

Aorta: Case Report

One-Stage, Hybrid Aortic Repair for a Migrated, Thrombosed, Floating Aortic Stent Graft

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A 50-year-old man with an acute type B aortic dissection underwent thoracic endovascular aortic repair in 2019. The patient presented again with chest pain and left arm numbness. Computed tomography scan revealed aneurysm expansion and extensive thrombus within a floating stent graft. He underwent explantation of the stent graft, zone 2 total aortic arch replacement with frozen elephant trunk, and left axillary artery bypass. Simultaneously, he underwent retrograde thoracic endovascular aortic repair extension and controlled balloon septal rupture. Two years after surgery, he remains without complication.

(Ann Thorac Surg Short Reports 2023;1:18-21)

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Aortic stent graft migration, intraluminal thrombus formation, and false lumen expansion are common thoracic endovascular aortic repair (TEVAR) complications usually managed medically or endovascularly. This case demonstrates severe aortic degeneration after TEVAR, necessitating stent graft explantation. Whereas open arch replacement and extensive stent grafting are typically separated to avoid spinal cord ischemia and other complications, this patient's anatomy required a hybrid approach. Rupture risk is significant; therefore, he underwent combined aortic arch replacement with frozen elephant trunk (FET), retrograde TEVAR, and controlled balloon septal rupture—the knickerbocker technique—simultaneously to fix this unique complication.

A 50-year-old man with a history of hypertension and type B aortic dissection treated with TEVAR presented

with dry cough and stabbing, left-sided chest pain similar to his type B dissection for 1 week. Since TEVAR, he experienced left arm paresthesia induced by movements lifting his arm above his shoulders. He also reported occasional syncope and extreme fatigue for the past 3 months. Past medical history included obesity and transient ischemic attacks (before TEVAR). The only significant examination findings were a blood pressure of 153/90 mm Hg and a heart rate of 78 beats/min.

Computed tomography angiography (CTA) of the chest demonstrated a free-floating stent graft with significant aneurysmal degeneration and thrombus formation within the stent and aorta. At the level of the carina, the mid-descending thoracic aortic diameter was 6.9 cm, compared with a previous diameter of 5.9 cm (Figure 1). Preoperative echocardiography and CTA demonstrated normal ventricular and valvular function. Elective total arch replacement with TEVAR explantation on cardiopulmonary bypass and redo TEVAR was planned.

Cannulation for cardiopulmonary bypass was performed through the right axillary artery and right atrium. Cardioplegia was given in antegrade and retrograde fashion. The patient was cooled to 28 °C. Selective cerebral antegrade perfusion was performed through the right axillary artery. Under circulatory arrest, a zone 2 aortic arch replacement was done using a 30-mm Vascutek multibranched Siena graft (Terumo). Previous TEVAR was distal to a primary intimal tear at the left subclavian artery level. During arch replacement, the old stent graft was removed (Figure 2); a 34 × 150-mm Gore cTag stent graft (W.L. Gore) was advanced antegrade through the surgical graft and deployed immediately distal to the left subclavian. The endograft and surgical graft were sutured together. After weaning of the patient off cardiopulmonary bypass and partial protamine reversal, right femoral access was obtained and the antegrade TEVAR was extended with 2 grafts—Gore cTag 37 × 150 mm and 37 × 200 mm—to land just above the celiac artery. The proximal stent graft within the surgical elephant trunk was balloon molded with a Gore trilobe balloon. Balloon aortoplasty with flap fracture—the knickerbocker technique—was performed 3 cm above the end of the stent graft, creating a distal landing zone. Completion aortography demonstrated good proximal and distal seal. The chest and axillary site were closed. The patient left the operating room on clevidipine, epinephrine, and phenylephrine.

The postoperative stay was 22 days. Reintubation, atrial fibrillation, and internal jugular venous thrombosis complicated his course. PredischARGE CTA and follow-up

Accepted for publication Nov 8, 2022.

