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MINI-FOCUS ISSUE: TRANSCATHETER INTERVENTIONS

ADVANCED

CASE REPORT: CLINICAL CASE

Urgent Open Atrial Transcatheter Mitral Valve Replacement as Bailout for Planned Surgery

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ABSTRACT

Hybrid transcatheter mitral valve replacement (TMVR) has shown great promise for patients with severe mitral annular calcification. However, there have been limited reports of its use as a bailout for planned surgical MVR. Here, we present a bailout TMVR with an excellent patient outcome. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2020;2:1115–9) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

A 63-year-old woman presented to our institution for surgical mitral valve replacement (MVR). She had undergone surgical aortic valve replacement and simple mitral valve (MV) decalcification 9 years prior for severe aortic stenosis and severe mitral annular calcification (MAC) with mild stenosis. Over the past year, she had developed progressive dyspnea, eventually leading to hospitalization. On evaluation, her vital signs were blood pressure of 151/56 mm Hg, heart rate of 78 beats/min, respiratory rate of 18 breaths/min, and oxygen saturation of 88% on ambient air.

The examination was notable for an irregular rate, grade 2/4 low-pitched diastolic murmur at the apex, and trace lower extremity edema.

LEARNING OBJECTIVES

- Hybrid TMVR has shown great promise in patients at high risk and those with previously nonoperable MAC due to its potential to address many limitations of prior therapies, such as LVOT, paravalvular leak, and valve device migration or embolization.
- This approach can be performed in an urgent setting by use of routine pre-operative transesophageal echocardiography, intra-operative balloon sizing, and direct visualization of valve positioning and deployment.

PAST MEDICAL HISTORY

The patient had a history of hypertension, rheumatic heart disease, atrial fibrillation (AF), diabetes, hyperlipidemia, chronic kidney disease, and morbid obesity (body mass index: 36.3 kg/m^2). She had an implantable cardioverter-defibrillator placed after developing sustained ventricular tachycardia following aortic valve replacement.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* author instructions page.

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ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

AML = anterior mitral leaflet

LVOT = left ventricular outflow tract

MAC = mitral annular calcification

MV = mitral valve

MVR = mitral valve replacement

TEE = transesophageal echocardiogram

TMVR = transcatheter mitral valve replacement

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included progression of MV disease, new left ventricular dysfunction, obstructive coronary artery disease, and poorly controlled arrhythmia.

INVESTIGATIONS

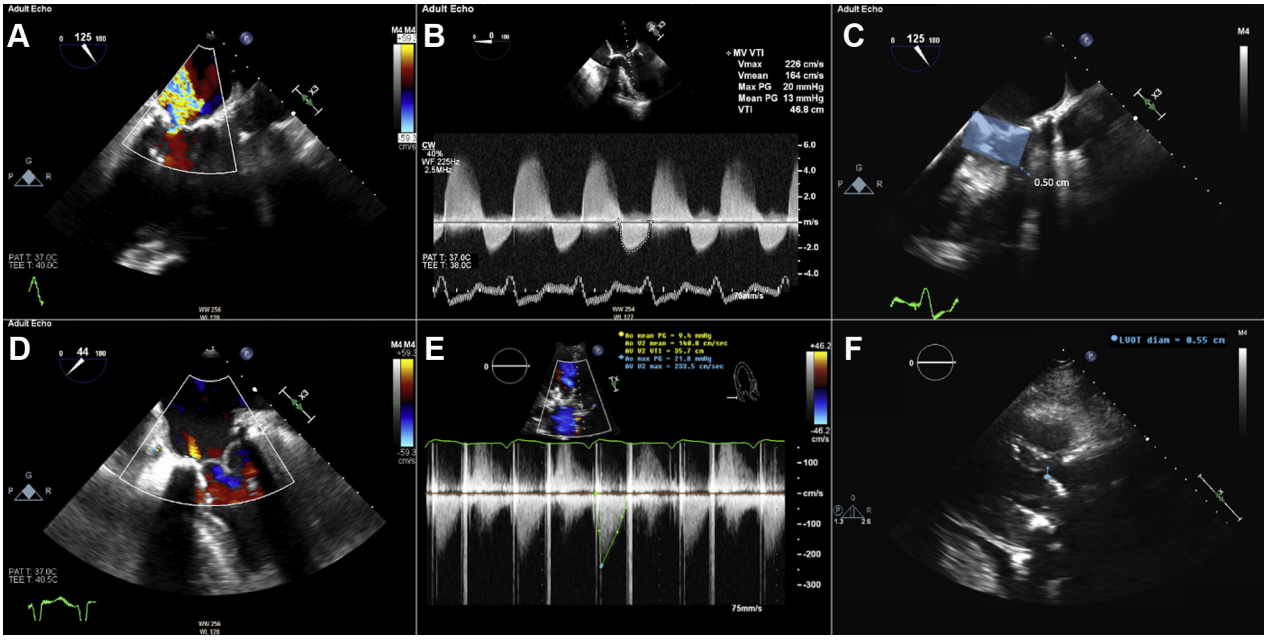
Pre-operative echocardiography demonstrated a severely dilated left atrium, severe MAC with severe mitral stenosis (mean transmitral gradient of 13 mm Hg), mild to moderate mitral regurgitation, severe tricuspid regurgitation, moderate-to-severe pulmonary hypertension, and left ventricular ejection fraction of 60% to 65% (**Figures 1A and 1B**, Video 1). Heart catheterization showed non-obstructive coronary artery disease. Her implantable cardioverter-defibrillator was also interrogated and showed no ventricular arrhythmias, with an AF burden of 4.2%.

