# Transcarotid artery stenting for carotid artery pseudoaneurysm using flow reversal technique

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## ABSTRACT

Carotid artery pseudoaneurysm results mostly from direct trauma, prior endarterectomy, prior dissection, radiation, and infections. There are many different surgical and endovascular treatment options for repair, and the choice of treatment depends on patient-, surgeon-, and institute-related factors. Studies have reported the efficacy of various endovascular techniques for aneurysm repair, including stent graft placement and coil embolization, with promising short- and long-term outcomes. In this report, we describe two cases of carotid artery pseudoaneurysm (after trauma and after carotid endarterectomy) treated successfully through transcarotid artery stenting using the flow reversal technique to minimize the risk of embolization and stroke. (J Vasc Surg Cases and Innovative Techniques 2018;4:115-8.)

Carotid artery pseudoaneurysm (CAP), an uncommon condition, is due to localized disruption of the arterial wall, resulting mostly from direct trauma, prior endarterectomy, prior dissection, radiation, and infection-related vasculopathy (human immunodeficiency virus infection and tuberculosis).[1-3] Overall, extracranial carotid artery aneurysms account for <1% of all arterial aneurysms. In carotid arteries, the proportion of true aneurysm to pseudoaneurysm varies widely in the literature, with pseudoaneurysms being the most common (36%-82%) and traumatic aneurysms next most common (12%-13%) of all the carotid artery aneurysms.[1,4,5] The incidence of CAP after carotid endarterectomy (CEA) is <1% of all CEAs performed.[6] Depending on the size and etiology, the common presentation of CAP includes pulsatile neck mass followed by neurologic symptoms, mass effects, or bleeding due to rupture. In case of traumatic CAP, the internal carotid artery (ICA) is most commonly involved. There are many different surgical and endovascular treatment options for repair, and the choice of treatment depends on patient factors (anatomy, comorbidities) and surgeon- and institute-related factors (eg, experience, imaging, and devices). Studies have reported the safety and efficacy of various newer endovascular techniques for aneurysm repair, including stent graft placement and coil embolization, with promising short- and long-term outcomes.[7-9] In this report, we describe two cases of CAP, after trauma and after CEA, that were treated successfully through transcarotid artery stenting (TCAR) using the flow reversal technique to minimize the risk of embolization and stroke. Both patients consented for the information in this report and its publication.

## CASE REPORTS

**Case 1.** A 26-year-old man presented to the emergency department with complete paralysis of his left upper and lower extremities. Magnetic resonance imaging showed ischemic stroke of the right middle cerebral artery and right anterior cerebral artery territory. The patient had a history of being involved in a road traffic accident 10 months before this visit, when he had multiple upper and lower extremity bone fractures that were treated without known complications. Six months later, the patient presented to another hospital with weakness in the left upper and lower extremities, which was completely resolved; head computed tomography performed at that time did not show any signs of stroke, and the patient was discharged home.

On this admission, carotid duplex ultrasound (DUS) showed a pseudoaneurysm of the distal right ICA measuring 2 cm in diameter with significant intramural thrombus. Three-dimensional computed tomography showed the aneurysm measuring 3.8 × 1.8 cm (Fig 1).

**Case 2.** A 60-year-old man presented with left hemispheric stroke and was found to have bilateral cerebral artery aneurysms. The patient was referred to neurosurgery for embolization of his aneurysms. Carotid DUS showed 90% right carotid artery stenosis, and CEA was performed by the neurosurgery service with a plan for aneurysm repair. Carotid DUS at 2 weeks of follow-up showed a right 5-cm CAP at the distal part of the patch with intramural thrombus. The pseudoaneurysm was approximately 1.3 cm distal to the origin of the right ICA and was a significant dilation of the posterior wall of the vessel. It measured 17 mm in greatest dimension with a 9.5-mm neck. A DUS image of the aneurysm is shown in Fig 2.

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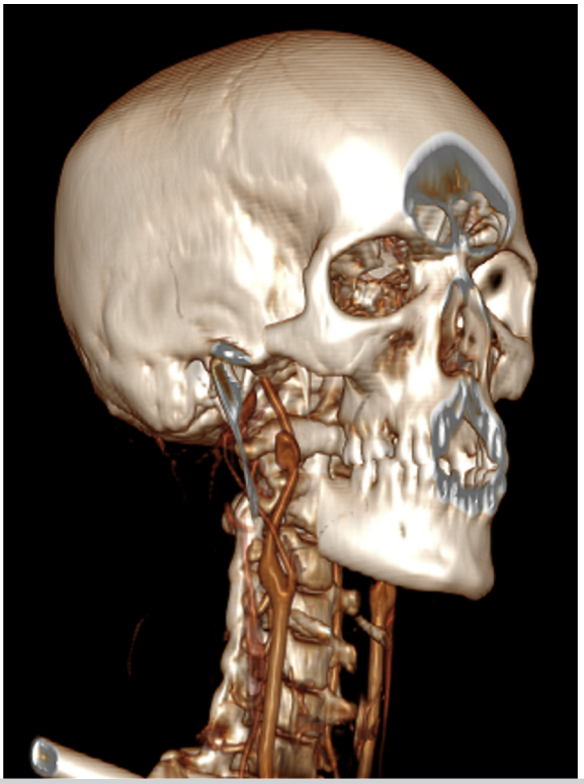

