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Challenging Case of Transcatheter Mitral Valve-in-Valve-in-Valve Replacement

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Statistical Analysis C
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Manuscript Preparation E
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Patient: Male, 39-year-old
Final Diagnosis: Degenerated bioprosthetic mitral valve
Symptoms: Chest pain • cough • dyspnea • orthopnea • paroxysmal nocturnal dyspnea
Medication: —
Clinical Procedure: Transcatheter mitral valve replacement
Specialty: Cardiology

Objective: Unusual clinical course

Background: A 39-year-old man with a complex valvular history of recurrent methicillin-resistant *Staphylococcus aureus* endocarditis with 2 surgical mitral valve replacements (in 2016 and 2017) followed by transcatheter mitral valve replacement (in 2019) presented with orthopnea, paroxysmal nocturnal dyspnea, chest pain, cough, and progressively worsening dyspnea on exertion.

Case Report: Extensive workup was performed, including transesophageal echocardiogram, which revealed a malfunctioning, severely stenotic bioprosthetic valve. Left and right heart catheterization revealed mild non-obstructive coronary artery disease and severe pulmonary hypertension. Given the patient's complex medical history, he was deemed to be at an elevated risk for repeat sternotomy and repeat valve replacement surgery. Therefore, he underwent a percutaneous transcatheter mitral valve replacement with a 26-mm SAPIEN 3 Edwards valve placed within the previous 29-mm SAPIEN valve. Post-procedural imaging revealed a well-placed valve with an improved mitral valve gradient.

Conclusions: This is one of the few rare cases of mitral valve-in-valve via a transcatheter mitral valve replacement approach with successful deployment of a SAPIEN 3 tissue heart valve. The patient experienced significant reversal of heart failure symptoms and improved exertional tolerance following deployment of the valve and was eventually discharged home in a stable condition.

Keywords: Mitral Valve • Mitral Valve Endocarditis • Transcatheter Mitral Valve Replacement

Abbreviations: **ViV** – valve in valve; **ViViV** – valve in valve in valve; **TMVR** – transcatheter mitral valve replacement; **TEE** – transesophageal echocardiogram

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/938415

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Background

Mitral stenosis (MS) and regurgitation are the most prevalent valvular diseases in the United States and are associated with increased incidence of mortality and heart failure [1].

Valvular diseases in the past were typically caused by rheumatic heart disease; however, now most valve diseases are degenerative [1]. Infective endocarditis remains uncommon, with an incidence of approximately 2 to 10 cases per 100 000 person-years [2]. It is known that bioprosthetic valves degenerate over time (approximately 15 years), and the criterion standard is reoperation despite its association with higher morbidity and mortality [3]. A valve-in-valve (ViV) treatment strategy with TMVR can be considered as an alternate option in patients with a high surgical risk.

Case Report

A 39-year-old man was admitted with symptoms of progressively worsening New York Heart Association class IV dyspnea for the past several months. He additionally had orthopnea, paroxysmal nocturnal dyspnea, chest pain, cough, and dyspnea on exertion.

His past medical history included chronic kidney disease, with hemodialysis, and a complex valvular history, starting with a methicillin-resistant *Staphylococcus aureus* (MRSA) endocarditis of his native MV in 2016. This was addressed with a 29-mm Epic porcine bioprosthetic valve. Recurrent bacterial (MRSA) endocarditis in 2017 with valvular dehiscence and mycotic aneurysms resulted in a redo MV replacement with another 29-mm Epic porcine valve. He was subsequently maintained on chronic antibiotic suppressive therapy with Bactrim. In 2019 as a result of calcification, severe pannus formation of the MV leaflets with severe stenosis was noted, requiring a transcatheter ViV replacement with a 29-mm SAPIEN 3 valve in 2019.

On presentation, his physical examination was remarkable for a normal cardiopulmonary finding, with regular heart rate and rhythm, no murmurs on auscultation, or jugular venous distension on inspection. Trace bilateral pitting edema was present. The pulmonary examination demonstrated a normal respiratory effort, and clear lung sounds were auscultated in all fields.

