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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Prophylactic Left Ventricular Outflow Tract Septal Ablation Before Transcatheter Mitral Valve Replacement

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ABSTRACT

An 82-year-old woman with severe respiratory distress and limitations in functional status was found to have severe mitral valve stenosis with annular calcification and referred for transcatheter mitral valve replacement. Prophylactic alcohol septal ablation was used pre-procedurally to minimize mortality risk due to obstruction of the left ventricular outflow tract. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2019;1:823–31) © 2019 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

An 82-year-old woman presented to the emergency department with severe respiratory distress that was progressive over the last 3 months. She was found to have lower extremity edema up to her thighs and diminished breath sounds with the use of accessory musculature along with bilateral crackles. Chest radiograph findings were consistent with acute pulmonary edema and cephalization of her pulmonary vasculature.

LEARNING OBJECTIVES

- To be able to understand the heart team approach and the role of multimodality imaging in planning and performing TMVR.
- To understand how to identify patients who are at risk for LVOT obstruction before the procedure and the role of prophylactic ASA in minimizing mortality risk.

PAST MEDICAL HISTORY

The patient had a past medical history of third-degree heart block status post permanent pacemaker, chronic obstructive pulmonary disease on 2 l of oxygen via nasal cannula, uncontrolled hypertension, and hyperlipidemia.

DIFFERENTIAL DIAGNOSIS

Exacerbation of the patient's underlying lung disease was considered in the differential diagnosis, along with heart failure with preserved ejection fraction and valvular insufficiency.

INVESTIGATIONS

Transthoracic echocardiogram (TTE) demonstrated left ventricular ejection fraction of 65% and interventricular septal thickening (**Figure 1**). In addition, TTE demonstrated severe mitral annular calcification

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Informed consent was obtained for this case.

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ABBREVIATIONS AND ACRONYMS

ASA = alcohol septal ablation

HRCT = high-resolution computed tomography

LAD = left anterior descending artery

LVOT = left ventricular outflow tract

MAC = mitral annular calcification

THV = transcatheter heart valve

TMVR = transcatheter mitral valve replacement

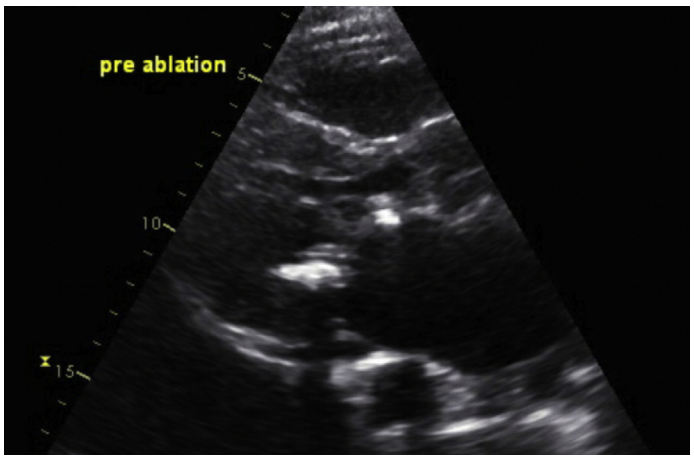
TTE = transthoracic echocardiogram

(MAC) with valve area 0.53 cm^2 and maximum and mean mitral valve pressure gradients of 23.2 and 13.4 mm Hg, respectively (Figure 2). The patient was evaluated by the cardiothoracic surgery team for possible surgical intervention; however, her Society for Thoracic Surgery risk score was 8.4% with a frailty index of 6, indicating frailty. Heart team discussion with the cardiothoracic surgery, cardiology, and structural heart teams resulted in referral of the patient for transcatheter mitral valve replacement (TMVR).

MANAGEMENT

Coronary angiography performed before TMVR was notable for 50% stenosis of the patient's mid-left anterior descending artery (LAD). Intravascular ultrasound showed severe mid-LAD stenosis with minimum lumen area <3 mm^2. High-resolution computed tomographic (HRCT) imaging showed severe MAC with annular area of 492.7 mm^2 (Figure 3) and complete obstruction of the neo-left ventricular outflow tract (neo-LVOT) using a virtual 26-mm Edwards Sapien 3 (Edwards Lifesciences, Irvine, California) transcatheter heart valve (THV). Basal left ventricular hypertrophy was identified, with the anterobasal septum and anterior wall measuring 13.5 mm (Figure 4).

