

VALVULAR HEART DISEASE

CASE REPORT: CLINICAL CASE

Paroxysmal Mitral Regurgitation Treated by Edge-to-Edge Repair



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ABSTRACT

A 76-year-old woman with a history of recurrent pulmonary edema was referred because of sudden worsening of dyspnea and cardiogenic shock. Eclipsed mitral regurgitation was identified as the cause. We applied hand-grip stress echocardiography in diagnosis and therapeutic evaluation and managed her condition by transcatheter edge-to-edge mitral valve repair. (JACC Case Rep 2024;29:102473) © 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/>).

A 76-year-old woman presented with sudden worsening of dyspnea. Initially, her blood pressure was 86/55 mm Hg, but it recovered to 137/92 mm Hg in 15 minutes. An electrocardiogram showed atrial fibrillation and negative T-wave in V₂-V₆ (Supplemental Figure 1). A radiograph showed bilateral pulmonary edema, and transthoracic echocardiography showed preserved left ventricular (LV) ejection fraction, left atrial dilatation, and mild mitral regurgitation (MR) (Figure 1). She was referred to our hospital for further investigation.

PAST MEDICAL HISTORY

The patient had a history of apical hypertrophic cardiomyopathy and hypertension. Three years before this admission, she experienced the first hospitalization to our hospital because of new-onset dyspnea. Since then she had had multiple hospitalizations for acute pulmonary edema and received a diagnosis of vasospastic angina and coronary microvascular dysfunction after an acetylcholine spasm provocation test (Videos 1 and 2) and functional coronary angiography (Supplemental Figure 2). She was taking nitrates and calcium channel blockers for prophylactic management. The result of functional coronary angiography was also positive, and a small dose of β -blockers was prescribed.

LEARNING OBJECTIVES

- To understand the concept of eclipsed mitral regurgitation.
- To recognize the clinical utility of hand-grip stress echocardiography for confirming the diagnosis of repeated significant MR and assessing the effectiveness of treatment.

DIFFERENTIAL DIAGNOSIS

During this hospitalization, the patient experienced recurrent dyspnea attacks, which spontaneously

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**ABBREVIATIONS
AND ACRONYMS****MR** = mitral regurgitation

resolved within 15 to 20 minutes. These attacks occurred without any identifiable trigger, and vasospastic angina and coronary microvascular dysfunction could have been contributing factors. Echocardiography at admission showed comparatively shallow coaptation of mitral leaflets resulting from annular dilatation. Consequently, we focused on the mitral valve.

INVESTIGATIONS

Ergometer exercise stress echocardiography was planned. The patient lay in a supine position. Before starting exercise stress, she suddenly experienced difficulty in breathing. Echocardiography was promptly performed, revealing significant dilatation of the left atrium and drastic, severe MR (Figure 2A, Videos 3 to 5). As the symptoms subsided the MR regressed to trivial (Figure 2B, Videos 6 to 9). On the basis of these findings and the medical history, we identified “eclipsed MR” as a potential explanation for the clinical course. Inasmuch as the regurgitation was not prominent under ordinary conditions, it was considered more challenging to determine the effectiveness of treatment in comparison with typical severe MR. We speculated that the changes in afterload contributed to the deterioration of MR and adopted hand-grip stress echocardiography (10 kg) as a simple and convenient method to clarify the underlying pathologic conditions and identify the MR jet area during eclipsed MR. The examination demonstrated an increase in afterload-induced dilatation of the left atrium, followed by enlargement of the mitral