A transthoracic echocardiogram (TTE) had recently been performed in the outpatient setting, revealing a severe MV stenosis. Initial laboratory workup was largely unremarkable, and no new or ongoing infections were noted. A transesophageal echocardiogram (TEE) was performed to further work up his worsening dyspnea, cough, and chest pain, which confirmed a malfunctioning, severely stenotic bioprosthetic valve (**Figures 1, 2**),

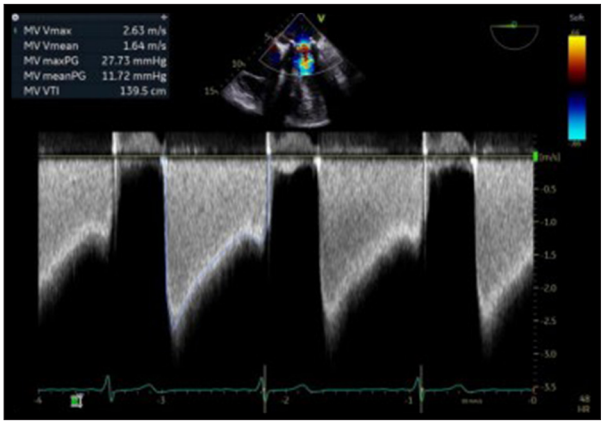

Figure 1. Pre-procedure transesophageal echocardiogram (TEE): Continuous wave inflow Doppler of mitral valve on TEE showing severe stenosis of bioprosthetic mitral valve with a mean gradiant of 11.72 mmHg.

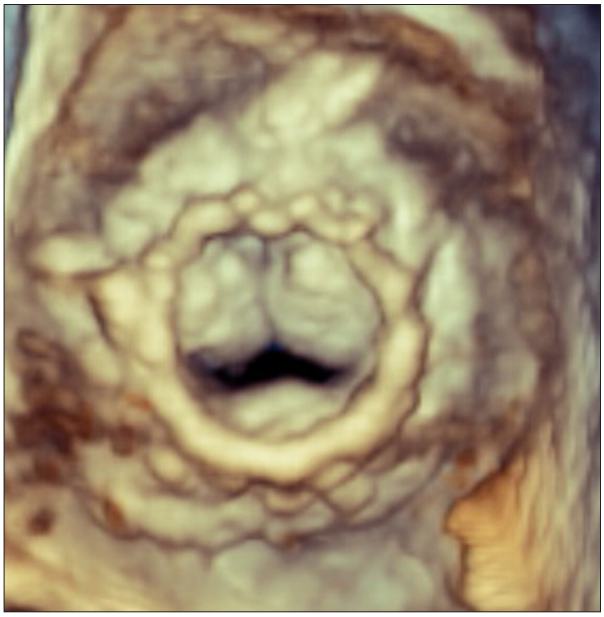

Figure 2. Three-dimensional image of severely stenotic bioprosthetic mitral valve on pre-deployment transesophageal echocardiogram: Surgeon's view from the left atrium showing severe leaflet restriction with severely reduced valve opening.

with the anterior leaflet fixed in the closed position. Severe stenosis was identified by a velocity time integral ratio of 4.35 and a mean pressure gradient of 12 mmHg at 52 beats per min. Computed tomography of the MV also revealed a severely stenotic bioprosthetic MV (29-mm SAPIEN 3 valve), seated within the surgical valve (29-mm St. Jude Epic bioprosthetic valve), with appropriate size and a low risk for left ventricular outflow tract obstruction (**Figures 3, 4**). Finally, a left and right heart catheterization were performed, which revealed mild non-obstructive coronary artery disease and severe

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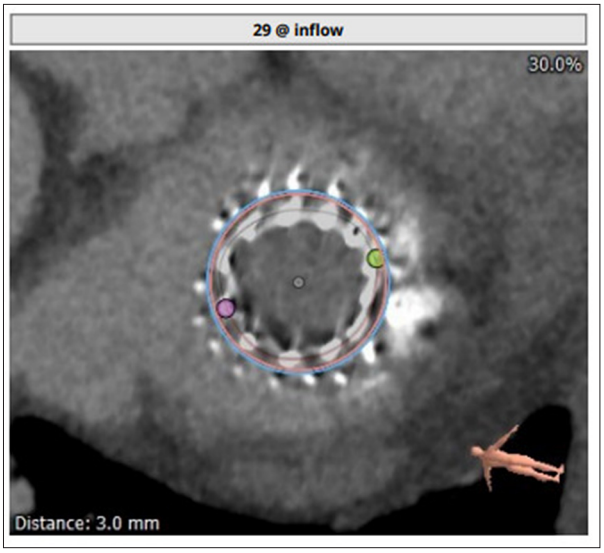

Figure 3. Computed tomography assessment of mitral valve: To assess annular size and to determine appropriate size of the new valve.

Figure 4. Computed tomography assessment of neo left ventricular outflow tract (LVOT): Shows average area of 26.44 mm after valve implantation, which would be low risk for LVOT obstruction.

pulmonary hypertension, with mean pulmonary artery pressure of 50 mmHg. Although his Society of Thoracic Surgeons score was not elevated, given 2 prior sternotomy procedures and a complex medical history including severe pulmonary hypertension, the cardiothoracic surgery team recommended a percutaneous valve-in-valve-in-valve (ViViV) procedure.

