

Deciding Factors for Treating Complicated Aortic Dissection

Evaluating aortic dissection and knowing when and how to intervene.

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Acute type B aortic dissection is defined by the development of a new intimal tear distal to the origin of the left subclavian artery. Patients with these dissections typically present with the onset of sharp back pain or abdominal pain, and these dissections are frequently associated with complicating features. Acute type B dissection may be complicated by either malperfusion of the distal arterial beds or rupture. The overall mortality rate of acute type B aortic dissection is between 5% and 10%. The majority of morbidity and mortality related to acute type B dissection occurs in the context of malperfusion syndromes or rupture, which complicate 25% to 50% of all type B aortic dissections. In the International Registry of Aortic Dissection, in a cohort of more than 1,000 patients, approximately one-third of the patients had some form of malperfusion by clinical signs and symptoms, and 43% were considered complicated.¹ Malperfusion occurs as a result of either sheering off or impingement of the branches of the aorta, or from severe compression of the true lumen of the aorta causing a pseudocoarctation-type physiology. In situations in which aortic branches are sheared off by the dissection flap, the entire flow into the distal vessel may be from the false channel.

EVALUATING ACUTE TYPE B AORTIC DISSECTION

We advocate an algorithmic approach to triage assessment and management of acute type B aortic dissections.² An efficient transfer system to rapidly move patients out of local emergency rooms to major aortic centers with robust multidisciplinary aortic teams is fundamentally important to improving the mortality outcomes in these patients. Direct communication should occur

between the accepting surgeon and the referring physician with detailed description of the patient's clinical status and review of the imaging. In cases of suspected life-threatening organ or limb malperfusion or cases of rupture, patients should be rapidly transferred directly to a hybrid operating room or interventional suite for diagnostic assessment and treatment. Patients without these higher-risk features should be medically stabilized and transferred to an intensive care unit with appropriate level of experience in managing dissection patients. The use of a hybrid operating room or interventional suite as a diagnostic and treatment facility minimizes unnecessary patient transfers within the hospital and ensures timely definitive treatment. In cases in which the diagnostic imaging is inadequate to either make a definitive diagnosis or plan treatment, rapid repeat CT angiography or contrast MRI should be performed, even if the patient has had a previous dye load.

THE DECISION TO INTERVENE IN COMPLICATED TYPE B DISSECTION

Within the realm of complicated acute type B dissections there, is a gradient of anatomic risk that drives decision making for intervention. The majority of patients with type B aortic dissection will show at least some angiographic suggestion of true lumen compression or branch vessel malperfusion. A patient presenting with occlusion or severe compromise of the patency of the celiac artery or superior mesenteric artery with abdominal pain represents a surgical emergency that requires intervention. All spinal malperfusion requires intervention to prevent permanent paralysis. Lower extremity malperfusion with associated limb-threatening ischemia also



Figure 1. Treatment of a type B dissection with malperfusion with TEVAR. A predeployment aortogram demonstrates acute type B aortic dissection (A). A postdeployment aortogram showing expansion of the true lumen and obliteration of the false lumen (B). Reproduced with permission from: Szeto WY, McGarvey M, Pochettino A, et al. Results of a new surgical paradigm: endovascular repair for acute complicated type B aortic dissection. *Ann Thorac Surg.* 2008;86:87-93.²

requires emergent intervention. Renal malperfusion may affect one or both renal arteries. High-quality CT angiography with delayed imaging provides a good picture of the true perfusion status of the kidneys. Duplex ultrasonography is also helpful to characterize renal perfusion.

The aggregate function of both kidneys must be considered before deciding to intervene for this indication. Renal malperfusion as a sole problem without other visceral or limb malperfusion is generally not an indication for an emergent intervention. The presence of ongoing persistent hypertension and rising creatinine with imaging suggesting poor renal perfusion may eventually require intervention, which can be done on a nonemergent basis. A severely compressed true lumen within the aorta itself, without true branch vessel compromise, may also cause low-grade distal malperfusion and, in rare situations, there can be complete obstruction of distal flow, which would require emergent intervention.

