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VALVULAR DISEASE

CASE REPORT: CLINICAL CASE

Atrial Tachycardia Facilitating Transcatheter Edge-to-Edge Repair for Severe Functional Mitral Regurgitation

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ABSTRACT

An 89-year-old woman with paroxysmal atrial tachycardia (AT) was diagnosed with severe atrial functional mitral regurgitation. On transesophageal echocardiography, the mitral regurgitation jet appeared larger during sinus rhythm and smaller during AT. During transcatheter repair of the valve, chronotropic agents were given to induce AT, assisting with leaflet capture. (J Am Coll Cardiol Case Rep 2024;29:102272) © 2024 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 89-year-old woman presented to the emergency room after 2 weeks of exertional dyspnea. Before the onset of those symptoms, the patient was able to ambulate within her home, but in recent weeks became dyspneic after a few steps. She had a blood pressure of 91/55 mm Hg, pulse of 67 beats/min, and SAO_2 95% on room air, but was noted to have recurrent episodes of a supraventricular tachycardia with heart rates increasing to over 130 beats/min. She had a 3/6 holosystolic murmur that radiated to the axilla; she had pulmonary crackles, but no jugular venous distension or lower extremity edema.

PAST MEDICAL HISTORY

She had a history of osteoarthritis, hypertension, and hyperlipidemia.

DIFFERENTIAL DIAGNOSIS

Differential diagnoses included acute coronary syndrome or decompensated heart failure, with tachyarrhythmia and valvular dysfunction as possible contributing etiologies.

INVESTIGATIONS

B-type natriuretic peptide level was 6,249 pg/mL and high-sensitivity troponin 13 ng/mL. Electrocardiography during an episode of supraventricular tachycardia had a long RP interval with retrograde P-wave morphology most consistent with atrial tachycardia (AT) (**Figure 1**). Transthoracic echocardiography showed a left ventricular ejection fraction of 55%-60%, normal left ventricular (LV) wall thickness and size, a severely dilated left atrium (LA) (volume index 65.4 mL/m^2), and grade III diastolic dysfunction. The

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ABBREVIATIONS AND ACRONYMS

AFMR = atrial functional mitral regurgitation

AT = atrial tachycardia

LA = left atrium

LV = left ventricle

MR = mitral regurgitation

TEE = transesophageal echocardiography

TEER = transcatheter edge-to-edge repair

patient had mitral regurgitation (MR) with a large central regurgitant jet and a vena contracta width of 0.8 cm, suggestive of severe MR (Videos 1 and 2). With the normal LV size and function, severely dilated LA, and history of atrial arrhythmias, the etiology for the MR was consistent with atrial functional mitral regurgitation (AFMR).

Transesophageal echocardiography (TEE) showed that the regurgitant jet was wide, between the A2 and P2 scallops, with a calculated regurgitant volume of 79 mL by proximal isovelocity surface area measurement and an effective regurgitant orifice area of 0.9 cm^2 when the patient was in sinus rhythm. Both anterior and posterior leaflets appeared mildly fibrosed, with restricted anterior and posterior leaflet motion in systole, consistent with Carpentier classification IIIb MR (Video 3). The mitral annulus and LA were severely dilated.

