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CASE REPORT

ADVANCED

CLINICAL CASE

Emergency Transcatheter Repair for Anterior Leaflet Tear Following Percutaneous Balloon Mitral Valvuloplasty

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ABSTRACT

We present the case of a 66-year-old woman who developed severe mitral regurgitation from rupture of the anterior mitral valve leaflet following percutaneous balloon mitral valvuloplasty. Emergency transcatheter mitral valve repair was used to reduce the severity of mitral regurgitation and facilitate definitive surgical treatment. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2023;23:101980) © 2023 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 66-year-old woman was transferred to our institution for management of symptomatic severe mitral stenosis. The patient had been hospitalized more than 10 times for acute decompensated heart failure. Despite optimization with beta-blockers and diuretics, the patient remained highly symptomatic with dyspnea and fatigue (NYHA functional class IV symptoms).

LEARNING OBJECTIVES

- To demonstrate the clinical presentation of mitral leaflet tear following percutaneous balloon mitral valvuloplasty to allow the rapid diagnosis of this rare procedural complication.
- To describe the treatment of mitral leaflet tear using transcatheter repair techniques to stabilize patients and facilitate definitive surgical treatment.

PAST MEDICAL HISTORY

The patient's medical history was significant for obesity (height 1.50 m, weight 88 kg, body mass index 39.1 kg/m^2), Charcot Marie Tooth disease with associated muscle weakness and limited ambulatory capacity, chronic obstructive pulmonary disease on home oxygen, paroxysmal atrial fibrillation, adrenal insufficiency, and systemic hypertension.

DIFFERENTIAL DIAGNOSIS

The potential causes of dyspnea in this patient might include heart failure, obesity, pulmonary disease, or occult coronary ischemia.

INVESTIGATIONS

Transthoracic echocardiography demonstrated normal left ventricular function, severe left atrial dilation, moderately impaired right ventricular function, and moderate right atrial dilation (**Figure 1**, Video 1). Rheumatic deformity of the mitral valve was

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ABBREVIATIONS AND ACRONYMS

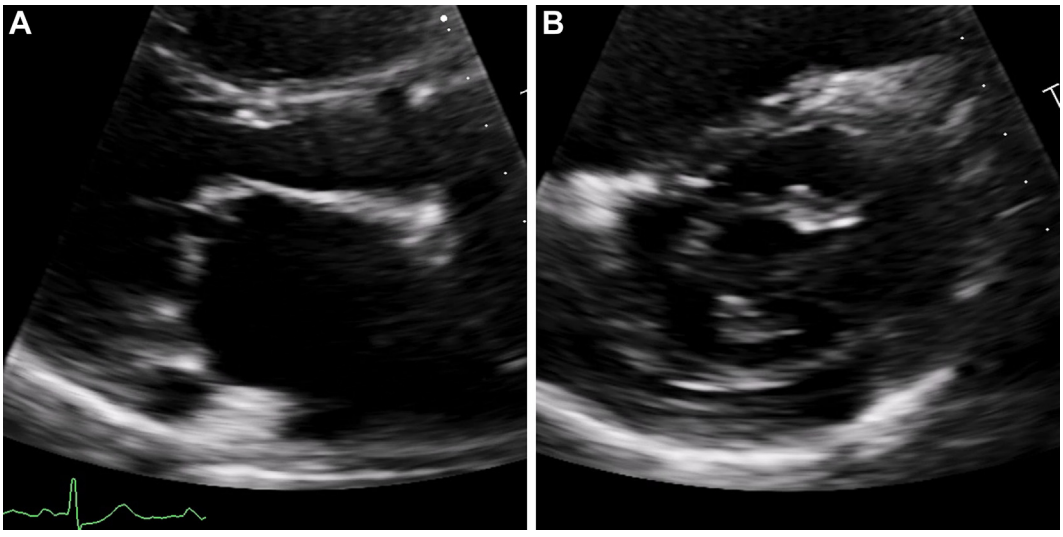
PBMV = percutaneous balloon mitral valvuloplasty

present and was associated with severe stenosis (mean gradient 16 mm Hg at 60 beats/min, mitral valve area by pressure half-time 1.0 cm^2) and trace mitral regurgitation. There was mild tricuspid regurgitation with an estimated right ventricular systolic pressure of 106 mm Hg. Right heart catheterization confirmed pulmonary hypertension due to left heart disease (mean pulmonary artery pressure 47 mm Hg) with combined post- and precapillary pulmonary hypertension (pulmonary capillary wedge pressure 25 mm Hg). Cardiac computed tomography demonstrated thickened mitral valve leaflets (**Figure 2**).