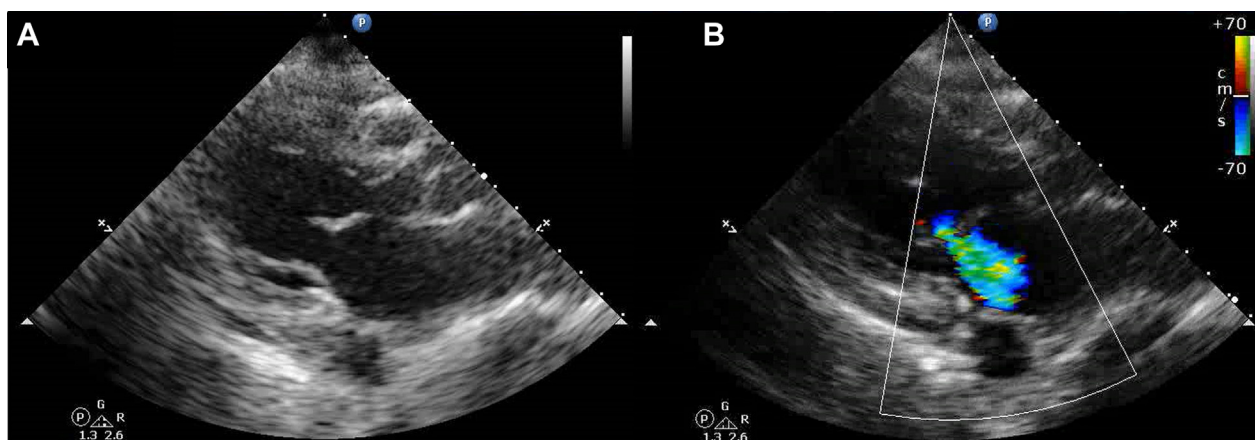
annulus. Subsequently, it revealed dilatation of the left ventricle and severely restricted motion of the mitral valve leaflet, resulting in the observed severe MR from central mitral valve segments (A2/P2). (Figure 3, Videos 10 to 13). The trend of each parameter is shown Table 1.

MANAGEMENT

Considering the patient’s frailty, our local heart team decided to perform transcatheter edge-to-edge mitral valve repair (TEER). With the patient under general anesthesia, intraoperative transesophageal echocardiography before clipping showed mild MR (Videos 14 and 15). One clip was deployed in A2/ P2 (Figure 4A), where the MR jet was most severe as shown by pre-operative hand-grip echocardiography. After the clip was grasped, blood pressure was intentionally increased using phenylephrine to mimic the condition observed during the hand-grip stress echocardiography. The echocardiography after clip grasping showed that MR was trivial and well controlled (Figures 4B and 4C).

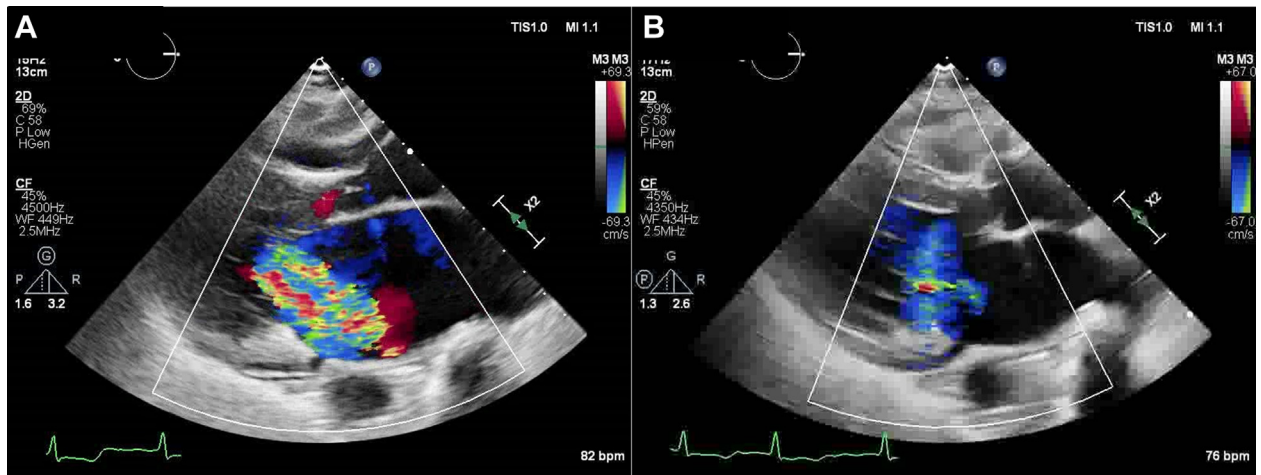
DISCUSSION

Eclipsed MR is a newly recognized entity; Avierinos et al¹ first reported 3 cases in 2007. It was characterized by transient acute massive MR in the absence of pre-existing LV remodeling and coronary artery stenosis. Baseline echocardiography typically shows almost normal mitral leaflets, and none or mild MR. LV ejection fraction is generally preserved, and acute