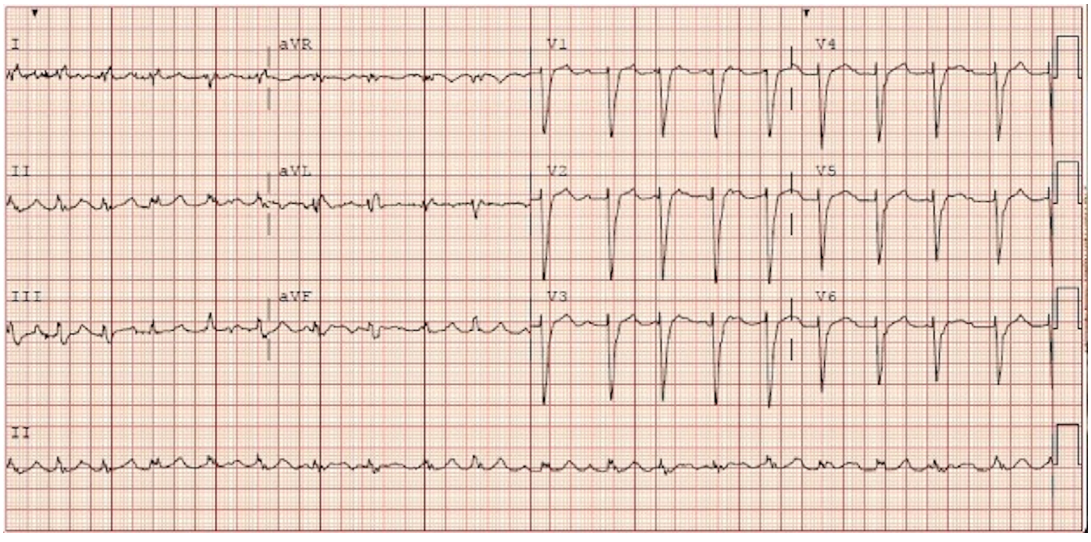
During TEE, the patient recurrently converted between AT and sinus rhythm. There were multiple parameters that suggested a decrease in MR severity while in AT compared with sinus rhythm, including an improvement in the tenting height (**Figure 2**), resolution of a coaptation gap that was visualized in sinus rhythm (Videos 4 and 5, **Figure 2**), a decrease in 2- and 3-dimensional vena contracta width (**Figure 3**), and decrease in continuous-wave Doppler signal intensity (**Figure 4**).

MANAGEMENT

The patient was started on intravenous furosemide. During her recurrent episodes of AT, her heart rates would increase to over 130 beats/min and her systolic blood pressure would drop to the 80s, requiring intravenous dobutamine.

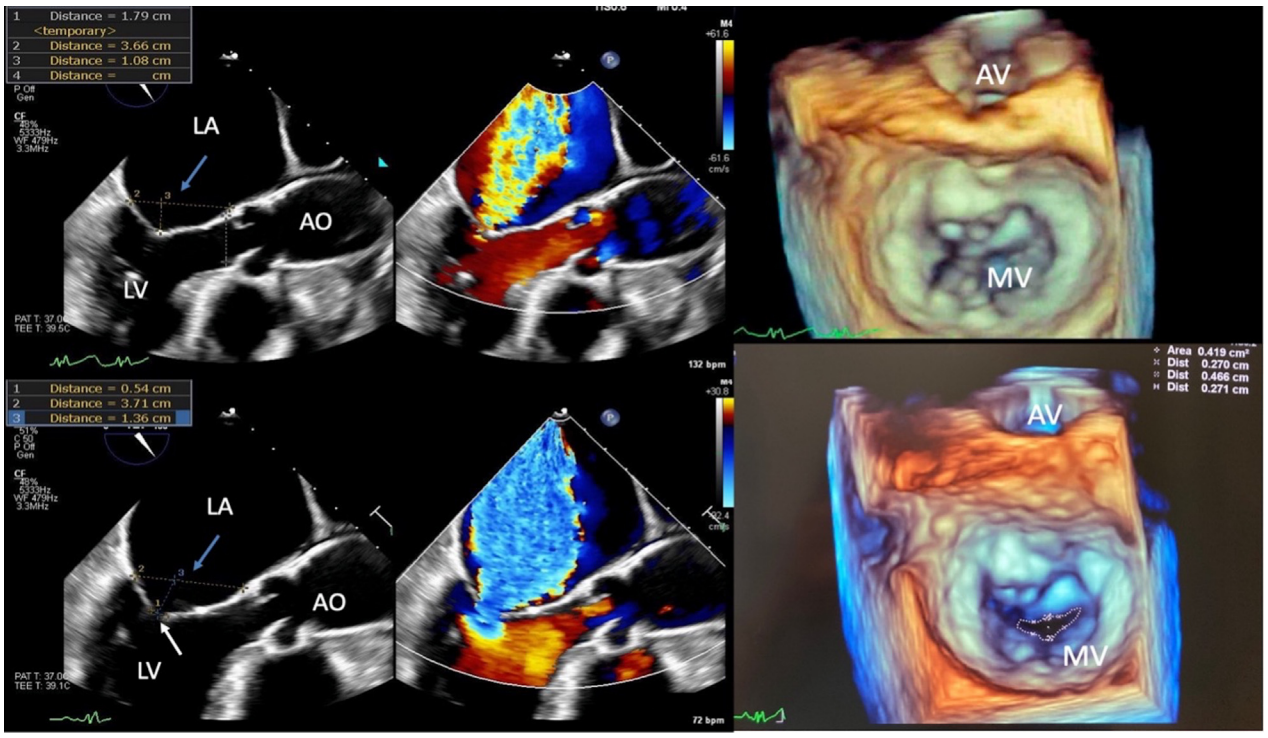
Given the patient's age and debility, the multidisciplinary heart team recommended mitral transcatheter edge-to-edge repair (TEER). Intraoperatively, the patient was in sinus rhythm, and initial attempts at grasping both leaflets were unsuccessful secondary to a large coaptation gap. Therefore, intravenous epinephrine was given to induce AT. MR severity improved, and the coaptation gap narrowed sufficiently to allow for better engagement of the clip arms with the valve leaflets. She successfully underwent placement of a MitraClip G4 NTW (Abbott) in the A2/P2 position, and follow-up echocardiography demonstrated mild to moderate residual MR while in sinus rhythm.

