TEVAR With Surgical Brachiocephalic Debranching

Facilitating safe repair of complex pathology.

BY TIMOTHY M. SULLIVAN, MD, FACS, FSVM, FACC

Endovascular repair has become the standard of care for most patients with aneurysms of the descending thoracic aorta, having largely replaced open repair due to its superior results and decreased risk of complications in a challenging group of patients. The instructions for use for most thoracic endografts require a 2-cm proximal neck of normal-caliber aorta to seat the graft. Unfortunately, many patients have aneurysmal dilation that extends to the origins of the brachiocephalic trunks (most commonly to the left subclavian and occasionally the left common carotid arteries), which necessitates the use of debranching techniques to allow the endograft to cover the origins of these vessels while maintaining distal perfusion.

CASE REPORT

An 86-year-old retired farmer presented to the vascular center for evaluation of a large aneurysm of the proximal descending thoracic aorta. His medical history was significant for hypertension, hypercholesterolemia, and chronic congestive heart failure secondary to severe tricuspid valve regurgitation. He had been hospitalized several times in the 18 months before presentation, and was successfully treated medically each time. Because of his advanced age, he was not considered to be eligible for surgical valve replacement. He lived at home with his wife and was ambulatory with a cane. Because of his comorbidities, his thoracic aneurysm had been followed with serial imaging for several years; he was referred when the aneurysm enlarged to > 8 cm in diameter. Before referral, echocardiography and a myocardial perfusion study were performed, which showed a normal ejection fraction, severe tricuspid regurgitation, and no evidence of myocardial ischemia. The findings of a carotid duplex ultrasound were normal. His physical exam was normal, with the exception of a cardiac murmur.

The patient's preoperative imaging studies were reviewed; the aneurysm was fairly focal, involving only the proximal portion of the descending thoracic aorta

Figure 1. Three-dimensional reconstruction of the proximal descending thoracic aortic aneurysm.

Figure 2. Computed tomographic angiography shows the thoracic aneurysm extending to the origin of the left common carotid artery.

Figure 3. The distal landing zone in the descending thoracic aorta had a maximum diameter of 31 mm.

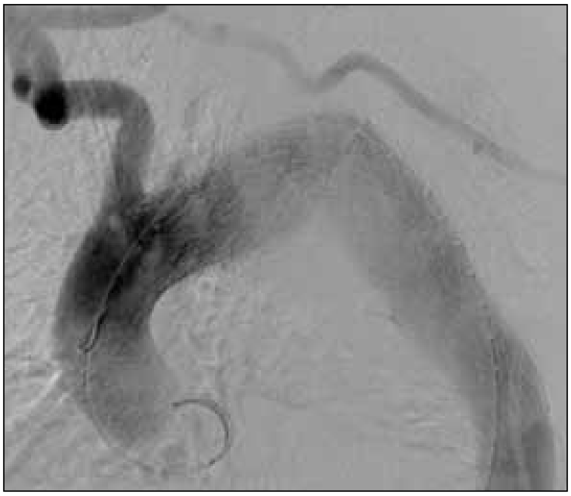

Figure 4. Completion arteriography demonstrates complete aneurysm exclusion and patent carotid-carotid bypass and carotid-subclavian transposition.

(Figures 1 through 3). An adequate landing zone was present in the proximal third of the descending thoracic aorta, measuring 31 mm in diameter using a centerline technique. Proximally, the aneurysm extended to the origin of the left common carotid artery; the proximal landing zone, between the origins of the innominate and left common carotid arteries, measured 34 mm in diameter. A small (4.5 cm) abdominal aortic aneurysm was identified, but there were no issues related to iliac stenosis, tortuosity, or calcification that would prevent delivery of a thoracic endograft through a 24-F sheath. To obtain an adequate proximal seal, an endograft would need to land at the trailing edge of the innominate artery, requiring coverage of the left common carotid and subclavian artery origins and concomitant carotid-carotid and carotid-subclavian revascularization.

After an extensive discussion with the patient and his family regarding the natural history of thoracic aneurysms and the risks and benefits of surgery, he elected to proceed. Although we considered performing the debranching and endovascular portions of the operation separately, we ultimately decided to perform the entire operation under one anesthetic. Because the endograft would not cover the distal portion of the thoracic aorta, we elected not to place a spinal drain.

Under general endotracheal anesthesia, the right common carotid artery was exposed via a longitudinal incision along the anterior border of the sternocleidomastoid muscle. Via a transverse left supraclavicular incision, the left common carotid was exposed, as well as the left subclavian artery. The left internal mammary and vertebral arteries were isolated, and both the common carotid and subclavian arteries were easily dissected proximally. Simultaneously, the right femoral artery was isolated via an oblique groin incision, and percutaneous access was achieved in the left common femoral artery. A retropharyngeal tunnel was made, and the patient was systemically anticoagulated using unfractionated heparin.

