

ASK THE EXPERTS

Acute TBAD: What Is Your Strategy Regarding Extent of Coverage and Use of Covered Versus Bare Stents?

Expert insight on treatment options for TBAD via TEVAR.

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Disclosures: None.

The introduction and rapid adoption of thoracic endovascular aortic repair (TEVAR) have resulted in a significant paradigm shift in the management of patients with acute type B aortic dissection (TBAD). For patients with a complicated presentation (eg, rupture and malperfusion), TEVAR has replaced open repair as the current standard of care. Patients with other complicated factors, such as uncontrolled pain and hypertension, benefit from TEVAR in addition to optimal medical therapy. There is a growing body of evidence supporting TEVAR for patients with uncomplicated

TBAD and imaging features that place them at high risk for subsequent aortic complications, such as aneurysm formation and rupture. Some of the most commonly implicated high-risk features include a total aortic diameter > 40 mm on presentation and a pressurized false lumen > 22 mm.

The coverage strategy during TEVAR is dictated by the indications for repair. For uncomplicated patients, coverage of the proximal entry tear down to the level of the diaphragm (zones 3, 4, and partially 5) is usually sufficient and achievable using a single long stent graft. The extent of aortic remodeling on follow-up imaging often correlates with the extent of coverage. The TEVAR segment often heals completely, but there is persistent flow into the false lumen of the residual distal aortic dissection. The benefits of aortic remodeling related to the extent of coverage must be balanced against the risk of paraplegia. The contribution of the T8 to T12 intercostal arteries is often significant, and sparing the segment above the celiac artery needs to be considered, when possible.

For complicated patients, the strategy is dictated by presentation. Patients with rupture often require coverage down to the level of the celiac artery. Any persistent

perfusion into the false lumen has to be addressed, including additional reentry tears in the abdominal aortic and iliac segments. A wide range of adjunctive procedures in the true and false lumen may be required to achieve complete false lumen thrombosis.

Patients with malperfusion often require additional intervention beyond simple aortic coverage with stent grafts. Although dynamic malperfusion is primarily addressed by closing the proximal tear and repressurizing the true lumen, static malperfusion (ie, extension of the dissection into an aortic branch) often requires

branch-specific intervention. Intravascular ultrasound is an invaluable adjunct imaging tool for guiding additional therapy. The recent introduction of bare aortic stents provides an additional tool in the armamentarium for those who treat these complicated patients. Early evidence in achieving complete aortic remodeling using bare stents in the distal abdominal aorta is very promising. Depending on the anatomic territory affected by the malperfusion, a combination of additional bare aortic stents and/or bare/covered stents for branches (mesenteric, renal, and iliac) may be required.



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When considering the best treatment modality for acute aortic dissection and associated acute aortic syndromes, it is essential to remember the fragility of the aorta after onset of the condition. This is reflected in the high mortality rate when untreated and the historically high mortality rate for open surgery. An endovascular approach has brought this condition more into the domain of vascular surgeons and interventionalists who may not have significant experience with it from the open surgery era. This has led to a sizable drop in perioperative mortality and morbidity but has also brought attention to a range of other potential problems, including retrograde type A dissection, rupture of the dissection flap distally, and the risk of neurologic complications.

The operating surgeon is responsible for proposing and executing the safest procedure during the acute phase that will achieve the main aim of early intervention: closing off the primary entry tear into the false lumen. Whatever the presenting problem is, that closure will usually lead to significant remodeling of the aorta, perhaps not back to baseline but enough to prevent further significant issues in the acute phase and longer.

Much of acute aortic dissection treatment involves a degree of compromise. We should not seek perfection in terms of imaging, remodeling, or aortic coverage. We should do the safest thing in the acute situation to get the patient out of the hospital alive with all limbs functioning.

