

HEART FAILURE AND CARDIOMYOPATHIES

CLINICAL CASE

Unpredictable Mechanical Mitral Valve Leaflet Motion in a Patient With Continuous-Flow LVAD



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ABSTRACT

BACKGROUND Patients with a pre-existing mechanical mitral valve (MV) who undergo left ventricular assist device (LVAD) implantation pose unique challenges owing to interactions between the device and valve.

CASE SUMMARY A 56-year-old man with a history of mechanical MV replacement and multiple interventions underwent LVAD implantation. After LVAD, the mechanical MV exhibited dynamic changes of leaflet mobility, from both stuck open to both moving freely. Despite these abnormalities, there was no clinically significant mitral regurgitation or hemodynamic impact. The patient was managed without surgery or thrombolytics and experienced no adverse clinical consequences related to mechanical MV dysfunction.

DISCUSSION This case highlights the dynamic behavior of a mechanical MV after LVAD implantation, with variable leaflet positioning without significant mitral regurgitation or thromboembolic complications.

TAKE-HOME MESSAGES The interaction between LVADs and mechanical valves can result in unexpected alterations in valve function and intracardiac hemodynamics, underscoring the need for individualized care. In select cases, conservative management may be appropriate. (JACC Case Rep. 2025;30:105710) © 2025 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

A 56-year-old man who had undergone left ventricular assist device (LVAD) (HeartMate 3, Abbott) implantation 6 weeks prior for nonischemic cardiomyopathy presented to the clinic with increasing shortness of breath and lower extremity edema. He was admitted to the hospital for further evaluation. On presentation, his heart rate was 103 beats/min, mean arterial pressure was 83 mm Hg, respiratory rate was

TAKE-HOME MESSAGES

- Abnormal mechanical mitral valve leaflet motion in patients after LVAD implantation may result from altered hemodynamics rather than structural pathology.
- A tailored, patient-specific approach integrating imaging, hemodynamics, and clinical context is essential for optimal management.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

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**ABBREVIATIONS
AND ACRONYMS****AV** = aortic valve**LVAD** = left ventricular assist device**MR** = mitral regurgitation**MV** = mitral valve**RHC** = right heart catheterization**TEE** = transesophageal echocardiography**TTE** = transthoracic echocardiography

24 breaths/min, and oxygen saturation was 96% on room air. Initial B-type natriuretic peptide was 455 pg/mL, and high-sensitivity troponin I was 60 ng/L. The patient's international normalized ratio was elevated at 4.5 on presentation, with prior values ranging from 2.48 to 4.6 over the preceding 3 weeks, indicating sustained therapeutic anticoagulation. Chest x-ray showed minimal pulmonary vascular congestion. The patient continued to have lower extremity edema, and transthoracic echocardiography (TTE) was suspicious for stuck mitral valve (MV), with only 1 leaflet moving.

PAST MEDICAL HISTORY

The patient had a 10-year history of heart failure with reduced ejection fraction. He had undergone mechanical aortic valve (AV) and MV replacements (31-mm St Jude valve) 10 years ago because of infective endocarditis involving both valves. Three years later, he developed a paravalvular leak around the mechanical MV, which was closed using an Amplatzer (Abbott) device. Subsequently, he experienced dehiscence of the mechanical AV, necessitating replacement with another mechanical AV 1 year before LVAD implantation. Additionally, he had prior gastrointestinal bleeds and a thoracic hematoma.