FIGURE 1 Echocardiography at Admission

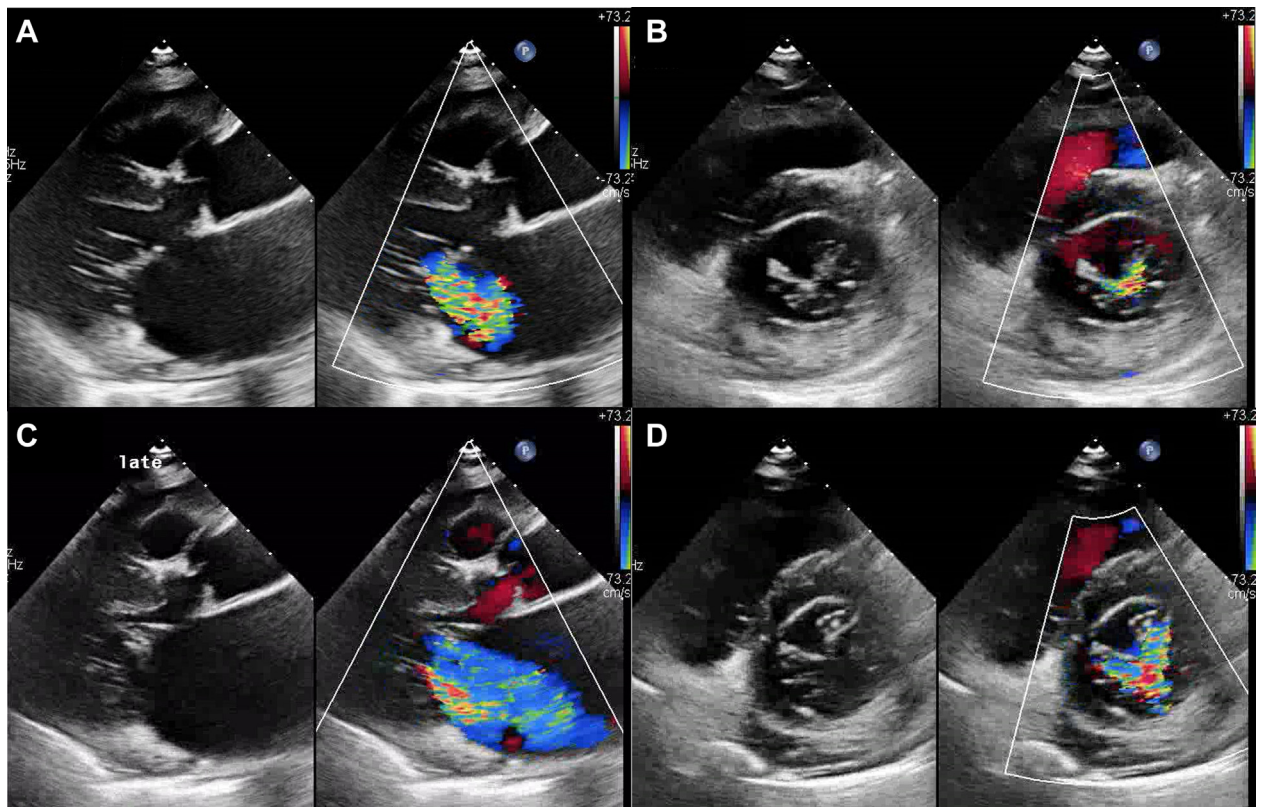
Echocardiography showed left atrial dilatation (A) and mild right ventricle-pulmonary artery (B).

FIGURE 2 Echocardiography at Dyspnea Attack



Significant dilatation of the left atrium and drastic severe mitral regurgitation was revealed (A). The regurgitation improved spontaneously (B).

FIGURE 3 Preoperative Hang-Grip Stress Echocardiography



Echocardiography showed mild mitral regurgitation (MR) at first in parasternal long-axis view (A) and short-axis view (B). MR was gradually exacerbated and became severe in 15 minutes in parasternal long-axis view (C) and short-axis view (D).