FIGURE 1 Transthoracic Echocardiogram Showing Interventricular Septal Thickening



Pre-transcatheter mitral valve replacement echocardiogram in the parasternal long-axis view showing interventricular septal thickening in diastole with septal thickness of 13.5 mm pre-ablation.

The decision was made to perform alcohol septal ablation (ASA) and to re-evaluate the neo-LVOT for possible TMVR. Based on the thickness of the septal wall and complete obstruction of the neo-LVOT as demonstrated by TTE and HRCT, ASA was planned in 2 consecutive septal perforators to decrease the risk of post-procedural TMVR obstruction. Right radial access was obtained, an EBU 3.5 guide catheter (Medtronic, Minneapolis, Minnesota) was used to access the left main coronary artery, and consecutive septal arteries were identified for ASA. A 0.014-inch Runthrough (Terumo, Tokyo, Japan) guidewire was advanced into the first septal artery. A 1.5- x 15-mm Sprinter balloon (Medtronic, Dublin, Ireland) was advanced and inflated in the proximal portion of the artery, after which the guidewire was removed. The septal area was visualized under echocardiographic guidance with saline, followed by injection of 0.6 mL of dehydrated alcohol in the first septal branch. The procedure was repeated in the second septal artery with 1 mL of dehydrated alcohol. The LAD was then wired, and the mid-LAD lesion was stented with a 2.5- × 16-mm Synergy drug-eluting stent (Boston Science, Marlborough, Massachusetts). The patient was admitted to the coronary care unit for observation. Repeat HRCT showed a basal septum measuring 4 mm and neo-LVOT area of 1.3 cm^2 using a virtual 26-mm Edwards Sapien 3 THV (Figure 5).

Because of the patient's severely limited functional status, the heart team decided to have her return 6 weeks after discharge for TMVR with a 26-mm Edwards Sapien 3 THV. Access was obtained via the right femoral vein, and a transseptal approach was used before positioning and deployment of the valve (Figure 6). Valve position was confirmed by echocardiography and fluoroscopy, and no paravalvular leak was noted. Post-procedural echocardiography showed a mean mitral valve pressure gradient of 4.7 mm Hg (Figure 7). The patient was discharged in stable condition with complete resolution of her symptoms at 1-week follow-up. No change in left ventricular ejection fraction or worsening of post-procedural mitral valve hemodynamics was noted at 6-month follow-up, and the patient returned to her baseline activities of daily living.

DISCUSSION

Patients who present with severe MAC causing severe mitral stenosis often are elderly with comorbid conditions that raise the surgical risk due to risk of stroke, embolization, and bleeding complications

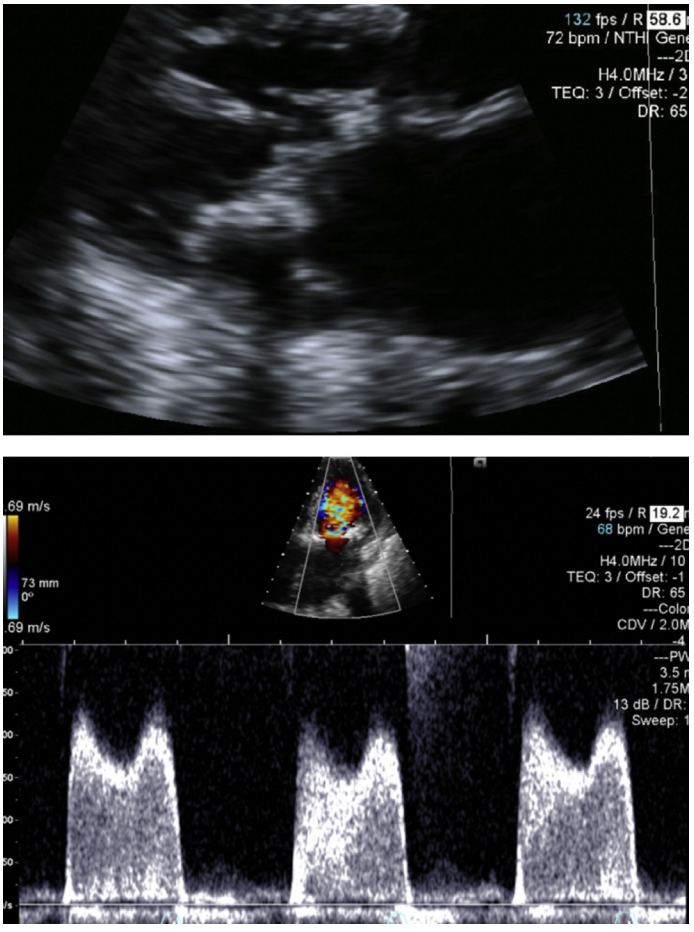
(1,2). TMVR with THV was shown to be feasible in the multicenter MAC Global Registry, with improvement in mean mitral gradients and symptoms (3). Deployment of THVs in the mitral position can lead to obstruction due to the valve geometry itself or the anterior leaflet being pushed into the outflow tract. Obstruction can be a devastating complication of the TMVR procedure. To minimize the risk of this often fatal consequence of the procedure, multimodality imaging has been used to assess risk before procedures and to develop optimal landing zones based on computer modeling (4). Imaging allows the operator to produce a virtual valve within a high-resolution CT image to identify the neo-LVOT and estimate the risk of obstruction, with smaller estimated neo-LVOT areas being of highest risk. A neo-LVOT <1.7 cm^2 is considered to be high risk for LVOT obstruction after THV placement (5).

