

# Mini-Bentall procedure and hemi-arch replacement

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## Clinical vignette

The patient was a 52-year-old lady who was referred with an ascending thoracic aortic aneurysm and stenotic bicuspid aortic valve. Computed tomography (CT) thoracic aortogram demonstrated maximal aortic dimensions measuring 4.5 cm, 5.9 cm and 4.4 cm at the levels of sinotubular junction, mid-ascending aorta and distal ascending aorta, respectively. There was no evidence of significant atheromatous disease in the thoracic aorta. She had no significant past medical history. Preoperative coronary angiogram revealed normal coronary arteries and transthoracic echocardiography demonstrated an aortic valve area of 1.2 cm<sup>2</sup> and mild diastolic dysfunction. The patient underwent a Mini-Bentall procedure and a hemi-arch replacement via a 7 cm access incision. There was no intraoperative transfusion required and patient was extubated 20 min after the surgery. She was discharged home on postoperative day 5 without any complications.

## Surgical techniques

### Preoperative planning

CT reconstructed images of the patient's thoracic aortic relative to the sternum and rib cage were obtained and assessed to plan for the upper hemi-sternotomy incision. This incision was terminated one intercostal space above the plane of the aortic annulus or at the level of sinotubular junction.

### Exposition

A 7 cm midline skin incision was performed from the angle of Louis to the 3<sup>rd</sup> intercostal space. A reverse 'J' hemi-

sternotomy was performed using a hand-held electrical saw to the 4<sup>th</sup> intercostal space on the right side. A mini-sternal retractor was placed in position. The pericardium was opened longitudinally. This access adequately exposed the aorta from the level of sinotubular junction to that of the distal ascending aorta. After full systemic heparinization was achieved with activated clotting time (ACT) greater than 450 s, peripheral venous cannulation was established using a 25 Fr multi-stage venous cannula (Maquet Getinge Group, Rastatt, Germany) under transesophageal echocardiography guidance. The arterial line was split into a 3/8 inch systemic perfusion limb and a 1/4 inch cerebral perfusion limb. The distal ascending aorta was carefully cannulated with a 20 Fr Elongated One-Piece Arterial (EOPA) cannula (Medtronic Inc, Minneapolis, MN, USA), which was snared in position and connected to the 3/8 inch tubing of the systemic perfusion limb after proper de-airing. A 16 Fr DLP pulmonary artery vent cannula (Medtronic Inc, Minneapolis, MN, USA) was inserted in the main pulmonary trunk. Cardiopulmonary bypass was established and systemic temperature was cooled to 25 °C.

### Operation

Under a low-flow condition, an atraumatic aortic cross-clamp was applied across the distal ascending aorta. Diastolic arrest was achieved with antegrade cardioplegia delivered. The aneurysmal segment of the ascending aorta was resected. During the cooling phase, the stenotic aortic leaflets were resected and the aortic annulus was completely decalcified. 2-0 Ethibond Excel annular sutures were used, starting from the commissure between the non-coronary annulus and left coronary annulus going clockwise

sequentially. Aortic annulus was sized for its intra-annular and supra-annular dimensions. An appropriate valve conduit was selected. Once the annular sutures were passed through the sewing ring, the valve conduit was parachuted in position. The annular sutures were tied and cut one by one around the annulus.

As soon as the systemic temperature reached 25 °C, the patient's head was packed in ice, the aortic cannula was clamped, the aortic cross clamp was removed and the patient's blood was drained into the reservoir. The under surface of the proximal aortic arch was resected. Selective antegrade cerebral perfusion was achieved by cannulating the innominate artery directly using a 15 Fr cerebral perfusion cannula. The open distal anastomosis was made with a separate Ante-Flo graft (Vascutek Ltd, Renfrewshire, Scotland), using a 3-0 running prolene suture. This anastomosis was reinforced with 3-0 pledgeted prolene sutures to ensure an absolute hemostasis. After completion of the open distal hemi-arch anastomosis, full systemic and cerebral perfusion was established via the side-arm of the Ante-Flo graft. The patient was rewarmed towards 37 °C. Attention was then turned to the proximal root replacement.

The left coronary artery button and then the right coronary button were prepared and re-implanted using 5-0 prolene sutures. Once the root procedure was completed, the proximal valve conduit was trimmed just above the Valsalva portion of the graft. A graft-to-graft anastomosis was performed using a continuous 3-0 running prolene suture. One 28 Fr soft drain was inserted and brought out below the xiphoid cartilage. Hemostasis was carefully checked and the patient was weaned from bypass uneventfully. Protamine was given to reverse the heparin effect. No transfusion was required.

### Comments

The Bentall procedure was first described in 1968 (1), encompassing the composite graft replacement of the aortic valve, aortic root and ascending aorta, with re-implantation of the coronary arteries into the graft via a median sternotomy incision. However, in the modern era of cardiac surgery, there is an increasing use of minimal access incisions such as ministernotomy and minithoracotomy

(2,3). In a Mini-Bentall procedure, exposure is obtained using an upper mini-sternotomy. The skin incision extends from the angle of Louis to the third intercostal space, usually measuring 5-7 cm in length, depending on the body size of the patient. Through this incision, it is possible to perform isolated aortic root surgery or in conjunction with hemi-arch replacement. In this particular case, the patient was extubated 20 min after the surgery and discharged home on postoperative day 5 without any complications.

Despite the minimal access approach, adequate cerebral protection is vital to reduce neurological complications. Based on recent evidence, I prefer to use moderate hypothermic circulatory arrest with antegrade cerebral perfusion through the innominate artery (4,5). It is important to emphasize that the fundamental surgical principles of a traditional Bentall operation should not be compromised. Furthermore, ensuring absolute hemostasis is of utmost importance in minimally invasive surgery and is critical to achieving optimal outcomes for patients undergoing a Mini-Bentall procedure.

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