FIGURE 1 Atrial Tachycardia



Twelve-lead electrocardiography shows a supraventricular tachycardia with a long RP interval with retrograde P waves and a left bundle branch block, consistent with atrial tachycardia.

FIGURE 2 **TEE Showing Mitral Regurgitation in Atrial Tachycardia vs Sinus Rhythm**



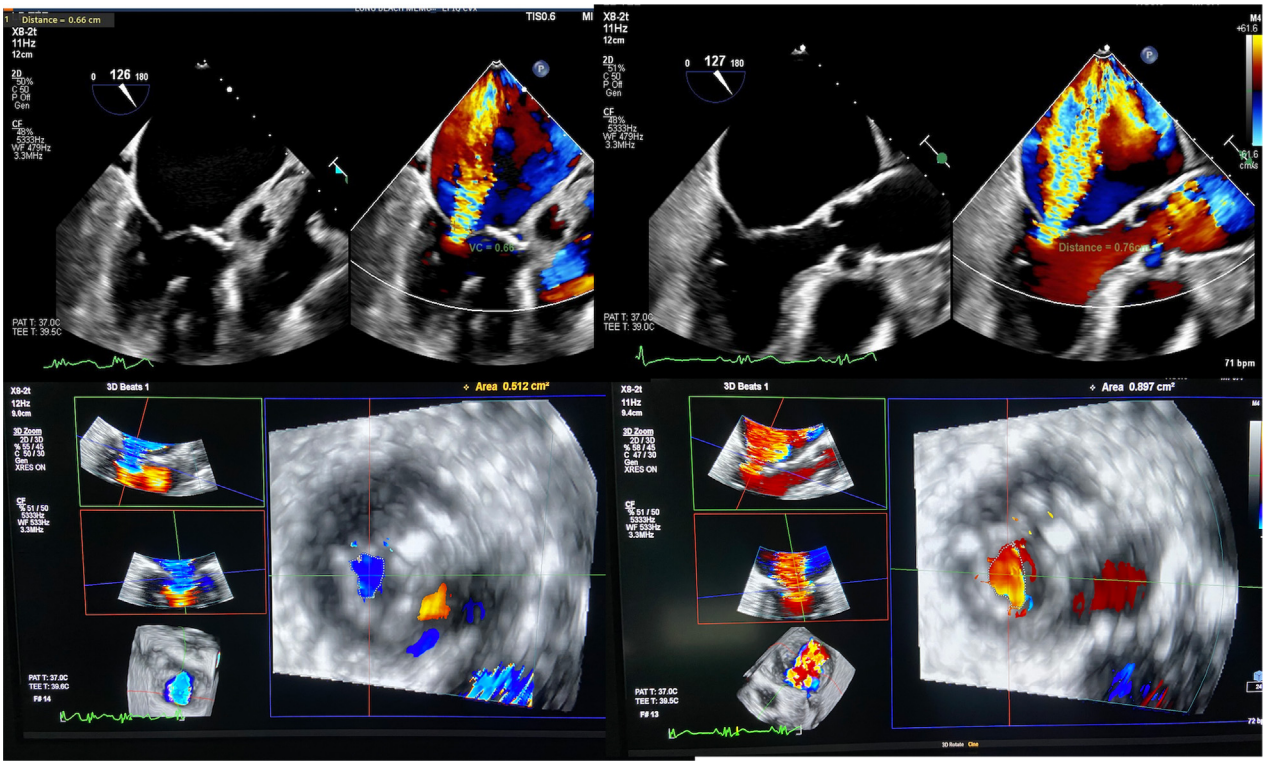
Two-dimensional transesophageal echocardiography (TEE), mid-esophageal long-axis view, without (left) and with (middle) color Doppler, and (right) 3-dimensional TEE of the mitral valve. While in atrial tachycardia (top), the tenting height is 11 mm and there is minimal coaptation gap. While in sinus rhythm (bottom), the tenting height is 14 mm. A coaptation gap of 5 mm is measured in 2 dimensions, 3 mm × 5 mm × 3 mm in 2 dimensions. AO = aorta; AV = aortic valve; LA = left atrium; LV = left ventricle; MV = mitral valve.

