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Distal Extent of Resection in Type A Dissection: Keeping It Simple

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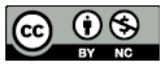

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Introduction

Type A aortic dissection is a surgical emergency that most cardiac surgeons working with adult patients must manage. Tertiary centers of excellence or aortic reference centers offer some relief to the general cardiac surgeon who may address aortic pathologies only rarely, but there are always patients who cannot be transferred and must be treated at the center of initial presentation. In recent years, experienced aortic surgeons have supported a more aggressive approach to the distal extent of resection. In most circumstances, however, a "simple" approach is appropriate to best ensure operative survival, and patient adherence to optimal medical therapy postoperatively reduces the need for late reoperation on the remaining aorta.

The most important goal of surgical treatment in acute type A aortic dissection is to address the impending causes of early death from aortic rupture with tamponade, coronary malperfusion, severe aortic regurgitation with left ventricular failure, and distal malperfusion with end-organ compromise. Secondary goals addressing the distal extent of resection include resecting the primary tear, when visible, and restoring distal true lumen flow to eliminate or limit false lumen flow. These factors contribute to positive remodeling of the distal aorta and decrease the risk of chronic descending and thoracoabdominal aneurysm formation as well as the need for subsequent reoperation. An approach to the treatment of aortic dissection has previously been outlined, noting that each patient is unique.[1] Each surgeon and surgical center is also unique regarding their experience with aortic surgery. Often, the best approach for general cardiac surgeons is to "get in and get out" to save the life of the patient, leaving complex distal reconstructions, if needed, to more experienced centers.[2] Drs Ouzounian and David[3] from Toronto note that "the general cardiac surgeon with limited aortic experience should perform the standard operation and save the patient's life." Dr Coselli[4] has also concluded that, "In this intrinsically complex disease, survival is the most important outcome"—more so than avoidance of or preparation for a second intervention. The selected operative approach should reflect the surgeon's experience because extending the operation beyond one's level of expertise can substantially increase risks of morbidity and mortality. This article focuses on a reproducible approach to the extent of distal resection and reviews the pros and cons of extending the resection beyond the hemiarch.

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Extent of Distal Resection

Outcomes with resection of the ascending aorta only vs outcomes with the hemiarch have previously been examined.[5-8] Rates of operative survival were similar, but the risk of late reoperation appeared to be lower with the hemiarch replacement strategy,[5,6] especially for anterior reoperation for dilation of the residual ascending aorta or arch, which was more common in patients undergoing ascending aorta replacement only (8% of survivors) than in patients undergoing hemiarch replacement (0% of survivors).[5] Distal late reoperation was most common in patients with an unresected primary tear, a connective tissue disorder, elevated systolic blood pressure (SBP) at late follow-up, and who were not taking a β-blocker.[7] Aortic reoperation at 10 years was necessary in 8% of patients with an SBP lower than 120 mm Hg at late follow-up compared with 26% of patients with an SBP between 120 mm Hg and 140 mm Hg and 51% of patients with an SBP greater than 140 mm Hg ($P<.001$). Reoperation was necessary in 43% of patients not taking a β-blocker compared with 14% of patients taking a β-blocker ($P<.001$).[8]

Sixty-nine patients were followed-up with serial computed tomography (CT) imaging to evaluate aortic growth and false lumen patency.[7] A total of 412 scans were reviewed, with a mean (SD) value of 6 (5) scans per patient (range, 2-25). The mean (SD) time interval between scans was 10.6 (16.6) months, with a mean (SD) follow-up period of 6.5 (5.5) years. The median (SD) late aortic growth rate was 1.8 (0.8) mm per year in the proximal descending aorta, 1.6 (2.6) mm per year at the diaphragmatic hiatus, and 1.3 (0.6) mm per year in the abdominal aorta. Though most patients (51%) did not demonstrate substantial aortic growth during follow-up, aortic growth was noted in 18% of successive CT scans in patients whose residual aortas did grow. The onset of growth was unpredictable, occurring most often after the first postoperative year. The mean (SD) postoperative time period for identified aortic growth was 59 (45) months (range, 1-167). Independent predictors of late growth were greater initial aortic diameters, patent false lumen (in 67% of patients), and elevated SBP at late follow-up.

Abbreviations and Acronyms

CT	computed tomography
FET	frozen elephant trunk
SBP	systolic blood pressure

An important question in the postoperative period is which time interval is most appropriate for serial CT imaging. Findings suggest that the interval should be individualized based on the size of the residual dissected aorta.[7] Table I demonstrates that if the residual aorta is smaller than 3.5 cm, growth is present in only 5% of scans performed at a 6-month interval compared with 21% of scans performed at a 12-month interval, so in patients with small aortas, yearly imaging is sufficient. In contrast, if the residual aorta is larger than 5.0 cm, growth is demonstrated in 34% of scans performed at 6-month intervals and in 83% of scans performed at 12-month intervals. More frequent imaging is likely appropriate in patients with aortas larger than 5.0 cm, especially once growth on serial examinations has been documented.