MANAGEMENT

After intravenous diuretic therapy and stabilization of symptoms, the patient was scheduled for surgical MVR and tricuspid valve repair. On the day of surgery, a repeat median sternotomy was performed, and she was placed on cardiopulmonary bypass. An extended septal approach through the right atrium was used to access the MV. The mitral leaflets and annulus were found to be completely calcified, preventing proper suture placement, and exposure was incredibly difficult because of body habitus and prior thoracotomy. At this point, interventional cardiology was consulted to evaluate for hybrid TMVR.

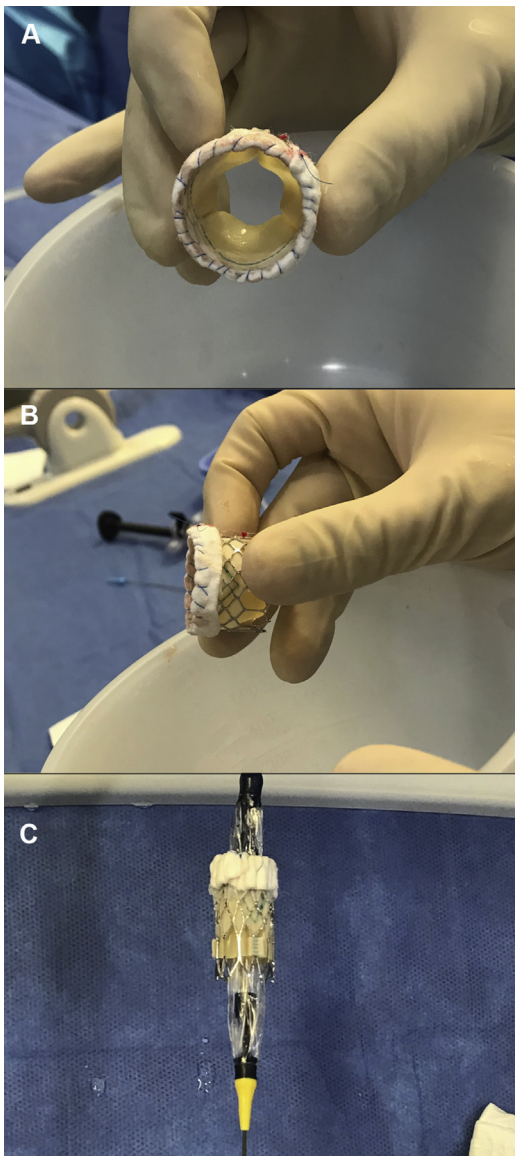
Without cardiac computed tomography, sizing of the valve annulus was based on the prior transesophageal echocardiogram (TEE). The mean MV annulus diameter was calculated at 32 mm by using 2-dimensional measurements from multiple planes. A crude drawing of a rectangular prosthesis in the apical 3-chamber view on a transthoracic

