Treatment of acute cervical internal carotid artery dissection using the Solitaire FR revascularization device

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SUMMARY

During treatment of a right internal carotid artery terminus aneurysm, an acute iatrogenic flow limiting dissection was caused in the cervical internal carotid. The true lumen was catheterized using a Mirage 0.008 microwire over an Excelsior SL-10 microcatheter, which was exchanged for a Marksman microcatheter. A 6 mm×30 mm Solitaire FR revascularization device was then deployed across the dissection as a salvage technique.

BACKGROUND

Intra-arterial dissection is a feared complication for both diagnostic cerebral angiography and endovascular intervention. In a retrospective analysis involving 6981 patients at a high volume US centre, the incidence of dissection is approximately 0.26%. In patients older than 35 years of age, the incidence can be up to 35%.¹ Sixty-six per cent of intra-arterial iatrogenic dissections represent minor intimal tears; these lesions can often be treated conservatively and result in a good clinical outcome. On the other hand, 33% of intra-arterial dissections are severe (>70% intraluminal narrowing), and result in flow limiting stenosis. When combined with a lack of cross fillings from the contralateral vessels, these patients are at an increased risk of major hemispheric stroke and must be treated surgically or endovascularly to protect the parent vessel from being occluded. The Solitaire FR flow restoration device (ev3, Irvine, California, USA) was FDA approved for the treatment of acute intracranial major vessel occlusion in the USA in March 2012 based on the results of the still ongoing SWIFT (Solitaire FR with the Intention for Thrombectomy) study.² However, no cases have been documented using this detachable stent for the treatment of acute iatrogenic major vessel dissection.

CASE PRESENTATION

A 59-year-old man was diagnosed with a right internal carotid artery (ICA) terminus aneurysm measuring 9×6×8 mm during the workup for diplopia. He had a history of hypothyroidism, hypertension, sleep apnea, degenerative joint disease, and a questionable history of ocular myasthenia gravis. He was subsequently admitted for stent assisted coiling of the aneurysm. He was loaded with aspirin and clopidogrel prior to the initiation of the procedure and placed under general anesthesia prior to the beginning of the procedure.

Diagnostic cervical and cerebral angiogram revealed a type 2 aortic arch with a tortuous right ICA with two adjoining 180° turns proximal to the

skull base (figure 1). A 6 F Neuron Lumen Delivery STR 6 cm×0.053 inch×95 cm guide catheter (Penumbra Inc, Alameda, California, USA) was initially advanced proximal to the first bend of the ICA over a 0.035 inch hydrophilic guidewire (Terumo Medical, Somerset, New Jersey, USA). The 035 guidewire was then replaced with an Excelsior XT-27 Flex 150 cm×18 cm microcatheter (Stryker, Fremont, California, USA) together with a Transend 300 Floppy 014 inch microwire (Stryker). However, attempts were made to pass the second bend without success, and at this time we identified intraluminal dissection of the right ICA distal to the first and proximal to the second 180° bend (figure 2).

TREATMENT

Further advancement of the Transend microwire resulted in the wire advancing into the false lumen. Therefore, the Transend wire was exchanged for an SL-10 2-TIP Marker STR 6 cm×150 cm over a Synchro2 Standard 0.014 inch×200 cm microwire (Stryker) in an attempt to catheterize the true lumen. Finally, we were able to gain access to the true lumen using a Mirage 0.008 inch×200 cm microwire. At this time, an Excelsior SL-10 2-TIP Marker STR 6 cm×150 cm microcatheter was advanced through the dissected segment of the vessel. The Mirage wire was withdrawn, and replaced with a Transend 300 Floppy 014 inch microwire. Attempts were made to deploy a 6 mm×30 mm Precise Pro Rx Nitinol Stent (Johnson & Johnson, Brunswick, New Jersey, USA) but the stent would not pass the dissection flap secondary to the tortuosity of the ICA. A Marksman catheter was then advanced over the exchange length Transend microwire distal to the lesion. A Solitaire FR revascularization device (6 mm×30 mm) was deployed across the lesion. Repeat angiographic injection demonstrated significant improvement in flow across the lesion (figure 3). The device was then detached using the GDC coil detachment system (Stryker).

OUTCOME AND FOLLOW-UP

Final angiographic runs of the cervical and intracranial circulation revealed improved flow across the dissection and no embolic sequelae in the distal intracranial circulation (figure 4). The patient was awakened from anesthesia without any neurological deficits. Three days later he was brought back to have his right ICA terminus aneurysm treated by left ICA access via the anterior communicating artery (figure 5). An M1 to A1 Neuroform3 EZ stent (Stryker) was placed across the neck of the aneurysm, which was then successfully coiled. He

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Figure 1 Right cervical carotid injections. Anteroposterior (A) and lateral (B) views demonstrate two 180° turns at the level of the skull base.

remained on dual antiplatelet therapy for his carotid stent as well as stent assisted coil embolization of his aneurysm, and was discharged home without further complications.

