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Case Report

Retrograde Ascending Aortic Dissection after Stent Grafting for Stanford Type B Aortic Dissection with Severe Limb Ischemia

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We report a rare case of retrograde Stanford type A aortic dissection after endovascular repair for complicated Stanford type B aortic dissection. A 45-year-old man presented with a sudden onset of back pain and was transferred to our hospital. Computed tomography demonstrated acute Stanford type B aortic dissection with lower limb ischemia. Emergency endovascular surgery was planned for repair of the Stanford type B aortic dissection. The patient suddenly developed recurrent chest pain 10 days after the initial procedure. Computed tomography revealed retrograde Stanford type A aortic dissection involving the ascending aorta and aortic arch. The patient underwent a successful emergency total aortic arch replacement.

Keywords: thoracic endovascular aortic repair, Stanford type B aortic dissection, retrograde type A aortic dissection

Introduction

Recent advances in the technique of thoracic endovascular aortic repair (TEVAR) have remarkably improved the treatment of thoracic aortic aneurysm. Although the standard therapy for uncomplicated acute Stanford type B aortic dissection (BAD) is medical treatment, surgical repair is indicated for complicated cases with rupture, malperfusion, uncontrolled hypertension, persistent pain, or aneurysmal dilatation.[1–3] TEVAR is considered a minimally invasive therapy, with lower operative morbidity and mortality rates than open surgical repair.[1,3,4] However, the modified TEVAR technique is sometimes associated with unique complications, such as endoleak and stent graft migration. The most serious complication after TEVAR for BAD is retrograde Stanford type A aortic dissection (rAAD) involving the aortic arch and/or ascending aorta, which requires extensive open surgical repair.[1,3]

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Case Report

A 45-year-old man presented to our hospital with a sudden onset of back pain. Computed tomography (CT) on admission demonstrated acute BAD. Dissection entry was found on the aortic arch just distal to the left subclavian artery orifice. Despite a stable hemodynamics, the patient experienced numbness and paralysis of bilateral lower limbs. CT revealed that the true lumens of the bilateral common iliac arteries were compressed by thrombosed false lumens; also, the femoral arteries were not palpable. No other organ malperfusion was observed. Therefore, emergency endovascular surgery was planned for repair of the complicated acute BAD (**Fig. 1**).

Under local anesthesia, both femoral arteries were exposed. A 34/24/159 Zenith TXD stent graft (Cook Medical, Bloomington, IN, USA) was inserted into the femoral artery to zone 2 position to exclude the site of dissection entry. Two additional metallic stents (36/123 and 36/164 Zenith; Cook Medical) were inserted into the true lumen of the descending aorta to the bifurcation with the abdominal aorta, commonly called the "PETTICOAT" procedure.[5] No additional balloon dilatation or fixation was performed during stent grafting after deployment. The orifice of the left subclavian artery was embolized using a vascular plug (AGA Medical Corporation, Plymouth, MN, USA). The final aortography revealed complete exclusion of the proximal entry site, maintained blood supply to the abdominal branches, and increased diameter of the true lumen. The blood supply to the lower limbs significantly improved, and the patient's symptoms disap-