DISCUSSION

Functional MR arising from disease in the LA has its own pathophysiologic and therapeutic implications. Proposed mechanisms for development include mitral annular dilation with insufficient valve remodeling, atriogenic leaflet tethering, disorganized atriogenic contraction leading to loss of mitral annular shape, and loss of atrial systole.[1] Diagnosis is made by echocardiography when MR is present in the setting of a normal LV size and left ventricular ejection fraction >50%, and the absence of primary leaflet pathology.[2] Other characteristic echocardiographic findings are an enlarged LA and mitral valve annulus area, and signs of LV strain.[1,2] Treatment of AFMR is guided by associated conditions and severity of regurgitation; surgical or transcatheter interventions have shown improvement in HF symptoms in severe cases.[3]

The present case of AFMR had several unique aspects. For one, the etiology of the patient's AFMR was likely a combination of heart failure with preserved ejection fraction and paroxysmal AT instead of atrial fibrillation. Although the presence of anterior and posterior leaflet tethering suggests that the mechanism of the MR was not exclusively related to atrial pathology, the severity of LA dilation and relatively preserved LV function supported AFMR as the predominant driver. Furthermore, during TEE, the patient recurrently converted between AT and sinus rhythm, with the MR jet appearing larger during the periods of sinus rhythm and smaller during AT. It is well established that the severity of functional MR is dynamic depending on various loading conditions, such as at rest compared with during exertion.[4] Although the exact mechanism of why the MR severity decreased during episodes of AT is unclear, previous reports have discussed how maneuvers such as rapid ventricular pacing and mechanical ventilation can increase the coaptation length and assist in leaflet grasp during TEER.[5] The present case illustrates the opportunity to use a patient's own

FIGURE 3 TEE With Vena Contracta Widths



Two-dimensional (top) and 3-dimensional (bottom) transesophageal echocardiography (TEE). There was a decrease in the amount of mitral regurgitation when the patient was in atrial tachycardia (AT) (left) vs in sinus rhythm (right). The 2-dimensional vena contracta width measured 0.66 cm in AT and 0.76 cm in sinus rhythm, and the 3D vena contracta width measured 0.51 cm^2 in AT and 0.9 cm^2 in sinus rhythm.

tachyarrhythmia to guide successful therapy. Furthermore, it exhibits the importance of preprocedural TEE, and how subtle differences in the dynamic nature of MR can guide treatment.

FOLLOW-UP

After her procedure, the patient's episodes of AT decreased in frequency, but she demonstrated brief episodes of Mobitz II heart block on telemetry. She was discharged the following day and referred for a pacemaker.

CONCLUSIONS

AFMR is a distinct clinical entity that arises out of diseases affecting the LA, such as heart failure with preserved ejection fraction and atrial arrhythmias. In the present patient, the severity of her MR was noted to be less when in AT compared with sinus rhythm; chronotropic agents were given to induce AT, which facilitated successful engagement of the clip arms with the valve leaflets. It is important for physicians to be mindful of the patient's presenting rhythm during echocardiographic evaluation of valvular regurgitation, because changes in the valvular hemodynamics may be used to guide successful therapy.

