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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Spontaneously Resolved Systolic Anterior Motion of Native Mitral Valve Leaflet After Transcatheter Mitral Valve Replacement

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ABSTRACT

Systolic anterior motion of a mitral leaflet can occur by various mechanisms and it is one of the causes of left ventricular outflow tract obstruction after transcatheter mitral valve replacement. We present a case of systolic anterior motion that resolved spontaneously as the anterior mitral leaflet adhered to the prosthesis. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2023;23:102005) © 2023 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 58-year-old man was referred for a transcatheter mitral valve procedure. He presented with heart failure based on severe mitral regurgitation after laparoscopic repair for gastric ulcer perforation 9 months previously. The patient had a history of myocardial infarction with impaired left ventricular function. There was no angina, however, an episode of out-of-hospital cardiac arrest occurred 4 months before transcatheter treatment. At that time, ventricular fibrillation was confirmed, with no evidence of myocardial infarction. He received an implantable cardioverter defibrillator after recovering without neurologic sequelae. Preoperatively, his exertional dyspnea was classified as NYHA functional class II-III. He had a grade 5/6 apical systolic murmur but no crackles on auscultation or peripheral edema. His blood pressure and pulse rate were 136/100 mm Hg and 67 beats/min, respectively. The patient gave us his written informed consent to publish the case.

LEARNING OBJECTIVES

- To understand the various mechanisms by which LVOTO can occur after TMVR.
- To understand that the motion of the native AML after TMVR can change due to interaction with the prosthesis.

MEDICAL HISTORY

The patient was taking metformin, metoprolol, perindopril, and tiotropium for type 2 diabetes mellitus, hypertension, and chronic obstructive pulmonary disease (Global Initiative for Obstructive Lung

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ABBREVIATIONS AND ACRONYMS

AML = anterior mitral leaflet

ASA = alcohol septal ablation

CT = computed tomography

LAMPOON = intentional percutaneous laceration of the anterior mitral leaflet to prevent outflow obstruction

LVOT = left ventricular outflow tract

LVOTO = left ventricular outflow tract obstruction

SAM = systolic anterior motion

TMVR = transcatheter mitral valve replacement

TTE = transthoracic echocardiography

Disease stage II). He was also taking a non-vitamin K oral anticoagulant for atrial fibrillation diagnosed 3 years prior. Peripheral vascular disease causing leg pain and moderate renal dysfunction (preoperative estimated glomerular filtration rate: 42.6 mL/min/1.73 m^2) were present.