Various modalities have been described that allow patients who previously may not have been candidates for TMVR to undergo this procedure and improve their quality of life and functional status. Intentional laceration of the anterior mitral leaflet to prevent LVOT obstruction is a transcatheter percutaneous technique that reduces the risk of obstruction (6).

ASA was first used in 1995 to help treat hypertrophic obstructive cardiomyopathy (7). In the structural heart landscape, it was previously described as a bailout technique if post-procedural LVOT gradients determined to be high by echocardiography indicated a risk for obstruction (8). This technique is now being validated and used in first-in-man studies to reduce the risk of obstruction before the TMVR procedure and allow patients who previously were excluded to safely undergo TMVR using THV in the mitral position (9).

Our case is unique because it shows that septal ablation can be a feasible method to significantly reduce septal thickness from 13.5 to 4 mm using ASA in 2 different septal arteries and thereby increase the neo-LVOT. In addition, significant heterogeneity exists in the population with neo-LVOT before TMVR. Current expert opinion is that there is a high risk for obstruction after THV placement with neo-LVOT <1.7 cm^2, and we demonstrated that this technique is feasible to improve quality of life and functional status in patients who do not fit that criterion. In the future, patients referred for TMVR should be analyzed on a case-by-case basis to determine the optimal strategy and procedural plan to deliver a positive outcome.

FIGURE 2 Transthoracic Echocardiogram Showing Mitral Annular Calcification and Pressure Gradients



Pre-transcatheter mitral valve replacement echocardiogram in the parasternal long-axis **(top)** and apical 4-chamber **(bottom)** views showing mean and maximum pressure gradients of 15.6 and 27 mm Hg, respectively, due to severe mitral annular calcification.

Multimodality imaging is a key component to procedural planning and success. Use of 2-dimensional and 3-dimensional TTE, transesophageal echocardiography, HRCT, and cardiac magnetic resonance imaging all can play a vital role in the accurate diagnosis of patient condition, procedural planning, intraprocedural guidance for intervention, and post-procedural follow-up. As the number of structural heart procedures increases, precise understanding of patient anatomy, procedural

