

CASE REPORT: CLINICAL CASE SERIES

Complications Following Percutaneous Mitral Valve Edge-to-Edge Repair Using MitraClip



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ABSTRACT

Percutaneous mitral valve edge-to-edge repair with MitraClip (Abbott, Abbott Park, Illinois) has emerged as an effective and safe treatment for symptomatic mitral regurgitation in suitable patients. The safety of the MitraClip procedure is well established, and the rate of major complications is 4.35%. We present 4 cases of mitral regurgitation in patients who had complications following the MitraClip procedure. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2021;3:370–6) © 2021 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/>).

INTRODUCTION

Chronic mitral regurgitation (MR) leads to progressive left ventricular dilatation and dysfunction. Uncorrected MR clinically manifests as heart failure, pulmonary hypertension, and increased mortality (1). Approximately one-half of patients with severe symptomatic MR are denied surgery because of older age,

comorbidities, and reduced left ventricular ejection fraction (EF) (2). Percutaneous mitral valve edge-to-edge repair using MitraClip (Abbott, Abbott Park, Illinois) has proven to be an effective and safe option in patients with symptomatic MR, with a significant reduction rate of hospitalization and all-cause mortality as compared with medical therapy alone (3,4). The safety of MitraClip is well established, and the rate of complications is low, with high procedural success (5). However, up to 4.35% of patients have experienced major adverse events related to the MitraClip procedure (6). Here we report a series of 4 patients with complicated cases who underwent the MitraClip procedure for severe symptomatic MR (Table 1).

LEARNING OBJECTIVES

- To understand the use of peri-procedural antibiotics in high-risk patients to avoid IE.
- To modify anticoagulation during the MitraClip procedure in patients with a high risk of thromboembolism.
- To endorse the detailed assessment of mitral valve area, mean gradient, and annular diameter using 2- and 3-dimensional TEE before and during MitraClip placement to avoid related mitral stenosis.

CASE 1: MitraClip-ASSOCIATED INFECTIVE ENDOCARDITIS

A 59-year-old woman presented with acute decompensated heart failure (ADHF). On examination, she had stable vital signs, with a heart rate of 86 beat/min

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and blood pressure of 141/85 mm Hg. Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) revealed a moderately dilated left ventricle with an EF of 30% to 35%. There was severe MR (Figure 1A, Video 1). She underwent MitraClip implantation (3 clips), with residual moderate MR (Figure 1B) with a mean gradient of 5 mm Hg across the mitral valve. Two months after discharge, she was admitted again with ADHF (New York Heart Association functional class III to IV) and fatigability. Her TEE showed multiple mobile masses attached to the atrial side of the mitral valve and clip with severe MR (Figures 1C and 1D, Videos 2 and 3). Her blood culture grew methicillin-resistant *Staphylococcus aureus*. Antibiotics were started initially, and she then underwent mitral valve replacement with a bio-prosthetic mitral valve. Despite the initial surgical success, her post-operative course was complicated by septic shock, acute renal failure, and prolonged intubation. She died 8 weeks after surgery.

CASE 2: ACUTE SINGLE LEAFLET DETACHMENT

A 57-year-old man was referred from a peripheral center for management of recurrent heart failure. His vital signs were stable (pulse, 90 beats/min; blood pressure, 99/60 mm Hg), and examination revealed a pansystolic murmur at the apex that radiated to the axilla. His TTE and TEE showed a moderately dilated left ventricle with an EF of 25%. There was severe MR

(Figure 2A). He underwent MitraClip implantation using conscious sedation. After the leaflet grab with the first clip, there was mild to moderate residual MR (Figure 2B), and the mean gradient across the mitral valve was 2 mm Hg. As soon as the Mitral clip was released, the severe MR reappeared, and further images showed complete detachment of the clip from the anterior mitral leaflet (Figures 2C and 2D, Videos 4 and 5). Another clip was implanted, and the patient had mild to moderate residual MR (Figures 3A and 3B, Video 6) with a mean gradient of 4 mm Hg.