MANAGEMENT

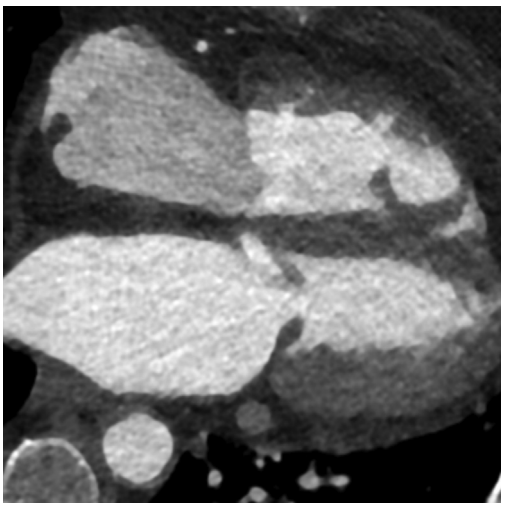
The case was discussed in a heart team meeting. The patient was felt to be at extreme risk for surgery, due to her significant comorbidities, severe pulmonary hypertension, and limited functional status, and therefore percutaneous balloon mitral valvuloplasty (PBMV) was recommended. Peri-procedural transesophageal imaging demonstrated thickened mitral valve leaflets (**Figure 3**, Video 2) with restricted motion but minimal calcification, and subvalvular thickening (Wilkins score 8), trivial mitral regurgitation and a mean gradient of 9 mm Hg under general anesthesia. The mitral valve area by 3-dimensional multiplanar reconstruction was 1.4 cm^2. Baseline left ventriculography confirmed no significant mitral regurgitation (**Figure 4**, Video 3). Transeptal catheterization was performed in the middle of the fossa ovalis. Baseline hemodynamics demonstrated a mean left atrial pressure of 35 mm Hg and a V-wave of 51 mm Hg (**Figure 5**). PBMV was performed with a 24-mm INOUE balloon (Toray Medical) based on the patient's height of 150 cm. There was no commissural opening and no significant change in the mitral valve gradient (11 mm Hg). PBMV was then performed with a 26-mm balloon. This resulted in a tear of the medial A2 leaflet resulting in severe mitral regurgitation (V-wave of 74 mm Hg). The patient became hemodynamically unstable, and an intra-aortic balloon pump was inserted. An emergency heart team meeting was convened, and the consensus was to attempt to stabilize the patient with a percutaneous mitral valve repair. The prior transeptal puncture was used for delivery of the steerable guide catheter. A MitraClip NT (Abbott Laboratories) was chosen because of the high baseline mitral valve gradient. The device was orientated across the anterior leaflet defect and advanced into the left ventricle with care taken to avoid entanglement in the subvalvular apparatus. Grasping was performed in the intercommissural view. The initial grasping resulted in a small residual anterior jet and so the device was repositioned closer to the annulus. Following release, there was mild to moderate residual mitral regurgitation (V-wave

FIGURE 1 Transthoracic Echocardiography



(A) Doming of the anterior mitral valve leaflet. **(B)** Reduced mitral valve orifice.

