

Why Do TEVAR Grafts Fail?

The Cleveland Clinic experience in treating serious complications that can occur after TEVAR.

BY ERIC E. ROSELLI, MD



In the 15 years since stent grafting has been applied to the treatment of thoracic aortic disease, devices have improved, and indications for use have expanded. Thoracic endovascular aortic repair (TEVAR) has become the preferred treatment option

for most descending disease, including aortic dissection. However, it is more common for thoracic aortic disease to involve the proximal aorta or multiple segments of the aorta than to be isolated to the descending aorta. Without disease-specific devices for treating the proximal aorta, operators have increasingly pushed the limits of use with commercially available devices.

The expanded use of TEVAR has also led to a greater appreciation for late complications. Some of the most serious complications, including retrograde aortic dissection and type I endoleak, can be life threatening and often require urgent conversion to open repair. Although technically feasible, TEVAR for chronic aortic dissection falls short of achieving the intended reverse aortic

remodeling in up to one-third of patients. Usually, this is due to persistent retrograde false lumen flow from distal entry tears. Both endovascular and open solutions have been successfully used to address these late failures. Finally, all patients with prosthetic endovascular devices are at risk for device infection. Depending on the source and severity of infection, this dreaded complication might require open surgical conversion with stent graft explantation.

The multidisciplinary aortic surgical team at the Cleveland Clinic has substantial experience in treating all of these very serious complications following TEVAR, many of which have required conversion to open repair.¹ This article reviews that experience, including outcomes and important lessons learned.

STENT GRAFT INFECTIONS

Severe graft infection represents the most complex indication for conversion to open repair after TEVAR. In our published experience with six of these patients, half of them died from intermediate complications. If

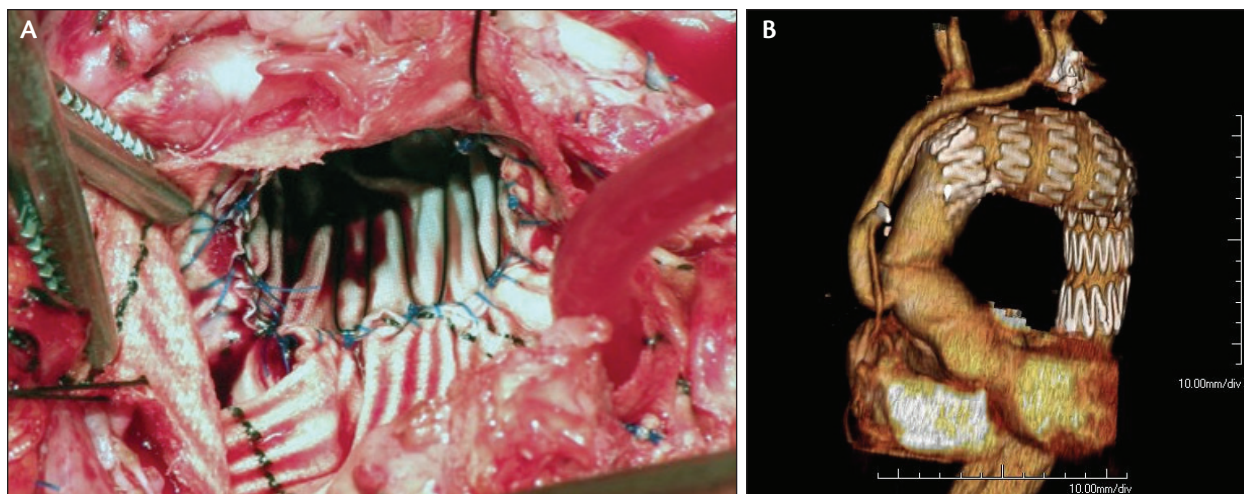


Figure 1. Proximal open thoracic aortic repair after TEVAR using a “reverse frozen elephant trunk” approach. An intraoperative photo (A) showing the stent graft in the arch being sutured to the surgical graft proximally, as well as a postoperative volume-rendered CT reconstruction (B).

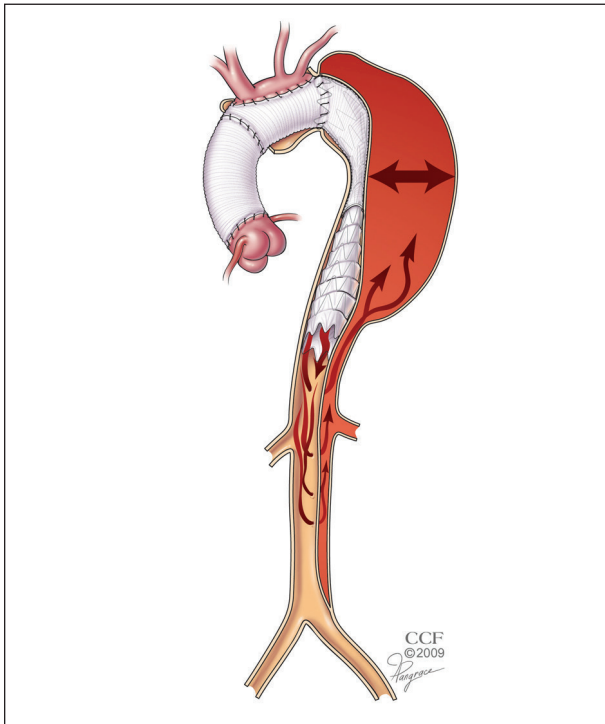


Figure 2. An illustration depicting retrograde false lumen perfusion after TEVAR for chronic dissection. Reprinted from *The Annals of Thoracic Surgery*, 92, Roselli EE, Sepulveda E, Pujara AC, et al, Distal landing zone open fenestration facilitates endovascular elephant trunk completion and false lumen thrombosis, 2078-2084, Copyright (2011), with permission from Elsevier.

