

## Case Reports

# Two Endovascular Stent Graft Repairs Needed for an Extrathoracic Aortic Graft: Distant Complications After an Original Open Repair for a Gunshot Wound to the Chest

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## Abstract

Although the management of traumatic injuries to the thoracic aorta has shifted toward endovascular management, the historical standard of care is open reconstruction. Choosing to reoperate when faced with a complication from a prior open repair can be challenging; endovascular management can be a reasonable option in this situation. This report describes a 54-year-old man with a remote history of open surgery for a traumatic injury to the descending thoracic aorta who underwent endovascular aortic stent graft placement for coverage of extrathoracic graft extension with pseudoaneurysm formation and distal embolization. He returned a year later with a type IIIb endoleak with rupture into the posterolateral chest wall. A second endovascular approach was used to successfully reline the graft and exclude the rupture.

**Keywords:** Aneurysm, false; aorta, thoracic; dissection, blood vessel; endovascular aneurysm repair; postoperative complications; stents; dissection, thoracic aorta

## Introduction

The optimal management of traumatic injury to the descending thoracic aorta has shifted from open surgical management to endovascular repair.<sup>1-3</sup> Managing the complications of a prior open surgical repair, especially in a multireoperative field, can often require an alternative approach to minimize operative morbidity. The patient in this report underwent endovascular repair of an extrathoracic extension of a prior aortic graft with pseudoaneurysm development. The patient later developed a type IIIb endoleak with contained rupture.

## Case Report

A 54-year-old man had a history of a thoracic gunshot wound at age 15 years. At that time, he underwent a median sternotomy and a left posterolateral thoracotomy with replacement of the descending aorta using a prosthetic graft. His general medical history was notable for hypertension, hyperlipidemia, diabetes mellitus, and paraplegia. His surgical history was unknown and largely deduced from his surgical scars and axial imaging, as he did not have significant insight into his medical history and had been a patient at multiple institutions.

In November 2019, the patient presented to an outside hospital with acute abdominal pain. Computed tomography (CT) demonstrated acute thrombosis of the celiac artery and superior mesenteric artery (SMA), and he underwent exploratory laparotomy, thromboendarterectomy of the SMA, and a common iliac-to-SMA bypass

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using a polytetrafluoroethylene graft. His recovery was uneventful. Because his preoperative CT had partially captured a pseudoaneurysm of the descending aorta with extension through the posterolateral chest wall, he underwent a dedicated CT angiogram of the chest. This demonstrated a chronic type A dissection involving the innominate, left carotid, and left subclavian arteries and showed the surgical replacement of the descending aorta. The posterior chest wall was disrupted from the previous gunshot wound, and the aortic graft was extending posteriorly into the chest wall muscles. There was pseudoaneurysm formation in the extrathoracic portion of the graft, with mural thrombus; this was thought to be the likely source of the patient's SMA thrombus (Fig. 1 and Fig. 2).

The patient was subsequently transferred to the reporting institution for surgical management. On arrival, he was hemodynamically stable, afebrile, and without leukocytosis. The decision was made to proceed with thoracic endovascular aortic repair (TEVAR). The right common femoral artery was accessed percutaneously, and the left common femoral artery was explored in an open fashion with open thrombectomy, endarterec-



**Fig. 1** Axial cardiac computed tomographic angiogram performed after patient's initial transfer to the authors' institution. This computed tomographic angiogram demonstrates extension of the descending thoracic aorta through the chest wall into the submuscular space with pseudoaneurysm and thrombus development apparent at the inferior edge of the pseudoaneurysm. There is disruption of the normal anatomy of the posterior chest wall. Other chronic thoracic findings include type A dissection involving the innominate, left carotid, and left subclavian arteries. In the abdomen, there is a thrombosis in the true lumen of the dissected suprarenal aorta, extending into the superior mesenteric artery. The ilio-superior mesenteric bypass is intact with recent postoperative changes in the abdomen. The left common femoral artery contains a nonocclusive thrombus.

Supplemental motion image is available for [Figure 1](#).