FIGURE 1 **Pre- and Post-Operative Echocardiography**



Pre-operative TEE showed **(A)** mild to moderate mitral regurgitation and **(B)** severe mitral stenosis with a mean transmitral gradient of 13.1 mm Hg. **(C)** Crude 2-dimensional drawings of the prosthesis on TEE were used for planning, demonstrating a neo-LVOT diameter of 0.5 cm. **(D)** Post-operative TEE showed a well-functioning MV prosthesis with trace paravalvular leak. Ten-day post-operative transthoracic echocardiography showed **(E)** no LVOT gradient and **(F)** a distance from prosthesis to anteroseptal wall of 0.55 cm. LVOT = left ventricular outflow tract; MV = mitral valve; TEE = transesophageal echocardiogram.

FIGURE 2 Intra-Operative Valve Device Preparation



The Sapien 3 valve was prepared with a 1-cm felt ring **(A, B)** sutured to the outside of the skirt edge and then **(C)** crimped onto the balloon.

echocardiogram and the 120° left ventricular outflow tract (LVOT) view on TEE estimated the neo-LVOT to be small (**Figure 1C**). Therefore, the plan was to remove the anterior mitral leaflet (AML), reassess annulus size by inflating 25-mm and 30-mm Z-Med balloons (B. Braun Interventional Systems, Bethlehem, Pennsylvania), and ultimately place an over-inflated 29-mm Sapien S3 (Edwards Lifesciences LLC, Irvine, California).

The valve was prepared with a 1-cm felt ring sutured to the outside of the skirt edge (**Figures 2A and 2B**) and crimped onto the balloon (**Figure 2C**). It was then delivered and positioned manually, under tactile feel, into the MV annulus (**Figure 3A**). Once it was in an appropriate position, the valve was deployed at high-pressure balloon inflation (**Figure 3B**, Video 2), and 5 sutures were used to anchor the prosthesis to the annulus. Following TMVR, the surgical team closed the left atrial appendage, performed an epicardial ablation for AF, repaired the atrial septum, and repaired the tricuspid valve.

DISCUSSION

Mitral annular calcification primarily affects elderly patients with multiple comorbidities (1). It is thought to be a degenerative process, with calcium extending from the posterior annulus anteriorly and into the ventricle. Until recently, management of MAC was limited to medical therapy and surgery. Although surgery remains the gold standard for patients with operable MAC who have severe valvular dysfunction and favorable anatomy, advances in TMVR have allowed for less invasive treatment of high-risk patients and those with previously nonoperable disease (2).

There have been isolated reports of successful TMVR with various techniques over the past decade. These include transapical, transseptal, and transatrial methods (2). The transapical approach allows easy access to the MV, however, it remains a surgical procedure with risks of thoracotomy and apical complications, but without the benefits of AML resection (2). The transseptal approach is a percutaneous procedure, but again, the AML cannot be resected (2). The transatrial approach is a hybrid TMVR strategy with the advantages of an open procedure with shorter cardiopulmonary bypass times.

In addition to direct visualization for valve positioning and deployment, a transatrial approach allows the AML to be resected to minimize the risk of LVOT obstruction, one of the primary complications of TMVR. Modifications can also be made to the Sapien 3 valve with 1 or more rows of felt at the atrial side to improve sealing against the MAC and minimize the risk of paravalvular leak (2). Finally, the open component allows the surgeon to perform concomitant cardiac procedures and place sutures from the noncalcified portions of the annulus to the Teflon cuff, which provides additional reinforcement and minimizes the risk of valve device migration or embolization (2).