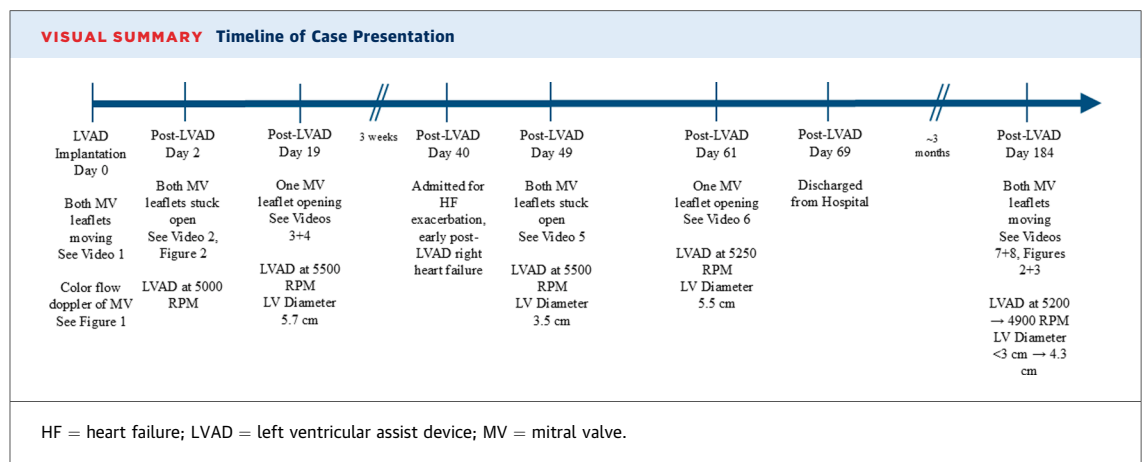
Despite optimization of valve function and guideline-directed medical therapy, the patient continued to deteriorate, leading to the need for durable mechanical circulatory support. He underwent HeartMate 3 LVAD implantation, as he was not a candidate for heart transplantation. During the LVAD surgery, the mechanical AV was replaced with a bioprosthetic valve, and he underwent single-vessel bypass grafting. No intervention was performed on

the MV given the surgical complexity and increased procedural risk.

CLINICAL COURSE

At the time of LVAD implantation, both the MV leaflets were moving (**Video 1, Figure 1**). The patient returned to the operating room on postoperative day 2 for a washout, during which the mechanical MV was found to have both leaflets fixed in the open position (**Video 2**). Just before discharge, only 1 of the leaflets was found to be fixed in the open position (**Videos 3 and 4**). Despite this finding, there was no evidence of significant mitral regurgitation (MR), and the patient demonstrated clinical improvement and was discharged.

Three weeks later, the patient was readmitted with worsening shortness of breath, raising concern for severe MR from impaired MV function. Repeat TTE demonstrated early post-LVAD right heart failure and showed that both leaflets were stuck open, which was confirmed on fluoroscopy (**Video 5**). Transesophageal echocardiography (TEE) was deferred because of the patient's tenuous respiratory status and refusal of further intubation. Given his poor surgical candidacy, a conservative management approach was adopted. The patient's respiratory status improved with milrinone for right heart failure and with diuresis. Repeat TTE before discharge suggested that 1 leaflet of the MV regained mobility; this was confirmed on fluoroscopy (**Video 6**). Given there was no convincing evidence of thrombus of the MV itself and with his prior history of bleeding, his anticoagulation strategy included a target international normalized ratio of 2.5 to 3.5. He was discharged on long-term milrinone and warfarin with twice-weekly outpatient anticoagulation clinic visits until his warfarin dose stabilized.



Over the following year, the patient was hospitalized multiple times for volume overload, right heart failure, and worsening kidney function. Serial echocardiography and fluoroscopy revealed dynamic variation in mitral leaflet motion, ranging from both leaflets being immobile in the open position, to 1 leaflet moving, to both leaflets functioning normally. A TEE performed during the final hospitalization showed both leaflets moving appropriately, without evidence of thrombus or pannus (Videos 7 and 8, Figures 2 and 3). Multiple right heart catheterizations (RHCs) demonstrated pulmonary capillary wedge pressures without tall V waves, suggestive of volume overload and not severe MR (Table 1). Chest radiographs during this period also showed improvement in pulmonary congestion.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included LVAD-related complications (early post-LVAD right heart failure), mechanical MV-related complications (pannus, thrombus formation), pulmonary hypertension, and acute severe MR.