CASE 3: THROMBUS FORMATION AT THE TRANSEPTAL PUNCTURE SITE DURING MitraClip PLACEMENT

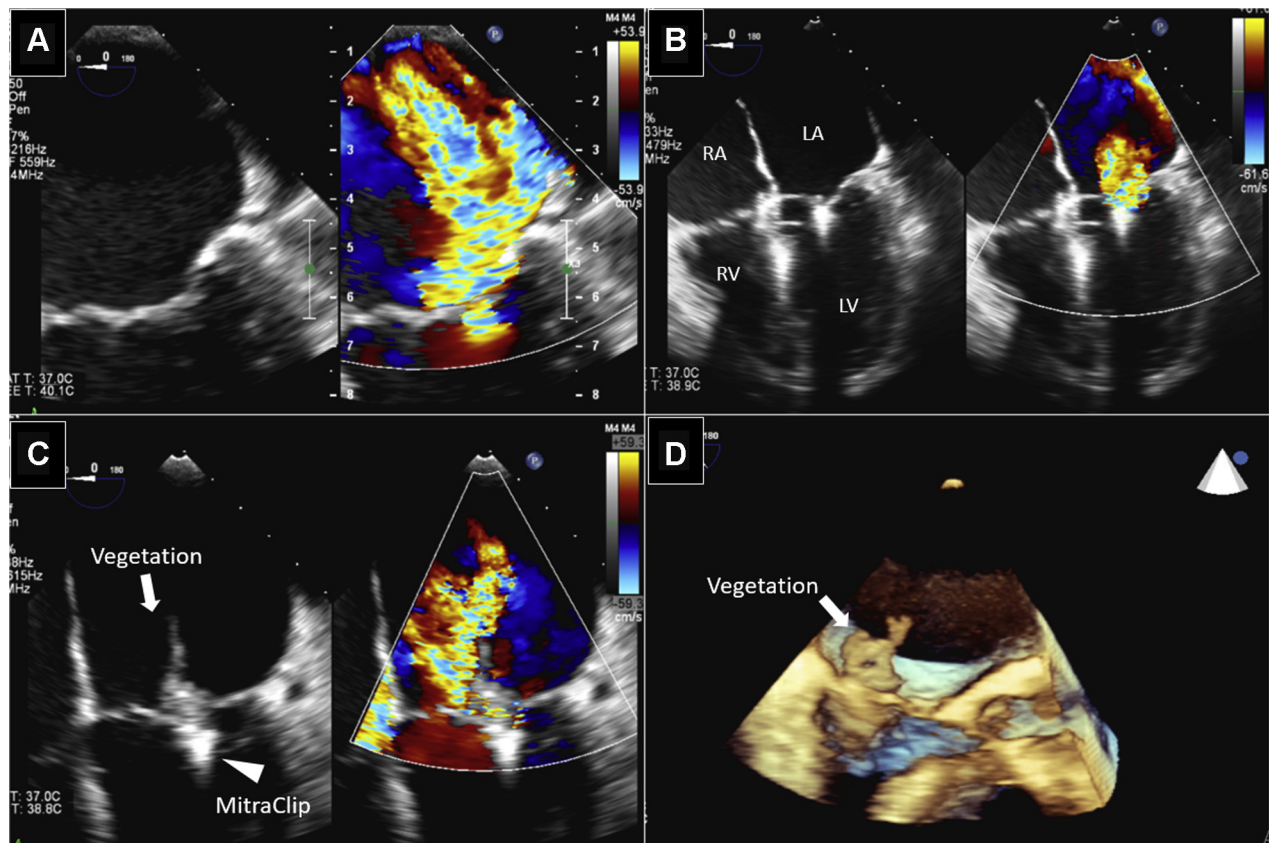
A 42-year-old man was admitted with ADHF. On examination, his pulse was 105 beats/min, and his blood pressure was 85/57 mm Hg. Cardiac examination revealed decreased intensity of the first heart sound and a pansystolic murmur radiating to the axilla. His TTE and TEE showed a severely dilated left ventricle with an EF of 20%. There was severe MR (Figure 4A). During MitraClip implantation, after the septal puncture, heparin (6,000 IU) was given routinely by injection. As soon as the first clip was advanced into the left atrium through the guide catheter, multiple mobile thrombi were noted in the right atrium near the puncture site (Figures 4B and 4C, Video 7).

