MINI-FOCUS ISSUE: VALVULAR HEART DISEASE GUIDELINES

ADVANCED

CASE REPORT: CLINICAL CASE

Preemptive Alcohol Septal Ablation Prior to Valve-in-Valve Transcatheter Mitral Valve Replacement With Bioprosthetic Balloon Fracture

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ABSTRACT

A 78-year-old woman with bioprosthetic mitral valve degeneration at high risk for reoperation was referred for transcatheter mitral valve replacement. We describe the use of a preemptive alcohol septal ablation pre-procedurally to minimize the risk of acute left ventricular outflow tract obstruction given the anticipated need for a bioprosthetic valve fracture. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:366–9) © 2021 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/).

HISTORY OF PRESENTATION

A 78-year-old woman underwent a surgical mitral valve replacement with a 25-mm Mosaic (Medtronic, Minneapolis, Minnesota) bioprosthesis in 2004, and immediately developed mild left ventricular outflow tract (LVOT) obstruction due to the interaction between the anterior portion of the prosthetic valve and the basal septum (**Figure 1**, Video 1). At the time of referral to our institution in 2019, she was experiencing heart failure symptoms refractory to medical therapy.

LEARNING OBJECTIVES

- To understand the emerging use of transcatheter valve-in-valve procedures for severely symptomatic patients with bioprosthetic mitral valve dysfunction judged by the heart team to be at high or prohibitive risk of reoperation.
- To understand the mechanism, established risk factors, and strategies to prevent acute LVOT obstruction after TMVR.
- The main limitations of valve-in-valve TMVR can be residual high gradients that can be overcome by bioprosthetic valve fracture, which can be an emerging risk factor for LVOT obstruction.

PAST MEDICAL HISTORY

The patient had a past medical history of pulmonary hypertension, atrial fibrillation, sick sinus syndrome status post permanent pacemaker, and a remote stroke.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included structural valvular degeneration and nonstructural causes of prosthetic valve dysfunction, such as infective

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endocarditis, pannus, or thrombus. Alternate or concurrent causes of heart failure with preserved ejection fraction were also considered.

INVESTIGATIONS

A transthoracic echocardiogram (TTE) showed severe bioprosthetic valvular degeneration resulting in significant mitral stenosis with a mean gradient of 12 mm Hg (Supplemental Figure 1), a velocity of 2.6 m/s across the LVOT, and a subaortic septal thickness of 16 mm. The patient also had an estimated right ventricular pressure of 75 mm Hg and dilated right-sided chambers. A transesophageal echocardiogram revealed a well-seated, degenerated, bioprosthetic (thickened leaflets) mitral valve, with mixed severe transvalvular bioprosthetic mitral regurgitation and moderate bioprosthetic mitral stenosis, with a mean gradient up to 13 mm Hg at heart rate of 62 beats/min. She was deemed not a surgical candidate by the heart team due to the multiple comorbidities mentioned previously and advanced frailty, hence a transcatheter mitral valve replacement (TMVR) was planned.

MANAGEMENT

A bioprosthesis valve fracture was anticipated given her small surgical valve and elevated transvalvular gradient, which would increase the risk of further LVOT obstruction given her preexistent LVOT gradient at baseline, small cavity size, and basal septal hypertrophy. Computed tomography angiography was used to create a multiplanar gated reconstruction of the mitral annulus in diastole to assess the size of TMVR landing zone, and the predicted neo-LVOT modeling was performed in end-systole. Her simulated neo-LVOT with a 23-mm Edwards Sapien 3 valve (Edwards Lifesciences, Irvine, California) was 252.4 mm^2 (Figure 2), which is above conventional thresholds (a neo-LVOT area of $\leq$189.4 mm^2 is usually considered high risk for LVOT obstruction post-TMVR), but still concerning given the anticipated valve fracture. In addition, she likely had a component of dynamic LVOT obstruction, with prior echocardiograms from an outside institution reporting transaortic velocities >4.5 m/s. Accordingly, the decision was made to proceed with a preemptive alcohol septal ablation (ASA) before TMVR, which is a strategy to allow for basal anteroseptal myocardial wall remodeling to reduce the risk of LVOT obstruction.

For the ASA, coronary angiography was performed before the TMVR and revealed no significant coronary artery disease. The second septal perforator was identified as the best target. A 0.014-inch guidewire was advanced into the target artery and an over-the-wire balloon (2.5-mm) was deployed. Angiography showed a competent seal existed (Figure 3), and echo contrast was injected into the vessel to confirm flow