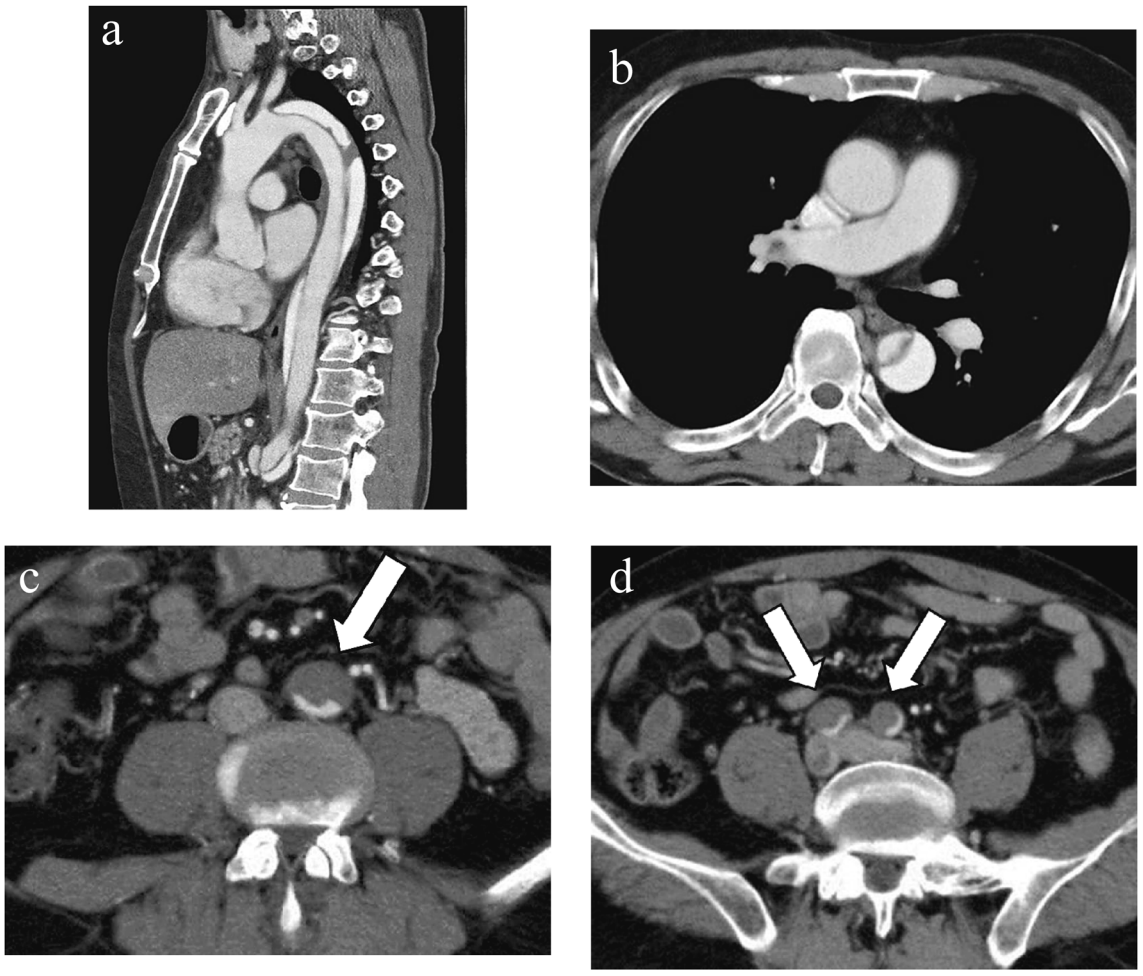

Fig. 1 Computed tomography showed acute Stanford type B aortic dissection (**a**, **b**). The dissection entry was found on the aortic arch just distal to the left subclavian artery orifice. The true lumens of the bilateral common iliac arteries were compressed by the thrombosed false lumen (**c**, **d**; arrow). There were no other organ malperfusions. The diameters of the ascending aorta, aortic arch, and descending aorta were 33, 28, and 30 mm, respectively (average diameter of the true lumen was 21.7 mm).

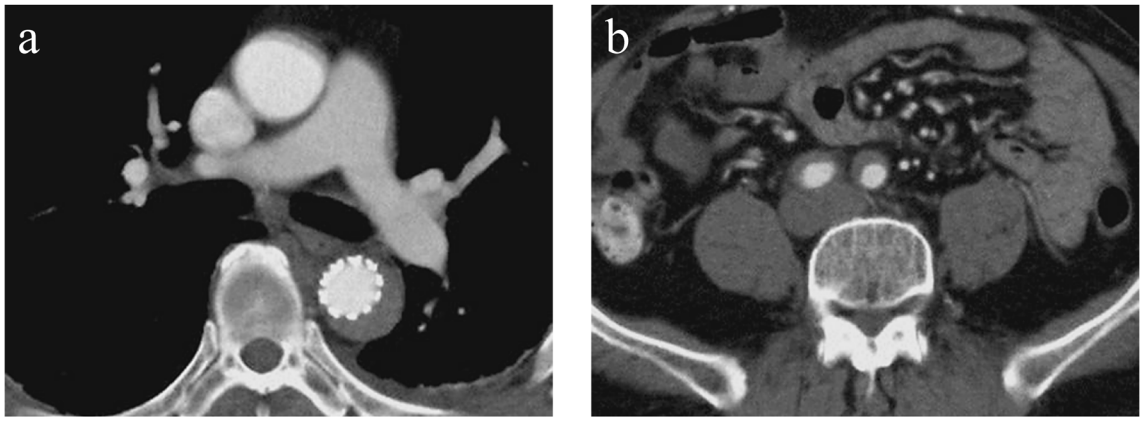

Fig. 2 Computed tomography 2 days after the procedure showed that TEVAR was successful, resulting in expansion and patency of the true lumen with no endoleak (**a**, **b**).

peared immediately after the procedure. CT taken 2 days after the procedure indicated that TEVAR was successful and resulted in expansion and patency of the true lumen without endoleak (**Fig. 2**).