INVESTIGATIONS

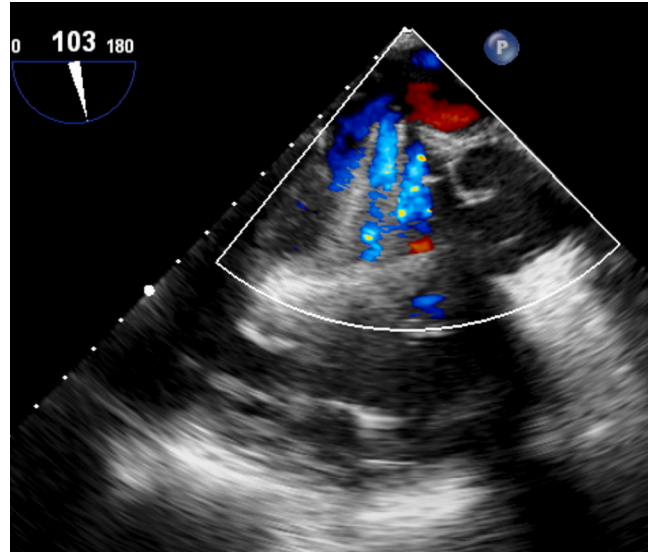
Over his clinical course, Swan-Ganz monitoring, RHC evaluation, frequent TTE and TEE examinations, and fluoroscopy demonstrated variable mobility of the mechanical MV leaflets (Videos 1 to 8, Figures 1 to 3, Table 1).

MANAGEMENT

The patient initially underwent ramp echocardiography to assess whether alterations in LVAD speed would influence the mechanical MV leaflet position. LVAD speed was decreased from 5,700 to 5,300 rpm to reduce left ventricular unloading and potentially restore normal leaflet motion. However, these changes had little effect on valve mobility. Notably, even immediately postoperatively, when the device was set to 5,000 rpm, both MV leaflets were observed to be fixed in the open position (Video 2).

Despite the immobile valve, the patient experienced no low-flow alarms throughout his clinical course, with flows >4 L/min, suggesting adequate blood flow from the left atrium to the LVAD. There was no clinical or laboratory evidence of hemolysis; lactate dehydrogenase levels remained stable around 300 U/L, and no hematuria was observed. Echocardiographic studies showed no signs of MR, and serial

FIGURE 1 Day 0: Transesophageal Echocardiography of Mitral Valve With Color Doppler, With Laminar Flow Through the Mechanical Mitral Valve and No Significant Mitral Regurgitation



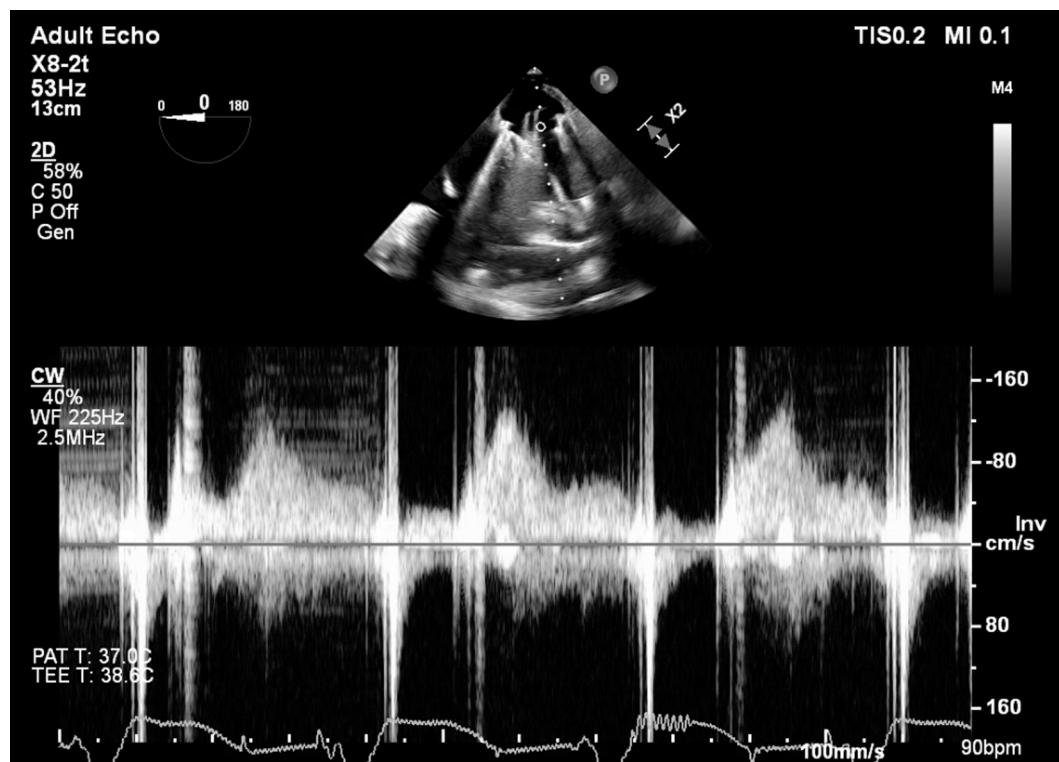
RHC demonstrated normal or near-normal pulmonary capillary wedge pressures (Table 1). Chest imaging revealed no evidence of pulmonary edema.