### Abbreviations and Acronyms

CT	computed tomography
SMA	superior mesenteric artery
TEVAR	thoracic endovascular aortic repair

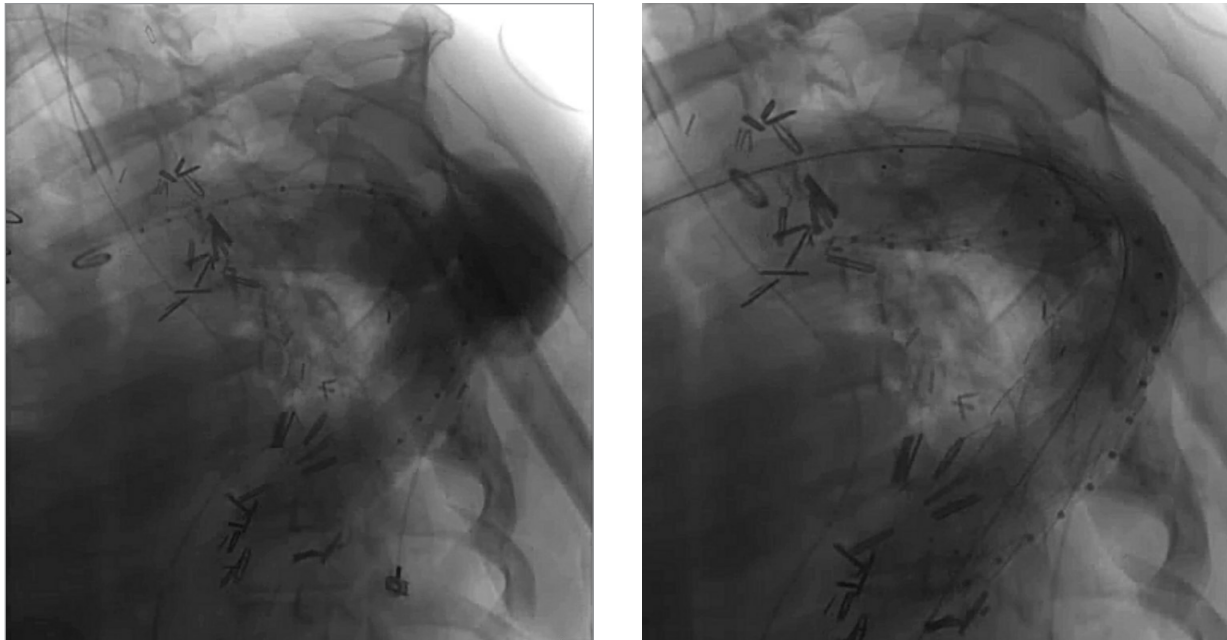
tomy, and patch angioplasty. TEVAR was performed in the usual fashion (Fig. 3A). Initially, it was difficult to track the endograft device through the extrathoracic aorta, so a 20F sheath was advanced over a dilator through the extrathoracic aorta into the proximal descending aorta. From there, the device was advanced through the sheath to the desired deployment zone in the proximal aortic graft; the sheath was pulled back to the distal thoracic aorta, and a 34 × 34 × 182-mm Valiant Navion thoracic endograft (Medtronic) was deployed (Fig. 3B). Intravascular ultrasound demonstrated good wall apposition and no evidence of extrinsic luminal compression by the ribs.

The patient, unfortunately, had a prolonged and complicated postoperative course. He developed bleeding from the proximal anastomosis of the common iliac-to-SMA bypass, which was managed successfully with



**Fig. 2** Sagittal cardiac computed tomographic angiogram demonstrates extension of the descending thoracic aorta through the chest wall into the submuscular space with pseudoaneurysm and thrombus development; there is disruption of the normal anatomy of the posterior chest wall, likely secondary to ballistic destruction.

Supplemental motion image is available for [Figure 2](#).