TABLE 1 Trend of Parameters During Hand-Grip Stress Echocardiography

Time Course, min	Pre	1	7	13	15 ^a	Rec1 ^b	Rec8	Rec15	Rec16	Rec17	Rec22
Systolic BP, mm Hg	123			133		58			89	135	130
Diastolic BP, mm Hg	86			86		46			70	102	82
LAD, mm	41.3	46.4	47.1		52.3		52.8	53.4			45.7
Annular diameter, mm	27	27.3	30.1		29.2		30.9	29.1			32.1
LVDd, mm	37.6	37.3	40.4		42		43.5	44.1			39.5
LVDs, mm	20	21	25.1		14.2		19.2	14.6			22.3
MR	mild	mild	moderate		severe		massive	massive			moderate

^a15 min; the finish point of exercise. ^bRec; recovery, ie, Rec1 means 1 minute after exercise end.
LVDd = Left ventricular end-diastolic diameter; LVDs = Left ventricular end-systolic diameter.

cardiogenic pulmonary edema has repeatedly occurred.² Its transient nature makes diagnosis challenging and increases the likelihood of its being overlooked.

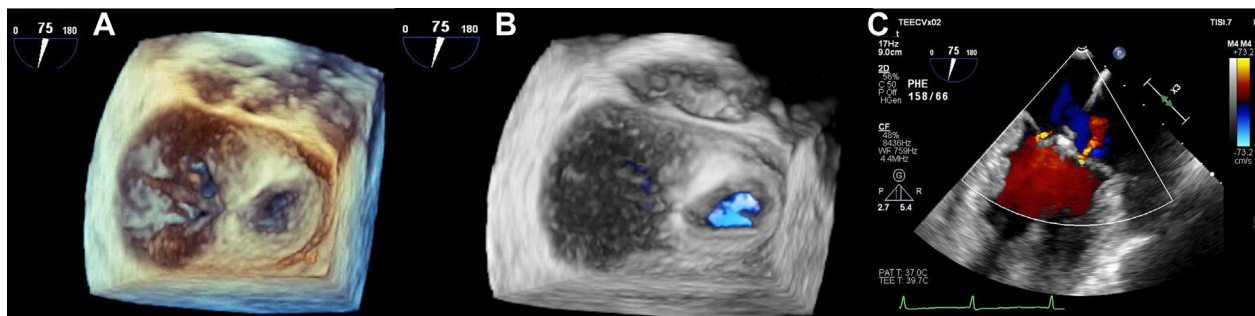
Milleron et al² proposed that patients with eclipsed MR typically include postmenopausal women with risk factors such as diabetes, hypertension, and mild renal failure. The characteristics of our patient, a postmenopausal woman with hypertension, were generally consistent with those in that report. Some aspects of the pathophysiological mechanisms of eclipsed MR have been mentioned in previous reports. First, coronary spasms and microvascular dysfunction have been proposed as speculative mechanisms.^{1,3} In our case, the diagnoses of coronary spasms and microvascular dysfunction had already been reached through previous catheter examinations, consistent with previous reports. Second, Milleron et al² quantified dynamic changes by measuring parameters at rest and during severe MR in 6 patients. We further evaluated the change in each parameter during hand-grip stress echocardiography

in a more detailed time-series analysis. From the trends in parameters, it is suggested that initially the annular diameter and left atrial diameter increased in response to the exercise load, followed by enlargement of the LV diameter.

In our patient, apical hypertrophic cardiomyopathy underlay her condition from the electrocardiogram and echocardiographic findings. A previous case report⁵ has suggested that transient acute severe MR associated with hypertrophic cardiomyopathy may occur, indicating that severe MR was not pure eclipsed MR but involved systolic anterior motion (SAM). However, in this case, LV outflow tract obstruction was not evident from echocardiography, suggesting that SAM is unlikely to be involved in the occurrence of severe MR.