FIGURE 2 Cardiac Computed Tomography



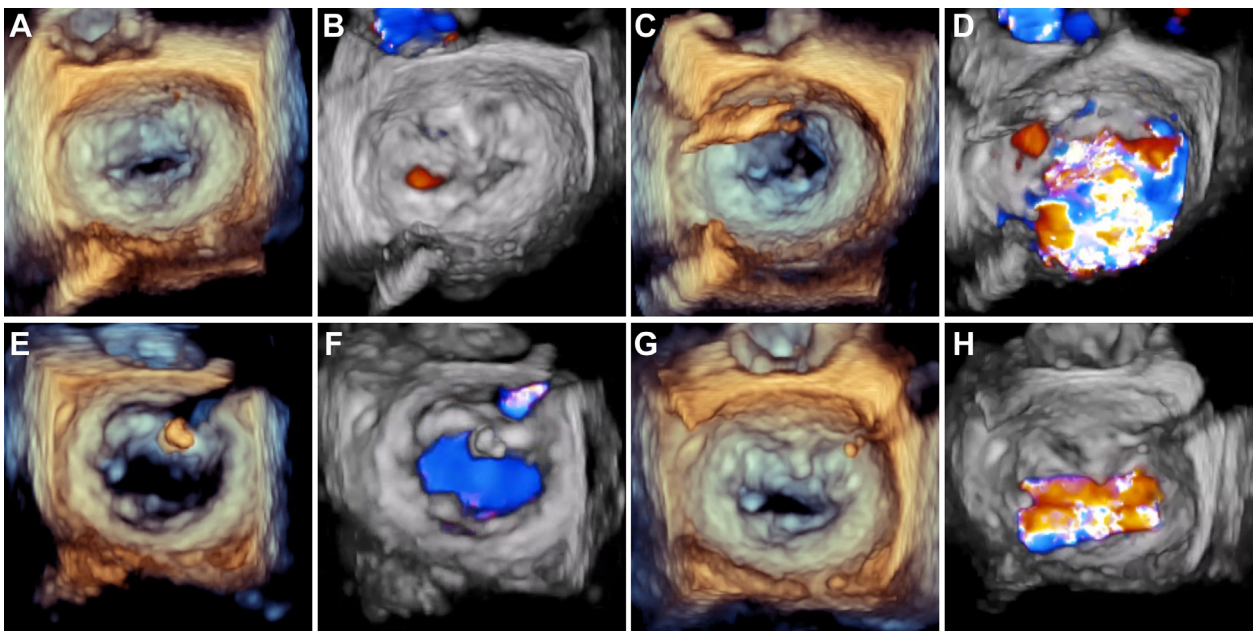
Cardiac computed tomography demonstrated thickened mitral valve leaflets.

48 mm Hg) and the mean gradient remained stable at 9 mm Hg. The patient's hemodynamics improved and a post-procedure transthoracic echocardiogram demonstrated a similar residual mitral valve gradient (mean gradient 17 mm Hg at 64 beats/min) and mild to moderate mitral regurgitation. The patient was able to undergo surgical mitral valve replacement 5 days later with a 29-mm Epic valve (Abbott Laboratories). Operative findings demonstrated that the tear had been partially opposed by the clip (**Figure 6**).