ABBREVIATIONS AND ACRONYMS

- ACT** = activated clotting time
- ADHF** = acute decompensated heart failure
- EF** = ejection fraction
- IE** = infective endocarditis
- MR** = mitral regurgitation
- PHT** = pressure half-time
- TEE** = transesophageal echocardiography
- TTE** = transthoracic echocardiography

| Patient # | Age (yrs) | STS Score (Mortality), % | Cause of Mitral Regurgitation | Estimated LVEF, % | Estimated Regurgitant Orifice Area (cm ²) | Regurgitant Volume (ml) | Complication | Management | Outcome |
|-----------|-----------|--------------------------|-------------------------------------|-------------------|---|-------------------------|--|--|---|
| 1 | 59 | 16 | Mixed (functional and degenerative) | 30-35 | 0.4 | 74 | Infective endocarditis | Antibiotics Mitral valve replacement | Death |
| 2 | 57 | 3.9 | Functional | 25 | 0.71 | 60 | Single leaflet device attachment | Implantation of another clip | Mild to moderate residual MR Significant improvement in symptoms |
| 3 | 42 | 2.3 | Functional | 20 | 0.41 | 48 | Thrombus formation at transeptal puncture site | Cancelation of procedure Anticoagulation MitraClip (Abbott, Abbott Park, Illinois) implantation after 5 days | Moderate residual MR Significant improvement in symptoms |
| 4 | 53 | 3.4 | Degenerative | 60 | 0.61 | 112 | Relative mitral stenosis | Mitral valve replacement | Asymptomatic |

LVEF = left ventricular ejection fraction; MR = mitral regurgitation; STS = Society of Thoracic Surgeons.

FIGURE 1 MitraClip-Associated Infective Endocarditis

Transesophageal echocardiography showing (A) mitral regurgitation followed by (B) mitral clip implantation and (C and D) vegetation attached to MitraClip. LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle.

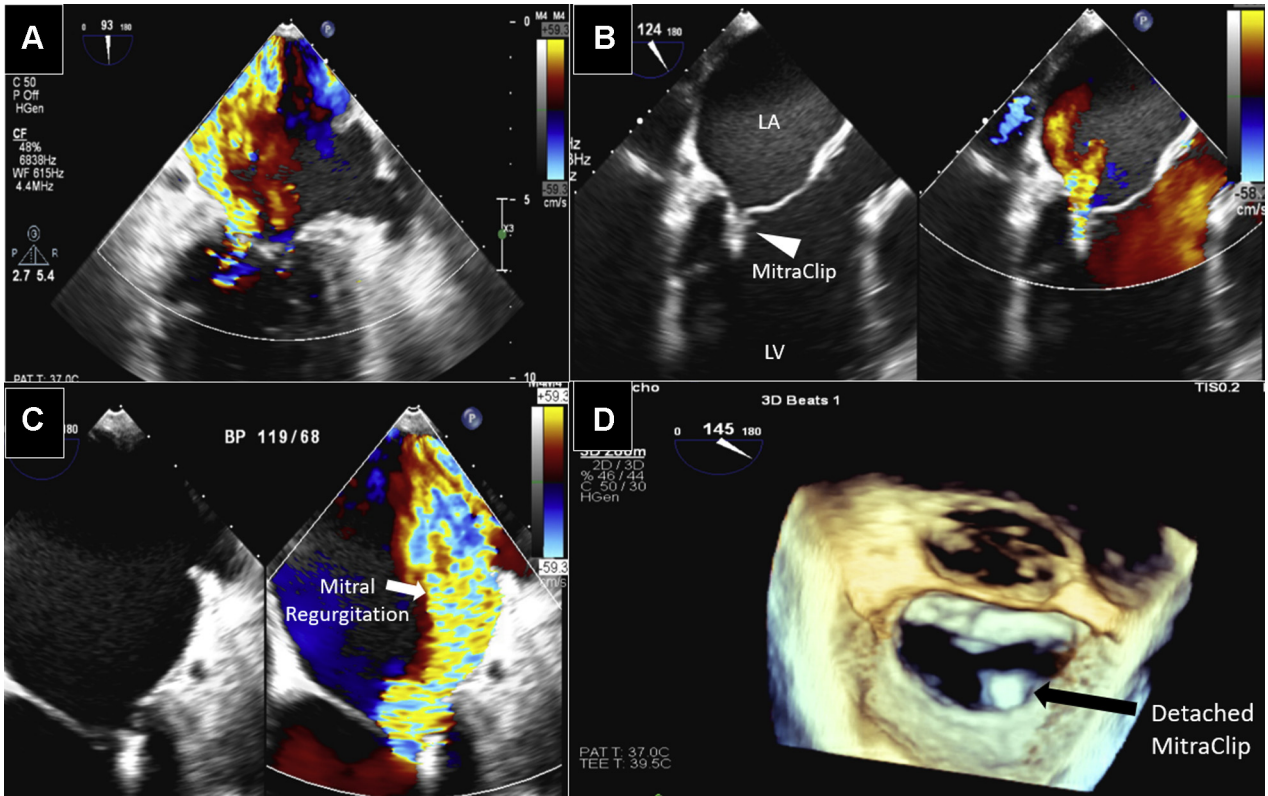
Activated clotting time (ACT) was 237 s and another 4,000 IU of heparin was given. The whole MitraClip system was gradually withdrawn, and the procedure was canceled. He was anticoagulated for 5 days and then underwent MitraClip implantation using 2 clips, with resultant moderate residual MR (Figure 4D, Video 8) and a mean gradient of 3 mm Hg. ACT was kept at more than 300 s in the second procedure.