Given the patient's significant comorbidities and high surgical risk, he was not considered a candidate for further surgical intervention. Therefore, a conservative management approach was pursued.

DISCUSSION

In patients with a pre-existing mechanical MV who undergo LVAD implantation, there is a theoretical risk of valve immobility or partial dysfunction due to altered hemodynamics.¹ However, replacing the mechanical valve adds to cardiopulmonary bypass time and may be technically challenging or infeasible in certain cases.¹ Although several reports have demonstrated the safety of retaining a functioning mechanical MV during LVAD implantation, this strategy should be carefully individualized based on patient-specific anatomical and hemodynamic factors.²

Our case is highly unusual in that the mechanical MV leaflet positions varied throughout the clinical course after LVAD implantation. The valve demonstrated dynamic behavior, ranging from both leaflets being fixed in the open position, to only 1 leaflet

FIGURE 2 Day 184: Transesophageal Echocardiography of Mitral Valve, With Mitral Gradient Within Expected Range

being immobile, and at other times, both leaflets functioning normally. Remarkably, despite this abnormal and fluctuating valve behavior, the patient exhibited no clinically significant MR. This was consistently supported by RHC data demonstrating stable hemodynamics, as well as imaging—including serial chest x-rays—that showed no evidence of pulmonary edema.

In general, a stuck-open mechanical MV—whether partial or complete—raises concern for severe MR. However, in patients supported by an LVAD, this risk is significantly reduced owing to continuous unloading of the left ventricle, which lowers left ventricular pressures and thereby decreases the likelihood and severity of MR.

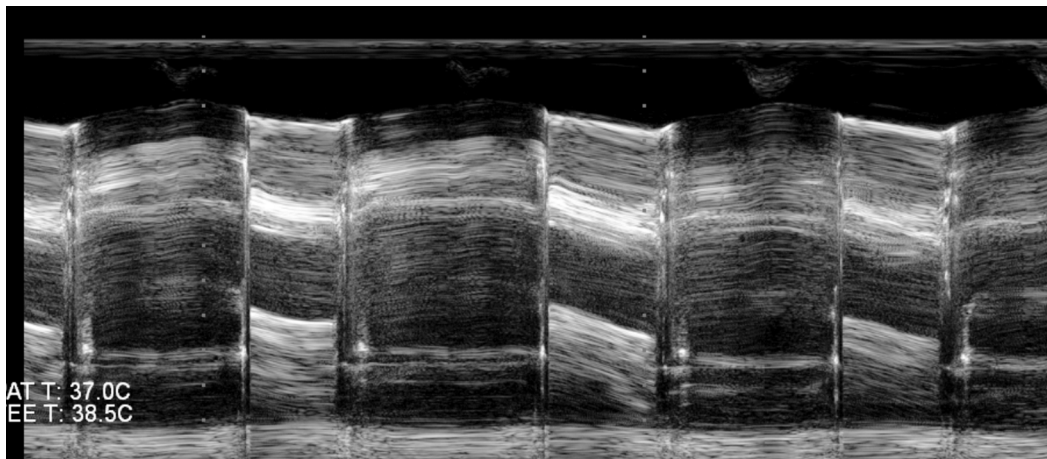
According to a post hoc analysis of the MOMENTUM 3 trial, the HeartMate 3 device was associated with a substantial and early reduction in functional MR, primarily because of effective left ventricular unloading.³ Importantly, the presence or