ABBREVIATIONS AND ACRONYMS

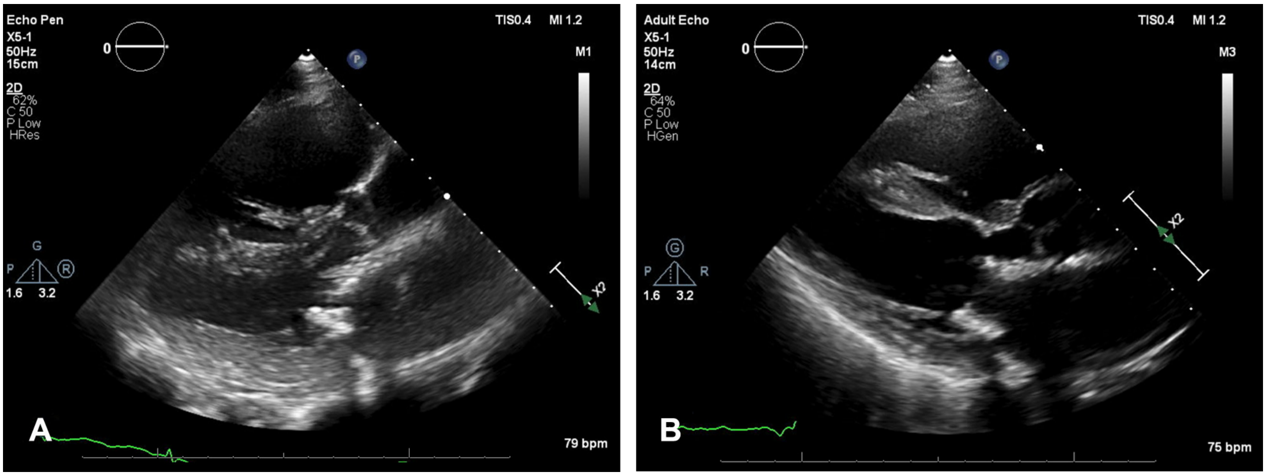
ASA = alcohol septal ablation

LVOT = left ventricular outflow tract

TMVR = transcatheter mitral valve replacement

TTE = transthoracic echocardiogram

FIGURE 1 Transthoracic Echocardiogram Parasternal Long-Axis View



(A) Transthoracic echocardiogram before alcohol septal ablation shows an obstruction of the left ventricular outflow tract by the anterior portion of the bioprosthetic mitral valve 25-mm Mosaic (Medtronic), which protrudes again the septum in systole. **(B)** Transthoracic echocardiogram 4 weeks postablation shows a substantial reduction in the thickness of the basal septum, and no significant left ventricular outflow tract obstruction in systole.

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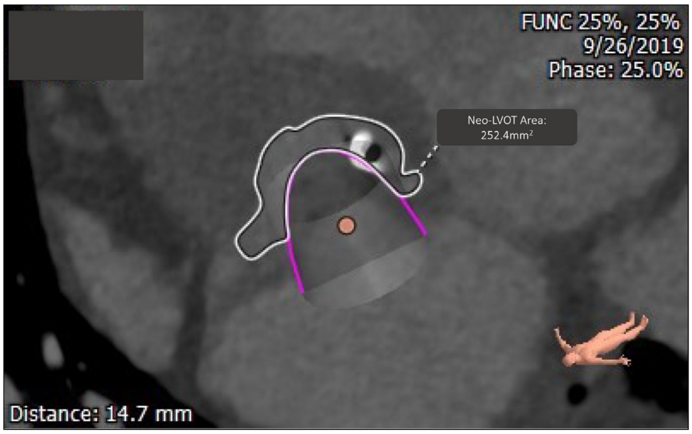
FIGURE 2 Computed Tomography Angiography Multiplanar Gated Mitral Valve Reconstruction

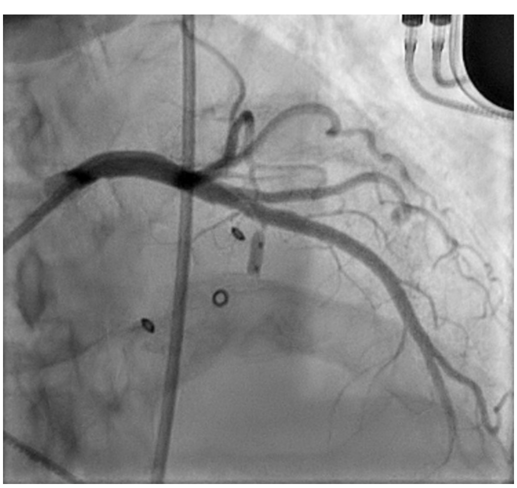


Computer-aided design modeling of the neo-left ventricular outflow tract with a 23-mm Edwards Sapien 3 valve (Edwards Lifesciences) before alcohol septal ablation shows a predicted area of 252.4 mm^2.

to the area of interest by TTE. Administration of 1.5 ml of 98% dehydrated alcohol was performed over 10 min. A TTE 4 weeks postablation showed akinetic basal anteroseptal, a small decrease in intraventricular septum width, and no resting LVOT gradient (**Figure 1**).

Transseptal valve-in-valve TMVR with a 23-mm Sapien 3 valve was performed 5 weeks after ASA

FIGURE 3 Alcohol Septal Ablation



Coronary angiography showing balloon occlusion of the second septal perforator prior to injection of alcohol septal ablation.