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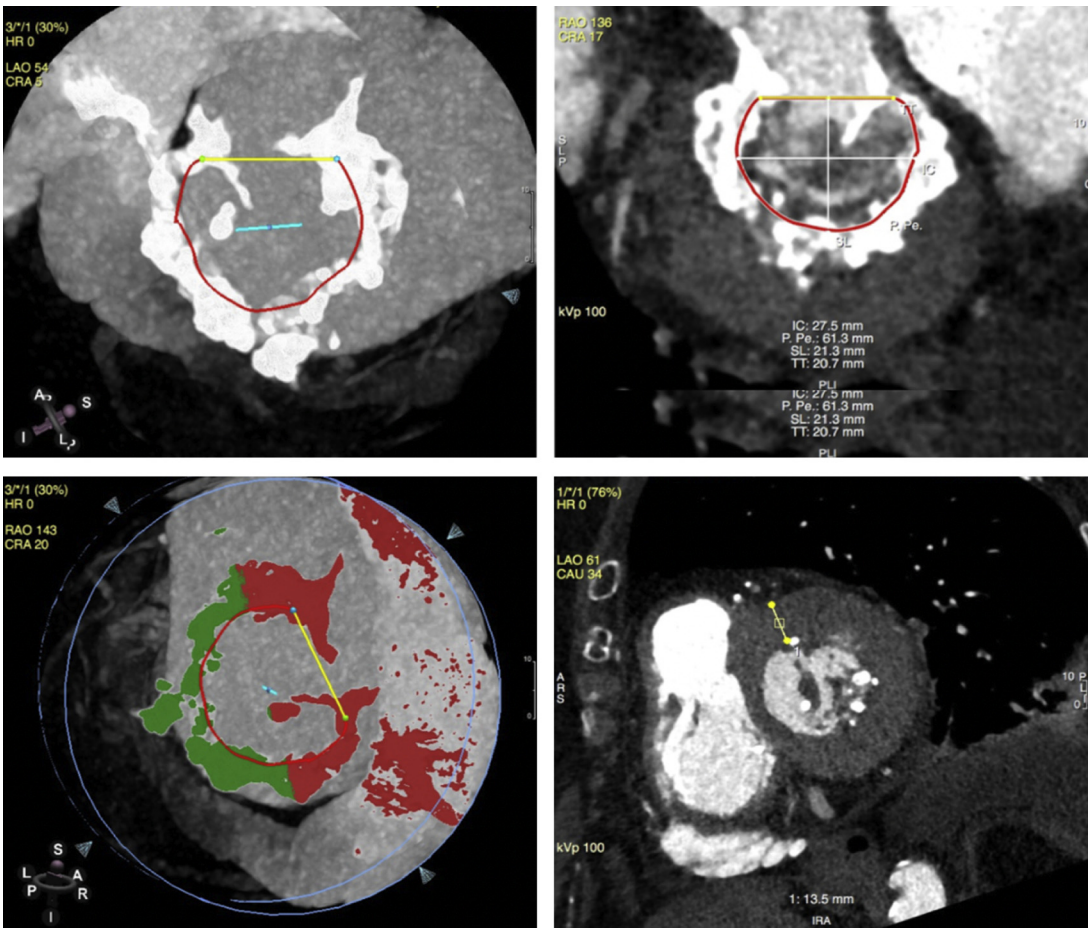
FIGURE 3 High-Resolution Computed Tomographic Imaging of Mitral Annular Calcification



High-resolution computed tomographic imaging showing mitral valve annular calcification with anterior and posterior calcium volumes of 1,825.7 and 790.8 mm^3, respectively, and septal thickness of 13.5 mm pre-ablation.

