic complications related to the use of fewer stents, and provides better approximation to the neck of the aneurysm⁴. Stent placement may potentially divert blood flow away from the coil mass within the aneurysm sac, theoretically preventing recurrence and therefore recurrent rupture of the aneurysm. Apart from requiring at least one largely patent posterior communicating artery, horizontal stent deployment also depends on the angle at which the posterior cerebral arteries bifurcate from the basilar artery.

This technique of horizontal stenting is best suited when the posterior cerebral arteries leave the basilar artery in a perpendicular direction or project from it at an acute angle, as in our case. If the posterior cerebral arteries leave the basilar artery at obtuse angles (i.e.

projecting superiorly), the Y stent technique may be preferred to minimize the amount of stress on the vessel wall and thereby better protect the neck of the aneurysm. Therefore, the decision to undertake Y stent treatment or perform horizontal stent deployment relative to the neck of the aneurysm depends not only on the presence of large posterior communicating arteries but is also dependent on the angle of the posterior cerebral arteries bifurcation relative to the basilar artery. If both of these factors are favorable, this case demonstrates that a good clinical and technical result can be achieved in the setting of circle of Willis navigation.

Development of new intracranial specific stents that are more flexible and easier to navigate through the cerebral circulation further expands the endovascular treatment options for wide neck and bifurcation aneurysms.

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