CASE 4: POST-MitraClip RELATIVE MITRAL STENOSIS

A 53-year-old man was electively admitted through the clinic because of persistent exertional dyspnea (New York Heart Association functional class II to III) despite adequate medications. On examination, his pulse was 84 beats/min, and his blood pressure

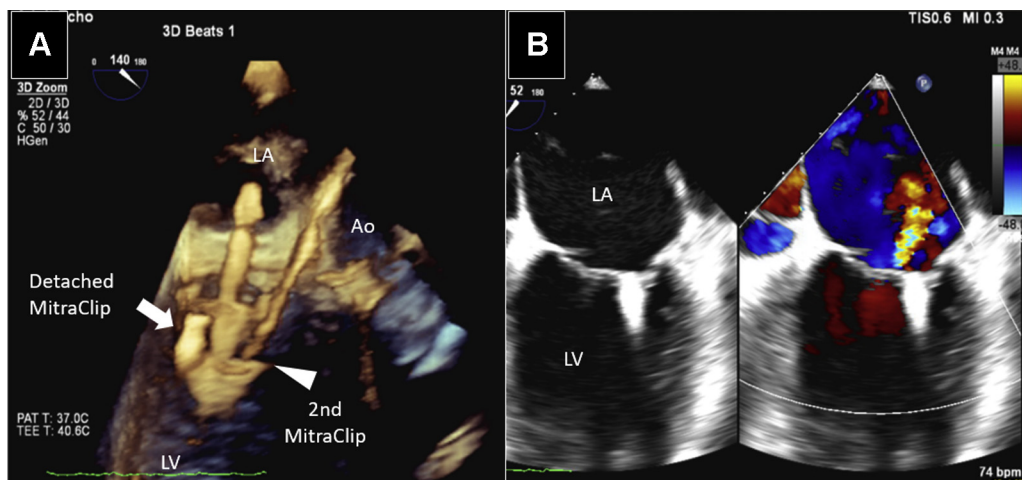
was 108/62 mm Hg, with a pansystolic murmur at the apex. Echocardiography showed normal left ventricular size and function with severe MR (Figure 5A, Video 9). The mean gradient was 3 mm Hg, and the mitral valve area was 3.9 (deceleration time = 190 ms; pressure half-time = 56 ms) (Figures 5B to 5D, Video 10). During the procedure, which was performed with the patient under general anesthesia, after the implantation of the first clip, TEE showed a mean gradient of 8 mm Hg across the mitral valve at a heart rate of 74 beats/min with mild residual MR (Figures 6A and 6B). The patient showed significant improvement in symptoms after the procedure. His subsequent TTEs showed gradually rising mean gradients across the mitral valve and a maximum gradient of 18 mm Hg (Figure 6C). TEE was performed to exclude causes of increased

