J.J. Naoum, M.D.

CHANGING PARADIGM IN ENDOVASCULAR TREATMENT OF DESCENDING THORACIC AORTIC DISSECTIONS

Joseph J. Naoum, M.D.; Michael J. Reardon, M.D.;
Mark G. Davies, M.D., Ph.D., M.B.A.

Methodist DeBakey Heart & Vascular Center, The Methodist Hospital, Houston, Texas

Abstract

Descending thoracic dissections originating distal to the origin of the left subclavian artery carry a significant mortality if left untreated. Past thinking advocated avoiding surgical treatment of acute Stanford type B or DeBakey type III dissections, reserving therapy for chronic dissections over 14 days to a month after presentation.[1] The current evolution of endovascular devices for the treatment of thoracic aneurysms has proven helpful in treating this pathology in a less invasive manner when compared to open surgical repair. The paradigm for treatment has evolved beyond the nature of the timing of the dissection: the current trend for treatment considers clinical findings and the development of complications. Complicated dissections include those that have developed aneurysmal dilatation >5.5 or 6 cm, organ or distal limb malperfusion, aortic rupture, uncontrolled hypertension even after adequate medical therapy, and persistent pain including rapid expansion of the affected aorta, among others (Table 1).[2-5] This article reports on the current paradigm involving thoracic endovascular aortic repair (TEVAR) of Stanford type B or DeBakey type III dissections.

Criteria for complicated descending thoracic aortic dissections
Rupture
Malperfusion
Aneurysmal degeneration
Rapid aortic expansion/dilatation
Uncontrolled hypertension on adequate medical therapy
Persistent pain attributed to the dissection

Table 1. Criteria for complicated descending thoracic aortic dissections.

Uncomplicated Descending Thoracic Aortic Dissection

Xu and associates evaluated their experience in treating 84 patients with chronic aortic dissection with endovascular stent grafting.[1] Only 3 patients were complicated and presenting with rupture. The entry tear was sealed in 91.7% of patients. Three patients died of rupture of the thoracic aorta because of endoleak, and when present, this accounted for 42% of the deaths. At 5 years, 75.2% of patients were alive without an endoleak or the need for any additional endovascular or surgical intervention. The authors suggest that with increased surgical experience and refinement of the stent grafts, results are expected to improve.

The INvestigation of STEnt Grafts in Patients With Type B Aortic Dissection (INSTEAD) trial prospectively enrolled 140 patients with a stable, uncomplicated type B dissection, and subjects were randomly assigned to be treated with stent graft placement and optimal medical therapy or to optimal medical therapy and surveillance.[6] Patients were considered unsuitable for randomization in the presence of acute complications or thoracic aortic diameter ≥6 cm. Notably, from 597 patients screened, only 140 met randomization criteria. Cumulative 1-year survival was 97% ± 3.4% with optimal therapy and 91.3% ± 2.1% with endovascular aortic repair. Aortic expansion >6 cm was more prevalent with medical treatment and was followed by crossover to TEVAR in 11.2% of patients and conversion to open repair in 4.4% of patients, accounting for a 15.6% conversion rate overall. Stent graft placement was associated with a 92.6% complete false lumen thrombosis and morphologic evidence of aortic remodeling that reached significance.

The INSTEAD trial revealed that the structural and morphologic remodeling associated with prophylactic TEVAR in uncomplicated patients did not improve survival compared to optimal medical therapy and careful surveillance at either 1 or 2 years.[6,7] For an

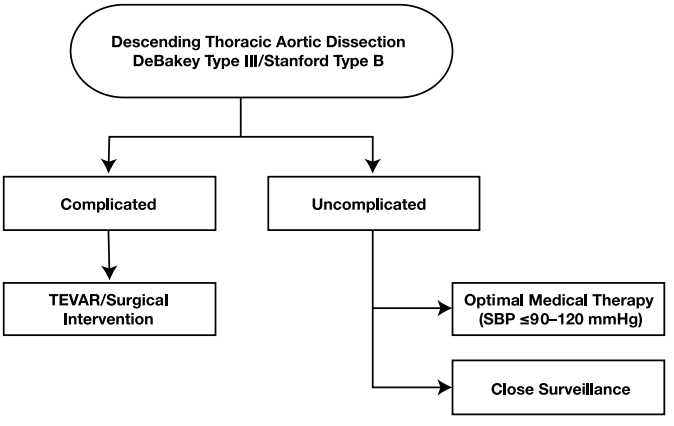

Figure 1. Basic algorithm for the treatment of descending thoracic aortic dissections.

uncomplicated descending aortic dissection, medical management has an excellent outcome as long as surveillance is used to identify progression of aortic disease and any complications that will then necessitate surgical intervention (Figure 1).

