Endovascular Stent Graft Treatment of Aortic Dissection

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Aortic dissection is the second most common investigational application of thoracic stent graft technology. The concept of endovascular stent graft repair of aortic dissection is predicated on successful placement of the device over the primary entry tear to obliterate blood flow into the false lumen. The intent is to mimic the effect of successful operative repair with isolation of the false lumen from the circulation and redirection of blood flow into the true lumen. As demonstrated in experimental models of dissection, coverage of the primary entry tear is the optimal method of relieving true lumen collapse and concomitantly promotes thrombosis of the false lumen. Interestingly, dissections with naturally thrombosed false lumen are associated with improved prognosis. False lumen patency, in contrast, contributes to progressive aortic dilatation and is a predictor of late mortality.

In the typical type B dissection case, progressive thrombosis proceeds distally, irrespective of the location of the primary intimal disruption. The tempo of false lumen thrombosis is variable and influenced by several factors such as the size of the false lumen and amount of residual false lumen flow via uncovered additional tears. Over time, the false lumen thrombus consolidates and the dissection lumen itself resolves. Besides such gains in aortic remodeling, this endovascular surrogate for open surgery confers additional benefits: the reversal of downstream branch vessel ischemia (particularly in patients with dynamic obstruction) and protection against thoracic false lumen aneurysm formation. In acute dissection, the reversal of dynamic obstruction occurs expeditiously after stent graft placement.

Clinical evaluation of stent grafts for the treatment of patients with complicated and uncomplicated acute type B dissection, a select subset of type A dissection, as well as chronic dissection with false lumen aneurysm formation are currently ongoing at a growing number of institutions around the world. Applications are limited to dissections with entry tears distal to the left subclavian artery. Initial results are encouraging. Unfortunately, as with that of TAA, the literature for aortic dissection often mixes outcomes from applications in different clinical contexts in terms of age of dissection, extent of disease, and presence of complications. Nonetheless, valuable lessons from this early experience have served to fuel progress in our understanding of the disease process as well as its management by less invasive means.

Although there is a general consensus that acute type B dissection should be managed medically with surgical treatment reserved for cases with complications, the intermediate and long-term outcomes resulting from this treatment paradigm remain unsatisfactory. The mortality rate among patients treated medically alone ranges from 11 to 20%. Furthermore, such patients are at continued long-term risk of aneurysm formation and rupture. Mortality among type B patients treated surgically ranges from 30 to 35% and is significantly worse for those complicated by end-organ ischemia.

Our group recently studied the use of thoracic stent grafts among 15 complicated acute type B and 4 retrograde type A dissection patients at Stanford and Mie University School of Medicine in Japan. Eleven of these patients exhibited symptomatic branch vessel obstruction. The primary entry tear was sealed in 95% of cases, with associated complete and partial thrombosis of the thoracic false lumen in 79% and 21% of patients, respectively. In all cases, true lumen expansion occurred immediately but no aneurysmal expansion or rupture was found on follow-up. More impressively, follow-up imaging found complete false lumen resolution and no residual evidence of dissection in six cases. Thirty-day mortality was 16% with no additional deaths during a mean follow-up of 13 months.

Hutschala and colleagues have also explored the use of stent grafts in a cohort of acute type B patients who were without indications for surgery and found similar outcomes. In light of these results, the INSTEAD (Investigation of Stent Grafts in Patients with type B Aortic Dissection), a prospective, multicenter, randomized, controlled clinical study, is underway to compare the 1-year outcome of type B aortic dissection treated by stent graft placement versus conventional antihypertensive therapy.

Endovascular stent graft treatment of aortic dissections offers the additional benefit of relieving dynamic branch vessel obstruction. In our 1999 study of acute dissection patients, 11 patients presented with symptomatic branch vessel obstruction involving 38 infradiaphragmatic vascular beds. Of these, 22 were obstructed exclusively by a dynamic process, 15 by both dynamic and static mechanisms, and 1 by static obstruction alone. After stent graft placement, all 22 of the branch vessels with exclusively dynamic obstruction and the 15 arteries with combined dynamic and static involvement were immediately reperfused. Adjunctive endovascular procedures were used to relieve persistent ischemia in the remaining obstructed cases. Upon review of the literature across multiple subtypes of aortic dissection, it is clear that successful entry closure was possible in 85 to 100% of cases. Since most primary entry tears in the descending aorta begin immediately distal to the left subclavian artery, adequate proximal anchoring of the device may be difficult. In several studies, anatomic selection criterion for minimum distance between entry tear and subclavian artery origin was set at 5 mm. Intentional coverage of the left subclavian origin with expectant management was commonly used in these studies. Alternatively, a device with a proximal segment consisting of a bare stent can be placed across the left subclavian artery to maximize the length of the graft contact with the aortic wall prior to the tear. However, in other settings, where there is a retrograde proximal extension of the dissection from the tear to the subclavian artery, it may be necessary to place the graft over the branch with its leading margin between the left carotid and subclavian arteries. In addition to carefully monitoring the patient postprocedure for ischemic symptoms referable to the covered left

subclavian, it is important to carefully image the thoracic aorta to exclude persistent perfusion of the false lumen via retrograde subclavian flow around the device. In parallel, successful entry tear coverage induced complete or partial thoracic false lumen thrombosis in 85 to 100% of patients, even in the settings of chronic and retrograde type A dissections. Partial thrombosis of the false lumen can still be advantageous and protect the false lumen from enlarging over time since systemic blood pressure is no longer directly transmitted through the primary entry tear. The age of the disease process may play a role in the degree of false lumen thrombosis; it has been found to be most pronounced in those dissections treated within 6 months of presentation. True lumen expansion and partial or full false lumen resolution was noted in several studies.

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