The postoperative course was quite stable with well-controlled blood pressure; however, the patient suddenly developed recurrent thoracic back pain 10 days after the procedure. Emergency CT revealed rAAD, involving the ascending aorta and aortic arch (**Fig. 3**). Therefore, an emergency surgery was performed. Under general anesthesia, the chest was opened via median sternotomy with relatively stable hemodynamics. Cardiopulmonary bypass was established with right axillary and femoral artery cannulation and cava drainage. The patient's body temperature dropped to 25°C, followed by lower body circulatory arrest with deep hypothermia. Antegrade selective cerebral perfusion was established with axillary arterial perfusion by brachiocephalic artery clamping and direct cannulation of the left common carotid artery. The entry of rAAD was found on the greater curvature of the aortic arch just proximal to the previous stent graft. Distal anastomosis was made to the aortic arch and the previous stent graft was involved in the distal anastomosis. The brachiocephalic and left common carotid arteries were reconstructed after the proximal anastomosis. The patient was discharged from the hospital 20 days after the second operation with no major complication.

Discussion

Recently, TEVAR has been increasingly used as a minimally invasive treatment option for thoracic aortic aneurysms and dissections, especially for patients considered to be at high risk for conventional open surgical repair.[1,2,4] Increasing technical experiences and improvements in stent graft devices have resulted in better clinical outcomes, with lower operative morbidity and mortality rates, and expansion of clinical indications.[1,2] The standard therapy for uncomplicated acute BAD is medical treatment, with surgical repair indicated for complicated cases, especially if rupture and malperfusion occurs.

However, the increasing use of TEVAR is accompanied by an increase in the incidence of unexpected complications. The most feared complication after stent graft for complicated BAD is rAAD involving the aortic arch and/or ascending aorta, which requires extensive open surgical repair and is associated with a higher mortality rate. Although previous reports have estimated the risk of rAAD after TEVAR to be 1.6%–2.4%, these complications remain rare, albeit life-threatening, and are often associated with corresponding higher rates of subsequent mortality of 33.6%–42.0%.[1–3,6,7] In these reports of aortic dissection and non-dissecting degenerative thoracic aortic aneurysms, the risk of rAAD was higher and frequently occurred after TEVAR for acute BAD, especially in cases complicated by rupture or malperfusion, at a reported incidence of 8.4%–10.0%.[1,2]

rAAD sometimes occurs with significant evidence of stent graft-induced aortic injury or in relation to manipulation of guide wires and sheaths during the procedure.[2,3] rAAD not only occurs during the procedure but also after the procedure during hospitalization and 3 months or longer after hospital discharge.[3] A previous report demonstrated surprising results, as the majority of patients (44%) presented with symptoms, such as chest pain, syncope, and stroke, but one-fourth were asymptomatic.[3] Of those, some patients were incidentally diagnosed with rAAD using routine CT after hospital discharge, and others were diagnosed after sudden death based on necropsy findings. Therefore, this fatal complication after TEVAR for BAD is concerning, as it could occur even after hospital discharge and may be asymptomatic.

Although the mechanism underlying rAAD remains unknown, various potential factors have been suggested, including female sex, stent graft oversizing, use of endografts to repair dissection, aggressive balloon angioplasty, additional balloon dilatation of the stent grafts after deployment, connective tissue disorders, endografts with proximal bare springs/barbs, and proximal endograft positioning within tortuous portions of the aorta or aortic arch.[2,3,6,7] The most important measure to avoid this fatal complication is to choose appropriate stent graft with adequate diameter, as stent graft oversizing is believed to be the most common risk factor for rAAD after TEVAR for complicated BAD, based on the present case.

Marfan syndrome was not indicated in the present case, and no additional post-balloon dilatation was performed after deployment of the stent graft. In this case, hemodynamics was quite stable and well controlled after TEVAR. However, there were some concerns for rAAD: (1) the proximal landing on the aortic arch excluded the dissection entry, which is a risk factor for rAAD; (2) use of a stent graft to repair an acute aortic dissection is a strong predictor for rAAD, but not degenerative thoracic aneurysm caused by deployment of an endograft into a fragile aorta; and (3) the risk of stent graft oversizing. In this case, a stent graft specialized for aortic dissection was used because the implanted device can virtually eliminate the bird's beak effect by employing a proximal sealing stent that orients parallel to the inner curvature of the aortic arch. Although a 34-mm device had no proximal bare spring, it was considered slightly too large for the 28–30-mm diameter of the aortic arch, as it would have been oversized by approximately 20%. We could not insert a 29-mm ball sizer inside the previous stent graft of the aortic arch intraoperatively, although endograft with