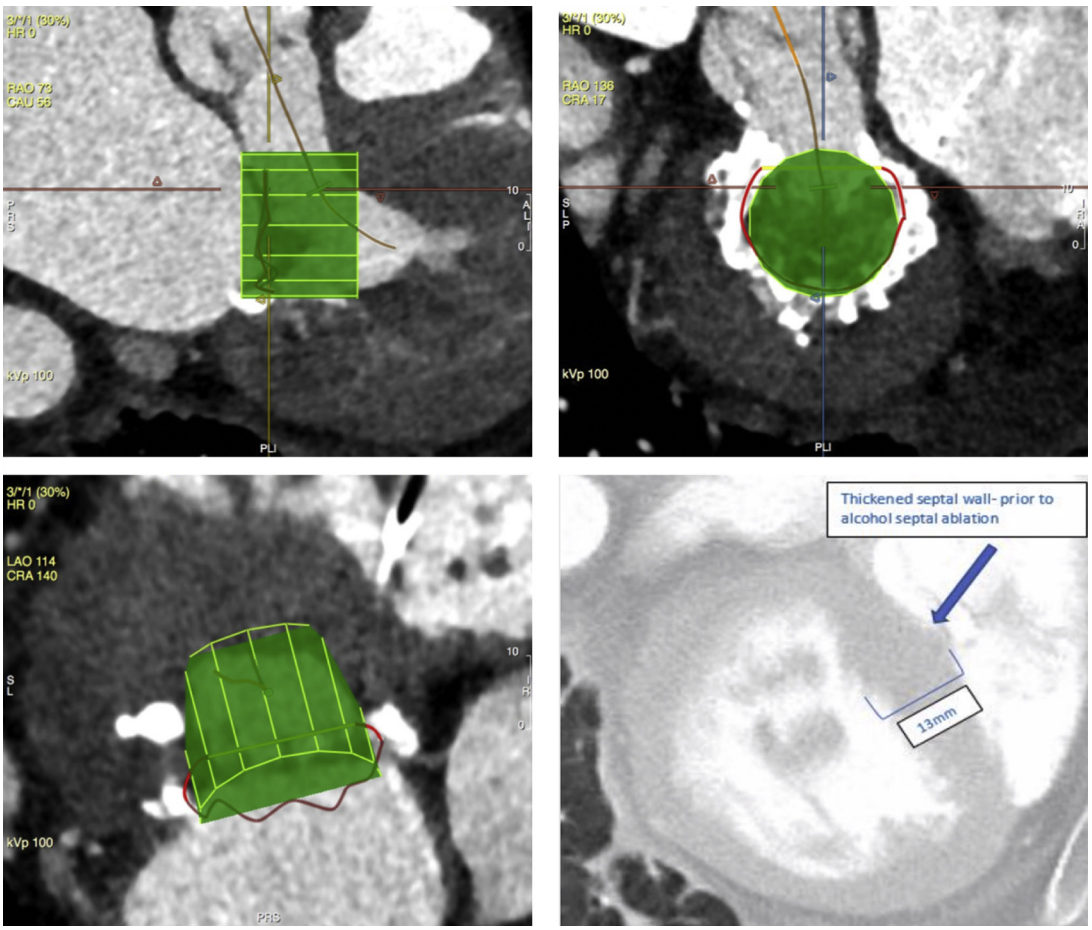
risk, and effect of device implantation on the hemodynamics of the cardiovascular system is paramount to achieving a successful outcome for patients. All imaging modalities available to the heart team should be incorporated in the planning and performing of these novel techniques (10).

Septal ablation is not without its own risks. If not carefully planned, delivery of alcohol for septal ablation can lead to ventricular septal defects. We present the case of a patient with severe MAC and discuss the role of multimodality imaging along with a heart team approach involving both the structural and interventional cardiology teams working in tandem to provide coordinated care to a patient at risk for obstruction with THV placement in the mitral position.

CONCLUSIONS

LVOT obstruction is a catastrophic complication of TMVR. Use of multimodality imaging and a heart team approach can help to identify patients most at risk for obstruction. Prophylactic ASA to decrease septal thickness can be performed before TMVR to minimize the risk of obstruction and thus decrease mortality risk.

FIGURE 4 **Pre-Ablation Neo-LVOT and Septum**



Pre-ablation neo-left ventricular outflow tract (LVOT) of a 26-mmm Edwards Sapien 3 transcatheter heart valve with 4-mm atrial offset at 20% and complete obstruction due to septal thickness of 13.5 mm.