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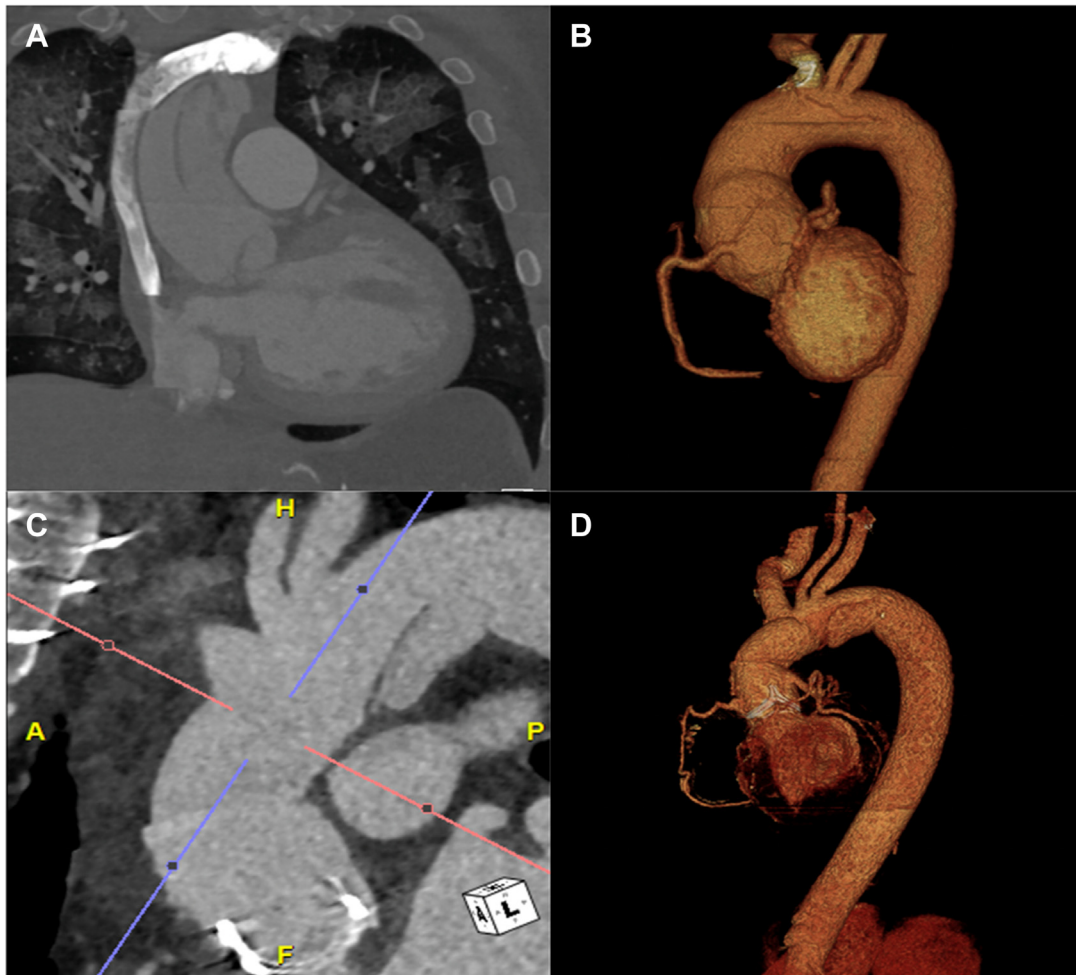


FIGURE 1 Preoperative computed tomography imaging of the aorta: (A, C) Coronal views and (B, D) 3D aortic reconstruction.

CTA at 6 and 10 months (Figure 3) showed stable aortic size and complete exclusion of false lumen and thoracic aortic aneurysm. Clinical follow-up is ongoing at 2 years without aortic complication.

