Transcarotid repair of carotid artery pseudoaneurysm after carotid artery endarterectomy with tandem distal internal carotid artery stenosis

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ABSTRACT

Pseudoaneurysm development after carotid endarterectomy is a rare occurrence. Even rarer is pseudoaneurysm formation associated with a distal carotid artery stenosis. We report the case of stent grafting of a carotid artery pseudoaneurysm and tandem high-grade distal stenosis through a transcarotid approach with active flow reversal. No reported cases of a transcarotid artery approach to address a carotid artery aneurysm with tandem stenosis were found in the literature. We show that it may be a safe alternative to a transfemoral artery approach or open surgery. (J Vasc Surg Cases and Innov Techniqes 2020;6:136-9.

Keywords: Carotid pseudoaneurysm; TCAR; Distal carotid stenosis

Carotid artery pseudoaneurysms are rare occurrences after carotid endarterectomy (CEA). It is even rarer to find tandem carotid artery stenoses. Carotid aneurysms and pseudoaneurysms can be definitively repaired through open or endovascular approaches. Open approaches are more common after a previous endarterectomy. When repair is performed through endovascular means, access through the femoral artery is most common; however, severe peripheral artery disease or difficult and diseased arches can make this challenging. With the patient’s consent, we describe a case of an asymptomatic pseudoaneurysm at the site of previous CEA associated with a high-grade distal internal carotid artery (ICA) stenosis repaired with stenting through a transcarotid cutdown and active flow reversal for neuroprotection.

CASE REPORT

A 72-year-old man presented for evaluation of carotid disease. He had history of right CEA 17 years earlier complicated by periprocedural stroke, leaving him with a modified Rankin scale disability score of 2. Surgery was performed at an outside hospital. It is unknown whether the carotid was patch repaired or closed primarily. The patient presented to our facility with a 3-cm outpouching of the right common carotid artery (CCA) and ICA with mural thrombus on carotid duplex ultrasound examination (Fig 1). The size of the outpouching suggested that this was not an oversized patch but rather a pseudoaneurysm or degenerated patch with pseudoaneurysmal enlargement. There was no evidence of infection clinically or radiographically. Evaluation with computed tomography angiography showed a 3.1-× 2.6-× 2.1-cm thrombus-filled pseudoaneurysm at the endarterectomy site and 85% stenosis distally at the C1-C2 level (Fig 2). Diagnostic angiography demonstrated an open and patent right CCA, enlargement at the carotid bulb consistent with the previous CEA and patch (Fig 3 A), and open and patent ICA with high-grade C1-C2 distal stenosis.

It was determined that the best option to minimize future stroke was to perform transcervical carotid stenting of the distal high-grade stenosis and then to exclude the proximal pseudoaneurysm with stent grafts using flow reversal for cerebral embolic protection.

TREATMENT

The patient was maintained on aspirin 81 mg, clopidogrel 75 mg, and pravastatin 10 mg daily before presentation and before and after the procedure. The patient was taken to the hybrid suite and placed under general anesthesia. The left common femoral vein was accessed, and the Silk Road Medical (Sunnyvale, Calif) venous sheath was placed within the modified Seldinger technique. A right CCA cutdown was performed through a 3-cm longitudinal incision at the neck base between the heads of the sternocleidomastoid. The CCA was dissected out and encircled with umbilical tape. A 5-0 Prolene U-stitch was placed on the anterior surface of the CCA. The patient was heparinized to maintain activated clotting time >250 seconds for the duration of the case. The CCA was accessed with a micro-puncture needle at the U-stitch. A 0.018-inch microwire was advanced 4 cm into the CCA. The needle was exchanged for a 4F microsheath and advanced 2 cm into the CCA. Oblique angiography identified the
pseudoaneurysm and carotid bifurcation. Subsequently, the Silk Road Medical 8F arterial sheath was inserted over a stiff 0.035-inch J-tipped wire. The neuroprotection system was then connected to the carotid arterial sheath and then to the venous return sheath.