In a recent study of five physician-sponsored investigational device exemption clinical trials among patients who underwent treatment of acute type B aortic dissection with thoracic aortic stent grafting, 31.8% had a rupture, and 71.8% had malperfusion—including 56% lower extremity, 36% renal, 20% visceral, 3% spinal cord, and 8% other forms of malperfusion.³

TREATMENT MODALITIES

The mainstay therapy for uncomplicated type B aortic dissection is blood pressure control, primarily with beta-

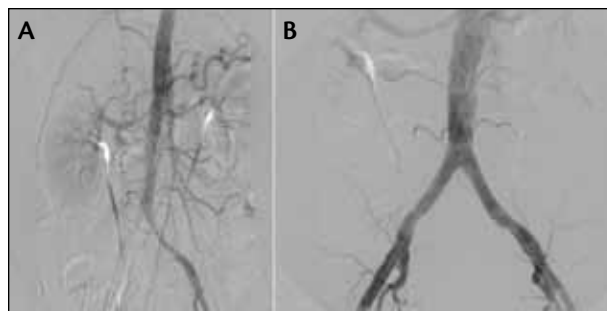


Figure 2. Management of distal malperfusion with adjunctive stenting. Intraoperative infrarenal aortogram showing malperfusion of the right lower extremity (A) and expansion of the true lumen after deployment of infrarenal aortic and bilateral iliac bare-metal stents (B). Reproduced with permission from: Szeto WY, McGarvey M, Pochettino A, et al. Results of a new surgical paradigm: endovascular repair for acute complicated type B aortic dissection. *Ann Thorac Surg.* 2008;86:87-93.²

blocking agents and intravenous vasodilators. Patients with complications but without life-threatening malperfusion or rupture should also be initially stabilized with this approach. Among patients with complicated type B aortic dissections who require urgent intervention, thoracic endovascular aortic repair (TEVAR) has revolutionized the treatment of these patients and dramatically improved outcomes versus other therapies. In the United States, the only TEVAR device approved for use in complicated type B dissection is the Conformable Gore TAG device (Gore & Associates, Flagstaff, AZ), which gained approval for the indication in September 2013. Patients with malperfusion syndromes are typically treated with placement of a stent graft to cover the intimal tear and the proximal one-third to one-half of the descending thoracic aorta (Figure 1). At this point, angiography is performed to determine if simply covering the entry tear has re-established perfusion to the malperfused arterial territory.

Adjunctive placement of stents into the visceral or branch vessels is performed when the true lumen appears to be wide open in the distal aorta beyond the stent graft but there continues to be a branch malperfusion (Figure 2). If there is still severe compression of the true lumen, a second thoracic aortic stent graft is placed and may be extended down to the level of the celiac takeoff to fully open the true lumen. In cases of rupture, the standard therapy is full descending aortic coverage from the proximal entry site to the level of the celiac. Invariably, due to the location of the primary entry tear, the origin of the left subclavian artery needs to be at least partially covered.



Figure 3. Patterns of aortic remodeling after TEVAR. A CT angiogram showing complete thrombosis and obliteration of the false lumen in the entire thoracoabdominal aorta (A, B), thrombosis and obliteration of the false lumen in the thoracic aorta but a patent false lumen in the abdominal aorta (C, D), and a patent false lumen in the entire thoracoabdominal aorta (E, F). Reproduced with permission from: Zeeshan A, Woo EY, Bavaria JE, et al. Thoracic endovascular aortic repair for acute complicated type B aortic dissection: superiority relative to conventional open surgical and medical therapy. *J Thorac Cardiovasc Surg.* 2010;140(suppl):S109-15; discussion S142-S146.⁵

When performing TEVAR, careful review of preoperative imaging is required to determine the most appropriate femoral artery for access. This is exposed and cannulated using the Seldinger technique. A soft wire is then extended into the aortic arch proximal to the tear site. The location of the wire in complex dissection cases may need to be closely verified with the location of the true lumen on the CT scan. In the early stages of achieving wire access into the aortic arch, transesophageal echocardiography may also be extremely helpful in assessing the aorta and the location of the wire. The wire is then exchanged for a stiffer wire, and intravascular ultrasound is performed to verify the location of the wire within the true lumen through its entire course. It is particularly dangerous for the wire to weave in and out of the true and false lumens because deployment of a stent graft in this situation may cause inadvertent aortic fenestration, aortic rupture, or deployment of