In my practice there are four fundamental principles for endovascular management of acute dissection:

1. Use a covered stent and be very cautious with oversizing. The maximum oversizing I would allow is 10%, but I try to choose a covered stent graft with a diameter close to or only just above the maximum diameter of the aorta in the proximal landing zone.
2. Land in a long, healthy proximal neck. I want at least a 15-mm—preferably a 20-mm—landing zone, which almost always involves coverage of the left subclavian origin. I do not routinely revascularize the subclavian artery. Evidence suggests that the risk of neurologic complications in acute aortic syndromes with subclavian coverage is low. The decision not to revascularize, except in very selected cases, is a sensible compromise considering the fragility of the vessels and patients.
3. Extend the stent graft (using the same graft type as for the proximal piece) down to the origin of the celiac artery. Data suggest that more extensive coverage does provide better remodeling and fewer reinterventions, and I do not feel this significantly increases the risk of paraplegia in dissections. I am very cautious in the degree of oversizing of the distal stent graft component.
4. Be patient and allow the aorta to remodel. Sometimes you see immediate opening up of the true lumen and reduction of the false lumen diameter. In other cases, this takes time, and as long as the proximal entry tear has been covered, there is no evidence of malperfusion distally, and the imaging is otherwise satisfactory, I am very conservative in doing anything more in the acute situation. I would reserve the use of distal bare stents to cases in which there is distal malperfusion or rupture of the distal dissection flap. My concern in the acute situation is again the fragility of the vessels. In most cases, less is more when reducing the procedural risk in the acute phase.



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Despite multiple trials and registries studying the management of acute TBAD, the optimal treatment remains elusive. Although best medical management for decades has included aggressive blood pressure control and serial imaging to assess aneurysmal degeneration, several series have confirmed that the goal of false lumen thrombosis is achieved more frequently with TEVAR to cover at least the proximal entry tear.¹ The potential advantages of TEVAR include reduced overall mortality, dissection-related mortality, and aortic rupture, but there is also a higher risk of retrograde type A dissection and a higher rate of aortic reintervention.²

The risk of retrograde dissection can be reduced by delaying TEVAR until the subacute stage (15–92 days). However, the need for future aortic reintervention is difficult to predict. Because the goal of TEVAR is thrombosis or collapse of the false lumen—ideally with subsequent remodeling of the aorta distally—many patients may be successfully treated with 10- to 15-cm-long covered stents extending from the subclavian artery (or left carotid with or without left carotid-subclavian revascularization). In straightforward TBAD with a single proxi-

mal entry tear, minimal coverage can be effective with fewer complications. Shorter thoracic aortic coverage is associated with decreased risk of spinal cord ischemia and is particularly indicated in patients with previous abdominal aortic grafts, occluded internal iliac arteries, or a requirement for subclavian artery coverage without revascularization. Longer stents (≥ 20 cm) or multiple stents may increase the risk of intraluminal thrombus, complicate future distal aneurysm treatment, or cause type III endoleaks.

Patients with obvious secondary or multiple entry tears may need more extensive aortic coverage with covered stents. Although the entire thoracic aorta can be covered, excluding the thoracic aorta at the diaphragm increases the risk of spinal cord ischemia, even with the use of spinal cord drainage. In select cases where the true lumen is collapsed but there are no obvious entry tears, bare dissection stents are indicated to expand the lumen without excluding the anterior spinal artery. These bare stents may complicate staged treatment of complex abdominal aneurysms or dissection, so they should be used judiciously in patients with extensive aortic disease and avoided in young patients (< 55 years) or those with possible connective tissue disease.

In summary, the optimal strategy based on available current literature of large registry data for endovascular management of TBAD is to place the shortest covered stent possible to cover entry tears during the subacute period (15–92 days). Longer aortic coverage and bare dissection stents should be used selectively with consideration of long-term consequences and risk of paralysis.

