Case Report and Review of Literature: Late Retrograde Type A Aortic Dissection With Rupture after Repair of Type B Aortic Dissection with a GORE TAG Endovascular Prosthesis

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Abstract

Acute aortic dissection is the most common catastrophic condition of the aorta. Treatment options include open surgery and thoracic endovascular aortic reconstruction (TEVAR). We present a late Type A dissection as a complication of the management of descending aortic dissections with TEVAR and a review of the literature. TEVAR of the thoracic aorta is a viable treatment option for the management of complicated descending thoracic aortic dissections. Careful patient selection is necessary as medical therapy successfully treats the majority of uncomplicated Type B dissections. TEVAR should be reserved for patients with complicated Type B dissections or those who fail nonoperative management. Close postoperative monitoring is necessary when TEVAR is performed and should be accompanied by lifelong surveillance. A high level of suspicion is important to identify retrograde Type A dissections in these patients given its rarity and the ambiguity of its clinical presentation.

Keywords

- ▶ aortic dissection
- ▶ endograft placement
- ▶ endograft repair
- ▶ percutaneous
- ▶ risk factors
- ▶ stent

One of the first reports of an acute aortic dissection was in 1760. England's King George II, then 76 years, was discovered dead on his bedroom floor. An autopsy revealed a 3.7 cm transverse tear in his ascending aorta, and a pint of coagulated blood distending his pericardium.¹ Acute dissection of the ascending aorta is the most common catastrophic condition of the aorta^{2,3} with an estimated incidence of 2.9 to 3.5 per 100,000.^{4,5} We are reporting a delayed aortic dissection secondary to thoracic endovascular aortic reconstruction (TEVAR) of a descending thoracic aneurysm which evolved from a descending thoracic dissection.

Case Presentation

A 62-year-old African American female patient presented to our institution with complaints of sudden onset back and

chest pain. She was diagnosed with an acute Type B dissection approximately 3 years prior (▶ **Fig. 1**). Over the next 30 months of her initial presentation, the dissection had resolved and she developed a symptomatic descending thoracic aneurysm despite maximal medical therapy. The aorta enlarged from 3.4 to 5.4 cm over that time (▶ **Figs. 2 and 3**). She underwent TEVAR placement with a 34 by 150 mm GORE TAG (W.L. Gore & Associates, Flagstaff, AZ) endograft. The endograft partially covered the left subclavian artery. Two centimeter landing zones were present proximally and distally. The aorta was 29 mm at the proximal landing zone and 28 mm at the distal landing zone (▶ **Figs. 3 and 4**). The endograft was dilated with a balloon as per the manufacturer's guidelines. A completion angiogram showed no evidence of endoleak and resolution of the aneurysm. She was discharged with resolution of her symptoms.

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Fig. 1 Type B aortic dissection.

The patient presented at our institution 4 months after her TEVAR repair with new complaints of sudden onset back and chest pain. A computed tomography angiogram (CTA) was performed and showed a Type A aortic dissection with evidence of hemopericardium (—Figs. 5 and 6). The patient was taken emergently to the operating room. Transesophageal echocardiogram revealed a false lumen within the aorta from the sinotubular junction to the distal arch and no evidence of aortic insufficiency. She was placed on ascending aortic and dual stage venous cardiopulmonary bypass and cooled to 18°C. Total bypass time was 244 minutes; total cross-clamp time was 81 minutes. During the 47-minute circulatory arrest, the dissection was inspected and repaired. The dissection originated from the medial aspect of the distal aortic arch, where the endograft had eroded through the aorta. A hemiarch replacement, incorporating the endograft and the distal aorta was completed using a running 4–0 prolene suture. An end-to-end proximal anastomosis was performed above the sinotubular junction of the aortic valve.

The patient was easily weaned from bypass. Heparin was reversed with protamine. The field was hemostatic after the procedure and she was transferred to the intensive care unit (ICU). Shortly after arriving in the cardiothoracic intensive care unit, the patient suddenly became asystolic. Resuscitation, including mediastinal exploration, and open cardiac massage

Fig. 2 Enlargement of aortic dissection to 4.1 cm.

Fig. 3 Enlargement of Type B dissection to 5.4 cm.

was performed. There was no evidence of bleeding, redissection, or other pathology. She was unable to be revived. A formal postmortem evaluation was denied by the family.

Discussion

Ascending aortic dissections left untreated may be associated with high mortality. Its clinical course is time sensitive with early mortality for ascending dissections (Stanford Type A) increasing from 1% in the first hour to 50% by 48 hours.^{3,6,7} Without appropriate surgical treatment, approximately 90% of patients with ascending aortic dissections die within 3 months of dissection, mostly from rupture.³ Dissections comprising lesions affecting the descending thoracic aorta (Stanford Type B) are managed with aggressive blood pressure control.^{8,9} A high percentage (80%) of these patients will however develop aneurysmal dilatation of the false lumen, requiring cardiothoracic surgical intervention in one-third of the cases.³

The management of Type B dissections with open surgical techniques is associated with high morbidity and mortality. Mortality rates range from 22 to 32% for surgically treated patients.^{5,10,11} Endovascular devices are approved for the

Fig. 4 Distal landing zone for thoracic endovascular aortic reconstruction. Notice resolution of distal flap.

