Endovascular repair of expanding thoracic aortic aneurysms in high surgical risk patients

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INTRODUCTION

Thoracic aortic aneurysms have historically required open surgical repair, with significant rates of morbidity and mortality.[1] During the past decade, less invasive endovascular repair techniques have been developed resulting in improved perioperative complication rates.[1‑3] The current era of thoracic endovascular repair is increasingly focused on medically complex, surgically high-risk or inoperable patients for both electives as well as emergent procedures in the interventional radiology suite, as the following two cases will demonstrate. We present two cases of endovascular repair of thoracic aortic aneurysm, both for surgically high-risk patients. An 81-year-old male presented with an enlarging 47 mm saccular thoracic aortic aneurysm. The patient underwent endovascular repair with a Medtronic Valiant® graft that was deployed immediately distal to the ostia of the left subclavian with successful exclusion of an aneurysm.

A 67-year-old male presented to the emergency department (ED) with a rapidly expanding 33 mm thoracic aortic false aneurysm. The patient underwent urgent endovascular repair with a gore TAG stent graft. Both patients were discharged to home after short hospital stays.

Patient 1
An 81-year-old male presented to the internal medicine clinic for routine care. Medical history included hypertension, coronary artery disease postcoronary stenting, atrial fibrillation, and a known saccular thoracic aortic aneurysm. A computed tomography (CT) angiogram of the chest, abdomen, and pelvis was performed which showed a saccular aneurysm measuring 4.7 cm, approximately 2 cm distal to the left subclavian artery and extending for 3.5 cm. His aneurysm had expanded by 11 mm since prior evaluation. He was referred to surgery. Upon evaluation, he was deemed an appropriate candidate for endovascular repair. The preanesthetic evaluation was performed which included two-dimensional echocardiogram that showed preserved left ventricular function.

After uneventful general endotracheal anesthetic induction, with invasive arterial and venous monitoring, a right common femoral artery exposure was performed. Key anesthetic goals included maintenance of hemodynamic stability, given the size of an aneurysm, with particular emphasis on avoiding marked increases in blood pressure on laryngoscopy. Anesthesia was induced gently with a titrated...
combination of fentanyl, etomidate, lidocaine, and rocuronium. The left common femoral artery was cannulated using seldinger technique with ultrasound guidance and a 5-french sheath placed. A pigtail catheter was advanced into the aortic arch. The exposed right common femoral artery was cannulated, and an 8-french sheath was placed. A Lunderquist wire was placed in the thoracic aorta. Angiography was performed of the aortic arch [Figure 1a]. A Medtronic Valiant® thoracic stent graft (Medtronic, Minneapolis, Minnesota, USA) was advanced into the thoracic aorta over the Lunderquist wire. Heparin (5000 units) was administered intravenously. The 36 mm × 100 mm graft was deployed just distal to the origin of the left subclavian with careful attention paid to hemodynamic control. Completion angiogram showed no evidence of endoleak and total exclusion of an aneurysm [Figure 1b]. The device, wires, and catheters were withdrawn, and the right common femoral artery was repaired and closed. Doppler flow was present bilaterally in the bilateral lower extremities. The patient was uneventfully extubated in the interventional radiology suite and had a stable postoperative course. He was discharged home in stable condition after a short hospital stay.

Patient 2
A 67-year-old male with a past history of an open repair for a Type A thoracic dissection presented to the ED with an outside CT scan performed for shortness of breath. A 33 mm penetrating ulcer of the descending thoracic aorta was seen, which was not present on imaging 18 months prior. His past medical history was significant for residual bilateral lower extremity weakness after his open aortic repair. He was evaluated by the vascular surgery service, and he was deemed to be appropriate for endovascular repair. Because a large area of thoracic aorta would be covered by the endograft and his history of prior aortic surgery, the patient was counseled that he was at increased risk of lower extremity weakness or paraplegia given his baseline weakness. A lumbar drain was placed preoperatively by the cardiac anesthesiologist following preanesthetic evaluation. Anesthetic induction proceeded uneventfully following placement of invasive arterial and venous monitoring, with the goals as described in the first patient, the focus being reducing the transmural pressure in the aorta and minimizing the hemodynamic effects of laryngoscopy and intubation.