resolution of MR did not affect 2-year mortality.³ These findings have been supported by other studies, reinforcing the observation that functional MR often improves after LVAD implantation and may not require surgical intervention in most of the cases.⁴

Another important concern with an immobile mechanical MV is the risk of thrombus formation due to blood flow stasis. This can lead to cardioembolic complications such as stroke or transient ischemic attacks.⁵ However, in our patient, there was no clinical or imaging evidence to suggest cardioembolic events. Serial echocardiography showed no thrombus formation on or around the valve. Additionally, laboratory markers did not indicate hemolysis, with lactate dehydrogenase levels consistently remaining in the 300s throughout the clinical course.

In patients without an LVAD, a stuck mechanical MV is typically attributed to thrombus formation or pannus overgrowth, and management generally involves fibrinolytic therapy or surgical valve

FIGURE 3 Day 184: M-Mode Through the Mechanical Mitral Valve, With Movement of Both Leaflets



replacement.^{5,6} However, in the setting of an LVAD, altered hemodynamics may be the primary cause of leaflet immobility. In such cases, the dysfunction may not be due to a structural obstruction but is rather a consequence of altered transvalvular flow. After excluding thrombus through appropriate imaging, careful manipulation of LVAD pump speed may be attempted as a therapeutic strategy to restore leaflet motion.

FOLLOW-UP

Our patient had a tenuous clinical course marked by multiple hospitalizations for volume overload, right heart failure, and worsening kidney function, none of which were attributable to valvular dysfunction. Given his overall frailty and comorbidities, he was not deemed a candidate for further surgical interventions. Ultimately, nearly 1 year after LVAD

implantation, he was transitioned to comfort care. Based on the clinical trajectory, we do not believe the mechanical mitral valve and the abnormal leaflet positioning contributed meaningfully to his overall clinical decline.

CONCLUSIONS

This case illustrates the complex interplay between intracardiac devices and cardiac structures. The hemodynamic changes induced by an LVAD can have unexpected effects on valve function and intracardiac flow dynamics. It underscores the importance of maintaining an open and adaptive clinical mindset when managing such patients. A comprehensive approach integrating hemodynamic data, advanced imaging, and individualized clinical assessment is essential to guide optimal decision-making and tailored patient care.

TABLE 1 RHC/Swan-Ganz Data Before and After LVAD Course

| Hemodynamic Parameter | 3 Days Pre-LVAD | Post-LVAD Day 2 | Post-LVAD Day 50 | Post-LVAD Day 182 |
|--|-----------------|-----------------|------------------|-------------------|
| Right atrium/central venous pressure, mm Hg | 18 | 8 | 19 | 21 |
| Right ventricle pressure, mm Hg | 58/14 (16) | - | 46/8 (18) | 38/11 (22) |
| Pulmonary artery pressure, mm Hg | 61/32 (44) | 37/19 (25) | 45/23 (30) | 38/22 (27) |
| Pulmonary capillary wedge pressure, mm Hg | 29 | - | 14 | 25 |
| Cardiac output (Fick), L/min | 6.45 | 6.6 | 7.5 | 7.28 |
| Cardiac index (Fick), L/min/m ² | 3.2 | 3.4 | 3.8 | 3.9 |
| Pulmonary vascular resistance, dyne/s/cm ⁻⁵ | 182 | - | 178 | 24.4 |

LVAD = left ventricular assist device; RHC = right heart catheterization.

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KEY WORDS acute heart failure, biotechnology, cardiac assist devices, echocardiography, left ventricle, mitral valve, valve replacement

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