



Robotic mitral valve repair with complete excision of mitral annular calcification

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Clinical vignette

A 57-year-old female with a history of mitral valve (MV) prolapse, in NYHA class II heart failure and sinus rhythm, presented for surgical evaluation. Transthoracic echocardiography (TTE) revealed severe mitral regurgitation (MR) due to bileaflet prolapse and a large mitral annular calcification (MAC). Left ventricular (LV) function was preserved. There was no other significant valvular disease. MAC was identified in cardiac catheterization and computed tomography angiography (CTA). There was no significant vascular disease precluding peripheral cannulation. Based on her evaluation, we thought she was a good candidate for robotic MV repair including complete MAC excision.

Surgical techniques

Preparation

Our techniques of totally endoscopic robotic MV repair (TERMVR) have been described (1,2). A retrograde cardioplegia catheter was placed into the coronary sinus under transesophageal echocardiography (TEE) guidance. Venous drainage was obtained with a 25-French long cannula inserted in the right atrium through the common femoral vein. Arterial return was obtained with a 21-French arterial cannula (EndoReturn, Edwards Lifesciences; Irvine, CA) placed through the common femoral artery above its bifurcation to preserve collateral blood flow through the profunda femoris artery. An endoaortic balloon catheter (IntraClude, Edwards Lifesciences) was inserted through the side limb of the EndoReturn.

Exposure

Three 8-mm instrument ports, a 12-mm camera port, and a 2-cm working port were placed through the right chest wall. The working and camera ports were placed in the 3rd intercostal space. The da Vinci Xi system (Intuitive Surgical; Sunnyvale, CA) was docked and hypothermic (28° celsius) cardiopulmonary bypass (CPB) was initiated. The pericardium was opened longitudinally anterior to the right phrenic nerve. Ventricular fibrillation was induced to stop LV ejection prior to IntraClude inflation. Antegrade cardioplegia (del Nido) was delivered through the IntraClude. Retrograde cardioplegia was repeated during aortic cross clamp. The left atrium (LA) was entered through Sondergaard's groove. The MV was exposed with the dual-blade retractor. A vent was placed in the left inferior pulmonary vein. The oblique sinus was opened. A suture was placed to tack the inferior wall of the LA to the diaphragm below the inferior vena cava. The left atrial appendage was closed in two layers with CV4 Gore-Tex (W. L. Gore & Associates, Inc.; Newark, DE) sutures.

Analysis of lesions

Intra-operative TEE had shown Type II P1 severe MR. MAC was seen in the region of the anterior or lateral commissure. MV inspection revealed enlarged leaflets with global myxomatous changes consistent with Barlow's. The lateral side of P1 was flailed. The presence of MAC at the hinge of A1, P1 and P2 was confirmed. There was no significant extension to the leaflet tissue precluding a repair. A1, P1 and P2 were detached from the annulus and

MAC extension to the LV was seen. There was no MAC continuity with the papillary muscles.

Operation

Mitral annular calcification was excised as a “monoblock” with electrocautery. The dissection was initiated between the calcium and the LA wall and progressed towards the LV base. This resulted in the dissociation of the AV groove. The AV groove was reconstructed with an oval-shaped bovine pericardial patch. The lower part of the patch was sutured to the LV with a series of 2-0 Ethibond (Ethicon Inc.; Rariton, NJ) horizontal mattress sutures with pledgets. The knots were tied with Cor-Knot (LSI Solutions, Ltd.; Victor, NY). The long diameter of the patch was sutured to the left atrial edge with a series of 2-0 Ethibond horizontal mattress sutures; these sutures were later used for securing the annuloplasty band. The flailed part of P1 (lateral half) was excised. The base of A1 was reattached to the subaortic curtain. The base of P1 and P2 was reattached to the upper edge of the patch. This was done with a running CV4 Gore-Tex interlocking suture. The commissure between A1 and P1 was reconstructed with a running back-and-forth CV5 Gore-Tex suture. The cleft between P1 and P2 was also closed. The repair was completed with an annuloplasty using a 38-mm Medtronic CG Future band (Medtronic; Minneapolis, MN). The hydrostatic test showed no residual regurgitation. The line of leaflet coaptation was parallel to the annuloplasty band.

Completion

The atrial vent was repositioned through the MV into the LV apex. The IntraClude was deflated with suction on the aortic root, after which the heart defibrillated spontaneously into sinus rhythm. While rewarming the patient, the LA was closed with CV2 Gore-Tex sutures on the beating heart. Deairing was obtained by filling the LV and applying moderate suction at the apex. The patient was weaned off CPB with minimal amount of inotropic support. CPB time was 215 minutes and aortic clamp time was 183 minutes.

Clinical results

Transesophageal echocardiogram demonstrated good leaflet motion without residual regurgitation, transvalvular gradient or SAM. The patient was discharged home on

post-operative day three. Discharge TTE showed normal LV function without residual MR. The patient remains asymptomatic without evidence of MR at five years follow-up.

Comments

Mitral annular calcification is a degenerative process characterized by progressive calcification of the MV annulus (3). MAC may involve the leaflet tissue, extend to the LV base or establish a continuity with the papillary muscles. In our experience, MAC was found in about 13% of the patients undergoing a MV procedure. MAC makes MV surgery more challenging and is associated with increased operative mortality and adverse events (4,5). However, TERMVR in the presence of MAC can be performed safely and effectively by experienced surgeons (1). Robotics provides excellent exposure and visualization of the MV facilitating precise MAC dissection with electrocautery, AV groove reconstruction and MV repair. The indication for MV repair vs replacement is determined by MAC extension to the leaflet tissue. The authors believe that complete MAC excision is preferable to leaving a large bar of calcium. Indeed, suturing an annuloplasty device or an artificial valve to MAC can lead to unfavorable or inconsistent results including prosthetic dehiscence, undersized prosthesis implantation, para-suture embolization of liquefied MAC, or injury to the circumflex artery. Atrioventricular (AV) groove reconstruction using a patch allows for lower tension of the suture lines reducing the risk of post-operative AV groove rupture. It also allows for no compromise in prosthesis size.

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Footnote

Conflicts of Interest: EAG and DFL are proctors for Intuitive Surgical.

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