The direct aortic cannulation for acute type A aortic dissection

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This article describes the surgical techniques demonstrated in our video, "The Direct Aortic Cannulation for Acute type A Aortic Dissection".

Acute type A aortic dissection is a life-threatening condition requiring emergency operation. The choice of arterial cannulation sites to institute cardiopulmonary bypass is still a topic of controversy. Central cannulation directly through the ascending aorta has been reported (1,2). It has a theoretical advantage of not changing the natural antegrade blood flow, and in doing so avoiding intraoperative malperfusion. We believe that accurate positioning of the tip of an arterial cannula is best achieved with epiaortic echo guidance. We use the Seldinger method through the non-dissected part of the aortic wall in most cases, usually via the left side of the ascending aorta. In the current video presentation (*Video 1*), only the small posterior aspect was not dissected. The case was also complicated by intermittent myocardial ischemia, bicuspid aortic valve and significantly dilated ascending aorta.

Here we describe in detail our surgical technique for direct aortic cannulation by the Seldinger method with epiaortic guidance.

Clinical vignette

The patient is a 50-year-old man who presented with sudden-onset back pain and chest discomfort at night. He was admitted to the emergency room in our hospital at midnight. Although he had pulsation at his four extremities, his blood pressure was fluctuating, and it dropped to 68 mmHg in systolic pressure. Preoperative electrocardiogram demonstrated ST segment elevations in leads II and aVF.

He had a history of hypertension and dyslipidemia. Computed tomography (CT) scan with contrast enhancement revealed a Stanford type A aortic dissection from the aortic root to the bilateral iliac arteries. The maximal diameter of the ascending aorta was 6.5 cm. The intimal tear was observed in the proximal ascending aorta. Organ perfusions were preserved, except the right coronary artery and pseudolumen perfusion to the right renal artery.

As per our unit policy for acute type A aortic dissections, the patient was immediately transferred to the operating room.

Surgical techniques

Preparation

Anesthesia was induced and the patient was intubated as per usual protocol. The right radial arterial line and cerebral oxygen saturation were monitored. Temperature probes were introduced at tympanic membrane, rectum and bladder. The transesophageal echocardiographic probe was then gently introduced to continuously evaluate conditions of the heart, the ascending aorta and the descending aorta. In this patient, we found that the ascending aortic dissection proximally reached the right coronary artery orifice, the intima was torn in the dilated proximal ascending aorta, and the descending aorta showed dissection. The left ventricular wall motion was not visibly impaired. Head surface cooling was started immediately after the endotracheal intubation.

The patient was scrubbed and prepped in the usual fashion. The right femoral arterial and venous lines were prepared in the sterile field.

Exposition

We planned a hemiarch aortic replacement with an open distal anastomosis, with a short period of moderate

hypothermic circulatory arrest. Concomitant single coronary artery bypass to the distal right coronary artery was also planned, to be done during the systemic rewarming phase. We take a saphenous vein segment for patients with suspected myocardial ischemia simultaneously during the median sternotomy.

Operation

After median sternotomy, the epiaortic echo assessment of the ascending aorta was performed to find the best place for insertion of the arterial cannula. In this patient, there was no accessible area of non-dissected wall in the anterior or lateral ascending aortic walls, so we decided to insert a guidewire through the pseudolumen to reach the true lumen with echo guidance.

A purse-string 3-0 suture was placed superficially. The guidewire was introduced while making sure that the tip was located in the true lumen via an intimal flap. A 20 French OptiSite™ arterial cannula (Edwards Lifesciences, Irvine, CA, USA) was inserted. The tip position was confirmed by echo. Test flow from the cardiopulmonary bypass was again assessed by echo. Two venous cannulas were introduced in the usual fashion to initiate the cardiopulmonary bypass with systemic cooling. The left ventricular vent tube was introduced, and a retrograde cardioplegic cannula was positioned with a purse-string suture at the coronary sinus in the usual manner.

