Masters of Cardiothoracic Surgery

Minimally invasive aortic valve replacement with Y-incision aortic root enlargement

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Clinical vignette

A 74-year-old man was referred for treatment of symptomatic severe aortic stenosis and moderate aortic regurgitation. His past medical history included hypertension, hyperlipidemia, hypertrophic obstructive cardiomyopathy, gastric bleeding, peptic ulcer and gastric leiomyoma. Transthoracic echocardiogram demonstrated severe aortic stenosis, moderate aortic regurgitation and preserved biventricular function. Computed tomography aortogram (CTA) for transcatheter aortic valve replacement (TAVR) revealed an aortic annulus of 504 mm^2, with appropriate coronary heights, but poor peripheral vascular access. Coronary angiography demonstrated mild non-obstructive coronary artery disease. Given the patient's age and poor peripheral vascular access for TAVR, minimally invasive aortic valve replacement was planned.

Surgical technique

General approach

An 8-cm incision is made extending from the sternomanubrial joint to the 4th intercostal space. An L-shaped upper hemisternotomy is made extending to the right. The thymic fat pad is divided and the pericardium is opened. Inferiorly, the pericardium is opened as far as possible before angling to the right. Pericardial retraction sutures are placed bilaterally. The distal aorta and right atrium are cannulated and the left ventricle is vented.

After initiating cardiopulmonary bypass (CPB), the aorta is cross-clamped and the heart is arrested. During cardioplegia administration, we dissect the soft tissues from the proximal aorta.

Exposure

We perform three maneuvers that greatly improve exposure. The pericardial stay sutures are anchored to the soft tissues above the sternum. The retractor is replaced over the pericardium, which brings the aorta up.

Prior to connecting the venous cannula, it is tunneled through a chest tube site. This retracts the appendage and removes the cannula from the operative field.

Our goal is to make a transverse aortotomy 2 cm above the sino-tubular junction. An aortotomy that is too low will make subsequent reconstruction of the aorta more difficult. Finally, three commissural stay sutures are anchored tightly, further bringing the aortic root into view.

The aortic valve is resected, and the annulus is debrided and sized. In this case, a 23-mm sizer was a tight fit, and a 25-mm sizer could not be accommodated. We routinely enlarge annuli that cannot fit a 25-mm valve.

The aortotomy is extended posteriorly to 2 cm above the left-non commissure. The commissure is then divided and the incision is carried below the annulus onto the aortomitral curtain. Posteriorly, the aortic root is dissected to the dome of the left atrium. The incision is extended to divide the right fibrous trigone up to just before the

membranous septum. The incision is similarly extended along the left fibrous trigone. New retraction sutures at the two halves of the divided left-non commissure are placed.

The incision is sized with a forceps, and a Dacron patch is trimmed to size. In general, we find that the patch needs to be at least 3.5 to 4 cm in width in order to reliably enlarge the root three valve sizes. The patch is anchored at the left-most extent of the sub annular incision and the suture is tied. The suture line is then carried along the aortomitral curtain towards the non-coronary sinus. It is particularly important for this layer to be hemostatic, as access to this area will be difficult later. Before carrying the suture line up the sides, the suture-line is inspected, and repair sutures are placed as needed. The suture line is then carried up to the top of the commissure on the right side. The same is done on the left side. Once the commissures are reached, both suture ends are secured.

The enlarged annulus is re-sized, and in this case, a 29-mm sizer fits easily. In order to mark the level of the valve sutures on the Dacron patch, it is helpful to line up the commissural post of the valve replica with the left-right commissure of the native annulus. We start the valve sutures at the left corner of the patch. We routinely use non-pledgeted sutures, except in cases where there are small areas of annular disruption. The right side of the first suture goes through the native annulus, while the second side goes through the corner of the patch. Subsequent sutures go up the side of the patch to the level of the marking. These sutures further reinforce the Dacron patch anastomosis. The crossing stitch typically straddles the anastomotic line. On the patch, the valve sutures are placed from the inside. The following set of sutures again travel along the side of the patch down to the native non-coronary annulus. The remaining valve sutures are placed in standard fashion through the native annulus. The sutures are then passed through the sewing ring of the prosthesis and the valve is seated and secured with Kor-knots.

To reconstruct the posterior aorta, the patch is shaped in triangular fashion. In general, a taller triangle works better than a shorter one. The anastomosis is then continued on the left side up to the apex of the triangle, followed by the right side. Once both sides are completed, the two sutures are then tied. The area of triangular intersection is reinforced with a pledged suture, that is then used to close the remaining aortotomy in two layers. The heart is deaired, the aortic cross clamp removed, and the patient weaned from CPB.

Post-operatively, the patient had an uncomplicated recovery. Transthoracic echocardiogram demonstrated a well-seated valve with no paravalvular leak and a mean gradient of 9 mmHg across the valve. CTA demonstrated a well-reconstructed posterior aorta with no protrusions, which we find can be avoided by using a tall triangle on the Dacron patch.

Comments

Patient-prosthesis mismatch is common after aortic valve replacement and can negatively impact long-term outcomes including survival (1,2). With the increased use of biological prostheses, placement of larger prostheses is ever more important to allow for appropriate valve-in-valve TAVR in the future (3). The Y-incision aortic root enlargement technique has enabled a straightforward approach to upsize the aortic annulus by up to five valve sizes (4). Here, we present our technique for Y-incision aortic root enlargement through a minimally invasive upper hemisternotomy.

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Footnote

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