FIGURE 2 Acute Single Leaflet Detachment

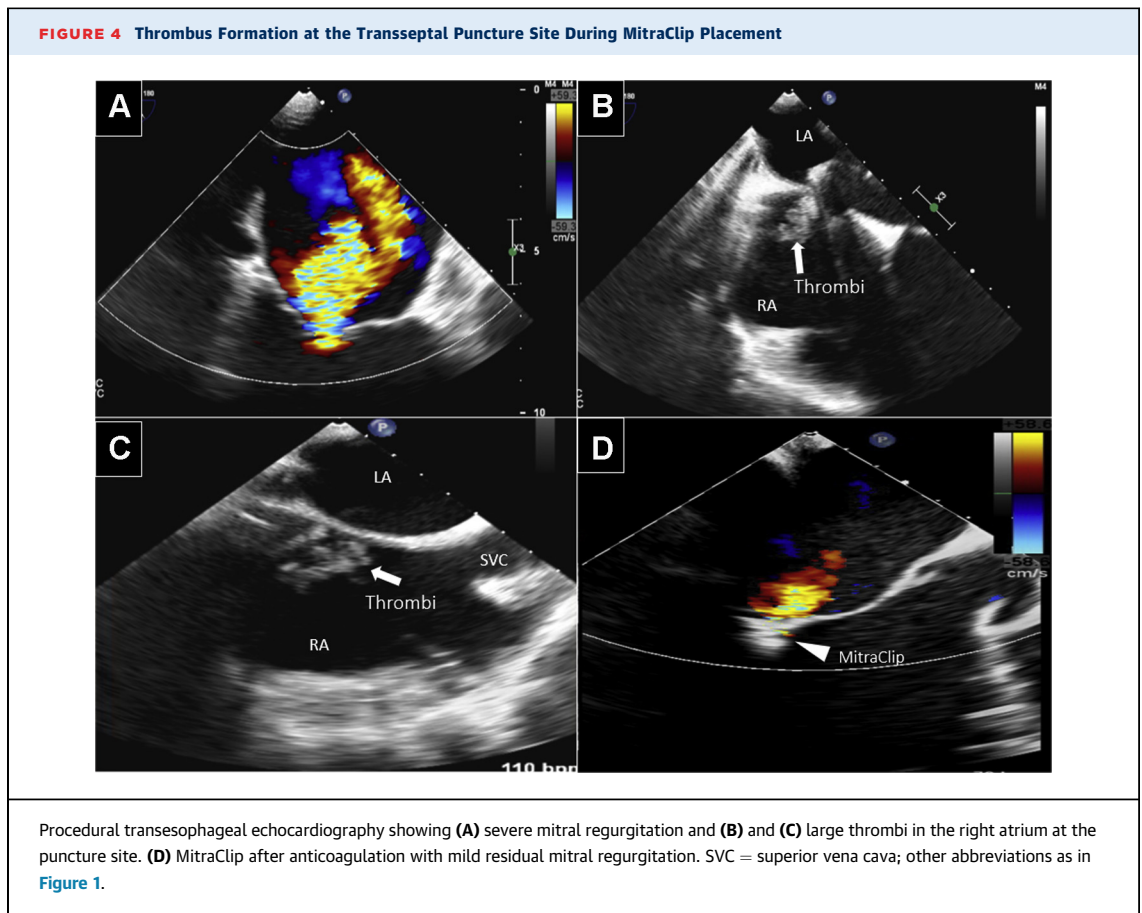


Transesophageal echocardiography showing (A) severe eccentric mitral regurgitation followed by (B) MitraClip implantation and (C and D) recurrent mitral regurgitation with a detached leaflet. BP = blood pressure; other abbreviations as in Figure 1.

FIGURE 3 Implantation of Second MitraClip After Acute Single Leaflet Detachment



(A) Procedural transesophageal echocardiography 3-dimensional live image showing a previously implanted clip (white arrow) attached to the posterior mitral leaflet and the second MitraClip (white arrowhead). (B) Mild residual mitral regurgitation after implantation of the second MitraClip. Ao = aorta; bpm = beats/min; other abbreviations as in Figure 1.



gradients, but it did not show any thrombus or mass. He was followed in the clinic for 6 months and then underwent mitral valve replacement with a metallic valve (Figure 6D) because of his symptoms of exertional dyspnea.