**Fig. 3 A)** Intraoperative aortogram demonstrates posterolateral extension of the aortic graft into the posterior chest wall with pseudoaneurysm. **B)** Intraoperative completion aortogram after successful deployment of the thoracic endograft with good wall apposition and successful exclusion of the pseudoaneurysm. Multiple surgical clips are seen throughout the thoracic cavity.

endovascular stenting. He developed a wound infection in the left groin operative site that required multiple operative irrigations and debridements and a rectus femoris muscle flap for coverage. He experienced multi-organ failure that required reintubation and prolonged ventilator support, nutritional support, placement of a feeding jejunostomy, and kidney replacement therapy via a tunneled hemodialysis catheter. Ultimately, he recovered and was extubated, started on an oral diet, and had the hemodialysis catheter and feeding jejunostomy tube removed.

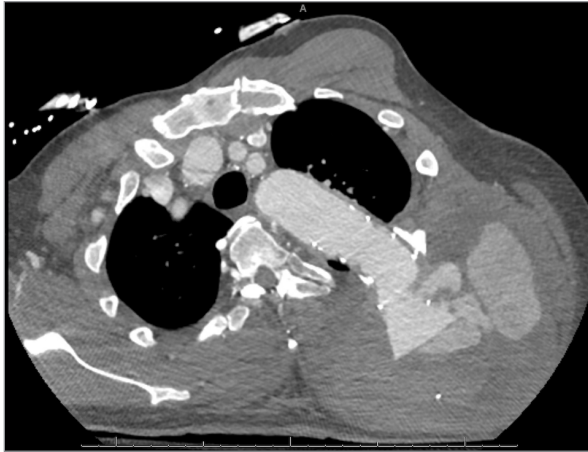
The patient was discharged home on postoperative day 99 after TEVAR and was then lost to follow-up. He returned to the emergency department in December 2020, 1 year after surgery, with chest pain radiating to his back. The patient had hypertension on arrival but afebrile and hemodynamically stable. He was noted to be anemic, with a drop in hemoglobin of 4 g/dL from his prior admission. A CT angiogram of the chest demonstrated fracture of the stent graft with contained rupture into the left posterolateral chest wall (Fig. 4 and Fig. 5). The patient was emergently transferred to the operating room.

Because of the patient's prior left groin infection and muscle flap, unilateral right common femoral artery percutaneous access was used for this reoperation.

Endograft deployment was otherwise performed in the standard fashion. Two 34 × 34 × 15-mm GORE TAG endografts (W.L. Gore & Associates, Inc) were deployed across the fractured stent, and an additional 34 × 34 × 10-mm GORE TAG endograft was deployed to extend the proximal seal zone to just distal to the origin of the left subclavian artery. To extend the distal aortic seal zone, a final 34 × 34 × 90-mm Valiant Navion thoracic graft was deployed. Postendograft angiography demonstrated good exclusion of the rupture (Fig. 6). The patient did well postoperatively and was discharged home on postoperative day 2.

## Discussion

To the authors' knowledge, this is the first documented case of an aortic graft in an extrathoracic position treated with TEVAR. The first challenge in this case was attempting to understand the patient's surgical history based only on his clinical presentation and imaging. The team deduced that the patient had undergone a median sternotomy and a left posterolateral thoracotomy to address the traumatic disruption of the descending aorta, and aortic reconstruction using 2 polyethylene terephthalate (Dacron) tube grafts sewn together. The destructive nature of the ballistic injury compromised



**Fig. 4** Axial cardiac computed tomographic angiogram performed 1 year postoperatively demonstrates a type IIIb endoleak with complete stent graft–strut disruption and contained rupture into the posterior chest wall musculature.