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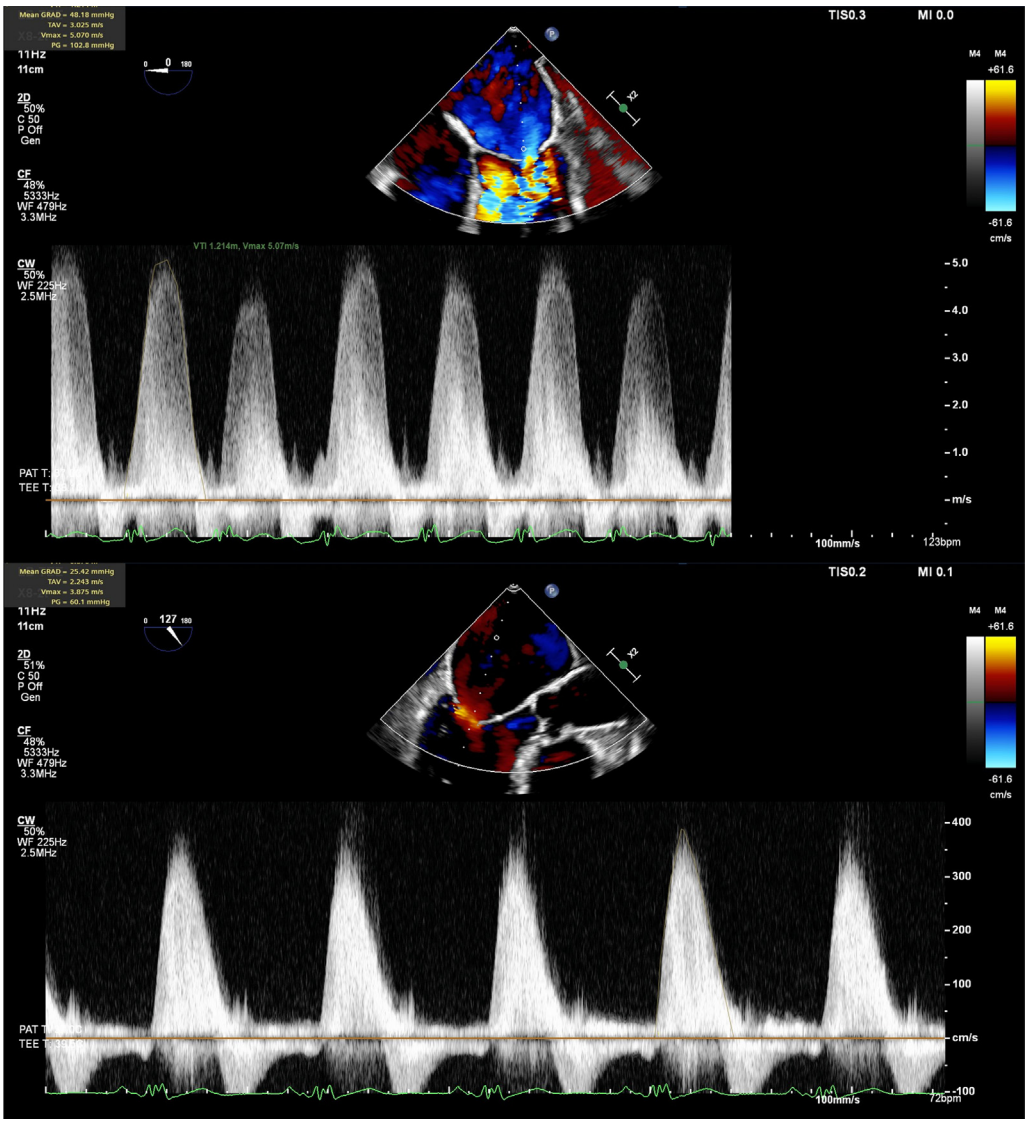
FIGURE 4 **Continuous-Wave Doppler in AT vs Sinus Rhythm**



Continuous-wave Doppler across the mitral valve demonstrated a parabolic contour while in atrial tachycardia (AT) (top) compared with a more triangular shape with early systolic peaking in sinus (bottom).

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KEY WORDS atrial tachycardia, echocardiography, mitral valve, preserved ejection fraction, valve repair

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