DISCUSSION

Intra-arterial dissection is a known complication for both diagnostic cerebral angiography and neurointervention. However, its occurrence is relatively rare due to the meticulous catheter manipulation and the development of soft tip guide catheters. However, in patients with tortuous vascular anatomy, the risk of occurrence is higher. Non-flow limiting dissections can be managed with antiplatelet agents or anticoagulation. However, flow limiting dissections must often be treated to prevent vessel occlusion. In patients with limited collateral flow from the contralateral circulation, this represents an even higher risk for a major hemisphere stroke, potentially leading to a devastating neurologic outcome.

Our patient represented a special challenge in that the dissection caused by the guide catheter resulted in a significant intimal flap, and left only a very small true lumen. This resulted in an extremely difficult catheterization of the true lumen in that the microwire preferentially selects for the false lumen because of the acute angle just proximal to the dissection flap. Excessive activities in the false lumen can worsen the dissection and increase the limitation of flow across the lesion. Other techniques for treating this type of dissection, such as subintimal flap penetration followed by balloon dilation, have been described in Israel.³ This remains highly risky if the procedure fails, especially when there is no good collateral circulation from the contralateral intracranial vasculature. After multiple attempts with the Mirage wire, and with a tincture of luck, the true lumen was catheterized with an SL-10 microcatheter. Conventional carotid stents failed to get beyond the dissection because of the tortuosity of the vessel proximal to the lesion.

Figure 2 Cervical injections. Anteroposterior (A) and lateral (B) views show the iatrogenic catheter induced dissection distal to the first 180° bend.

Figure 3 Cervical anteroposterior (A) and lateral (B) views demonstrate the presence of the Solitaire FR flow restoration device across the dissected segment of the right internal carotid artery, resulting in significant improvement in flow across the lesion.

Figure 4 (A, B) Post stenting intracranial injections show no embolic events or major vessel ischemia, and demonstrates the right internal carotid artery terminus aneurysm.

Figure 5 (A, B) Post Neuroform stent assisted coiling of the right internal carotid artery terminus aneurysm from the contralateral internal carotid artery access via the anterior communicating artery.

A Wingspan stent (Stryker) were also considered, but the largest diameter is only 4.5 mm, which would not be sufficient in this case, as the ICA had a diameter of 5.8 mm.

The Solitaire FR 6 mm revascularization device is designed for mechanical thrombectomy in the ICA with the option of detaching the stent. However, it has less radial force compared with a conventional carotid stent. As the Solitaire device is designed to navigate to intracranial vessels, it also has a greater maneuverability across tortuous vessels. The Solitaire device was used as a salvage technique. In Europe, the same device is also approved for aneurysm bridging (Solitaire AB neurovascular remodeling device), and comes with the Solitaire detachment system that detaches the stent electrolytically. As the Solitaire AB is not approved in the USA, a GDC coil detachment system was used in this case as a substitute. Consideration was also given to wait for the dissection to heal and possibly re-attempt treating the aneurysm from the ipsilateral side. However, our concern was if the dissection resulted in primary vessel occlusion, treating the aneurysm from the contralateral side would result in significant limitation of flow during catheterization of the anterior communicating artery, as this patient had a small hypoplastic posterior communicating artery, thus risking the occurrence of stroke. If we waited for the dissection to heal and the stent to endothelialize, we would still face the challenge of a tortuous ICA by approaching the aneurysm from the right side. Therefore, after allowing the kidneys to rest from the contrast load, we elected to treat the aneurysm from the contralateral side 3 days later.

This case demonstrates that iatrogenic ICA dissection can be difficult and a clinical challenge to treat, and that the Solitaire FR revascularization device may remain a viable option as a salvage therapy *only* when all conventional means have been exhausted.

Learning points

- Navigating a tortuous cervical ICA with a guide catheter can be risky and may induce flow limiting iatrogenic dissection.
- The Solitaire FR revascularization device may be used as a stent in the ICA to treat iatrogenic dissections when all conventional treatment options have been exhausted.
- Consideration of accessing the aneurysm from the contralateral carotid must be made in the setting of difficult anatomy on the ipsilateral side.
- Once an intraoperative complication develops during an elective procedure, consider aborting the procedure and returning on a later day to finish treatment if possible after thoroughly analyzing all potential treatment options.

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Competing interests None.

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