Editorial

Surgical approach to mitral annular calcification—the Cleveland Clinic experience

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Introduction

Mitral annular calcification (MAC) is a progressive, degenerative disease of the fibrous skeleton of the mitral valve, often associated with degenerative leaflet disease and valve dysfunction (1). A recent expert consensus document from the American Association of Thoracic Surgery on the management of MAC patients addresses imaging, patient selection, risk stratification, and therapeutic options (2). At the Cleveland Clinic, 629 mitral valve surgeries were performed on patients with moderate or severe MAC in the past 5 years. This editorial describes the Cleveland Clinic surgeons' current approach to MAC.

Preoperative evaluation

Cardiac multidetector computed tomography (MDCT) with three-dimensional (3D) reconstruction provides invaluable assessment of MAC, including calcium extension (anterior, posterior, circumferential, trigonal, depth, and leaflet involvement), annular size, calcium density, and proximity to the circumflex artery (3). The Guerrero and Agatston scores, developed for non-surgical purposes, are used to objectively quantify MAC severity (4). Ideally, the preoperative MDCT is performed without contrast for calcium scoring and density evaluation, as well as with contrast for 3D reconstruction and relation to the circumflex artery (3). Risk stratification is based on patient comorbidities, frailty, and technical difficulty related to MAC severity (2). For severe calcification, mitral valve replacement is anticipated; however, if there is limited annular calcification with prolapse, repair can be attempted. Other factors to consider in surgical planning are patient body surface area and size of the left ventricular cavity to avoid patient-prosthesis mismatch (PPM) and atrio-ventricular (AV) groove disruption.

Surgical strategies

Repair

Repair is feasible in many MAC cases with degenerative leaflet disease and regurgitation without stenosis. Mitral valve repair is associated with superior late outcomes compared to replacement, even in cases of MAC (2). Feasibility of valve repair is determined by leaflet pathology and mobility, the distribution of MAC, and surgeon experience. The principles for leaflet repair are identical to those used in non-MAC patients. Importantly, the repair must be supported by an annuloplasty ring (5). A thin or focal bar of MAC still allows anulus reduction and is easy to work around, while a thick, infiltrating calcium bar does not. When the calcium bar must be addressed, the leaflet is carefully released by incising the base along the anulus. Leaflet repairs/resections are performed before or after releasing the leaflet. The calcium bar is debrided with a rongeur, and reinforced as needed, leaving the posterior capsule intact to minimize the risk of AV groove disruption. The remaining annular defect is repaired with a running suture that closes the gap between the atrium and ventricle, followed by reattachment of the posterior leaflet and annuloplasty ring (2,5). When calcium is left behind

and sutures are passed around the bar, an oversized ring is used.

Replacement

If valve repair is not feasible due to leaflet calcification or extensive MAC, the valve should be replaced with a prosthesis of adequate size while avoiding paravalvular leak. Our current approach is a MDCT-guided debridement, with calcium removal as necessary to allow implantation of a prosthesis 27 millimeters or larger. It is uncommon in cases of extensive MAC that all calcium can be left *in-situ* and sutures placed around the calcium bar, risking PPM and paravalvular leak. The posterior leaflet is separated from the calcium bar and preserved to later support posterior annular sutures at valve implantation. Calcium removal with rongeur debridement is our preference, while others have suggested using ultrasonic energy devices for control of depth (2). Leaving some calcium and an intact posterior capsule reduces the risk of AV groove disruption and injury to the circumflex artery. To support the defect left after debridement, we use a Felt strip the width of the debrided groove. For wider defects or when AV groove fat is visible, a pericardial patch is sutured to ventricular and atrial muscle to cover the defect using a parachute technique, reinforcing the ventricular side of the patch with pledgetted sutures (6,7). Pledgetted valve sutures are then passed first through preserved posterior leaflet, then through the pericardial patch or felt, through the posterior MAC capsule, and finally passed out the atrial edge of the debrided defect for smooth seating of the prosthesis. Using a prosthesis with a generous sewing cuff and adding a felt washer may reduce risk of paravalvular leak (8).

Maintenance of ventricular-annular continuity is critical to long-term preservation of left ventricular function; however, extensive fibrosis of sub-valvular structures limits leaflet-chordal-sparing. Using both leaflets for support may crowd the left ventricular inflow/outflow. A posterior leaflet-chordal-sparing approach, with reattachment as a buttress along the posterior anulus, ensures an open left ventricular outflow (2).

In rare cases of AV groove disruption, the prosthesis must be removed, and an endocardial patch sewn to ventricular and atrial myocardium using a parachute technique with interrupted pledgetted sutures to reinforce the ventricular component. A new, smaller prosthesis is then placed, with the posterior sutures anchored to the atrial component of the patch.

Commando procedure

MAC caused by radiation presents the most challenging scenario: (I) circumferential, dense calcification extending from the aortic anulus, the aortomitral curtain and trigones, and onto the anterior leaflet of the mitral valve, often combined with (II) small annuli risking PPM (9). The Commando procedure provides adequate exposure to facilitate debridement of trigonal calcification and reconstruction of the aortomitral curtain, allowing a larger prosthesis size to be implanted without increasing mortality (10). Posterior MAC can also be debrided from the anterior Commando approach with or without extension onto the left atrial dome.

Conclusions

Surgical approach to MAC is tailored to the severity of MAC and associated patient factors. The valve can be repaired when MAC is limited to the anulus and leaflet mobility is preserved, resecting calcium as necessary for annular stabilization. More extensive MAC requires valve replacement with debridement of calcium to allow proper seating of an adequately sized prosthesis. For anterior fibrous skeleton calcification, the Commando operation is an option. While MAC makes correction of mitral valve pathology more challenging, successful repair or replacement can be achieved with low mortality at experienced centers, when following a systematic approach.

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Footnote

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