Fig. 5 Type A dissection arising proximal to thoracic endovascular aortic reconstruction graft.

Fig. 6 Dissection in the ascending aorta with hemopericardium and hemomediastinum.

treatment of descending thoracic aortic aneurysms but have been successfully utilized in the management of acute aortic syndromes and traumatic aortic rupture.^{12,13}

The use of endovascular stenting in complicated Type B dissections, first reported by Dake et al in 1999⁸ has rapidly increased in many centers due to its lower morbidity and mortality compared with open repair, especially with respect to complications involving spinal cord ischemia.^{12,14} Endovascular repair however is also associated with significant complications. Aneurysm development, aortic rupture, stroke, paraplegia, bowel infarction, limb ischemia, endoleaks, endoprosthesis extrusion, artero-esophageal fistula, and retrograde Type A dissection have all been described.^{6,12,15–18}

Retrograde Type A dissection after TEVAR has a reported incidence of 1.33 to 2.5%,^{19,20} mostly occurring intraoperatively. It is however associated with mortality rates as high as 42 to 57%.^{19,21} Other aortic endovascular procedures including the FDA approved stenting of descending thoracic aneurysms have also been associated with Type A thoracic aortic dissection.^{12,22} The fragility of the aortic wall as well as stent grafting-related factors may contribute to this complication. Identified factors include female gender, aggressive balloon

angioplasty, and the use of proximal bare spring stent grafts^{19,21}; although in our patient a covered stent was utilized. We postulate that shear stress on an underlying pathologically weakened aorta was the cause of her dissection. There was direct evidence of stent graft-induced injury at surgery or necropsy in half of the patients analyzed in a multicenter European study.¹⁹

The management of Type B thoracic aortic dissection with endovascular devices will likely expand in the near future. However, considering the success medical management with and its lower morbidity when compared with surgical alternatives, careful patient selection is essential.^{23,24}

The Cardiovascular Interventional Radiological Society of Europe (CIRSE) has published guidelines on indications for the use of endograft in treating aortic dissections.⁶ These include the following:

- Acute Type B dissection in unstable patients when medical therapy cannot guarantee that blood pressure is controlled at a recommended low level (systolic BAP $\leq$ 120 mm Hg).
- Complicated acute Type B dissection when the dissection involves an abdominal branch or the peripheral arteries, with consequent ischemia.
- Chronic Type B dissection to avoid progressive dilatation of the aorta, with aneurysm formation and progressive risk of rupture.
- Chronic Type A dissection after surgical repair of the ascending aorta when the descending aortic false lumen is still patent and a progressive increase in its size/volume is observed during follow-up.
- Endovascular treatment is also recommended to solve ischemic branch complications correlated with the dissection.

It is important to have a high index of suspicion for retrograde Type A dissections during follow-up after successful endovascular stenting in patients with Type B dissections as this complication although occurring infrequently is associated with high mortality. We therefore recommended close lifelong surveillance after repair: a recent retrospective study has recognized this complication occurring up to 36 months after the index procedure² and 202 days in another study.⁷

Whenever possible, these procedures should be performed by experienced surgeons at high-volume centers.¹⁴ Minimal manipulation of the aorta would reduce the risk of subsequent dissections. The use of bare metal stents has been associated with retrograde Type A dissections.^{19,25} A recommendation to avoid these would however have to be balanced with the possibility that bare metal stents reduce the more commonly occurring debilitating neurological complications. A compromise would be to utilize bare metal stents with protected/covered landing zones to reduce shear stress on the aorta. Careful selection of the endograft would reduce radial forces and also attenuate the chances of developing a later dissection.

Conclusion

TEVAR of the thoracic aorta is a viable treatment option for the management of complicated descending thoracic aortic

dissections with lower morbidity and mortality compared with open surgery.^{12,26,27} It will likely find a wider application with improving operator expertise and experience coupled with improved endograft design. Careful patient selection is necessary at this time as medical therapy successfully treats the majority of uncomplicated Type B dissections with low mortality and morbidity. TEVAR should be reserved for patients with complicated Type B dissections or those who fail nonoperative management, because the mortality and morbidity of TEVAR, including retrograde Type A dissections, may compromise any additional benefit.⁷

Close postoperative monitoring is therefore necessary when TEVAR is performed, especially outside the recommended device instructions for use, and this should be accompanied by lifelong surveillance after the initial procedure.^{6,21} A high level of suspicion is important to identify retrograde Type A dissections in these patients given its rarity and the ambiguity of the clinical presentation.

Disclosures

The authors have no conflicts of interest, financial, or other disclosures.

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