the stent graft in the wrong lumen. Once the stiff wire is verified to be in the true lumen throughout its course and advanced into the ascending aorta, the TEVAR device is positioned to cover the entry tear. The graft is deployed, allowing at least 2 cm of proximal landing zone proximal to the primary entry tear. Sealing the entry tear usually requires coverage of the left subclavian artery. Once the graft is deployed, repeat angiography is performed, and additional stent grafts are placed in the aorta, or stents are placed in the branch vessels as needed. Newer technology, such as the TX2 dissection system (Cook Medical, Bloomington, IN) employs bare-metal stents with low radial force that may be placed across the visceral segment to fully expand the true lumen.

In rare cases in which open surgery is required, visceral malperfusion can be treated with a short segment of graft in the descending aorta to re-establish the true lumen. Extra-anatomic bypasses may also be employed to re-establish flow to the viscera and, in particular, to the lower extremities using a femoral artery-to-femoral artery bypass, or even a right axillary artery-to-femoral bypass in rare cases. Malperfusion may also be treated with fenestration, although this approach is most often used in cases in which TEVAR and adjunctive branch vessel stenting is not feasible or has failed. It is particularly useful in cases of spinal malperfusion because TEVAR will not likely reestablish flow to the intercostal arteries. Fenestration may be performed either with open surgical technique or with endovascular approaches. In experienced hands, endovascular fenestration employed as a primary strategy for malperfusion has shown excellent results.⁴

RESULTS OF TEVAR FOR COMPLICATED TYPE B DISSECTION

In a recent study from our institution of 147 acute type B dissection patients, 77 presented with rupture or malperfusion complications.⁵ Among these, 45 underwent emergent TEVAR, and 32 underwent traditional open surgical therapy or received medical management. Mortality was dramatically reduced with TEVAR, with an overall 30-day mortality rate of 4% in the TEVAR group, 40% in the surgical group, and 33% in the medical management group. Positive aortic remodeling occurred in 77% of patients, with complete thrombosis of the false lumen in the descending thoracic aorta at the level of the endograft (Figure 2). Among these, complete aortic remodeling with thrombosis of the false lumen of the entire thoracoabdominal aorta was seen in 28% of patients, and thrombosis of the false lumen at the level of the stent graft with persistent false lumen patency below the stent graft was seen in 49% of patients. In the remaining 23% of patients, persistent patent false lumen in the entire thoracoabdominal aorta was observed.

RETROGRADE DISSECTION

Retrograde extension of a de novo dissection flap into the proximal arch and ascending aorta (ie, retrograde type A dissection) is a devastating complication that generally requires urgent or emergent open surgical repair depending on presentation (Figure 3). Retrograde type A dissection occurs in 2% to 10% of TEVARs for complicated type B dissection and carries a significant mortality rate. We have recently reported our experience with this complication in a series of more than 75 emergent TEVARs for acute complicated type B dissection. We demonstrated a retrograde dissection rate of more than 5%, although several of these were focal arch dissections that did not require reintervention.⁶ The overall mortality rate for TEVAR patients who developed retrograde type A dissection was 18%. The frequency of retrograde dissection should temper enthusiasm for very early intervention in patients who can be initially stabilized medically. For non-life-threatening malperfusion, such as renal malperfusion or severely compressed aortic true lumen without overt branch vessel compromise, we advocate waiting at least 7 days from symptom onset to intervention to allow the aorta to heal somewhat before manipulation.

To date, most TEVAR devices have been designed primarily to treat stable aneurysmal pathology, not dissection or other complex indications. As such, aggressive oversizing, more rigid devices, the presence of protruding bare-metal springs or barbs, and high radial force, particularly in the proximal seal zone, all designed

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for anchoring proximally in aneurysmal pathology, are potential causes of retrograde dissection in the acute phase.

CONCLUSION

Complicated acute type B dissection is frequently a surgical emergency that requires management by an experienced interdisciplinary team. TEVAR has revolutionized the treatment of cases of severe malperfusion or rupture versus open techniques or medical management and may also provide significant beneficial remodeling of the aorta to prevent future aortic dilatation. Extension of TEVAR to treating uncomplicated type B aortic dissections will require completion of ongoing clinical trials to determine safety and efficacy. ■

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