Right common femoral artery exposure was performed, and the left common femoral artery was accessed using ultrasound guidance and Seldinger technique. The right femoral artery was cannulated with an 8-french sheath, and a Lunderquist wire was advanced into the thoracic aorta. Through the left femoral artery, a pigtail catheter was advanced into the aortic arch and an angiogram was performed [Figure 2a]. The 8-french sheath was exchanged for a 24-french sheath and a GORE® TAG® Thoracic Endoprosthesis (Gore Medical, Flagstaff, Arizona, USA) was advanced into the thoracic aorta over the Lunderquist wire. Heparin (150 units/kg) was given intravenously and a 37 mm × 150 mm graft was deployed, with stable hemodynamic conditions. Completion angiogram showed exclusion of the aortic defect and no endoleak [Figure 2b]. The device, wires, and catheters were withdrawn, and the right common femoral artery

Figure 1: (a) Present aortogram of expanding saccular thoracic aneurysm, (b) poststent completion aortogram of repaired saccular thoracic aneurysm
was repaired and the groin closed. The patient was extubated uneventfully. Doppler flow was present in his bilateral lower extremities, and no neurologic changes were noted during his hospitalization. The lumbar drain was removed on postoperative day 1, and he was discharged home in stable condition after a short hospital stay.

**DISCUSSION**

Thoracic aortic aneurysms have been historically repaired by open surgical techniques. These procedures often resulted in significant morbidity including stroke, paralysis, and 30 days mortality approaching 20% or higher, and up to 84.4% morbidity for elective open repair. Endovascular repair of thoracic aortic aneurysms presents an approach to this surgical problem with potentially less morbidity and mortality, with 30 days mortality rates of 2% and 30% days morbidity rates of 12–41%.[4,5] After approval by the USA Food and Drug Administration in 2005 endovascular repairs of thoracic aortic aneurysms increased significantly in the ensuing years,[1] particularly in older patients with more comorbidities.[2] Long-term comparison of open repair versus endovascular repair has shown significantly less morbidity with similar all-cause mortality.[1] However, the endovascular repair group did have a significantly higher reintervention rate which necessitates follow-up surveillance imaging of these repairs. These studies demonstrate the safe use of these devices in a population who would otherwise be deemed too high risk for open surgery.

Saccular aortic aneurysms have historically been perceived as possessing a greater risk for rupture than fusiform aneurysms.[6] More recent studies of saccular versus fusiform aneurysms have shown similar growth rates[7] and presumably similar rupture risks as based on size. While the true rupture rate of saccular aneurysms remains unknown, no conclusive data exists regarding their worse prognosis.

Perioperative lumbar spinal drainage can be considered for the prevention of spinal cord ischemia. Rates of paralysis after open repair of thoracic, abdominal aneurysms range from 13.8% to 16%.[8,9] Patients undergoing endovascular repair have decreased rates of paralysis or neurologic compromise from 1.8% to 6.6%.[2,10-12] The first case presented had a focal aneurysm, a small segment of the aorta planned for coverage, and no prior aortic surgery and thus we considered the risk of spinal cord ischemia in this patient to be extremely low and a lumbar drain was not used perioperatively. In the second case, given the larger area of the aorta to be covered, his prior history of aortic surgery, and already compromised neurologic status, a lumbar drain was used.

**CONCLUSION**

We report the management of two high-risk patients with multiple co-morbidities and enlarging thoracic aneurysms. Both patients underwent successful, uncomplicated, and endovascular exclusion of their saccular thoracic aortic aneurysms.

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**Conflicts of interest**

There are no conflicts of interest.

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