COMMENT

TEVAR is a common treatment of a variety of aortic diseases, often resulting in shorter in-hospital stays and improved perioperative outcomes and mortality compared with an open approach.¹ Despite these encouraging short-term and midterm results, TEVAR limitations include endoleak, stent graft migration, and stent graft-induced aortic injury, which can lead to treatment failure and higher reintervention rates. Stent graft migration is a rare complication caused by improper endograft sizing, imprecise stent graft deployment, or further aortic degeneration. Reintervention after TEVAR

is most often for endoleak and is managed endovascularly, with rates of freedom from reintervention at 10 years of 60.9%²; stent oversizing, large aortic dilation, and anticoagulant therapy can also necessitate reintervention.² Open surgical reintervention after TEVAR is reported between 0.4% and 7.9%.^{3,4}

The urgency of this case necessitated hybrid aortic surgery rather than the typical 2-stage approach. This involved simultaneous TEVAR and FET, using both antegrade and retrograde stent graft deployment with the simple Gore cTAG deployment mechanism. The knickerbocker technique allowed complete aneurysm exclusion in 1 procedure. Without it, exclusion of the pathologic process depends on false lumen thrombosis over time, perpetuating rupture risk. In addition, up to 50% of chronic dissections treated with TEVAR and no adjunctive technique to close the false lumen may never achieve complete false lumen thrombosis.⁵ This

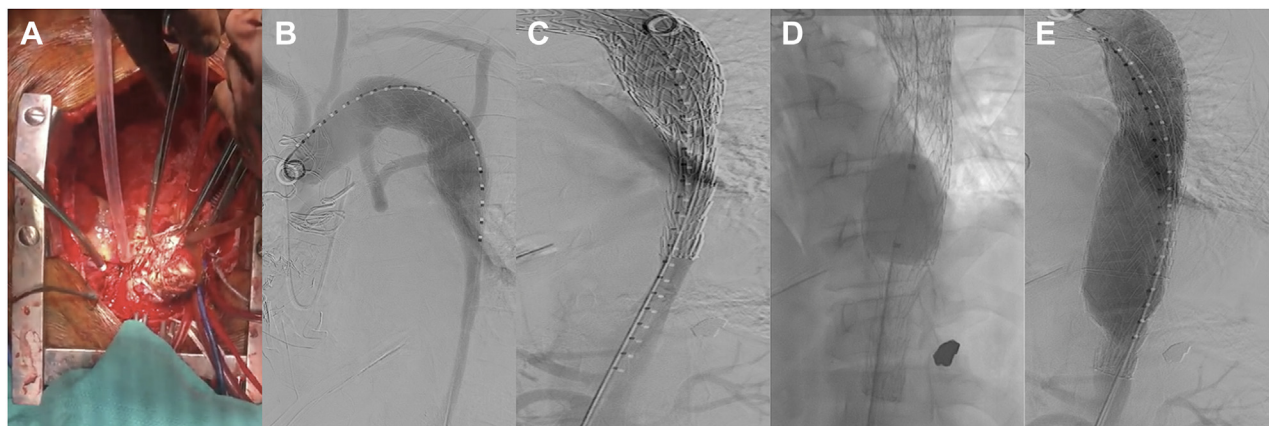


FIGURE 2 Intraoperative radiological findings: (A) TEVAR explant and (B, C, D and E) Redo TEVAR with controlled balloon septal rupture.

technique enables a better endovascular dissected aneurysm exclusion than TEVAR alone, often eliminating the need for a second open surgical repair.

In a large series, 32% to 60% of 2-stage arch replacements failed to complete the second stage and 40% of nonreturning patients died of aortic rupture.⁶ In

patients with extensive degenerative aneurysm of the descending aorta, 63.1% of those who underwent the FET procedure alone demonstrated no aneurysmal sac shrinkage in follow-up.⁶ Although a 1-stage approach eliminates the rupture risks associated with the waiting period between procedures, it is still uncertain whether