TABLE I. Percentage of Patients Who Demonstrate Aortic Growth on Successive Computed Tomography Imaging Studies Following Repair of Type A Dissection, Depending on the Size of the Aorta at the Initial Imaging Study and the Time Interval Between Scans

	Time interval between scans		
	Patients with aortic growth at <6-mo intervals, %	Patients with aortic growth at 6- to 12-mo intervals, %	Patients with aortic growth at >12-mo intervals, %
Aorta size, mm			
<35	5	13	21
35-49	12	27	31
≥50	34	23	83

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Dr Coselli from Baylor College of Medicine[4,9] has summarized his conservative approach to distal resection in acute type A dissections. His group extended resection to the aortic arch in 7% of patients, an approach that was associated with increased circulatory arrest, cardiopulmonary bypass time, and myocardial ischemia times.[9] A hypothermic circulatory arrest time longer than 30 minutes was associated with increased incidence of cerebral vascular accident (P=.03). As a result, Dr Coselli concluded that "a conservative approach to the distal end of the repair can address the primary objectives," which include prevention of ascending aortic rupture, re-establishment of true lumen flow to reverse branch-vessel malperfusion, and maintenance of a competent aortic valve. Preventza and coauthors[10] reported their real-world experience with the frozen elephant trunk (FET) extension during repair of type A dissections. Paralysis or paraparesis, a complication that rarely manifests with classic hemiarch replacement, was still uncommon but statistically more common when implanting a 15-cm stent graft vs a 10-cm stent graft (11.6% vs 2.5%; P<.001).

A recent review of the Society of Thoracic Surgeons National Database identified 8,937 patients who underwent type A dissection at 772 centers between 2014 and 2017.[11] There was an operative mortality rate of 17% and a postoperative stroke rate of 13%. The review found that stroke risk was lower with perfusion through the axillary or brachiocephalic artery vs the femoral artery as well as with the use of retrograde cerebral perfusion vs hypothermic circulatory arrest alone or with antegrade cerebral perfusion. Stroke risk was higher with total arch replacement than with hemiarch or ascending aorta–only replacement (18% vs 12% vs 13%; P<.001), but it was independent of lowest hypothermic circulatory arrest temperature (12% at >25 °C, 12% at 22-25 °C, and 13% at <22 °C; P=.15).

Controversies regarding the recommended extent of distal resection in type A dissection prompted the Canadian Thoracic Aortic Collaborative[12] to compare 234 patients undergoing extended arch replacement with 695 patients undergoing hemiarch repair at 9 centers between 2002 and 2021. It is important to note that selection bias may have played a role in this study: These 9 centers have dedicated aortic surgery departments, such that extended resection was more likely performed by experienced aortic surgeons than by general cardiac surgeons. In the extended-resection group, 40% of patients underwent an aortic arch procedure, while 60% of patients also underwent a descending thoracic aortic intervention such as FET or a dissection stent. The collaborative analyzed operative mortality rates and composite adverse outcomes, including death, stroke, bleeding, acute kidney failure, sternal wound infection, and prolonged ventilation. There was no significant difference in mortality rates with either approach (21% with extended arch replacement vs 19% with hemiarch repair; P=.42). They did, however, find that composite adverse outcomes were more prevalent with extended arch replacement than with hemiarch replacement (hazard ratio, 1.47; P=.001). The 1 benefit to extending the distal resection was that CT scan resolution of distal malperfusion improved by 30% with the addition of a descending aortic intervention.

Some aortic experts now favor a zone 2 distal anastomosis with proximal bypass to the innominate and left carotid arteries. This approach does not extend the cerebral ischemic time appreciably in experienced hands, and it facilitates later thoracic branch graft placement to complete the arch and proximal descending artery repair.[13] This 2-step approach accomplishes essentially the same distal remodeling goal as the acute treatment of the proximal descending artery at the time of initial emergency repair, but it allows adjunct spinal cord protection measures, including spinal cord drainage, that are generally not practical in the acute setting because of expected coagulopathy and the emergent nature of the procedure.

Roselli and colleagues at the Cleveland Clinic[14] have recently reported their results with an interesting approach to address the distal arch. The branched stented anastomosis FET repair (B-SAFER) procedure employs a homemade distal single-branch graft to remodel the distal arch and proximal descending aorta. A standard FET is deployed in zone 2. A fenestration is made within the graft to facilitate placement of a covered stent into the left subclavian orifice. The thoracic stent graft is then secured to zone 2 with interrupted sutures, and a standard hemiarch replacement is performed. In contrast to Bavaria's approach, the innominate and left carotid arteries are left in situ, but this region, once the proximal and distal aorta have been reconstructed, rarely presents with late growth. Long-term follow-up with both of these approaches is eagerly anticipated. Early analysis to identify the subset of patients with favorable anatomy for such approaches is being performed. These data highlight the need for continuous reevaluation of

thought processes regarding the "best" surgical treatment of acute type A aortic dissection.

Key Considerations

During acute repair of type A aortic dissection, the extent of distal reconstruction must be carefully considered. The general cardiac surgeon should perform the procedure with which they are most comfortable because early and late results are not dramatically different among various approaches. The immediate goal should be to fix the acute abnormalities that could lead to early death. Extension to the arch and beyond should be reserved for aortic centers with extensive experience in distal arch surgery.

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