This data provides evidence that supports the treatment of uncomplicated Type III aortic dissection with optimal blood pressure control with an SBP ≤90-120 mmHg and with additional careful surveillance at 3- to 6-month intervals to identify potential complications.[7, 8]

Complicated Descending Thoracic Aortic Dissection

In a report by Pearce and colleagues,[9] 127 patients were treated with TEVAR for a type III thoracic aortic dissection; of those, 15 patients had a complicated and acute presentation. Indications for repair in the latter group included malperfusion in 53% of patients, persistent pain in 27%, and aortic failure in 33%. Malperfusion resolved in 80% of patients. Overall 30-day complications occurred in 46.7% and were associated with 13.3% mortality, 13.3% paraplegia, and 13.3% renal failure needing hemodialysis. The authors stressed that the intent of intervention was the stabilization of the true lumen and correction of malperfusion. During follow-up, they observed the successful exclusion of the entry flap and thrombosis of the false lumen. Interestingly, this was not associated with a reduction in the overall aortic size, a finding that is in contrast with a reported 71% decrease in aortic size observed with TEVAR in the treatment of complicated chronic dissections.[10]

Steuer and associates investigated the early and long-term outcomes of TEVAR for complicated type III dissections.[11] A retrospective review was carried out in 50 patients with acute complicated aortic dissection and in an additional 10 patients with complications >14 days after the onset of symptoms. Complications included rupture, end-organ ischemia, and acute dilatation. Within 30 days, these 60 patients had a 3% mortality rate, a 2% incidence of paraplegia, and a 5% stroke rate. Five-year survival and freedom from reintervention were 87% and 65%, respectively. The authors concluded that for acute complicated type B aortic dissection, TEVAR can be performed with excellent survival. However, its morbidity and durability still need further evaluation.

A complicated acute type B aortic dissection requires early intervention. Rakhlin and associates utilized TEVAR to treat 26 patients with malperfusion, 22 patients with rupture, and 17 patients with both complications as a result of an acute aortic Type B dissection.[12] Thoracic endografting alone was successful in treating 95% of patients with thoracic aortic rupture while being effective only in 58% of cases of malperfusion. In the latter group, 42% required additional adjunctive procedures to restore end-organ perfusion, predominantly to the lower extremity in 50%. While TEVAR alone was sufficient to manage aortic disruption in patients with rupture, additional procedures were necessary in cases with malperfusion. This suggests that endovascular therapy must be tailored to each patient presentation in order to achieve improved results.

In a similar study by Szeto and colleagues, 35 patients were treated with TEVAR for acute complicated Type B aortic dissection.[2] Rupture was present in 18 patients and malperfusion in 17. The primary tear site was successfully covered in 97.1% of patients. Coverage of the left subclavian artery was needed in 71.4% of patients. In cases of malperfusion, adjunctive procedures were necessary in 88.2%. Thirty-day mortality was 2.8%, while 1-year survival reached 93.4% ± 4.6%. Renal failure, stroke, and permanent spinal cord ischemia each occurred in 2.8% of patients and vascular access complications in 14.2%. Length of hospital stay was greater in patients with malperfusion compared to patients presenting with rupture. However, another report has shown a 16% 30-day mortality associated with TEVAR in the treatment of acute complicated aortic dissection in which 79% of patients had either malperfusion or rupture.[4]

The indications for treatment of acute aortic dissections usually involve rupture, malperfusion, and in fewer instances persistent and uncontrolled hypertension. Complications in chronic dissections usually involve aneurysmal degeneration or progression, even though rupture and malperfusion can still occur. Parsa and colleagues published their mid-term results using TEVAR for the treatment of complicated acute and chronic type B aortic dissections.[10] Their definition of acuteness was the 2-week mark after onset of symptoms. The 30-day mortality and paraplegia or paresis were both at 2%. Endoleaks were present in 21% of patients, and 23.4% required reintervention with distal endografting extension for downstream dilatation. As a result, the authors recommend that in chronic complicated dissections, the endograft should be extended up to the celiac axis.