**Fig 1.** Computed tomography three-dimensional image of right distal carotid artery aneurysm.

**Repair.** Both patients were premedicated with dual antiplatelet agents including aspirin 300 mg and clopidogrel 300 mg. In both patients, a cutdown technique was performed under local anesthesia at the base of the neck through a 3-cm vertical incision between the two heads of the sternocleidomastoid muscle. The dissection was performed proximal to the omohyoid muscle, and the internal jugular vein was retracted laterally. A 3-cm segment of the common carotid artery (CCA) was dissected, and a vessel loop was placed proximally at the level of the clavicle. Both patients were given 80 units/kg of heparin intravenously. A 5.0 Prolene purse-string suture was placed at the anterior wall of the CCA. A micropuncture needle was used to access the CCA at the purse-string suture. A 0.018-inch microwire was advanced through the needle 4 cm only into the CCA. The microneedle was exchanged to a 5F soft MicroSheath (Bard Peripheral Vascular, Tempe, Ariz) that was advanced only 2 cm into the CCA. Angiography was performed in anterior and oblique views to confirm access of the true lumen of the CCA and to open the carotid bifurcation. Fade technique was used to guide the 0.018-inch wire into the external carotid artery. The MicroSheath was advanced with the dilator over the microwire into the external carotid artery. The microwire was exchanged to the 0.035-inch stiff wire. The MicroSheath was exchanged to the Silk Road 8F arterial sheath (Silk Road Medical, Sunnyvale, Calif) over the stiff wire. This sheath can be advanced only 2 cm into the CCA. During the cutdown, the second team established access to the contralateral common femoral vein with standard ultrasound puncture.

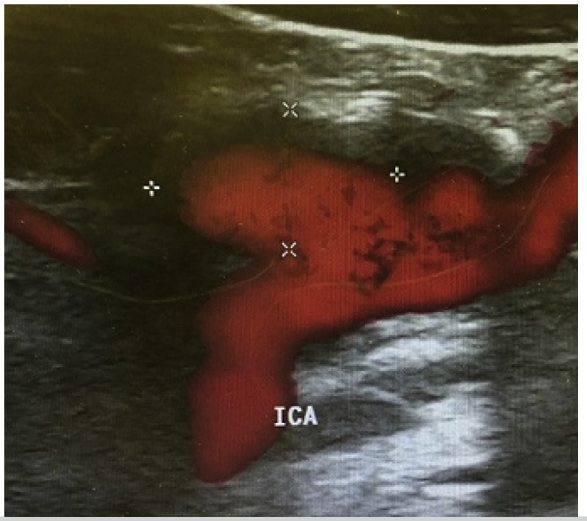


**Fig 2.** Duplex ultrasound (DUS) image of post-carotid endarterectomy (CEA) right carotid artery pseudoaneurysm (CAP). *ICA*, Internal carotid artery.

The Silk Road 8F venous sheath was inserted into the common femoral vein. The arterial line was connected to the venous sheath through the flow reversal connecting tubing. After a therapeutic level of activated clotting time was ensured, the CCA was clamped with an atraumatic vascular clamp proximal to the arterial sheath at the level of the clavicle. This established active cerebral reversal flow neuroprotection. Angiography was performed through the arterial sheath while holding the flow stopper button on the flow modular regulator. This angiogram showed the anatomy of the distal ICA and the aneurysm (Fig 3). This imaging helped confirm the diameter of the ICA proximal and distal to the aneurysm as well as the length needed to cover the entire length of the aneurysm. Next, we advanced a 0.018-inch (190-cm) wire under reversal flow into the distal ICA using fade fluoroscopy technique. Next, we advanced and deployed a Viabahn endoprosthesis (W. L. Gore & Associates, Flagstaff, Ariz) through the arterial sheath. The size of the stent was 5/50 mm for the first patient and 6/50 mm for the second patient, ensuring complete coverage of the entire aneurysm and at least an additional 1 cm proximal and distal to healthy carotid artery. We repeated angiography, which showed complete exclusion of the aneurysm and preservation of the external carotid. Aneurysm repair was accomplished using the Viabahn endoprosthesis through TCAR with the ENROUTE Transcarotid Neuroprotection System (Silk Road Medical) for stroke prevention. More technical details of TCAR have been described before.[10] Both patients remained neurologically stable during and after the procedure. Carotid DUS confirmed stent patency with thrombosis of the CAP 2 weeks after the procedure. Patients were free of neurologic complications at 30 days, 3 months, and 12 months of follow-up. Carotid DUS confirmed stent graft patency and resolution of the aneurysms.

## DISCUSSION

The selection of a surgical vs an endovascular treatment approach depends on multiple etiologic, anatomic, and