Masters of Cardiothoracic Surgery

# Repair of type A aortic intramural hematoma with ascending and hemiarch reconstruction using circulatory arrest and retrograde cerebral perfusion

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## Clinical vignette

A 74-year-old male presents to the emergency room with acute chest pain radiating to the back. He has a history of hypertension, chronic kidney disease, compensated cirrhosis and 30 pack-year smoking. He is hemodynamically stable with normal neurologic exam. A computed tomography (CT) angiogram of the chest reveals an intramural hematoma (IMH) involving the entire thoracic and abdominal aorta associated with a pericardial effusion. An intimal tear was visible in the mid ascending aorta. The patient is then taken to the operating room for emergent surgical repair of Stanford type A IMH.

## Surgical techniques

### Preparation

The patient is positioned supine on the operating room table over a shoulder roll. Standard preparation includes general endotracheal anesthesia, radial arterial line, pulmonary artery catheter, near-infrared cerebral oximetry and transesophageal echocardiography (TEE) probe placement. Electroencephalography (EEG) monitoring is used whenever available.

### Exposition

A median sternotomy is performed, a pericardial well created and systemic heparin administered. It is not unusual to encounter bloody fluid in the pericardium. The aorta is inspected, and care is taken not to disturb the fine tissue planes containing the hematoma.

### Operation

The ascending aorta is cannulated directly over a wire using the Seldinger technique (1). An 18-gauge needle is used to access the true lumen and a soft J wire is advanced into the true lumen of the proximal descending thoracic aorta; with its position confirmed with intraoperative TEE. The tract is serially dilated and the cannula is advanced over the wire. We routinely use the OptiSite™ Arterial Perfusion Cannula (Edwards, Lifesciences, Irvine, CA, USA) size 18 or 20 Fr. A dual stage venous cannula is placed in the right atrium in the standard manner. The superior vena cava (SVC) is dissected, encircled with an umbilical tape, cannulated with a right-angle cannula, and Y-connector is attached to the venous line. This cannula will be used for retrograde cerebral perfusion (RCP) during circulatory arrest. A retrograde cardioplegia cannula is placed in the coronary sinus. Cardiopulmonary bypass is instituted and a left ventricular vent is placed via the right superior pulmonary vein. Core cooling is initiated with the goal of achieving a flatline EEG when available, a nasopharyngeal temperature of 16 to 18 ℃, or for a total cooling period of 50 minutes, whichever is reached first. The aortopulmonary window is dissected and an aortic clamp applied. Retrograde cardioplegia is initiated while the aorta is transected above the sinotubular junction (STJ). The aortic root is debrided just enough to expose the coronary ostia, retrograde cardioplegia is discontinued and antegrade cardioplegia is given directly into the coronary ostia. The ascending aorta is resected to the level of the STJ and the aortic root wall is debrided. The mobile pieces of the IMH are removed. The aortic valve is resuspended at the level of the commissures using pledgeted 4-0 polypropylene sutures. The aortic root is reconstructed using the neomedia technique with felt strips placed in between the separated layers of the aortic wall and secured with running 5-0 polypropylene sutures. Retrograde cardioplegia might be given during this time and is of additional utility if complex root reconstruction is needed. The STJ is sized using an intra-annular valve sizer. An appropriately sized Dacron graft is then sutured to the level of the STJ using a running 4-0 polypropylene suture. The suture line is reinforced with an external felt strip placed in between the loops of the suture line at the portion of the STJ that was not reconstructed to aid with hemostasis. Antegrade cardioplegia infused through the graft allows for myocardial protection, testing the competence of the aortic valve and hemostasis at the suture line. Mattress pledgeted sutures are placed as needed. Once core cooling is reached, an intravenous injection of steroids is given, cardiopulmonary bypass is stopped, the aortic and right atrial cannula are clamped and the aortic clamp is removed. The SVC is snared around the angled cannula and RCP is administered with a goal venous pressure of 20–25 mmHg. The aortic cannula is removed, and the aortic arch is resected along the lesser curvature down to the level across the lumen from the left subclavian artery. Effective RCP delivery is confirmed with the visualization of dark blood return from the arch vessels. The aortic arch is then examined. All visible mobile clot is removed and all areas of separation within the aortic wall are reconstructed using the neomedia technique. The hemiarch is sized with an intra-annular valve sizer and an appropriately sized Dacron graft is sutured using a running 4-0 polypropylene suture. For both the proximal and distal suture lines, we lay the graft inside the aorta for better hemostasis (on-lay anastomosis). The graft is then cannulated with an arterial cannula, de-aired thoroughly and clamped while cardiopulmonary bypass is resumed. The SVC snare is released and RCP interrupted. Rewarming is started 5 minutes after resumption of cardiopulmonary bypass. Hemostasis is checked and repair mattress pledgeted sutures are placed as needed. Both grafts are now tailored to reproduce the natural aortic curvature of about 110°. The graft-to-graft anastomosis is completed with a running 3-0 polypropylene suture. A venting catheter is placed on the anterior aspect of the graft. The heart is de-aired and the clamp is removed. The retrograde cardioplegia cannula is removed, and a ventricular temporary pacing wire is placed. Once venous return temperature has reached 35 °C, weaning from cardiopulmonary bypass is initiated in a standard fashion.

### Completion

Once off cardiopulmonary bypass, cannulae are removed and protamine administered. Hemostasis is achieved, chest tubes are placed and the sternum is reapproximated with stainless steel wires.

## Comments

### Clinical results

In our experience, aggressive hemiarch replacement under deep hypothermic circulatory arrest and RCP for acute type A aortic dissection has been associated with an excellent perioperative morbidity and mortality as well as long-term outcomes. Perioperative death, stroke and acute renal injury were 12%, 5% and 14%, respectively (2).

### Advantages

Deep hypothermia provides excellent cerebral protection for circulatory arrest time less than 30 minutes. RCP is an adjunct to effectively flush the cerebral circulation from air and debris without manipulation and/or clamping of the cerebral vessels needed with antegrade cerebral perfusion.

### Caveats

It is critical to confirm the position of the RCP cannula in the SVC and not in the azygos vein. RCP pressure should be maintained at around 20–25 mmHg, near-infrared spectroscopy (NIRS) should be symmetrical and >60% and dark blood return should be observed coming from the cerebral vessels' ostia. If this is not the case, the surgeon should confirm that the RCP cannula tip is at the SVC/innominate vein junction and that the cannula is effectively snared. In some cases, valves in the central venous circulation impede perfusion to portions of the brain, so deep hypothermia is always required for cerebral protection as well as the readiness to convert to antegrade cerebral perfusion when in doubt. In cases where extensive arch reconstruction is needed, we believe that RCP alone is not sufficient and should be supplemented with antegrade cerebral perfusion, especially for circulatory arrest times longer than 30–40 minutes. In these cases, RCP might be used at the beginning of circulatory arrest while the arch is debrided and antegrade cannulae are being positioned. It can also be used towards the end of the circulatory arrest time to help de-air the cerebral circulation and fill the aorta.

 

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None.

## Footnote

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

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## References

1. Frederick JR, Yang E, Trubelja A, et al. Ascending aortic cannulation in acute type a dissection repair. Ann Thorac Surg 2013;95:1808-11.
2. Rylski B, Milewski RK, Bavaria JE, et al. Long-term results of aggressive hemiarch replacement in 534 patients with type A aortic dissection. J Thorac Cardiovasc Surg 2014;148:2981-5.

 