Using an 8-mm nonringed polytetrafluoroethylene graft (Gore & Associates, Flagstaff, AZ), carotid-carotid bypass was performed. While maintaining perfusion to both carotid arteries, the proximal left common carotid artery was ligated (near its origin), as was the proximal left subclavian artery. The subclavian artery was sufficiently redundant to allow for its transposition to the left common carotid artery. This was done as an end-to-end anastomosis to the disconnected proximal left common carotid artery.

Attention was then turned toward the endovascular repair. Because of the significant size discrepancy between the proximal and distal landing zones, the distal graft (34-mm X 10-cm TAG, Gore & Associates) was placed first. Subsequently, a 37-mm X 10-cm TAG graft was placed, landing just distal to the innominate artery origin. After balloon dilation, completion angiography was performed, showing a patent carotid-carotid bypass, a patent subclavian-carotid transposition, and no evidence of endoleak (Figure 4). The patient spent 2 days in the intensive care unit and was discharged on postoperative day 7. A CT scan at 6 weeks identified a patent carotid-carotid bypass in a retropharyngeal location (Figure 5) and an excluded aneurysm sac (Figure 6). The patient remains well, with compensated congestive heart failure, 3 years after his operation.

DISCUSSION

Endovascular repair of thoracic aortic pathology can be extremely challenging, especially in patients with hostile proximal necks. Although prospective data are not available, a meta-analysis by Rizvi et al[1] suggests that, if feasible, the left subclavian artery should be revascularized to avoid the potential complications of stroke, spinal cord ischemia, and exercise-induced ischemia of the upper

Figure 5. Follow-up CT scan shows patent carotid-carotid bypass in the retropharyngeal tunnel.

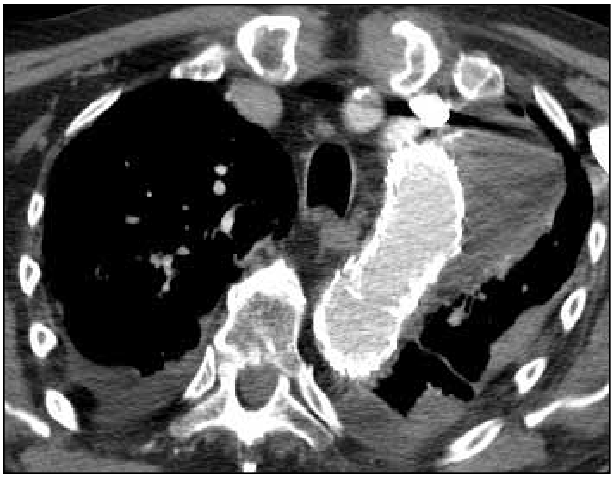

Figure 6. Follow-up CT shows the excluded aneurysm with the endograft in place.

extremity (ie, arm claudication). In an urgent situation, this may not be possible. In cases where the endograft must be landed over the common carotid or innominate arteries, revascularization is mandatory.

Brachiocephalic bypass or transposition has historically proven safe and durable, although the data have been gleaned primarily in patients with occlusive disease. A 2011 comprehensive analysis of surgical and endovascular treatment of the brachiocephalic trunks by Aziz, Gravett, and Comerota[2] describes a high technical success rate and superior durability of surgical bypass in patients treated for brachiocephalic occlusive disease. The risk of stroke in patients undergoing cervical debranching for aneurysmal disease is higher than those undergoing surgery for occlusive disease, likely due to manipulation of large devices in the aortic arch in patients who, by definition, have more proximal aneurysmal disease. Similar findings were reported in the TAG Pivotal study, in which the risk of stroke was higher in patients undergoing carotid-subclavian bypass or transposition.[3]

The snorkel or chimney technique has been utilized to provide perfusion to the visceral vessels in patients with hostile anatomy and in the brachiocephalic trunks with good short-term success. It is typically used in patients at high risk for open repair or with anatomy that is outside the instructions for use of the particular thoracic endograft and in cases where surgical debranching is not feasible. Preliminary data provided in an abstract by Shahriari and Williams[4] identified 15 patients in their practice who underwent thoracic endograft repair with the snorkel technique for aneurysms involving the brachiocephalic trunks. All patients were successfully treated. At 16-month mean follow-up, branch vessel patency was 93%. All patients were considered to be high surgical risk.

A study by Cires et al[5] describes their experience with combined endovascular and surgical debranching in nine patients having endovascular repair of complex thoracic pathology, including thoracic aneurysm, thoracic aortic transection, aortotracheal fistula, and aortic dissection. A total of nine brachiocephalic trunks underwent endovascular debranching, and an additional six vessels underwent surgical debranching with bypass. One patient suffered a fatal stroke; at follow-up (2–25 months), all branch vessels remained patent.

SUMMARY

Endovascular repair of complex pathology of the thoracic aorta—specifically in patients whose aneurysmal disease extends to the brachiocephalic trunks—typically requires debranching procedures to facilitate safe repair. The case described herein demonstrates the feasibility of surgical debranching, even in patients with significant medical comorbidities. ■

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