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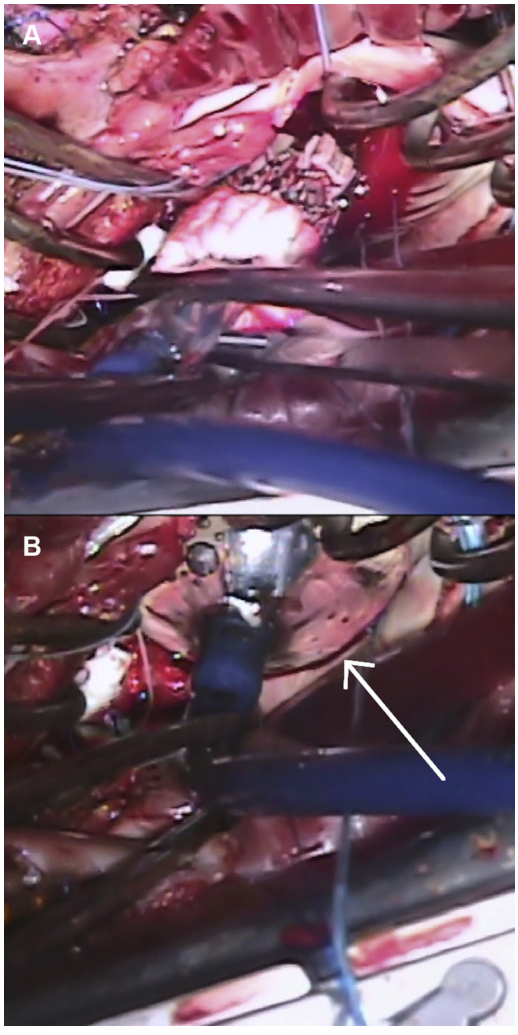
FIGURE 3 Intra-Operative Valve Device Positioning and Deployment



(A) The Sapien 3 valve was delivered and positioned manually into the MV annulus. **(B)** Once in position, the valve was deployed at high-pressure balloon inflation.

Recent multicenter studies have reported the outcomes of TMVR in patients with MAC. Although they demonstrated that transapical and transseptal approaches are feasible, they were associated with significant adverse outcomes. The 1-year mortality among these studies ranged from 22% to 54%, especially in patients with consequent LVOT obstruction (1,2). Further studies and advances are required to overcome the challenges of transapical and transseptal approaches in patients with severe MAC who are not candidates for surgery (1,2).

Despite the growing use of hybrid TMVR, there have been limited reports of its use as a bailout for complicated MVR in patients with MAC (3,4). A variety of annulus-sizing techniques have been used for TMVR planning, with cardiac computed tomography being the most reliable method for evaluating the degree and extension of MAC, annular dimensions, and LVOT obstruction risk (1,2). In our case, upon being called for assistance, our planning was done with the use of the pre-operative TEE, which is routinely performed for every MV procedure. With it, we could estimate prosthesis size, confirmed via intraoperative balloon sizing, assess the risk of LVOT obstruction, and address it with AML resection.

FOLLOW-UP

Post-operative TEE showed a well-functioning MV prosthesis with a trace paravalvular leak (**Figure 1D**, Video 3). The patient's post-operative course was uncomplicated, and she had resolution of her pre-operative symptoms with no complaints at her 6-week follow-up visit. Transthoracic echocardiogram at post-operative day 10 showed a mean transmitral gradient of 8.1 mm Hg, no LVOT gradient (**Figure 1E**), a neo-LVOT diameter of 0.55 cm (**Figure 1F**), no paravalvular regurgitation, and no significant mitral or tricuspid regurgitation.

CONCLUSIONS

Mitral annular calcification significantly increases the risk of MVR because of the comorbidities of this patient population and the technical challenges of the surgery. A hybrid approach via open transatrial TMVR has shown great promise because of its potential to address many limitations of both surgical and transcatheter therapies in patients with severe MAC (2). We presented a case of a bailout hybrid TMVR without prior computed tomography imaging. Although our patient had an excellent outcome, this case illustrates the importance of imaging before scheduled MVR in patients with MAC to better assess the valvular anatomy before surgery and avoid the need for bailout procedures.

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KEY WORDS bailout, hybrid, transatrial, transcatheter mitral valve replacement, urgent

APPENDIX For supplemental videos, please see the online version of this paper.