The proximal CCA was clamped with a Rummel tourniquet, and flow reversal was verified. A 300-cm 0.014-inch Spartacore (Abbott Vascular, Santa Clara, Calif) wire was advanced into the ICA beyond the pseudoaneurysm and tandem stenosis. Because of the high-grade stenosis in the distal ICA, the artery was predilated with a 3- × 20-mm balloon and then stented with 6- × 40-mm ENROUTE stent (Silk Road Medical) to fully cover the lesion in the distal right ICA. The stent was postdilated with a 4.5- × 20-mm balloon. Proximal to the stenosis, the pseudoaneurysm was excluded with a 6- × 50-mm and a 7- × 50-mm Viabahn (W. L. Gore & Associates, Flagstaff, Ariz) with 2.5-cm overlap in the ENROUTE stent and Viabahn stent grafts. Completion angiography demonstrated widely patent stents without evidence of stenosis, dissection, or distal embolization. There was early filling of the pseudoaneurysm with a swirling pattern. This was thought to represent a type IA endoleak and believed to be due to full anticoagulation and the proximity of the sheath to the proximal edge of the stent graft (Fig 3, B). A type II endoleak was expected at this time because of retrograde filling of the external carotid artery but was not clearly demonstrated. The decision was made to not exclude the external carotid artery as it had a small 2-mm origin, with a 90-degree bifurcation off the CCA, and it was thought likely to thrombose without any outflow. The case was completed with flow reversal time totaling 33 minutes.

Postoperative day 1 carotid duplex ultrasound examination confirmed successful exclusion of the pseudoaneurysm without endoleak or stenosis. This was reconfirmed with postoperative day 3 computed tomography angiography (Fig 4). The 6-month and 1-year carotid duplex ultrasound examinations showed successful exclusion of the pseudoaneurysm and widely patent stents. At 16 months of follow-up, the patient has remained free of neurologic sequelae, restenosis, or endoleak.

**DISCUSSION**

Carotid artery aneurysms and pseudoaneurysms are uncommon occurrences with potential for devastating neurologic sequelae. Progressive conical growth of the carotid artery aneurysm has the potential for rupture, distal embolization, and local compression, leading to palsy, stroke, or transient ischemic attack. Management consists of prompt surgical or endovascular treatment to prevent neurologic complication. The conservative approach to carotid aneurysms in the first half of the 19th century had an estimated 71% mortality. A later study placed mortality at 21%. Treatment of carotid aneurysms is evolving from operative to endovascular intervention. Benefits of the transition include fewer procedure-related complications and reduced convalescence. An endovascular approach avoids difficult neck dissection and increased risk of cranial nerve disability. It is favored in poor surgical candidates and with distal lesions, traumatic pseudoaneurysms, multiple lesions, or hostile necks as a result of previous irradiation or neck dissection.

The transcarotid approach was chosen for our patient because of previous CEA in addition to tandem distal carotid stenosis. Endovascular treatment of the pseudoaneurysm is traditionally performed through transfemoral access. Compared with CEA, transfemoral carotid stenting has shown higher periprocedural stroke rates possibly related to embolization during catheterization of the aortic arch and lesion manipulation before neuroprotection.

Newer techniques include a transradial or transcarotid approach. The Safety and Efficacy Study for Reverse Flow Used During Carotid Artery Stenting Procedure (ROADSTER) demonstrated that the ENROUTE Transcarotid Neuroprotection System for stroke prevention in high-risk patients with carotid artery stenosis is a safe and effective technique for revascularization. Stroke rate was 1.4% at 30 days, and ipsilateral stroke rate was 0.6% at 1 year. The novel approach combines surgical cutdown on the carotid artery and temporary CCA occlusion with reversal of flow through a temporary arteriovenous shunt. Cerebral vasculature is protected against embolization by avoiding the aortic arch through surgical CCA access while providing robust flow reversal and neuroprotection throughout the stenting procedure.
Fig 2. A, Preoperative right internal carotid artery (ICA) radial computed tomography reconstruction. B, Preoperative right ICA axial cut demonstrating the cross section of the pseudoaneurysm. The dashed oval encompasses the pseudoaneurysm.

Fig 3. A, Preoperative right carotid artery angiogram. B, Postoperative digital subtraction angiogram of right internal carotid artery (ICA) demonstrates widely patent stents without evidence of stenosis or dissection. The pseudoaneurysm filled early with contrast material and can be clearly seen in the image. This was thought to represent a type IA endoleak due to the patient’s being fully anticoagulated and the proximity of the sheath to the proximal edge of the stent graft.
Rizwan et al.\textsuperscript{10} showed that transcarotid artery revascularization with cerebral flow reversal is a viable option for repair of carotid pseudoaneurysm by defect exclusion through stenting. We further demonstrated that the principles of transcarotid artery revascularization with the ENROUTE Transcarotid Neuroprotection System can be extended to repair carotid pseudoaneurysms with tandem high-grade distal ICA stenosis through an off-label approach.

**CONCLUSIONS**

Tandem carotid artery pseudoaneurysm and distal stenosis can be successfully treated through a transcarotid endovascular approach with flow reversal. It may be a safe alternative to the transfemoral artery approach or open surgery.

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