The patient underwent a percutaneous transcatheter MV replacement (TMVR) with a 26-mm SAPIEN 3 Edwards valve placed within the previous 29-mm SAPIEN valve with TEE

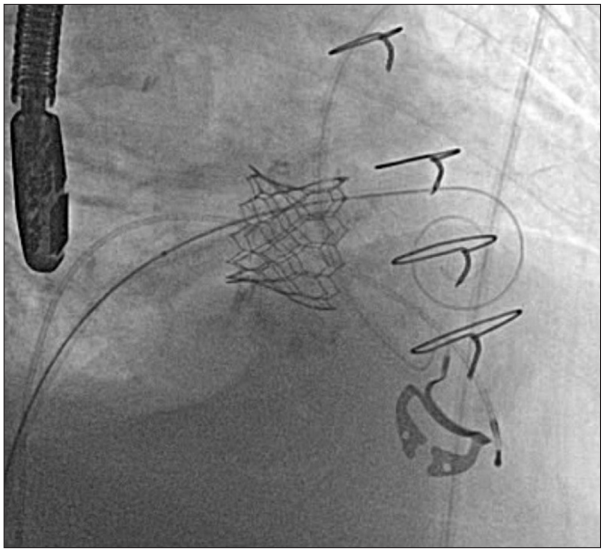

Figure 5. Prior to dilation: Fluoroscopy shows overlapping previously deployed valve stent struts.

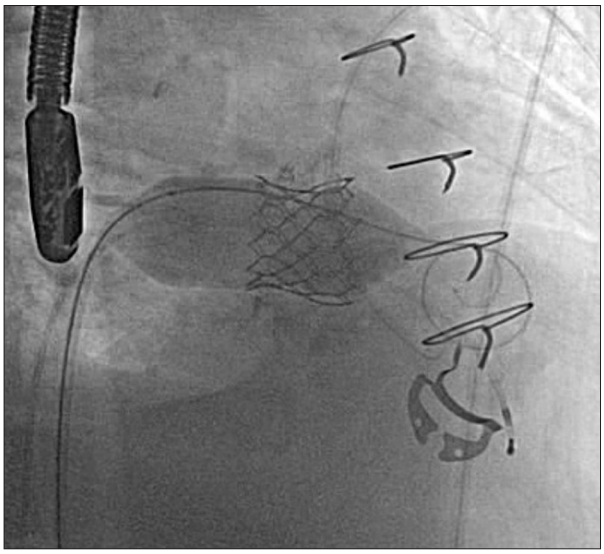

Figure 6. Persisting waist: Fluoroscopy shows significant waist after initial balloon inflation.

guidance. With careful consideration, we were able to fracture the incompletely expanded SAPIEN 29-mm bioprothetic valve ring, using a 26-mm×4.5-cm true balloon deployed at 14 atm. **Figure 5** shows the valve appearance prior to balloon dilatation, followed by the presence of a significant waist (**Figure 6**), and finally resolution of the waist and obvious fracture of the previous valve (**Figure 7**). This allowed adequate deployment of the new bioprosthesis (**Figure 8**). The post-procedural TTE revealed a well-placed SAPIEN TMVR valve with an improved MV gradient of 7 mmHg, down from 12 mmHg, with a new velocity time integral ratio of 1.0 (**Figure 9**). He was eventually discharged home with significant improvement in his symptoms (New York Heart Association class I).

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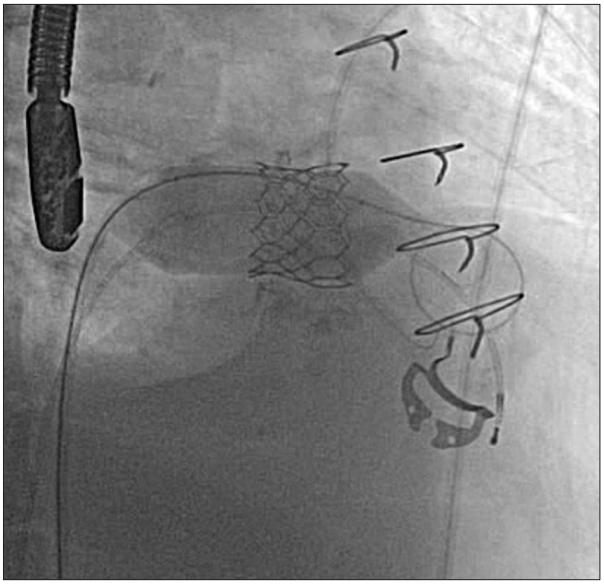

Figure 7. After dilation: Fluoroscopy shows resolution of waist and fracture of the stent struts after high pressure inflation of the balloon.

