Effectiveness of treatment of innominate artery stenosis with retrograde supra-aortic stent using a flow reversal stent system

Besem Beteck, MD , Robert Corn, MD, and Bradley R. Grimsley, MD

Division of Vascular Surgery, Baylor University Medical Center, Dallas, Texas

ABSTRACT

We present the case of a 71-year-old man with critical stenosis of the innominate artery after previously undergoing bilateral carotid artery endarterectomies. We used an open retrograde approach of the right carotid artery to stent the innominate artery lesion employing the new ENROUTE Transcarotid Stent System with flow reversal.

KEYWORDS Flow reversal system; innominate artery stenosis; retrograde stenting; supra-aortic stent

Endovascular treatment of supra-aortic atherosclerotic lesions via the traditional femoral or brachial approach carries risk of atheroembolization resulting in stroke. Retrograde access of the common carotid artery with stent angioplasty of these focal supra-aortic lesions was first reported by Queral and Criado in 1996 as they used Palmaz stents to treat focal aortic branch lesions.¹ We report the use of the ENROUTE Transcarotid Stent System (*Figure 1*) with flow reversal for treatment of stenosis of the innominate artery.

CASE PRESENTATION

A 71-year-old man who had previously undergone bilateral carotid artery endarterectomies was found to have a critical innominate atherosclerotic lesion. His upper extremity pulses were asymmetrical. Otherwise, the patient was completely asymptomatic. Computed tomographic angiography revealed that the brachiocephalic trunk had marked atherosclerosis at its origin, resulting in severe stenosis (*Figure 2*). The right subclavian artery origin was patent without hemodynamically significant stenosis.

The patient was scheduled for elective surgery under general anesthesia. Ultrasound was used to gain access to the left common femoral vein where an 8 F sheath was placed in anticipation of the flow reversal ENROUTE Transcarotid Stent System. A small oblique incision was made at the base

of the neck, the right common carotid artery was dissected free, and an adventitial purse-string suture was placed in the area of the planned artery cannulation.

Ultrasound was then used to gain access to the right common femoral artery, and a 5 F sheath was placed. Through this sheath, a diagnostic pigtail catheter was advanced to the ascending aorta, where an aortogram showed critical stenosis of the innominate artery with flow into the right common carotid and subclavian arteries (*Figure 3a*). The patient received systemic heparinization using 100 units/kg of intravenous heparin to achieve an activated clotting time >250 seconds.

The right common carotid artery was clamped distally and a micropuncture needle was used to cannulate the artery in retrograde fashion, and angiogram revealed the lesion. The micropuncture sheath was exchanged for the 8 F ENROUTE transcarotid sheath and flow reversal was then confirmed after the system was connected to the 8 F common femoral vein sheath. After crossing the lesion with a 0.035-inch hydrophilic guidewire, balloon angioplasty was performed to predilate the lesion initially with a 3 × 20 mm balloon followed by a 5 × 60 mm angioplasty balloon. This was followed by stenting of the lesion with a GORE VIABAHN VBX 9 × 39 mm stent, which was deployed covering the area of stenosis with approximately 1 to 2 mm of

Corresponding author: Besem Beteck, MD, Division of Vascular Surgery, Baylor University Medical Center, 621 N. Hall Street, Dallas, TX 75226 (e-mail: Busobes2011@gmail.com)

Color versions of one or more of the figures in this article can be found online at www.tandfonline.com/ubmc.

Received April 24, 2018; Revised May 26, 2018; Accepted May 29, 2018.

the stent protruding into the aortic arch. This stent was post-dilated with a 5 × 60 mm angioplasty balloon. Subsequent angiogram revealed excellent flow through the stent with good forward flow through the carotid and innominate

Figure 1. Artist's drawing of the component parts of the ENROUTE Transcarotid Neuroprotection System plus completed circuit layout. Image courtesy of Silk Road Medical, Sunnyvale, California.

Figure 2. Computed tomographic angiography showing extensive calcification (arrow) at the orifice of the innominate artery.

arteries. A small dissection was noted at the distal aspect of the stent, and a 10 × 40 mm angioplasty balloon was used to balloon this area, including the stent, with subsequent resolution of the dissection flap (*Figure 3b*).

The ENROUTE circuit was then disconnected, the right carotid common carotid artery was unclamped followed by removal of the 8 F sheath, and the previously placed purse-string suture was tied to close the arteriotomy. Heparin was partially reversed and the neck incision was then closed. Both femoral sheaths were removed, and the patient was extubated. He was neurologically intact and moving all extremities at the end of the case.

DISCUSSION

The concern with endovascular treatment of supra-aortic lesions has been the antegrade crossing of tight aortic arch ostial lesions with the periprocedural risk of embolic events, especially in patients with difficult arch anatomy (types II and III aortic arches). The hybrid approach of carotid endarterectomy and retrograde stenting of supra-aortic vessels in patients with multilevel atherosclerotic occlusive supra-aortic trunk disease is a safe approach where traditional carotid endarterectomy is combined with the minimally invasive treatment of a proximal lesion via retrograde access of the common carotid artery. Several authors have demonstrated the safety of this approach, including a meta-analysis that revealed a 30-day periprocedural mortality of 0.7% and stroke rate of 1.5%.^{2,3}

The results of the ROADSTER trial established the safety and efficacy of the ENROUTE Transcarotid Neuroprotection System in preventing stroke during carotid stenting, with a 30-day stroke rate of 1.4%, the lowest rate reported to date.⁴ The dynamic flow reversal system was designed to minimize the risk of embolization with robust flow reversal in both the ipsilateral internal carotid artery and external carotid artery without occlusion of the external carotid artery and eliminates the need for manipulation in the arch.⁴

Figure 3. Angiogram (a) before stenting, showing significant narrowing at the innominate orifice and (b) after stenting (white arrow), showing flow through the innominate artery (black arrow).

Figure 4. Calcific debris and plaque captured in the ENROUTE Transcarotid Neuroprotection System filter.

The flow reversal in our case minimized embolization not only to the left carotid artery but also to the vertebral and right subclavian arteries (*Figure 4*). Our patient had previously undergone bilateral carotid endarterectomies and

only required treatment of his innominate artery lesion. We demonstrate here that using the ENROUTE Transcarotid Stent System with flow reversal is safe in retrograde treatment of supra-aortic disease.

ORCID

Besem Beteck <http://orcid.org/0000-0002-1914-0949>

Bradley R. Grimsley <http://orcid.org/0000-0002-6313-081X>

1. Queral LA, Criado FJ. The treatment of focal aortic arch branch lesions with Palmaz stents. *J Vasc Surg.* 1996;23:368–375.
2. Sfyroeras GS, Karathanos C, Antoniou GA, Saleptsis V, Giannoukas AD. A meta-analysis of combined endarterectomy and proximal balloon angioplasty for tandem disease of the arch vessels and carotid bifurcation. *J Vasc Surg.* 2011;54(2):534–540. doi:10.1016/j.jvs.2011.04.022.
3. Makaloski V, Deimling C, Mordasini P, et al. Transcarotid approach for retrograde stenting of proximal innominate and common carotid artery stenosis. *Ann Vasc Surg.* 2017;43:242–248. doi:10.1016/j.avsg.2017.02.009.
4. Kwolek CJ, Jaff MR, Leal JJ, et al. Results of the ROADSTER multicenter trial of transcarotid stenting with dynamic flow reversal. *J Vasc Surg.* 2015;62(5):1227–1234. doi:10.1016/j.jvs.2015.04.460.