*Supplemental motion image is available for Figure 4.*

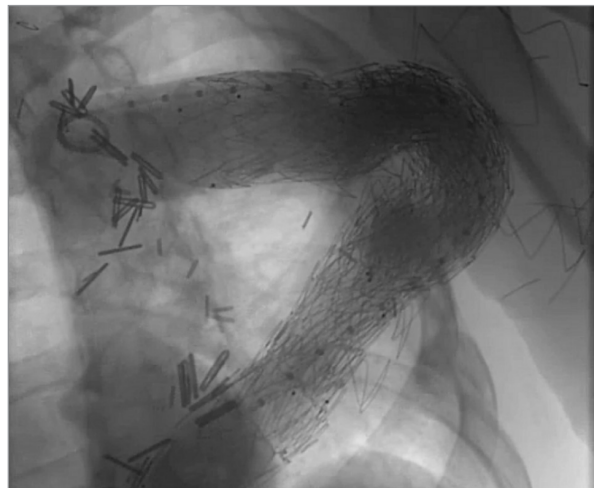
his posterior thoracic cage architecture, and the graft likely sat in the space created by this injury and migrated further into the posterior chest wall over time. The suture line between the 2 grafts in this posterior chest wall defect likely broke down with respiratory motion, leading to development of the pseudoaneurysm in the posterior chest wall muscles.<sup>4</sup> Although an infectious etiology to this pseudoaneurysm was in the differential diagnosis, the patient had no signs of systemic infection and had a negative blood culture on admission.

The operative challenge during the patient's first presentation was to manage his extrathoracic aorta and resultant pseudoaneurysm to prevent further distal embolization. Given the patient's medical comorbidities and multiple operative approaches to the descending aorta, a decision was made to attempt endovascular exclusion of the pseudoaneurysm. Although technically successful, the patient ultimately experienced an acute graft disruption. This is now a known complication of the Valiant Navion device: 11 patients participating in the Valiant EVO clinical trial experienced structural failures of the endograft.<sup>5</sup> Four of the 11 patients developed a type IIIb endoleak secondary to stent fracture, the same complication seen in the patient in this report. It is interesting to note that, although the 1-year results of the trial were promising, these structural defects were identified between 36 and 49 months after initial TEVAR.<sup>5,6</sup> The patient in this report experienced his rupture 12 months after TEVAR. An inherent defect in the structural integrity of the endograft may have



**Fig. 5** Sagittal cardiac computed tomographic angiogram performed 1 year postoperatively demonstrates a type IIIb endoleak with complete stent graft–strut disruption of the endograft and contained rupture into the posterior chest wall musculature.

*Supplemental motion image is available for Figure 5.*



**Fig. 6** Intraoperative completion angiogram after relining the endograft; a complete proximal and distal seal was achieved with no evidence of endoleak; there is successful exclusion of the ruptured graft; and the fractured stent struts of the original graft can be seen in the soft tissue of the lateral chest wall.

*Supplemental motion image is available for Figure 6.*

contributed to his eventual graft disruption, stent fracture, and contained rupture. Although intraoperative intravascular ultrasound during the index procedure did not demonstrate extrinsic compression of the stent graft by the ribs, it is possible that chest wall excursion and extrinsic friction may have also contributed to this rupture. The decision to cover this pseudoaneurysm using an endovascular approach prevented additional embolic events and ultimately allowed the patient to be discharged home.

The patient returned 1 year later with acute graft disruption and rupture into the posterior chest wall; this occurred before the initial recall of the Valiant Navion endograft. Emergent endovascular repair and relining was performed with a GORE TAG device, for which no type III endoleaks have been reported over 5 years of use.<sup>7,8</sup> Previously reported outcomes suggest that the initial indication for TEVAR is likely a major contributing factor in predicting endograft failure. Therefore, this patient's initial off-label and unique indication for TEVAR was likely a contributing factor to the subsequent acute rupture, in addition to the inherent defects in the endograft.<sup>9</sup> Despite the off-label use, choosing an endovascular approach in both procedures provided the patient with a minimally invasive intervention in a reoperative field.

The challenges in the second procedure involved dealing with an unusual erosion, herniation of the thoracic aorta, and weighing surgical options in a multireoperative surgical site. Although the initial minimally invasive option required a reintervention, it ultimately allowed the patient a quick second intervention with successful exclusion of the rupture and a rapid discharge to home.

## Conclusion

Repair and exclusion of an extrathoracic aorta with pseudoaneurysm into the soft tissue of the posterior chest wall poses an unusual challenge for vascular surgeons. Open surgical repair remains the standard of care, but in a frail, patient with paraplegia who has undergone multiple operative interventions of the thoracic aorta, an endovascular approach is a feasible option that minimizes operative morbidity.

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