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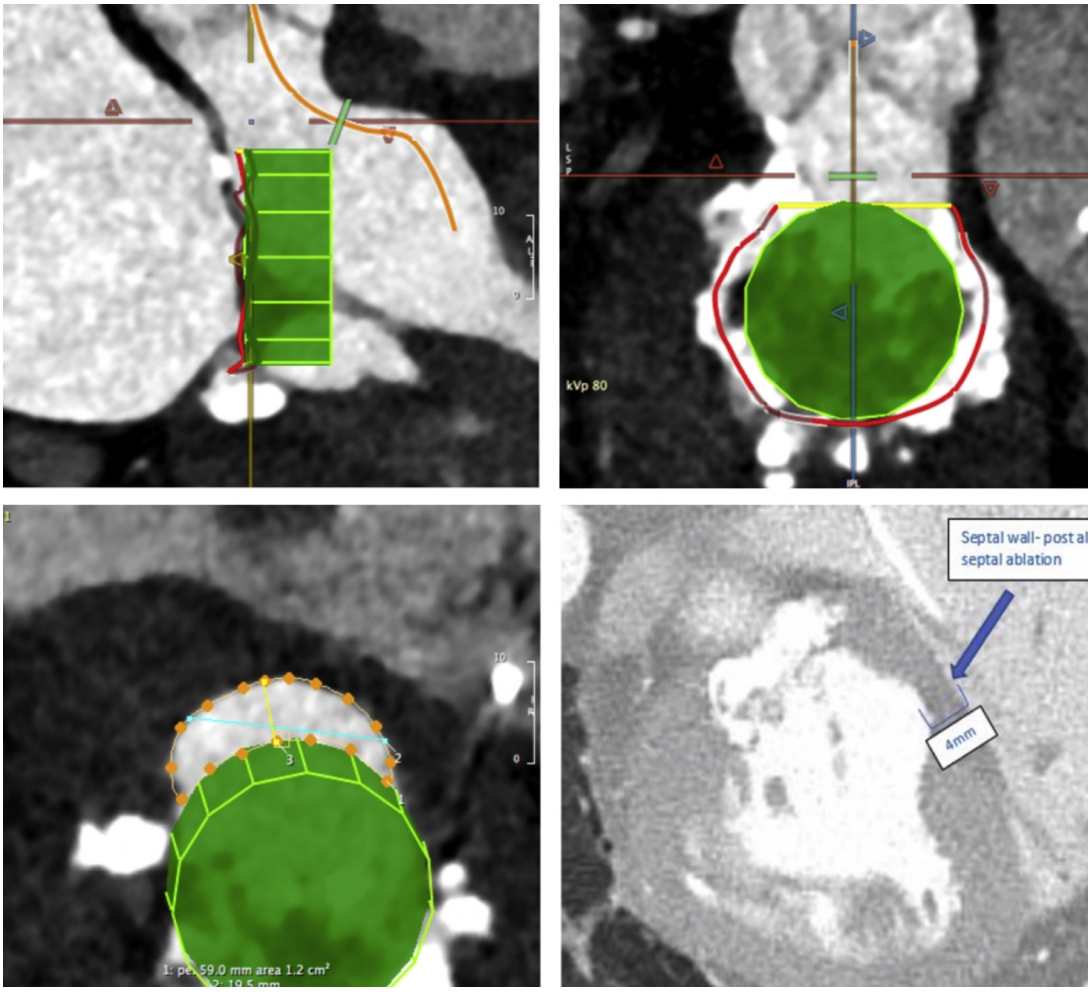
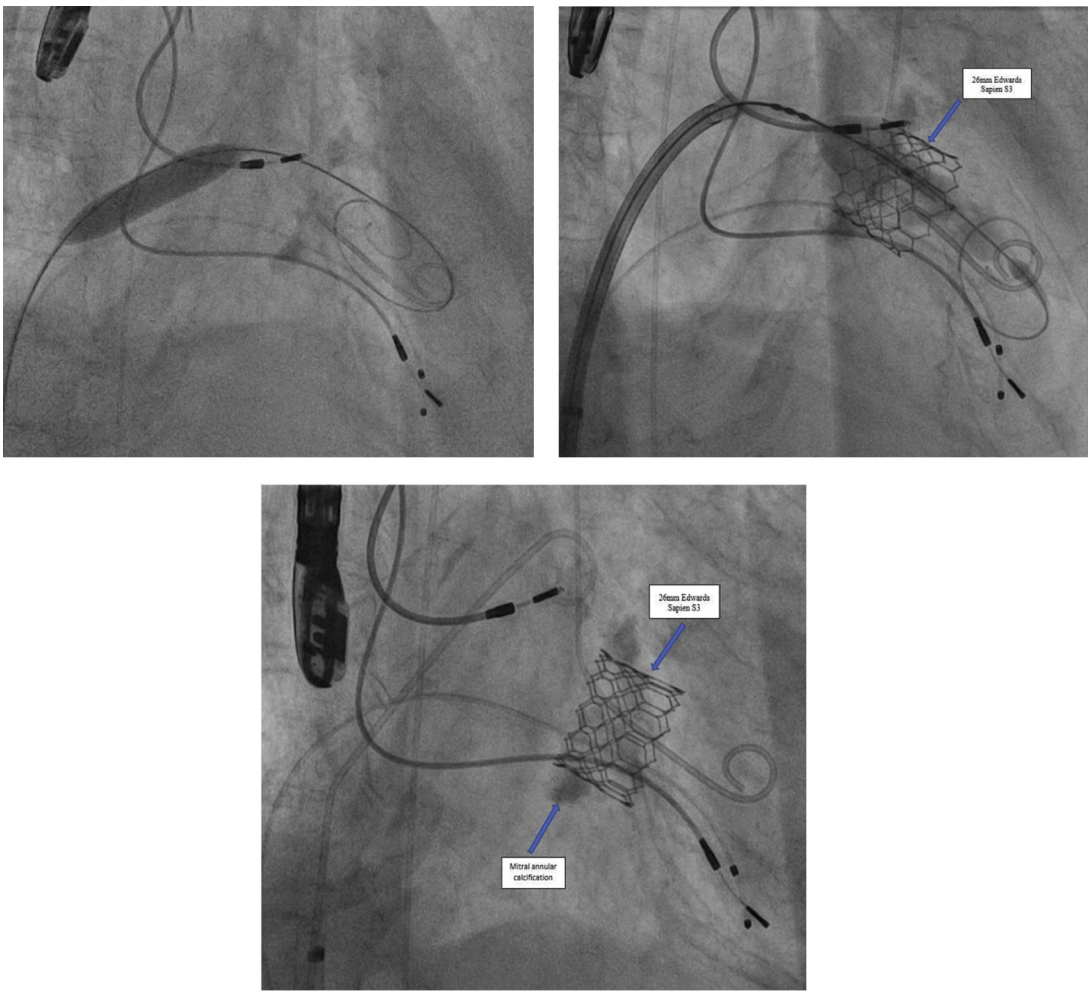
FIGURE 5 Post-Ablation Neo-LVOT and Septum