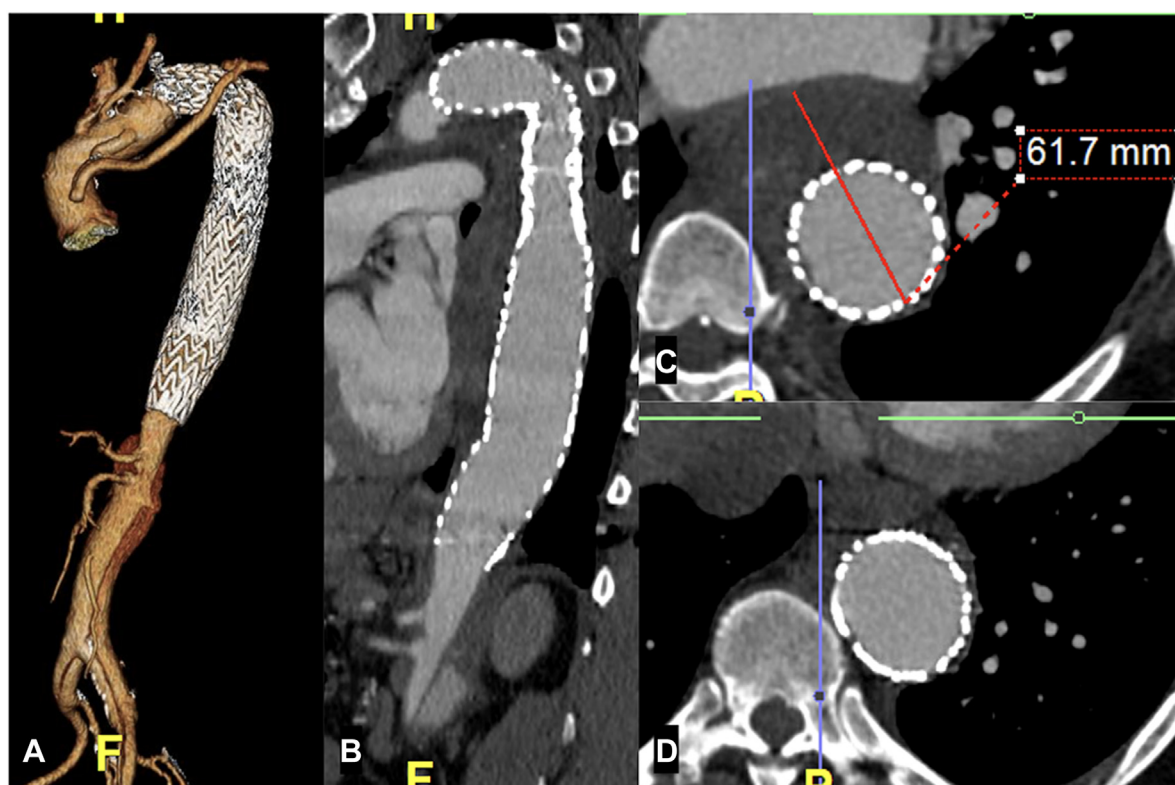


FIGURE 3 Postoperative contrast enhanced computed tomography imaging: (A) 3D aortic reconstruction, (B) Sagittal and (C, D) Coronal views of the aorta.

the risks of a single-stage approach are less than those of a 2-stage procedure.⁶ A study demonstrated 3.6% mortality between the 2 procedures and 75% due to rupture.⁷ Another study with 94 patients reported that 11% of patients died before the second procedure.⁷

The risk of death in the interval between the 2 procedures is nonnegligible. Cardiac arrest and cardiopulmonary bypass probably serve only to heighten the risk of neurologic, renal, or other complications from TEVAR. Whereas these risks remain lower in endovascular procedures than in open procedures,² it is difficult to predict the combined risk. In the 1-stage approach, spinal cord ischemia poses the main risk; therefore, the patient was cooled to 28 °C and underwent selective cerebral antegrade perfusion, but a lumbar drain was not used.

In conclusion, simultaneous hybrid aortic repair of the arch and descending aorta including TEVAR

explantation and new TEVAR implantation combined with FET is rarely clinically required and performed. Despite increased risks, the urgency of this case made it necessary. Our approach was successful for total arch repair and aneurysmal treatment. Further research is needed to fully understand the costs and benefits; however, this 1-stage hybrid approach seems to be a viable option in cases with extensive, time-sensitive complications.

FUNDING SOURCES

The authors have no funding sources to disclose.

DISCLOSURES

The authors have no conflicts of interest to disclose.

PATIENT CONSENT

Waived. Institutional review board approval was waived because the patient was deidentified.

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