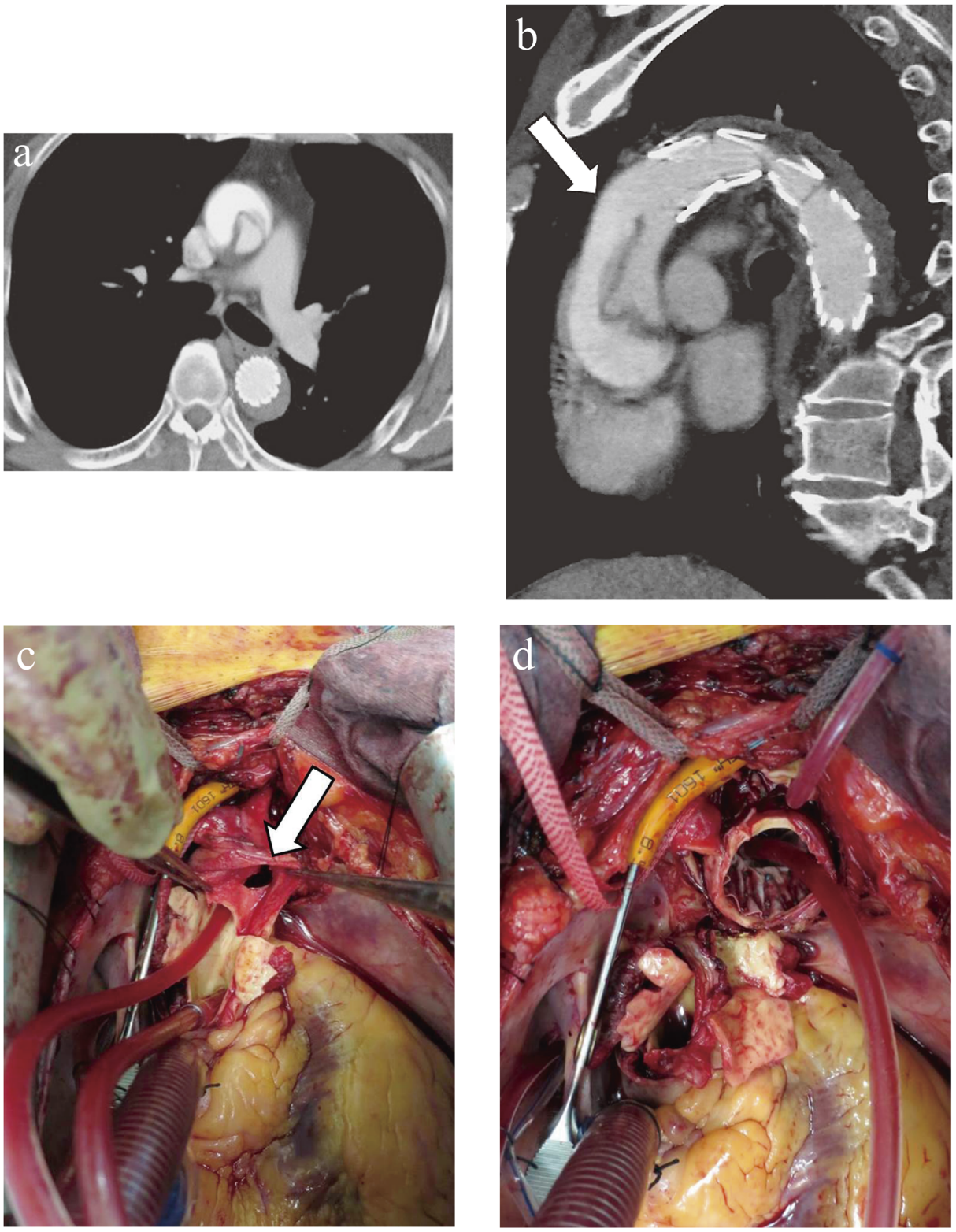

Fig. 3 Emergency computed tomography 10 days after TEVAR revealed retrograde Stanford type A aortic dissection (rAAD) involving the ascending aorta and aortic arch (**a**). The entry of rAAD was on the greater curvature of the aortic arch just proximal to the previous stent graft (**b**, **c**, arrow). Distal anastomosis was made to the aortic arch and the previous stent graft was involved in the distal anastomosis (**d**).

a proximal diameter of 34 mm was deployed. Excessive radial force due to oversizing of stent graft prostheses by 20% in relation to the diameter of the aorta has also been proposed as a potential risk factor for rAAD after TEVAR.[2,7]

Conclusion

We encountered a rare case of rAAD after TEVAR for complicated BAD, which was successfully repaired via emergency open surgery. For patients complicated with BAD, TEVAR is a preferable and less invasive treatment option that can effectively seal the proximal entry site to maintain true lumen blood flow rather than conventional descending aortic replacement through left thoracotomy. However, rAAD is a possible complication after TEVAR for acute BAD. Therefore, rAAD should be considered as a potential fatal complication that can occur even after discharge.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Disclosure Statement

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Author Contributions

All authors critically read, discussed, and approved the final draft of the manuscript.

Study conception: YT, KH
Data collection: KA, YS
Analysis: HI
Investigation: MT, MI, YH
Writing: YH, MT
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

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