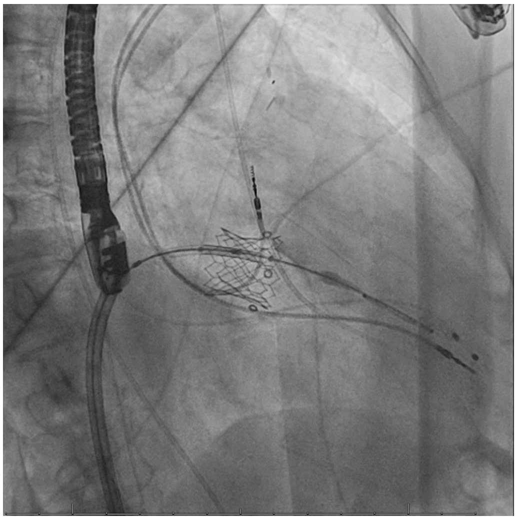
(**Figure 4**). Immediately following the implant, a mean gradient of 8 mm Hg was noted across the TMVR valve and none across the LVOT. Accordingly, bioprosthetic valve fracture was performed under rapid ventricular pacing with a 24-mm True balloon (Bard Peripheral Vascular). Fracture was confirmed by the release of the balloon waist and sudden drop in the inflation pressure (**Figure 5**, Video 2). The mitral gradient was reduced to 5 mm Hg (Supplemental Figure 2) and there was still no gradient across the LVOT. The patient was discharged in stable condition on postoperative day 2.

DISCUSSION

Valve-in-valve TMVR is an acceptable treatment option for high surgical risk patients with structural valvular degeneration of mitral bioprosthesis (1) and its use is increasing in the United States. Valve-in-valve TMVR for small bioprosthetic valves often results in high residual gradients. The first case of bioprosthetic mitral valve fracture to overcome this problem was recently reported (2). This approach can presumably increase the risk of acute LVOT obstruction, which is an inherent risk with TMVR, particularly in patients with predisposing anatomic risk factors (3). The mechanism for LVOT obstruction is permanent anterior displacement of the native anterior leaflet or surgical mitral valve, preventing flow from entering the aortic outflow tract. Established risk factors for this complication present in our case were small LV cavity size, basal septal hypertrophy, hyperdynamic left ventricle, and significant right ventricular dilation (4).

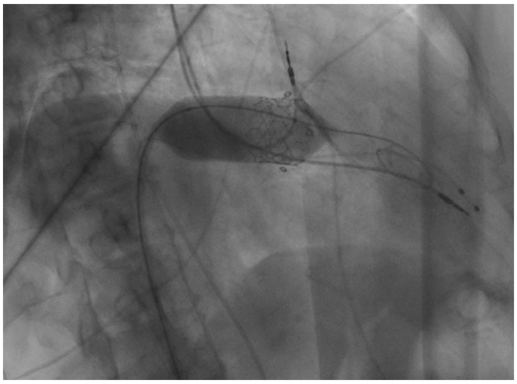
ASA has been developed to treat severe septal hypertrophy in hypertrophic cardiomyopathy, but its preemptive use before TMVR to prevent LVOT obstruction is a promising and safe strategy that has been reported mostly in patients with severe mitral annular calcification, and in only a few patients undergoing valve-in-valve TMVR (4). However, the application of preemptive ASA before valve-in-valve TMVR with bioprosthetic valve fracture has not yet been reported. Here we describe a case using this novel strategy in a patient with a degenerated small bioprosthesis with some degree of fixed and dynamic LVOT obstruction at baseline. Clinicians are likely to face similar clinical dilemmas more often as the rate of utilization of valve-in-valve TMVR increases, particularly among patients with smaller mitral prostheses. Our case demonstrates the feasibility of a preemptive ASA in this type of clinical scenario, and adds to the armamentarium of the treating interventionalist.

FIGURE 4 **Valve-in-Valve Transcatheter Mitral Valve Replacement Procedure**



The 23-mm Edwards Sapien 3 valve (Edwards Lifesciences) deployed into the surgical mitral valve under rapid ventricular pacing.

FIGURE 5 **Mitral Bioprosthetic Balloon Fracture**



High-pressure balloon inflation to fracture the mitral bioprosthetic valve with a 24-mm True balloon (Bard Peripheral Vascular) under rapid pacing.

Other strategies, like intraprocedural intentional laceration of the anterior mitral leaflet to prevent LVOT obstruction (LAMPOON) (in this case, tip to base) and bail-out ASA have been used as potential solutions to prevent iatrogenic LVOT obstruction. However, the LAMPOON procedure is technically challenging, and few operators have experience performing this procedure. ASA as a bail-out strategy for LVOT obstruction has been reported, but mortality remains high given the extent of hemodynamic compromise in the acute situation.

FOLLOW-UP

At 1 month, a TTE was repeated that showed similar hemodynamics to the prior post-procedure study (normal bioprosthetic valve function with a mean gradient of 6.9 mm Hg) and her heart failure symptoms completely resolved (Video 3).

CONCLUSIONS

Preemptive ASA has been shown to be a feasible and safe strategy to prevent acute LVOT obstruction after TMVR in high-risk patients. This strategy is also feasible in patients requiring valve-in-valve TMVR with bioprosthetic valve fracture who have predisposing anatomic factors to develop acute LVOT obstruction.

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KEY WORDS mitral valve, valve replacement, vascular disease

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