DISCUSSION

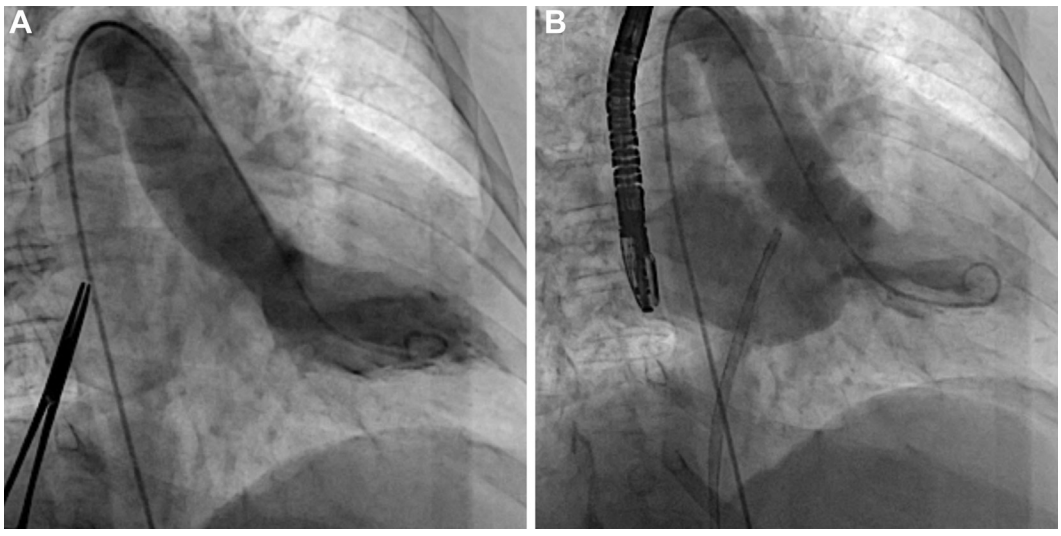
The treatment options for mitral stenosis include medical therapy, PBMV, surgical repair, commissurotomy, and mitral valve replacement. Anatomical assessment is an important consideration when selecting candidates for PBMV, and is most commonly performed using the Wilkins score, which assesses leaflet calcification, thickness, and mobility, and thickness of the chordal apparatus.[1] This assessment is best performed using echocardiographic, rather than computed tomography imaging.[2] A number of alternate scoring systems may offer superior ability to predict adverse procedural outcomes.[3-9] These anatomical features must then be incorporated with clinical factors to help guide the heart team in selecting the optimal treatment strategy for the patient and may assist in identifying patients in whom mitral valve interventions might be associated with less favorable long-term clinical outcomes.[10]

FIGURE 3 Transesophageal Echocardiography



(A and B) Baseline imaging. **(C and D)** Following percutaneous balloon mitral valvuloplasty with a 26-mm balloon. **(E and F)** Initial positioning of MitraClip NT across the anterior leaflet tear. **(G and H)** Final procedural outcome.

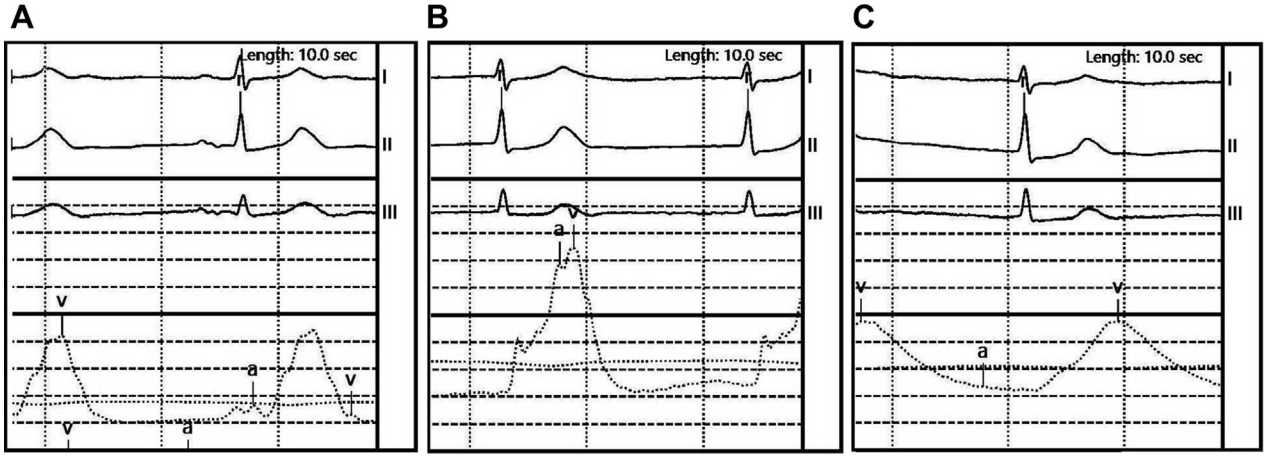
FIGURE 4 Peri-Procedural Cineangiography



(A) Baseline left ventriculography demonstrated no mitral regurgitation. **(B)** Following percutaneous balloon mitral valvuloplasty there was severe mitral regurgitation.

