



# Robotic posterior bar decalcification and mitral repair in mitral annular calcification

Didier F. Loulmet, Ali Hage, Eugene A. Grossi

Department of Cardiothoracic Surgery, NYU Langone Health, New York, NY, USA

Correspondence to: Didier F. Loulmet, MD. 530 1st Avenue, Suite 9V, New York, NY 10016, USA. Email: Didier.Loulmet@nyulangone.org.



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## Clinical vignette

A 78-year-old man was diagnosed with mitral valve (MV) regurgitation following new-onset atrial fibrillation. A transesophageal echocardiogram (TEE) revealed severe type II (P2) MV regurgitation with a left ventricular (LV) ejection fraction of 60%. A gated chest computed tomography angiography (CTA) with three-dimensional (3D) reconstruction identified two-segment mitral annular calcification (MAC) centered on P1 and extending to the A1 and P2 hinges. The recommended treatment was robotic MV repair, including MAC excision, left atrial appendage closure, and cryoablation.

## Surgical techniques

### Preparation

The patient was placed in a supine position with the right chest elevated at a 30-degree angle. Following the creation of a 20-mm service port in the third intercostal space (ICS) at the mid-axillary line, four additional 8-mm ports were positioned: a left instrument port (2nd ICS, between the shoulder and nipple), a camera port (3rd ICS, anterior axillary line), a left atrial retractor port (4th ICS, mid-clavicular line), and a right instrument port (5th ICS, mid-axillary line). Cardiopulmonary bypass was initiated via peripheral cannulation, and the patient was cooled to 30 °C.

### Exposure

The operation was performed entirely thoracoscopically using the da Vinci Xi surgical system. The pericardium

was opened longitudinally above the right phrenic nerve. A flexible transthoracic aortic clamp was introduced through the working port to occlude the distal ascending aorta. Antegrade del Nido cardioplegia was administered to induce myocardial arrest and was re-dosed hourly. The left atrium (LA) was accessed via the Sondergaard groove. A dual-blade dynamic retractor was used to expose the MV, and a vent was placed into the left inferior pulmonary vein. The LA appendage was closed with a running, back-and-forth 4.0 Gore-Tex suture, which was extended to plicate the LA wall between the lower pulmonary veins and the mitral annulus.

### Operation

MV analysis confirmed Barlow's disease, revealing a flail medial P2 and MAC just below the anterior commissure, which involved the hinges of A1, P1, and P2, consistent with the preoperative CTA findings. To minimize smoke and prevent camera fogging, MAC excision was performed exclusively by sharp dissection rather than our preferred electrocautery technique. The hinges of P2, P1, and A1 were successively detached from the annulus, extending past the left trigone. The MAC attached to the posterior leaflet (PL) was then excised *en bloc*, with care taken to preserve the leaflet tissue. The PL was subsequently tacked against the septum using the dual-blade retractor to maximize exposure of the atrioventricular (AV) groove.

Annular assessment revealed dissociation of the AV groove along the hinge of P1 and the lateral half of P2, while the medial portion of the P2 hinge remained intact. The resulting 1-cm separation between the LA and LV edges met the institutional threshold for patch

reconstruction. Patch ventriculoplasty was performed using a bovine pericardial patch (Edwards Lifesciences Corp., Irvine, CA, USA). The patch was secured to the LV with a series of 2.0 Ethibond pledgeted horizontal mattress sutures, placed deeply to engage the compact myocardium while avoiding a transmural course or involvement of the AV groove epicardium. The bedside surgeon secured the knots using the Cor-Knot (LSI Solutions, Ltd.; Victor, NY, USA) system while the console surgeon applied firm pressure to maintain the patch against the LV edge. Each knot was individually visualized during tightening, and each suture was tied immediately after being placed in order to limit the number of strings in the operative field. We also proceeded from left to right, or from the easiest part to the most difficult in terms of exposure. The non-dissociated part of the annulus was repaired with pledgeted horizontal mattress sutures only. The patch was secured to the LA edge with a series of 2.0 Ethibond horizontal mattress sutures. These will be used later for attaching the annuloplasty device. Its upper edge was trimmed, leaving a 5–7 mm rim of tissue for PL reattachment and potential height augmentation.

The PL was reattached to the patch with a 4.0 Gore-Tex interlocking suture technique to create a hemostatic suture line and prevent a purse-string effect. Where a patch was not needed, the PL was sutured directly to the native annulus. The repair concluded with an anterior commissure reconstruction and the placement of a pair of artificial chords to correct any residual prolapse. Annuloplasty was performed with a semi-rigid band. The lateral part of the band was attached with the same sutures used to anchor the patch to the LA, which effectively sealed the AV groove. The remainder of the band was secured with horizontal mattress sutures placed along the non-dissociated part of the annulus.

## Comments

In the initial series of 500 consecutive patients undergoing isolated robotic MV repair, MAC was identified in approximately 13% of cases (1). The case presented here, while not representing the most extensive form of MAC, illustrates the most common pattern—typically localized to the P1–P2 hinge (1). In that series, MAC excision was achieved in 94% of patients, one-third of whom required annular reconstruction with a bovine pericardial patch (1). Short-term outcomes were excellent, with 100% freedom from more than mild mitral regurgitation (MR), no strokes

or pacemaker implantations, and a 30-day mortality rate of 3% (1).

In a subsequent cohort of 1,441 patients, a specific analysis compared outcomes in those requiring LV patch ventriculoplasty versus those undergoing non-patch repairs. MV repair was achieved in over 80% of the pericardial patch group, compared to 98% in the non-patch group. There were no significant differences in postoperative stroke, 30-day mortality, or 3-year survival between the two groups (2). It is important to note that the extent of MAC does not determine a patient's eligibility for this procedure; instead, eligibility depends on whether the patient has sufficient physiological reserve to tolerate this relatively prolonged operation.

Robotic assistance provides near-microscopic visualization and superior instrument dexterity, making it an ideal platform for complex procedures like MV repair necessitating MAC excision and AV groove reconstruction. However, this approach should be reserved for highly specialized teams with advanced expertise in both robotics and MV surgery.

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## Footnote

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

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