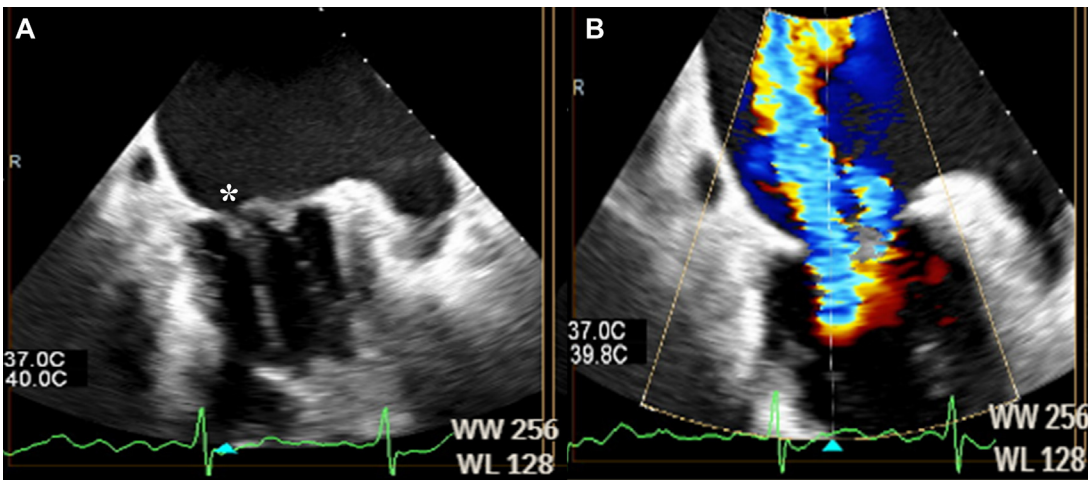
INVESTIGATIONS

Transthoracic echocardiography (TTE) and transesophageal echocardiography showed a left ventricular ejection fraction of 46%, restriction of P3 due to wide inferolateral infarction with fibrosis, and consequent severe mitral regurgitation in A3/P3 (**Figure 1**, Videos 1 to 3). There was no left ventricular dilatation, and right ventricular function was good, but right ventricular systolic pressure was elevated to 55 mm Hg, and calcification of the posterior annulus was observed. Coronary angiography confirmed diffuse severe stenosis of 3 vessels, and cardiac magnetic resonance imaging showed no viability of the inferior/inferolateral wall, so medical management was planned without coronary intervention. Computed tomography (CT) angiography confirmed complete occlusion from the left common iliac artery to the left superficial femoral artery and from the right external iliac artery to the right superficial femoral artery. Cardiac CT revealed mild mitral annular calcification and a not excessively long anterior mitral leaflet (AML) (19 mm) (**Figure 2**). Assuming transcatheter mitral valve replacement (TMVR) using Tendyne prosthesis (Abbott), the projected minimal area and height of the neo-left ventricular outflow tract (LVOT) at end-systole were 2.25 cm^2 and 7 mm, respectively (**Figure 3**), suggesting a borderline risk of neo-left ventricular outflow tract obstruction (LVOTO).

MANAGEMENT

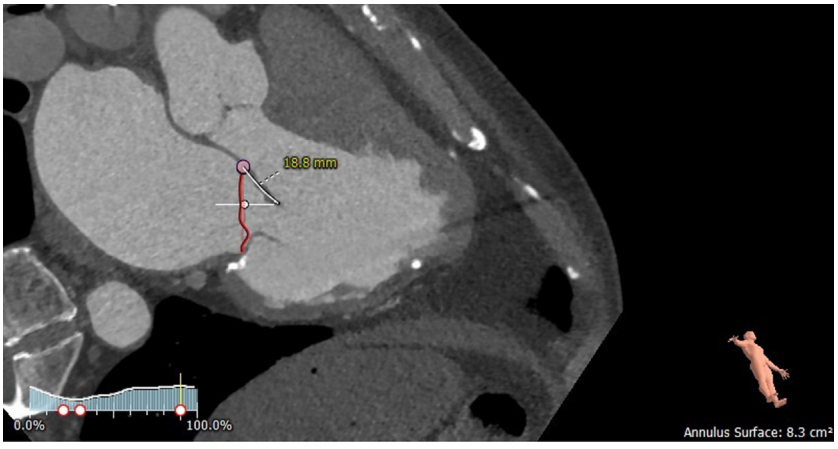
The patient refused surgery, citing general weakness due to rapid weight loss (−7 kg) after gastric surgery and various underlying diseases. Due to the unsuitable anatomy for edge-to-edge repair (posterior annular calcification and insufficiently large mitral valve area [3.5 cm^2]), the heart team decided to perform TMVR. A TMVR prosthesis was implanted transapically under general anesthesia. After valve deployment, transesophageal echocardiography revealed good valve function and no paravalvular leakage; however, a narrow neo-LVOT and systolic anterior motion (SAM) of the native AML with a significant pressure gradient was identified (Videos 4 and 5). Continuous-wave Doppler imaging showed neo-LVOTO with a peak gradient up to 85 mm Hg (**Figure 4**). After fluid replacement and afterload augmentation using norepinephrine, the peak gradient improved to 35 mm Hg, and vital signs remained stable (systolic blood pressure: 130-150 mm Hg and pulse rate 70 beats/min).

FIGURE 1 Preoperative TEE Bicommissural View



A cut plane through both commissures showing **(A)** restriction of P3 leaflet and resulting gap between A3 and P3 **(asterisk)** and **(B)** regurgitation jet. TEE = transesophageal echocardiography.