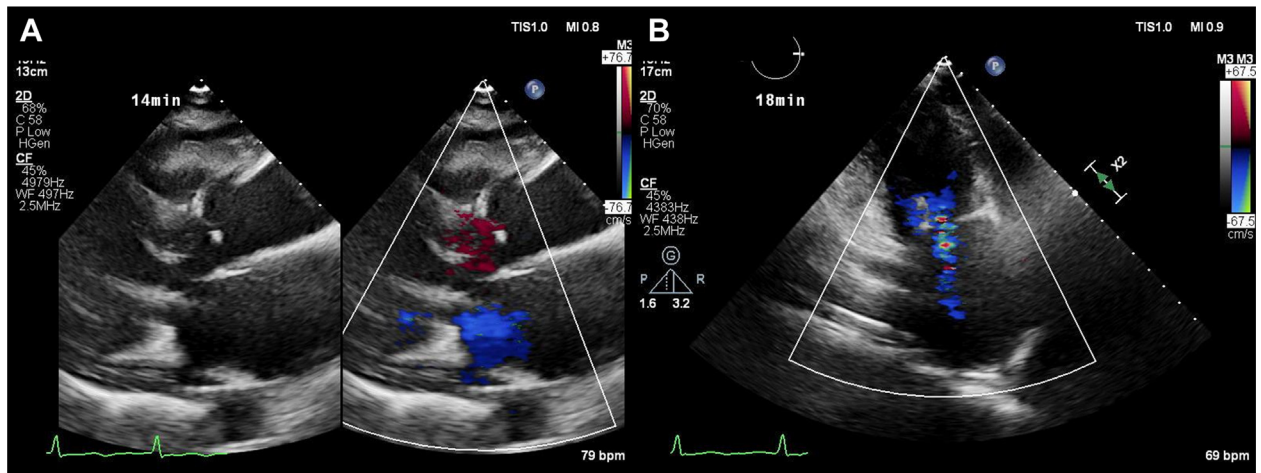
Moreover, there have been reports showing transient complete left bundle branch block and associated LV dyssynchrony. In our case, the electrocardiogram at dyspnea attack was performed during the previous hospitalization (Supplemental Figure 3). It showed that atrial fibrillation persisted, and no new

FIGURE 4 Intraoperative Transesophageal Echocardiography



Three-dimensional imaging after clip deployment at A2/P2 (A) and color Doppler image depicting trivial mitral regurgitation (MR). (B) Two-dimensional transesophageal echocardiography showed well-controlled MR (C).

FIGURE 5 Postoperative Hand-Grip Stress Echocardiography



Echocardiography showed that mitral regurgitation was regulated within mild in parasternal long-axis view (A) and apical 2-channel view (B).

conduction abnormalities were observed. By contrast, deepening negative T waves and further ST-segment depression were noted, suggesting a possibility of transient ischemia associated with known coronary spasm.

Although there is no gold standard treatment for eclipsed MR, in some cases attacks could be controlled by preventing spasms with calcium channel blockers.¹ However, in most cases attacks are uncontrollable, necessitating intervention for the mitral valve. Whereas previous reports primarily described mitral valve replacement surgery, 2 cases are reported in which TEER was performed and in both cases the outcomes were favorable.^{3,5}

In this case we adopted hand-grip stress echocardiography for evaluation of pathologic characteristics and confirmation of treatment effect. Among the various modalities of exercise stress echocardiography, hand-grip stress was chosen for its cardiac stress selectivity. Although ergometer exercise is isotonic exercise resulting in both preload and afterload increase caused by increased venous return, hand-grip stress entails isometric exercise resulting in higher blood pressure and predominantly afterload increase.⁴ We selected hand-grip stress echocardiography in this case because it facilitated the simple elevation of afterload using vasopressors intraoperatively and enabled confirmation of MR control postoperatively by applying the same stress protocol as preoperatively.

FOLLOW-UP

One week after TEER, hand-grip echocardiography was performed again during the hospitalization and showed no MR exacerbation (Figure 5). The in-hospital clinical course was uneventful, and the patient was discharged. Approximately 1 year has passed since the intervention, and the patient has been in stable condition with no recurrence of symptoms.

CONCLUSIONS

The sudden and repeated episodes of significant MR, leading to cardiogenic shock have been well controlled so far with TEER intervention. The outcome of this procedure should be assessed through long-term follow-up.

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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 eclipsed mitral regurgitation, hand-grip stress echocardiography

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