The major complications of PBMV include mortality, stroke, cardiac tamponade, and severe mitral regurgitation. Severe mitral regurgitation necessitating cardiac surgery may occur in approximately 0.9% to 2.0% of patients.[11] Sizing based on the intercommissural distance may be associated with a larger mitral valve area and reduced mitral regurgitation severity, when compared with height-based sizing methods.[12] Although emergency surgery is clearly the optimal treatment for severe mitral regurgitation, our patient, with multiple medical comorbidities was a poor candidate for a salvage operation, and therefore our heart team felt that a stabilizing procedure should be attempted.

FIGURE 5 Left Atrial Pressure Recordings

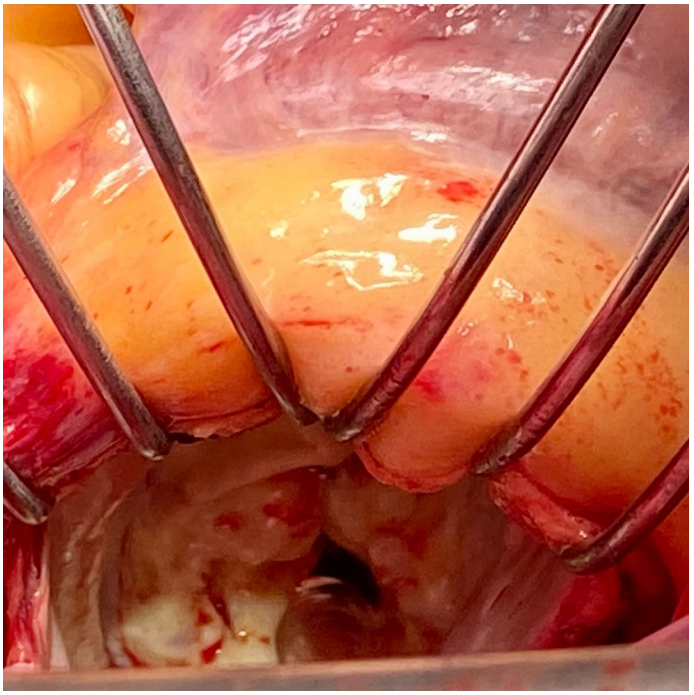


(A) At baseline the V-wave was 51 mm Hg. **(B)** Following percutaneous balloon mitral valvuloplasty the V-wave increased to 74 mm Hg. **(C)** Following intervention with an NT device the V-wave reduced to 48 mm Hg.

Transcatheter mitral valve repair has been reported as a potential treatment strategy for congenital anterior[13,14] and posterior[15] mitral valve clefts, but has not to our knowledge, been described in the setting of an acute leaflet tear from a PBMV procedure. One key consideration to obtaining a technical success in this procedure was the usage of the shorter and narrower NT device, which facilitated an anterior device placement, and helped ensure an acceptable post-procedure mitral valve gradient. Two- and 3-dimensional transesophageal echocardiography was also critical to guide key procedural steps, including the unusual device orientation, device positioning, and leaflet grasping views. Although invasive hemodynamics improved with placement of the clip, it should be recognized that the magnitude of the V wave may not be reflective of the severity of mitral regurgitation, especially in an unstable patient.[16]

Ultimately, although this technique was successful in partially opposing the torn mitral valve leaflet and significantly reducing the severity of mitral regurgitation, placement of the device resulted in a severe residual mitral valve gradient, a not unexpected outcome given that severe mitral stenosis is generally considered a contraindication to mitral valve repair.[17] Therefore, we would recommend that this strategy should be considered only as a bridging procedure, to facilitate optimization of the patient before proceeding with surgical intervention.

FIGURE 6 **Operative Findings**



The mitral valve leaflets are thickened and the mitral valve orifice is significantly reduced. The anterior mitral valve leaflet tear has been reduced by the clip.

FOLLOW-UP

The patient was discharged home on postoperative day 7. At 3-month follow-up, the patient reported a significant improvement in symptom status (NYHA functional class II) and has not had any further readmissions for heart failure.

CONCLUSIONS

This case demonstrates the technical feasibility of transcatheter mitral valve repair to treat an anterior leaflet tear, as a stabilizing procedure, to allow for definitive surgical treatment.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS **echocardiography, mitral valve, valve repair**

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