the infection has not compromised the integrity of the aorta and the imaging does not demonstrate obvious air around the device, we first try to manage these patients medically. If the infection is due to a process occurring in the periphery of the lung, it can usually be treated with the placement of additional stent grafts to control hemoptysis and prolonged organism-specific intravenous antibiotics followed by oral antibiotics, sometimes for life. If the esophagus or more central airways are involved, then the infected devices must be removed to control the infection, and this usually needs to be done urgently. If the patient is young and can tolerate a multistaged repair, then they may stand a chance at survival with a clear plan for extra-anatomic bypass, debridement of the infected field (which may include esophagectomy and diversion), and later, reconstruction.²

TYPE I ENDOLEAKS

Type I endoleak is one of the most common indications for secondary surgical intervention after TEVAR. In our series of 50 open reoperations after

TEVAR, 19 (38%) were for type I endoleaks. These may be proximal (14 of 19 in our series) or distal type I endoleaks (5 of 19 in our series). In a retrospective review of the imaging at the Cleveland Clinic, all of these patients had shorter-than-recommended landing zones or another use of the stent graft that was considered off-label.

Proximal type I endoleaks are often treatable with proximal endograft extension. This usually requires coverage of the left subclavian artery with pre-emptive left subclavian artery revascularization. If this approach does not provide an adequate landing zone, we have also used an open conversion strategy.

One option for patients with proximal endoleak is to transpose or debranch the arch by creating bypasses originating from the ascending aorta, extending the endovascular repair more proximally into the arch or distal ascending aorta. The stent graft may be delivered in a retrograde or an antegrade fashion.³ Although we have performed this procedure in select patients, several authors have demonstrated that this is still a high-risk procedure, with a significant risk of persistent endoleak or retrograde dissection in up to 11% of patients.⁴

More often, we have chosen to convert these patients by using the “reverse frozen elephant trunk” operation (Figure 1). This is performed using cardiopulmonary bypass, hypothermic arrest, and selective antegrade brain perfusion via cannulation of the right axillary artery with a side graft.⁵ Once the distal circulation is arrested, the arch is opened, and the previously placed stent graft may be directly sutured into the aortic arch. If the old stent graft is too distal in the aorta for direct suturing, then an additional device may be added to bring the repair more proximal and facilitate direct suturing. Typically, the more proximal aorta is replaced with an interposition graft because patients with arch aneurysms usually have some underlying ascending aortopathy as well.

PERSISTENT FALSE LUMEN PERFUSION IN CHRONIC DISSECTION

The use of stent grafts to treat chronic dissections in the setting of an aneurysm is currently controversial because of the uncertainty of thromboexclusion of the false lumen (Figure 2).⁶ An increasing body of data suggests that the rate of false lumen thrombosis in the treated segment is approximately 70% and may be predicted by the extent of aorta dissected.^{7,8} If the endovascular therapy does not achieve the desired reverse remodeling, then the patients can safely be converted to a hybrid distal reconstruction.¹ This indication for open conversion represented one-third of the cases in our series. In that regard, TEVAR and open repair should be considered complementary options for the treatment of patients with chronic aortic dissection



Figure 3. A volume-rendered three-dimensional reconstruction CT scan demonstrating open repair post-TEVAR of a type 2 thoracoabdominal aortic aneurysm. Reprinted from *The Annals of Thoracic Surgery*, 97, Roselli EE, Abdel-Halim M, Johnston DR, et al, Open aortic repair after prior thoracic endovascular aortic repair, 750–757, Copyright (2014), with permission from Elsevier.¹

and aneurysm (Figure 3). As such, we will explain to our patients who are undergoing TEVAR for chronic dissection that the chances of them needing a later open repair may be as high as 25% to 30%.

RETROGRADE DISSECTION

This is an increasingly recognized and significant complication of TEVAR. In a large review, the incidence was nearly 2% and 3% to 8% in patients who were treated with TEVAR for chronic and acute aortic dissection, respectively.⁹ We reviewed our experience with retrograde dissection, and nearly all of the cases in this series occurred in patients with a history of previous aortic dissection. The key to saving these patients is timely diagnosis and transfer to a center where the techniques of hypothermic circulatory arrest are commonly practiced.

In our series of 15 patients, one died soon after arrival to the emergency department because she did not arrive in time to get to the operating room. The other 14 were treated with reverse frozen elephant trunk repair, with excellent

results (there were no deaths, two patients with respiratory failure, and no strokes, renal failure, or spinal cord injuries).¹⁰

CONCLUSION

The precise denominator is unclear because many of our patients who required conversion to open repair after TEVAR had their initial procedure at another institution. In our experience with more than 1,400 TEVAR procedures, a very small number (< 3%) have required conversion to open repair.

Although hospital survival has been good in our experience with open conversion after TEVAR, late survival was less than favorable, and 42% of patients required additional operations. Many of the late open and endovascular operations were performed for progression of aneurysmal degeneration either related to the presence of a chronic dissection or a known connective tissue disorder consistent with the progressive nature of extensive aortic aneurysmal disease.

Conversion to open repair after thoracic stent grafting may be indicated for type I endoleak, retrograde dissection, chronic aortic dissection with persistent false lumen perfusion and growth, or graft infection. These salvage operations are complex but can be completed safely with good early outcomes and preservation of the stent graft (hybrid repair) in most cases. Late outcomes are consistent with the chronic disease state of these patients. ■

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