Perspective

Surgical techniques in type A dissection

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Acute aortic dissection is a surgical emergency that must be urgently managed, with the primary goal of restoring flow to the dominant true lumen in the downstream aorta. Our preference at the Cleveland Clinic is for an open distal anastomosis technique without aortic clamping, as it permits more accurate approximation of dissected layers and more homeostatically secure anastomosis. During this procedure we employ right axillary end-to-side graft perfusion, followed by deep hypothermic circulatory arrest and antegrade brain perfusion. The distal anastomosis is performed without felt strips or glue. Critical to achieving a successful outcome is meticulous de-airing of the arch, diligent myocardial protection, and a water-tight anastomosis prior to discontinuing cardiopulmonary bypass.

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Acute ascending aortic dissection is a surgical emergency and the primary goal of surgery is to save the patient's life by restoring flow to the dominant true lumen in the downstream aorta. The conventional treatment for acute dissection has been complete resection of the intimal tear and replacement of the ascending aorta, often combined with a hemiarch replacement (1-9).

Our preference is for open distal anastomosis technique without aortic clamping for acute type A aortic dissection as it allows a more accurate approximation of the dissected layers and a direct visualization of any arch tears (3,6,7,8). It allows for hemostatically secure anastomosis in a fully visualized aorta and to extend the repair into the arch (or more distal). Aortic clamping can induce false lumen pressurization, leading to propagation of the dissection and malperfusion. There is also increased risk of inducing additional aortic injury via the clamp itself. We apply the aortic clamp only if the heart distends on fibrillation because of severe aortic regurgitation. Myocardial protection is of utmost importance in these operations and we achieve this by using initial induction with antegrade and retrograde blood cardioplegia and repeat retrograde cardioplegia every 15 to 20 minutes.

The procedure on the ascending aorta and arch is performed through a median sternotomy. Cardiopulmonary bypass is routinely initiated with arterial cannulation by way of the right axillary cannulation with an 8-mm end-to-side graft. The venous cannulation can be either with bicaval cannulation or dual-stage venous cannula, depending on the surgeon's preference for retrograde brain perfusion. The patient is cooled and circulatory arrest is initiated once the nasopharyngeal temperature reaches 18 to 20 ℃ with the patient's head down and packed in ice, in addition to CO_2 field flooding. Selective brain perfusion is started through the right axillary artery, using a flow of 10–15 mL/kg/min and perfusion pressure maintained at 45–60 mmHg (10). Bispectral monitoring of anesthesia depth is routinely used (10). If retrograde brain perfusion is used, reversing the flow through the superior vena caval cannula with proximally placed tourniquet above the azygos vein is usually used (11). A flow rate necessary to produce a superior vena caval pressure of 15 to 25 mmHg is optimal and does not generally cause brain edema. Retrograde brain perfusion may also flush atherosclerotic material and air from the brachiocephalic vessels.

Once the circulation is arrested, the aorta is opened, the inner intimal septum is incised and the aorta is transected both proximally and distally. In patients with an arch intimal

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tear with a known connective tissue disorder or with an arch rupture, the aortic arch is replaced. Small, localized tears in a non-aneurysmal arch can be repaired.

The distal anastomosis is angled so that the anastomosis is just proximal to the innominate artery and ends in the lesser curvature of the arch (3). The anastomosis is performed with a 4-0 or 5-0 running polypropylene suture, without outside felt strips. Although we do not use Teflon® felt routinely, it is a very popular and commonly used technique of suture reinforcement in acute dissection surgery (5,9). We do not use any glue or adhesives either to approximate the dissected layers or as a hemostatic agent since we have been able to achieve excellent results without their use. Special emphasis is placed on ensuring watertight suture lines. After distal anastomosis is completed, total body perfusion at low flow is then restarted after applying the clamp on the graft proximal to the anastomosis. The distal anastomosis is then reinforced with multiple interrupted horizontal mattress 4-0 polypropylene pledgeted sutures. For the proximal suture line, internal posterior horizontal mattress sutures are liberally used, particularly near the left main ostium. Prior to discontinuing cardiopulmonary bypass, all the anastomoses are carefully checked for hemostasis and pledgeted sutures are used liberally. Any bleeding sites or potential gaps in the suture line are not ignored, but are further strengthened (12).

If the aortic arch has to be replaced, the distal end-to-end anastomosis between the prosthetic graft and the aorta is performed beyond the left subclavian artery, usually with an elephant trunk approach (3). Depending on the morphology and the location of the intimal tear, the reimplantation of the supraaortic vessels can be done 'en bloc' as an island of aortic wall or by separate re-implantation of the arch branches using a trifurcated graft, like in patients with dissection extending into the arch vessels or young patients with connective tissue disorders.

The brachiocephalic vessels are excised as a Carrel patch with a 1-cm rim of aorta and attached to the graft (3). A Teflon® patch that has been tailored with a buttonhole for the brachiocephalic arteries is used to buttress the patch, which is then sutured to the graft with a running suture. If an arch graft (with separate pre-fabricated limbs for the head vessels) is used, the antegrade systemic flow can be started via the fourth perfusion limb after clamping the graft proximal to the distal anastomosis, if there is concern about flow from the axillary/subclavian artery perfusion graft.

Aortic root management

Acute aortic regurgitation in type A dissection can be caused by: (I) acute dilatation of the aortic root by an expanding false lumen, resulting in incomplete aortic valve closure; (II) a dissection extending into the aortic root and disrupting aortic valve commissural attachments, resulting in valve leaflet prolapse; and (III) a portion of dissection flap prolapsing through the aortic valve in diastole, preventing adequate leaflet closure. Because valve leaflet morphology is normal, the native valve can be successfully preserved in majority of patients. A partially dissected aortic root may be repaired with aortic valve resuspension. Extensive dissection of the aortic root should be treated with aortic root replacement with a composite graft or with a valve sparing root replacement. Sinus-retaining, valve-conserving techniques are inappropriate in patients with pre-existing root pathology like Marfan syndrome or annulo-aortic ectasia. These cases require either aortic root replacement with a composite prosthesis or valve-sparing root replacement.

If the entire aortic root is diseased, either destroyed by dissection or by marked annuloaortic ectasia, then a composite valve graft should be inserted. In most patients needing a composite mechanical valve root, we sew a 6 mm tube graft to the left main and check for hemostasis during perfusion (3,8,13). In more elderly patients with undissected ostia, the coronary buttons are carefully mobilized and reconstituted with Teflon® felt doughnuts. The left coronary button is implanted first with 5-0 polypropylene suture, followed by the right coronary button. After the coronary buttons are implanted, the graft is clamped and the root placed under pressure by running cardioplegia using a small coronary 'giver' to check for hemostasis. Any leaks are repaired at this stage.

In-hospital mortality after surgery for acute type A aortic dissection in the United States has been reported to be 21 [1995–2003]–26% [2003–2008] in two studies based on the Nationwide Inpatient Sample (14,15). Due to techniques described above and improvements in perioperative care, the acute mortality for 889 patients presenting (from 2000–2014) with acute aortic syndrome of the ascending aorta at our institution was 5–10% (16). The in-hospital mortality of 114 patients managed surgically recently (March 2010 to May 2013) at our center was only 4% (17).

Conclusions

Critical to achieving a successful outcome for acute aortic

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dissection repair is meticulous de-airing of the arch, absolutely diligent myocardial protection, and a watertight anastomosis before discontinuing cardiopulmonary bypass.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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