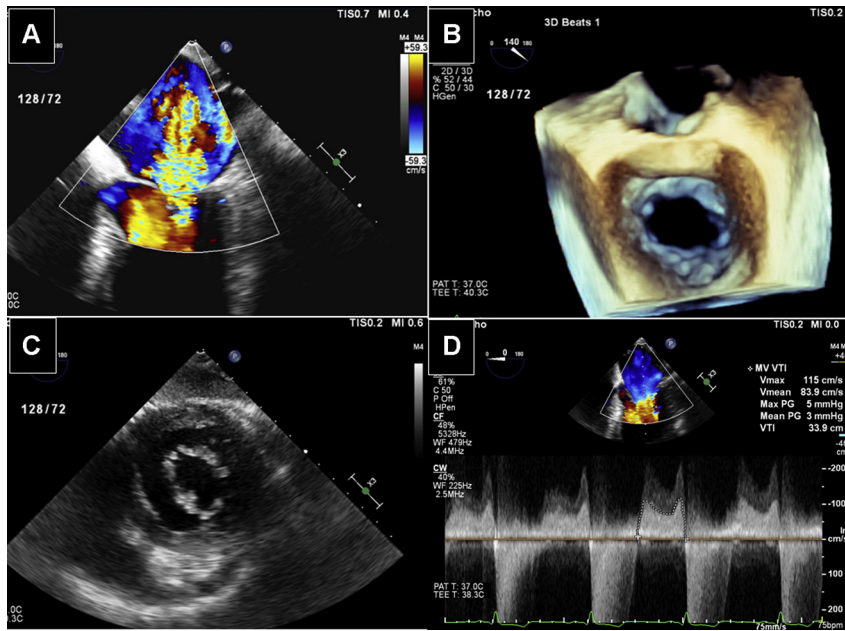
DISCUSSION

The presence of prosthetic material at the mitral valve makes it vulnerable to infective endocarditis (IE). The incidence of IE related to MitraClip is 0.2% over 5 years, and it is considered an independent predictor of in-hospital mortality (5). In addition to traditional risk factors of the foreign body-related IE, the number of clips can increase the likelihood of endocardial infection. The use of peri-procedural antibiotics should be considered if implantation of more than 2 clips is planned, in the presence of other predisposing factors of IE. The single-leaflet detachment rate has declined significantly with the growing experience of operators and newer generations of MitraClip devices. More recent data have reported a rate of detachment as low as 2% (5). Echocardiography plays a guiding role in assessing the adequacy of

mitral leaflet capture, and 5 mm of leaflet grab is considered satisfactory. Regardless of the timing of single leaflet detachment, most patients can be managed by placement of additional clips without the need for surgical intervention.

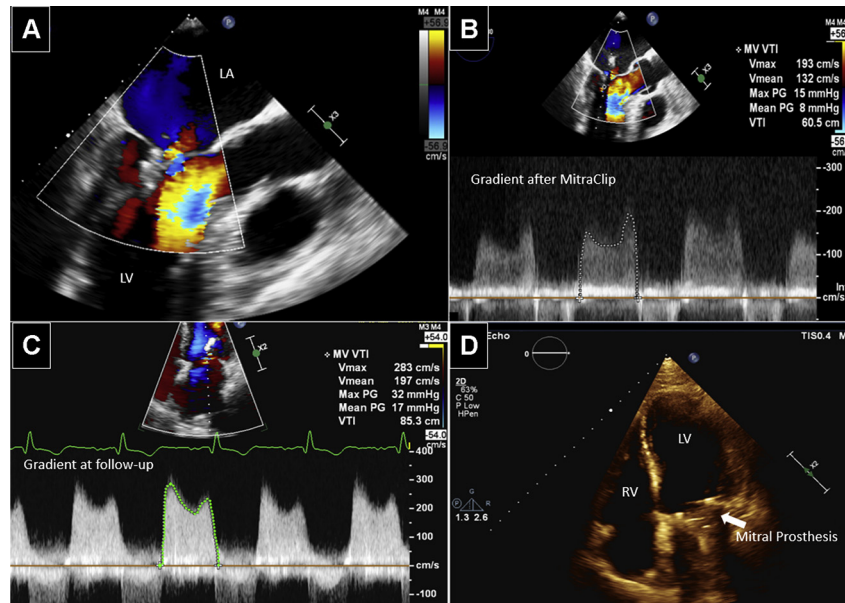
The rate of ischemic events secondary to thromboembolism is quite low (<1%) during the MitraClip procedure (3,5,8). The presence of thrombogenic material, chamber dilatation, low cardiac output, and atrial fibrillation increases the risk of thrombus formation during the procedure. High levels of anticoagulation are achieved during the procedure by keeping the ACT between 250 and 300 s. Transeptal puncture can result in injury to the interatrial septum, which can serve as a nidus of thrombus formation (7). Low-dose anticoagulation (heparin 2,000 to 25,000 IU) can be considered soon after venous access, especially when an expert operator is available in patients with a high risk of thromboembolism. The incidence of relative mitral stenosis after MitraClip therapy is not well established, and post-procedural mean gradients across the mitral valve of more than 5 mm Hg are reported in up to 25% of patients (8). Higher post-procedural gradients are linked to poor outcomes