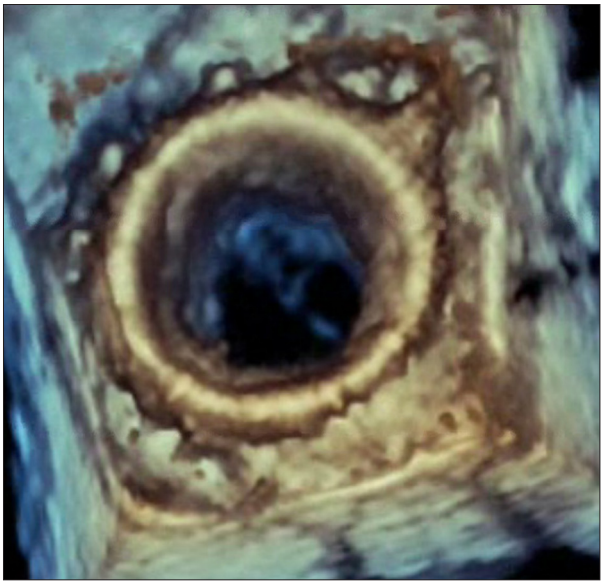

Figure 8. Three-dimensional image of bioprosthetic mitral valve on post-deployment transesophageal echocardiogram: Surgeon's view showing successful placement of the new bioprosthetic mitral valve with full leaflet opening and improved valve area, as compared with Figure 2.

Discussion

Bioprosthetic valves have an advantage over mechanical valves because of fewer thrombotic complications and avoidance of anticoagulation, but they degenerate over time needing reintervention. The early use of TMVR for ViV procedures was off label until approval in 2017 by the Food and Drug Administration.

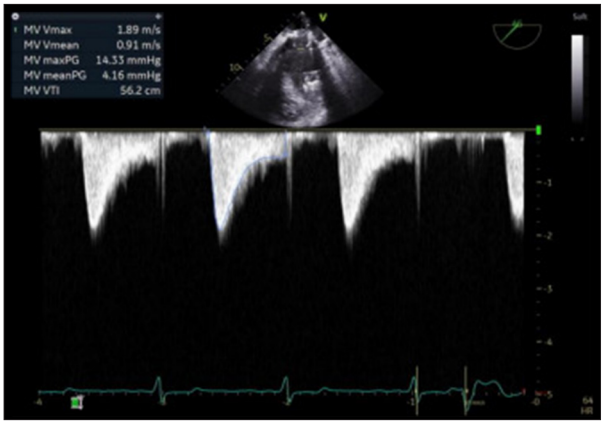

Figure 9. Post-procedure transesophageal echocardiogram: Continuous wave inflow Doppler of mitral valve post-deployment showing resolution of severe stenosis and an improved mean gradient of 4.16 mmHg.

The 30-day mortality rate of the ViV procedure was 3.9% in 2019, down from 8.8% in 2014 [4]. The first ViV TMVR was performed in 2009 via a transapical approach [2]. The transapical approach has largely been replaced by the transseptal approach since 2014, from 76% to 3.8% of procedures being performed transapically [3,4]. A prospective registry study measuring 1-year mortality in 1529 patients with degenerated bioprosthetic mitral valves concluded that the transcatheter mitral ViV procedure had high technical success, low 30-day and 1-year mortality rates, and significant improvement of heart failure symptoms [5,6].

While there are few cases of ViViV mitral procedure (11 reported from 2016 to 2019) [4], the frequency with which ViV procedures are being done is increasing [7]. The Society of Thoracic Surgeons/American College of Cardiology Transcatheter Valve Therapy registry noted a steady increase in ViV TMVR. From 2014 through 2019, the case load increased 10-fold from 71 to 873 mitral ViV procedures [3,4,7]. Overall, the ViV TMVR has a procedural success rate over 90%, with readily reproducible and predictable results [3,7]. While studies have indicated favorable outcomes for ViV TMVR, comparable results on reversal of heart failure symptoms and sustained valve performance have not been replicated in cases of ViViV TMVR due to the paucity of cases.

Conclusions

This is a unique case of a successful TMVR in a previously placed transcatheter MV inside an original bioprosthetic mitral ViViV, with significant improvement in heart failure symptoms.

Institution Where Work Was Completed

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Declaration of Figures' Authenticity

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