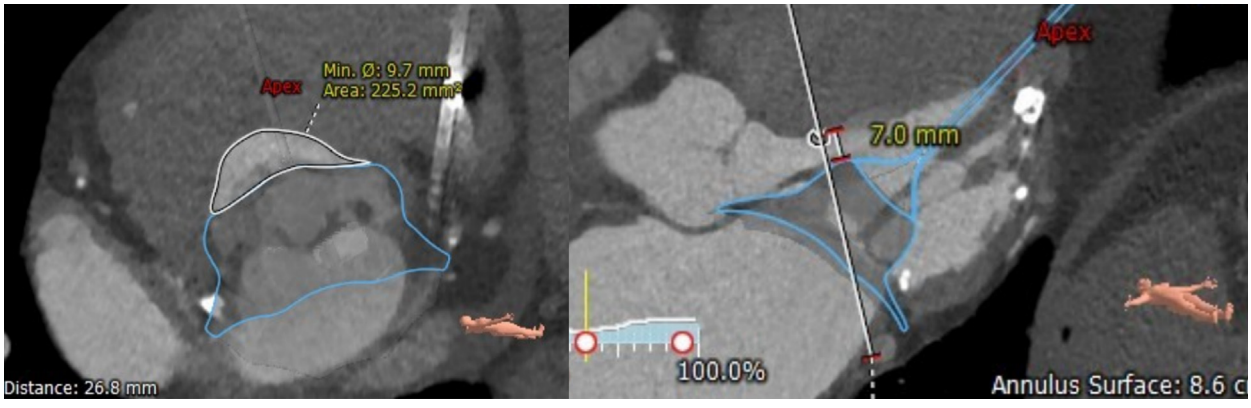
FIGURE 2 **Preprocedural CT**



The length of AML is 19 mm. CT = computed tomography.

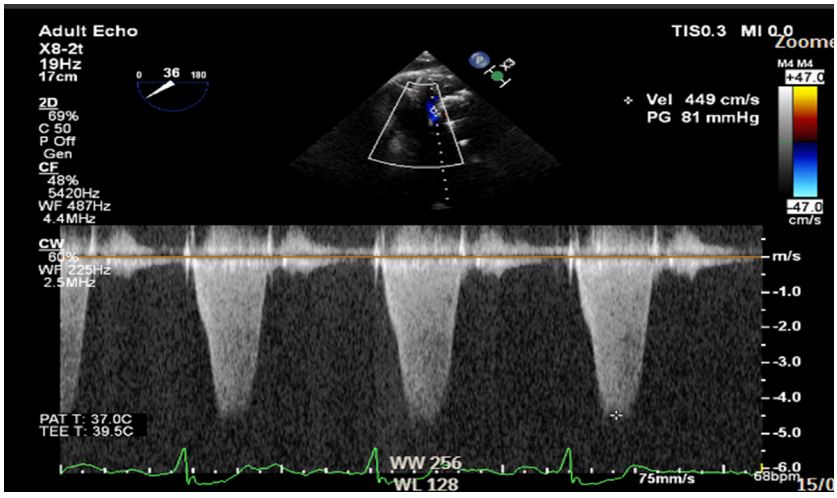
Therefore, the prosthesis was retained. Postoperatively, the patient was extubated after a few hours. TTE performed before transfer to the general ward on postoperative day 1 revealed a peak flow velocity of the neo-LVOT of about 3 m/s (similar to the previous day). However, atrial fibrillation with a rapid ventricular response (pulse rate: 100-105 beats/min) and congestive heart failure occurred on the third postoperative day; creatinine and liver enzyme levels increased and urine output decreased. For hemodynamic monitoring, the patient was moved to the intensive care unit on the fourth postoperative day, and intravenous landiolol was administered along with volume replacement. Pulse rate was adjusted to around 60 beats/min, and the patient's condition began to improve. TTE on postoperative day 5 revealed persisting SAM and flow acceleration in the neo-LVOT (Videos 6 and 7). However, the peak pressure gradient decreased to 6 mm Hg (**Figure 5**). Thereafter, the patient recovered smoothly, and he was transferred to the general ward on postoperative day 8 and discharged on day 14. Repeat TTE before discharge revealed ongoing LVOT narrowing and SAM, but there was no significant neo-LVOT pressure gradient. TTE at 1.5 postoperative months showed the AML adhered to the prosthesis,

FIGURE 3 **Preprocedural CT Virtual Implantation of the Intended Tendyne Valve (Abbott) at End-Systole**



The projected minimal area and height of the neo-left ventricular outflow tract is 2.25 cm^2 and 7 mm, respectively. Abbreviations as in **Figure 2**.

FIGURE 4 **Intraoperative LVOTO**



Continuous-wave Doppler TEE with a systolic peak gradient of 81 mm Hg. LVOTO = left ventricular outflow tract obstruction; other abbreviations as in **Figure 1**.