FIGURE 5 Pre-Procedure Evaluation of Mitral Valve (Case 4)



Transesophageal echocardiography images showing (A) severe mitral regurgitation and (B) a 3-dimensional zoom en face view of the mitral valve. (C) Open commissures on the transgastric short-axis view. (D) The mean gradient across the mitral valve. Max = maximum; MV = mitral valve; PG = pressure gradient; V = velocity; VTI = velocity time integral.

FIGURE 6 Post-MitraClip Relative Mitral Stenosis



Procedural transesophageal echocardiography reveals (A) trivial mitral regurgitation after implantation of MitraClip and (B) a mean gradient of 8 mm Hg across the mitral valve. (C) A mean gradient of 17 mm Hg on follow-up transthoracic echocardiography. (D) The mitral prosthesis. Abbreviations as in Figures 1 and 5.

after MitraClip therapy (8,9). Pre-procedural assessments of mitral valve area, mean gradients, and mitral annular diameter are crucial to predict relative mitral stenosis after the MitraClip procedure.

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REFERENCES

1. Enriquez-Sarano M, Akins CW, Vahanian A. Mitral regurgitation. *Lancet* 2009;373:1382-94.
2. Mirabel M, lung B, Baron G, et al. What are the characteristics of patients with severe, symptomatic, mitral regurgitation who are denied surgery? *Eur Heart J* 2007;28:1358-65.
3. Feldman T, Kar S, Elmariah S, et al. Randomized comparison of percutaneous repair and surgery for mitral regurgitation 5-year results of EVEREST II. *J Am Coll Cardiol* 2015;66:2844-54.
4. Stone GW, Lindenfeld J, Abraham WT, et al. Transcatheter mitral-valve repair in patients with heart failure. *N Engl J Med* 2018;379:2307-18.
5. Eggebrecht H, Schelle S, Puls M, et al. Risk and outcomes of complications during and after MitraClip implantation: experience in 828 patients from the German TRAns catheter Mitral valve Interventions (TRAMI) registry. *Catheter Cardiovasc Interv* 2015;86:728-35.
6. Franzen O, Baldus S, Rudolph V, et al. Acute outcomes of MitraClip therapy for mitral regurgitation in high-surgical-risk patients: emphasis on adverse valve morphology and severe left ventricular dysfunction. *Eur Heart J* 2010;31:1373-81.
7. Bilge M, Saatci Yaşar A, Ali S, Alemdar R. Left atrial spontaneous echo contrast and thrombus formation at septal puncture during percutaneous mitral valve repair with the MitraClip system of severe mitral regurgitation: a report of two cases. *Anadolu Kardiyol Derg* 2014;14:549-50.
8. Neuss M, Schau T, Isotani A, et al. Elevated mitral valve pressure gradient after MitraClip implantation deteriorates long-term outcome in patients with severe mitral regurgitation and severe heart failure. *J Am Coll Cardiol Intv* 2017;10:931-9.
9. Patzelt J, Zhang W, Sauter R, et al. Elevated mitral valve pressure gradient is predictive of long-term outcome after percutaneous edge-to-edge mitral valve repair in patients with degenerative mitral regurgitation (MR), but not in functional MR. *J Am Heart Assoc* 2019;8:e011366.

KEY WORDS echocardiography, endocarditis, mitral valve, stenosis, systolic heart failure

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