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This question depends on the presentation of the patient. In the setting of “complicated” TBAD, I manage rupture and malperfusion differently. Patients present-

ing with rupture need to minimize false lumen flow immediately. Entry tear coverage is a good start; however, false lumen flow can persist within and beyond the stent grafted segment, either through distal fenestrations in the septum or reentry flow through the visceral and iliac vessels. To minimize thoracic septal fenestrations and flap mobility—which can enable persistent false lumen flow—after coverage of the primary entry tear, I extend TEVAR down to the celiac artery to promote as much stagnant flow within the false lumen as I can. In this particular situation, I will not add a bare-metal stent (BMS) immediately unless there is concomitant malperfusion. Postoperatively, I will obtain a CTA before discharge and then again at 1 and 3 months. If aortic growth is > 0.5 cm, I will add a BMS to influence

positive remodeling for easier subsequent intervention to treat aneurysmal degeneration. If there is still persistent false lumen flow adjacent to the rupture, noticed either intraoperatively or postoperatively, I will employ direct false lumen adjuncts such as coil embolization, plugs, or additional exclusion of distal reentry flow with covered stents.

In the setting of malperfusion, I exclude the entry tear while minimizing the extent of thoracic coverage (150 mm) and follow with a BMS to the level of the aortic bifurcation or end of the dissection within the aorta. Data from STABLE I very clearly demonstrate reproducible low mortality (5.5%) and paraplegia rates (1.8%) using this management strategy.^{1,2} I do not overlap the BMSs across the visceral segment because this may result in more difficult secondary interventions if/when needed.

I very rarely perform any false lumen adjuncts at the time of initial management, particularly in the acute setting. Getting the patient out of trouble and living to fight another day is my main goal. I want to allow the bare metal to remodel the aorta and monitor closely. If significant aortic growth is found at the 3-month interval, then you are positioned well to manage the false lumen with a simple endovascular intervention through what now is equivalent to an in situ fenestrated endograft. Direct false lumen adjuncts, endografts, and covered stents are then available in the subacute and chronic setting with much less risk of stroke and retrograde dissection.

1. Lombardi JV, Cambria RP, Nienaber CA, et al. Prospective multicenter clinical trial (STABLE) on the endovascular treatment of complicated type B aortic dissection using a composite device design. *J Vasc Surg.* 2012;55:629-640.e2.

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In the last 2 decades, TEVAR has emerged as the treatment of choice for complicated acute TBAD. These procedures can be offered with much better initial results than open surgery and have the potential to solve critical situations such as malperfusion or impending rupture. More recently, bare stents with a low radial force specifically designed for this purpose have been used distally with a fabric-covered stent graft to improve the expansion of the true lumen. This technique is commonly referred to as PETTICOAT and has shown promising initial results; however, the natural history of the aorta after TEVAR (with or without PETTICOAT) performed for TBAD is still not completely clear. Data recently gathered from systematic reviews and registries concluded that TEVAR for TBAD does not prevent subsequent aneurysmal degeneration of the thoracic or abdominal aorta, and this carries an increased risk of death.

Of the several potential mechanisms that have been advocated to explain aneurysmal degeneration of the dissected aorta, one that seems to fit with the clinical and experimental findings is related to a situation in which the false lumen is a channel parallel to the true lumen that is pressurized simultaneously but has a restricted outflow in diastole. (This situation is similar to type I endoleak during EVAR.) A consequence of this concept is that to prevent aneurysmal degeneration of the dissected aorta—as an alternative to the induction of complete thrombosis of the false lumen—one can pursue the creation of unrestricted flow in the two lumens or, even better, the restitution of a single-channeled vessel. The latter has been obtained clinically via the STABILISE technique. Regular covered endografts are used proximally in the thoracic aorta and low radial force BMSs are used more distally and down to the aortic bifurcation. The true lumen is then ballooned to intentionally disrupt the dissection lamella and obtain a single-channeled aorta. Many technical subtleties are needed to perform this technique safely and effectively; however, the most important precaution is to use compliant balloons only at the level of the covered endografts and noncompliant balloons no larger than the whole aorta at the level of the bare stents.

The need for a treatment that not only fulfills the requirements of patients in the acute and subacute phase but also prevents their aortas from undergoing aneurysmal dilatation is evident, and the STABILISE technique is emerging as a valuable option. ■