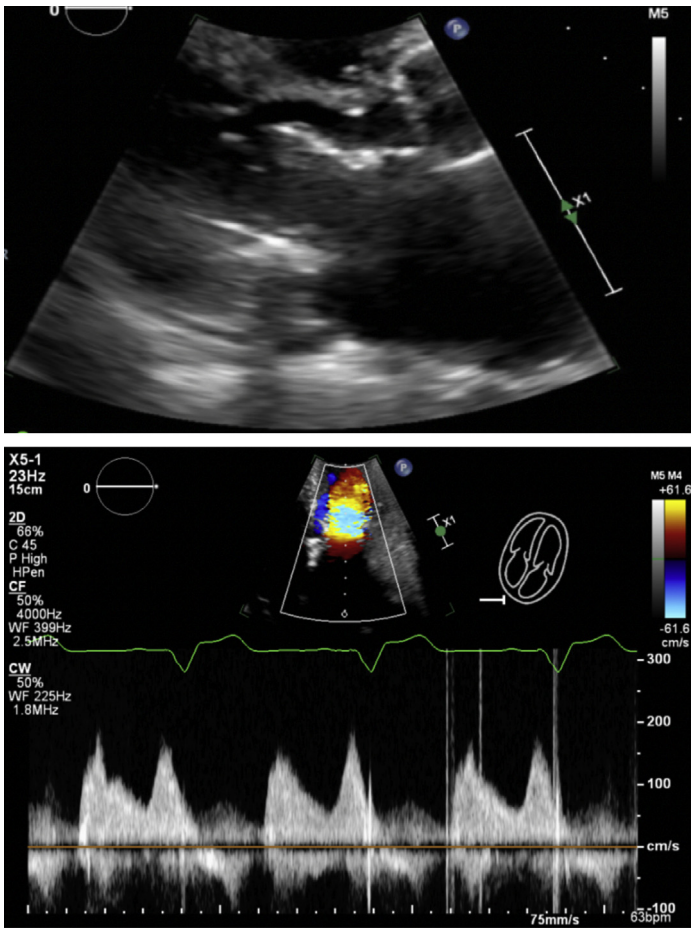
Post-ablation neo-left ventricular outflow tract (LVOT) of a 26-mmm Edwards Sapien 3 transcatheter heart valve with 4-mm atrial offset at 20%, septal thickness of 4 mm, and neo-LVOT area of 1.3 cm^2.

FIGURE 6 **Angiography of Transcatheter Mitral Valve Replacement**



Deployment of a 26-mm Edwards Sapien 3 transcatheter heart valve in the mitral position via a transseptal approach.

FIGURE 7 Post-Procedure Transthoracic Echocardiogram



Post-transcatheter mitral valve replacement echocardiogram in the parasternal long-axis **(top)** and apical 4-chamber **(bottom)** views showing mean and maximum pressure gradients of 4.7 and 13 mm Hg, respectively.

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