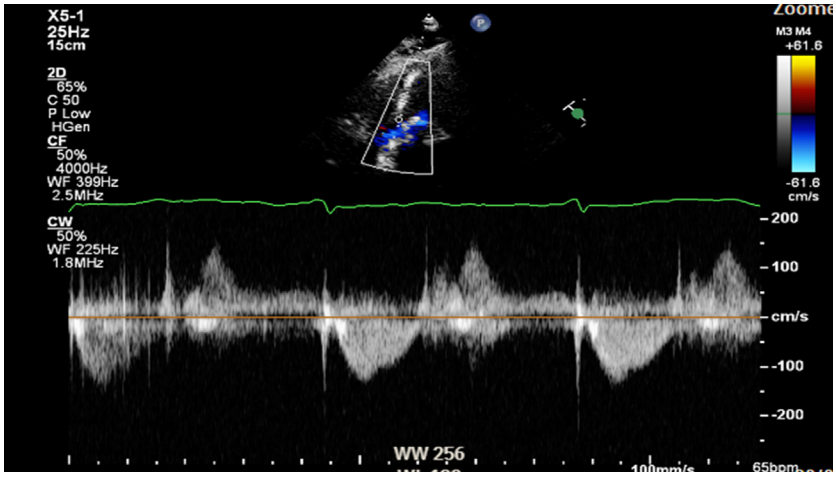
confirming spontaneous resolution of the previous SAM (Video 8). Moreover, flow acceleration in the neo-LVOT was no longer observed (Video 9).

DISCUSSION

TMVR is an emerging alternative to surgery in high-risk patients, and various devices are being developed and studied. The TMVR prosthesis used in this case is a fully retrievable trileaflet porcine pericardial valve mounted on a self-expanding nitinol frame.[1] It is the only Conformité Européene-approved transcatheter mitral valve implant,[1] and promising results were reported in an early feasibility study at 2 years.[2]

LVOTO occurs after about 7%-9% of TMVRs.[3] It is caused by LVOT narrowing from anterior prosthesis protrusion or by SAM of the native AML. In principle, surgical correction is necessary for persistent severe

FIGURE 5 **Residual LVOTO on Postoperative Day 5**



Continuous-wave Doppler TEE with a systolic peak gradient of 6 mm Hg. Abbreviations as in **Figures 1 and 4**.

LVOTO that does not respond to medical management. However, most patients undergoing TMVR are high-risk, therefore, bail-out procedures, such as alcohol septal ablation (ASA)[4] or intentional percutaneous laceration of the anterior mitral leaflet to prevent outflow obstruction (LAMPOON)[5], can be considered. However, they have been applied sparingly. Therefore, it is important to exclude patients unsuitable for TMVR by predicting the neo-LVOT area with preoperative cardiac CT simulation,[6] and, if necessary, a pre-emptive procedure should be performed. In this case, ASA or LAMPOON could have been a good way to prevent LVOTO. However, although the expected neo-LVOT area (225 mm^2) was insufficient to exclude postprocedural LVOTO, it was larger than the previously known cut-off value for the high-risk group (170-190 mm^2); therefore, the probability of LVOTO was regarded as low. Additionally, our hospital was not ready to perform LAMPOON at the time when we managed this case in 2021. So, ASA or LAMPOON as a pre-emptive procedure was not planned.

Unexpectedly severe LVOTO may follow valve deployment even when preoperative screening is not suggestive of LVOTO. In such cases, the operator must decide whether to retrieve the prosthesis. Close observation with medical management can yield favorable outcomes if vital signs remain stable, LVOTO responds to medication, and ventricular function is amenable to beta-blockers and volume replacement. We confirmed that the neo-LVOT pressure gradient improved after adjustments of pulse rate, preload, and afterload, even when SAM persisted. It is noteworthy that SAM can improve spontaneously as adhesion occurs between the metal frame of prosthesis and the native AML. This interaction after TMVR was not previously reported, and additional research is needed. This can be considered when determining the management of SAM after TMVR in the future.

FOLLOW-UP

At 17 postoperative months, the patient's condition was classified as functional class II. TTE showed neither SAM nor LVOTO. The prosthesis was functioning well with a mean pressure gradient of 2 mm Hg and no paravalvular leakage.

CONCLUSIONS

For patients with LVOTO with SAM after TMVR, first-line medical management is appropriate in selected cases. Over time, SAM may spontaneously resolve as the native AML adheres to the prosthesis.

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KEY WORDS left ventricular outflow tract obstruction, systolic anterior motion, transcatheter mitral valve replacement

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