The goals of TEVAR in complicated aortic dissection are to achieve coverage of the proximal aortic primary tear to allow expansion of the true lumen and the concomitant thrombosis or obliteration of the false lumen (Figure 2). The end result is to re-establish adequate flow through the aorta and distal end-organ or limb perfusion.[2, 8, 9, 13]

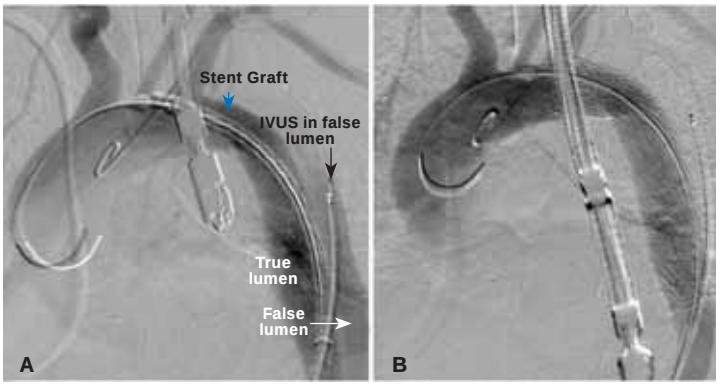

Figure 2. Treatment of a complicated aortic dissection. (A) Arteriogram before stent graft deployment showing perfusion of the false and true lumen. (B) Arteriogram following successful stent graft deployment with coverage of the proximal aortic primary tear, expansion of the true lumen, and lack of perfusion of the false lumen.

Aortic Remodeling Following TEVAR

Thrombosis of the false lumen is expected to lead to its eventual shrinkage and obliteration. Its effects are believed to stabilize the dissected aorta and allow for its remodeling.[13, 14] In the INSTEAD trial,[6] the process of false lumen thrombosis in the aorta was enhanced with TEVAR, achieving 92.6% complete thrombosis and morphologic evidence of aortic remodeling confirmed by radiographic imaging at one year. This intuitive concept does not always hold true, thus highlighting the fact that multiple factors come into play. Pearce and colleagues showed that even with persistent exclusion of the entry flap and consistent thrombosis of the thoracic lumen in their patients, reduction of the overall aortic size was not observed during an 11 ± 6-month follow-up.[9]

Patency of the false lumen is a major factor affecting the natural progression of the aorta, whether treated with TEVAR or medical therapy. With failure to thrombose, the false lumen will maintain blood flow and lead to malperfusion, rupture, aneurysmal dilatation, and compression of the true lumen, even if treated with

a stent graft. Thus, the presence of an endoleak can correlate with increased mortality and rupture.[1]

In contrast to TEVAR treatment of descending aortic dissections, optimal medical treatment alone failed to demonstrate expansion of the true lumen or shrinkage of the false lumen, leading to aortic expansion >6 cm in 15.6% of patients.[6, 7] In addition, it has been associated with 13.7% mortality.[15] However, ruptures have still been observed in the face of false lumen thrombosis in 22.6% of medically treated patients and in 31.6% of patients who experienced partial thrombosis.[15] It is possible that aortic thrombus diminishes nourishment to the vessel wall, thus weakening it in the setting of increasing radial pressure in the former case.[16] Formation of partial thrombus leads to flow obstruction in the false lumen, increasing the existing pressure in that channel and possibly leading to rupture.[2, 13]

Conclusions

Our current understanding of descending aortic dissections should now lead us to shift our thinking from acute and chronic dissections to the concept of complicated and uncomplicated dissections. The timing in which the dissection occurs is important; however, surgical or endovascular treatment should be guided by the presence of symptoms rather than by the existence of the dissection alone. In uncomplicated cases, medical management is optimal. Endovascular treatment of descending aortic dissections has emerged as a less invasive and promising tool to combat this condition in symptomatic patients with an otherwise near-lethal disease.

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