When the tympanic membrane temperature reached 25 degrees Celsius, the cardiopulmonary bypass was stopped. Cold blood cardioplegia was administered through the retrograde cannula and was repeated every 20 minutes. There was a large transverse tear in the proximal ascending aorta. The aortic wall was mostly separated, except in a small area of the posterior ascending aorta. The part of the adventitia just above the right coronary orifice was thin.

The aortic wall was excised from the level of the right brachiocephalic artery orifice to the sinotubular junction (STJ). In the distal aorta, the separated wall was simply reapproximated without glue. A felt strip was used outside only. The hemiarch aortic anastomosis was constructed with an artificial woven graft of 30 mm Gelweave™ (Terumo, Japan) in telescoped fashion, with the graft end positioned inside of the aortic lumen, with an overlap of about 1 centimeter. A simple running suture technique with 4-0 Prolene with an SH needle was used. Many surgeons use stitches at intervals of around 3 mm and bite depth of 5 mm, but we have found that a running suture with larger stitch intervals (around 8–9 mm) and greater bite depth (about 1 cm) both prevents bleeding and reduces risk of uneven strain.

After completion of the distal anastomosis, the cardiopulmonary bypass was resumed from the graft. The temperature of the body was rewarmed thereafter. The distal anastomosis was checked for hemostasis.

Next, the distal right coronary artery was exposed and an 8 mm arteriotomy was made. A saphenous vein segment was grafted to the artery. 7-0 Prolene running suture was used.

The proximal aorta was observed. The aortic valve was bicuspid. The commissures were located 180 degrees apart and there was no raphe in either cusp. There was only limited degeneration of the valve; neither regurgitation nor stenosis was detected by transesophageal echo assessment after the induction of anesthesia. The size of the aortic root seemed normal. We decided to reconstruct the proximal aortic anastomosis with the graft at the level of the STJ. The separated aortic walls were rejoined with BioGlue between them. A single running suture of 4-0 Prolene with an SH needle was used to construct the proximal anastomosis with a felt strip outside.

The saphenous vein graft was anastomosed to the aortic graft proximally with a 5-0 Prolene running suture. After the ventricles were deaired, the cross clamp of the graft was released. The heart started to beat spontaneously. We were able to terminate the cardiopulmonary bypass with a minimal dose of intravenous dopamine. No mechanical support was required. We checked hemostasis again, then the chest was closed. The patient was transferred to the ICU in a stable hemodynamic condition.

Completion

The operative procedure was a hemiarch aortic replacement using a 30 mm Gelweave graft, with an aorto-coronary artery bypass grafted to the distal right coronary artery. The cardiopulmonary bypass time was 126 minutes. The circulatory arrest time was 28 minutes, and the lowest tympanic membrane temperature 24.6 degree Celsius. The cardioplegic arrest time was 84 minutes.

The patient's postoperative recovery was uneventful. The endotracheal tube was removed the next day. His hemodynamic condition was stable. Postoperative echocardiography was performed prior to discharge, and it showed neither aortic regurgitation nor aortic stenosis, and normal left ventricular function. The postoperative contrast-enhanced CT scan showed the saphenous vein graft was

patent and showed no further dilatation of the remaining aorta. The pseudolumen of the distal aorta stayed open, but neither significant aortic dilatation nor malperfusion of distal organs were detected. After discharge, we shall follow up his condition for three months, then yearly thereafter in our outpatient clinic.

Comments

In surgical repair of acute type A aortic dissection, it is crucial to avoid any organ damage. Central cannulation with the Seldinger technique is an attractive option with many advantages including simplicity, speed of cannulation, short brain cooling time and preservation of the natural arterial flow pattern. Precise and accurate confirmation of the cannula location is mandatory for safety. In our method as shown in the video, the epiaortic echo assessment plays a very important role to locate the guidewire, the dilators and the tip of the arterial cannula.

However, in cases with suspected ruptured ascending aorta, cardiac tamponade and cardiogenic shock, we carefully avoid this central cannulation approach and employ femoral arterial and venous cannulation to initiate cardiopulmonary bypass prior to sternotomy. Otherwise we use this approach for most cases of acute type A aortic dissection with satisfactory outcomes (2).

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Footnote

Conflict of Interest: The authors declare no conflict of interest.

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