



Use of ultrasonic aspirator for decalcifying the mitral annulus during mitral valve replacement

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Clinical vignette

An 82-year-old woman with symptomatic severe mitral regurgitation (MR) was referred to our center's multidisciplinary valve team for intervention. Given her age, comorbidities of hyperlipidemia, osteoporosis, and skin cancer, and declining exercise tolerance, she was deemed to be at prohibitive risk for surgical intervention. She underwent an attempted mitral transcatheter edge-to-edge repair (TEER) procedure that failed to achieve sufficient reduction in MR after multiple attempts. Given extensive mitral annular calcification (MAC) and a large annulus precluding transcatheter mitral valve replacement (MVR) or other minimally invasive surgical approaches, she was subsequently planned for open MVR via median sternotomy.

Surgical technique

Preparation and exposition

Computed tomography (CT) angiogram of the heart showed moderate amount of MAC extending from posteromedial commissure to the medial part of P1 with thick block in the P3 area. Additional 3D reconstruction images were obtained with 3mension to better understand the extent of the calcium. Intraoperative transesophageal echocardiography revealed severe eccentric MR from P3 flail with an anteriorly directed jet as well as moderate functional tricuspid regurgitation (TR). Bicaval and ascending aortic cannulation were carried out and antegrade cardioplegia was administered.

Operation

The left atrium was accessed through Sondergaard's groove and an Adams retractor (Delacroix-Chavelier, Paris, France) was placed to facilitate mitral valve exposure. Upon inspection, the mitral valve had myxomatous degenerative disease with bileaflet prolapse and ruptured chords to the posterior leaflet. There was a moderate amount of MAC encompassing between 180 and 270 degrees of the annulus. The valve was not repairable, and the decision was made to proceed with MVR. The anterior leaflet was released at the base with chordal preservation and later used to buttress the sutures placed in the posterior annulus. Using the Sonopet[®] surgical ultrasonic aspirator (Stryker, Kalamazoo, MI, USA), calcium was carefully debrided from the mitral annulus. Typically, the debridement is started in the center of P2, although this can be initiated anywhere. It is not required to remove all the annular calcium, just enough to allow for good seating of the prosthetic valve of adequate size and/or place annular suture. It is particularly useful to debride areas where calcium is protruding into either atrium or ventricle. 2-0 Ticron (Medtronic, Minneapolis, MN, USA) pledgeted annular sutures were placed in a non-everting fashion with needle exiting at the atrial side of annulus or base of the posterior leaflet. If needed the It is important to place needle accurately and to follow judiciously the curve of the needle without torque or rotation that can fracture or disrupt calcium. This is especially important at the transition of MAC and ventricular muscle. Here we used 33 mm Mitris Resilia (Edwards Lifesciences, Irvine, CA,

USA) valve. All sutures were secured with CorKnot (LSI Solutions, Victor, NY, USA) which allows for very accurate gauging of suture tension. The left atrium was closed with a running 3-0 polypropylene suture. The right atrium was subsequently opened to expose the tricuspid valve, and tricuspid annuloplasty was done using a 28 mm Tri-Ad annuloplasty band (Medtronic, Minneapolis, MN, USA).

Completion

The patient was weaned off cardiopulmonary bypass without difficulty. There was no mitral paravalvular leak, only trace TR, and good biventricular function at the conclusion of the case. The patient developed junctional bradycardia and ultimately required permanent pacemaker implantation but otherwise had an uneventful postoperative course.

Comments

Surgical intervention on the mitral valve in the setting of significant MAC is technically challenging and can increase the catastrophic risks of atrioventricular (AV) groove disruption, bleeding, and valve dehiscence (1). These considerations may favor the use of TEER especially in an elderly or frail patient, yet such techniques are not always successful and it remains critical to be proficient at surgical management of the mitral valve.

Various surgical techniques have been described to perform mitral surgery in the face of MAC, falling on a spectrum from aggressive decalcification and annular reconstruction with pericardium to complete avoidance of the calcium ring and implanting a prosthesis in an atrial neo-annulus (2,3). At the core, this decision-making strikes a balance between facilitating placement of a larger prosthesis and reduced risk of paravalvular leak as more calcium is debrided while simultaneously heightening the risk of AV groove disruption. Aggressive decalcification with total excision of MAC is a complex operation with minimal margin for errors and even in the best of hands is associated with close to 10% operative mortality (1). Mitral valve replacement without MAC debridement can be accomplished safely when there is minimal MAC but generally only allows for a smaller prosthesis and paravalvular leaks can be challenging to manage.

The method described here using the Sonopet ultrasonic aspirator takes an intermediate approach aimed at partial rather than complete decalcification. The limited resection

seeks to debulk enough calcium to soften the annulus to permit adequate suture placement, allow for placement of an appropriately sized valve, and ensure proper valve seating. Compared to traditional methods of decalcification using sharp dissection or electrocautery, the Sonopet device selectively targets anhydrous tissue such as calcium while sparing hydrous tissues including muscle, nerves, and vasculature, thereby rendering a safer dissection (4). Furthermore, the aspirator component effectively clears the field of debris that pose embolic risks, potentially reducing the risk of stroke (4). While no large scale randomized studies exist, Brescia and colleagues have previously described their institutional experience using the Sonopet aspirator in a cohort of 15 patients with 0% operative deaths or strokes compared to 10% and 17% in the non-ultrasonic aspirator comparison group (3). Other individual case reports such as that published by Fakim *et al.* and Alomari *et al.* have similarly demonstrated success with this technique (4,5).

Conclusions

The presence of MAC significantly raises procedural risk and requires deliberate technical planning. Emerging reports including the one presented here have demonstrated the safety and utility of ultrasonic aspiration devices such as the Sonopet device as adjunctive measures to more precisely emulsify and aspirate annular calcium. While future studies with expanded patient cohorts are warranted, this novel technology may serve a pivotal role in reshaping the surgical management of MAC and complex mitral valve disease.

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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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