Transcatheter Aortic Valve Embolization in a Patient With a Left Ventricular Assist Device

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INTRODUCTION

Patients with end-stage heart failure commonly require a left ventricular assist device (LVAD) as treatment, either as a bridge to cardiac transplantation or as destination therapy if the patient is not a candidate for transplantation. As a result, LVAD implantation rates have significantly increased in the past decade, with improvements in survival.[1,2] A common complication associated with LVAD implantation is the development of aortic regurgitation (AR) from possible aortic root diameter enlargement and commissural fusion due to a lack of aortic valve opening.[3] Transcatheter aortic valve implantation (TAVI) is established as an alternative to open surgery in patients with aortic stenosis (AS) and is gaining popularity for AR in high-risk AR patients who would not be good candidates for a surgical aortic valve replacement (SAVR).[4] Studies have been performed to compare in-hospital mortality between patients with SAVR versus TAVI, and no significant differences in outcomes were found.[5] Despite being a more challenging procedure, prior case reports have proven that TAVI for AR has been successfully performed on patients who have an LVAD.[6] This case report presents a patient with an LVAD and severe AR who underwent eventual TAVI that was complicated by valve migration into the left ventricle.

CASE PRESENTATION

A 46-year-old man with a history of end-stage nonischemic cardiomyopathy status post–LVAD placement 5 months prior at an outside institution, chronic kidney disease stage 3, pulmonary hypertension, prior pulmonary embolism, seizure disorder, and mild intellectual disability was evaluated for worsening severe fatigue and dyspnea and found to be in cardiogenic shock. Transesophageal echocardiography (TEE) was performed and revealed severe AR (Figure 1, Video 1) due to a nearly immobile left coronary cusp with a large coaptation defect (regurgitation orifice area of 0.7 cm^2 by the proximal isovelocity method) as well as moderate mitral regurgitation and moderate to severe tricuspid regurgitation by vena contracta width. The patient was deemed to be a high-risk candidate for SAVR due to worsening functional status, redo sternotomy, chronic kidney disease, and complicated cardiac history. As a result, the decision was made to undergo TAVI to correct the AR, despite the known risk of device instability or embolization.

The TAVI was performed in the cardiac catherization lab with fluoroscopic guidance under moderate sedation. As measured by cardiac computed tomography, a 29 mm balloon expandable valve with 20% oversizing was advanced across the native aortic valve and deployed. Aortography showed minimal AR, and the valve initially appeared stable, but within minutes, the valve had embolized into the left ventricle (LV). Initial transthoracic echocardiogram (TTE) images confirmed the diagnosis and revealed a highly mobile valve moving in a circular pattern within the LV (Figure 2, Video 1). Initially, no signs of LVAD inflow obstruction were evident; however intermittent low-flow alarms occurred. Subsequently, general anesthesia was induced, the patient was intubated, and a TEE probe was inserted for continuous imaging.

Despite successful snaring of the embolized TAVI valve, it could not be guided back into the aortic annulus. A second 29 mm balloon

VIDEO HIGHLIGHTS

Video 1: Two-dimensional TEE, midesophageal short-axis (65°; *left*) and long-axis (155°; *right*) views with color-flow Doppler, demonstrates severe AR with lack of coaptation along the edge of the left coronary cusp.

Video 2: Two-dimensional TEE, midesophageal 4-chamber view (0°), demonstrates the echo-bright, circular mass appearance of the balloon expandable valve adjacent to and intermittently obstructing the LVAD inflow cannula.

Video 3: Intraprocedural two-dimensional TEE, midesophageal long-axis view (142°) with color-flow Doppler, demonstrates the balloon expandable valve settled over the LVAD inflow cannula leading to obstruction and a high-velocity LVAD inflow pattern.

Video 4: Intraprocedural live three-dimensional TEE, midesophageal 4-chamber (0°) volume-rendered view with color-flow Doppler, demonstrates the TAVI valve settled over the LVAD inflow cannula.

Video 5: Postoperative two-dimensional TEE, midesophageal aortic valve long-axis (142°) view with color-flow Doppler, demonstrates a mild paravalvular leak and subtle rocking motion.

View the video content online at www.cvcasejournal.com.

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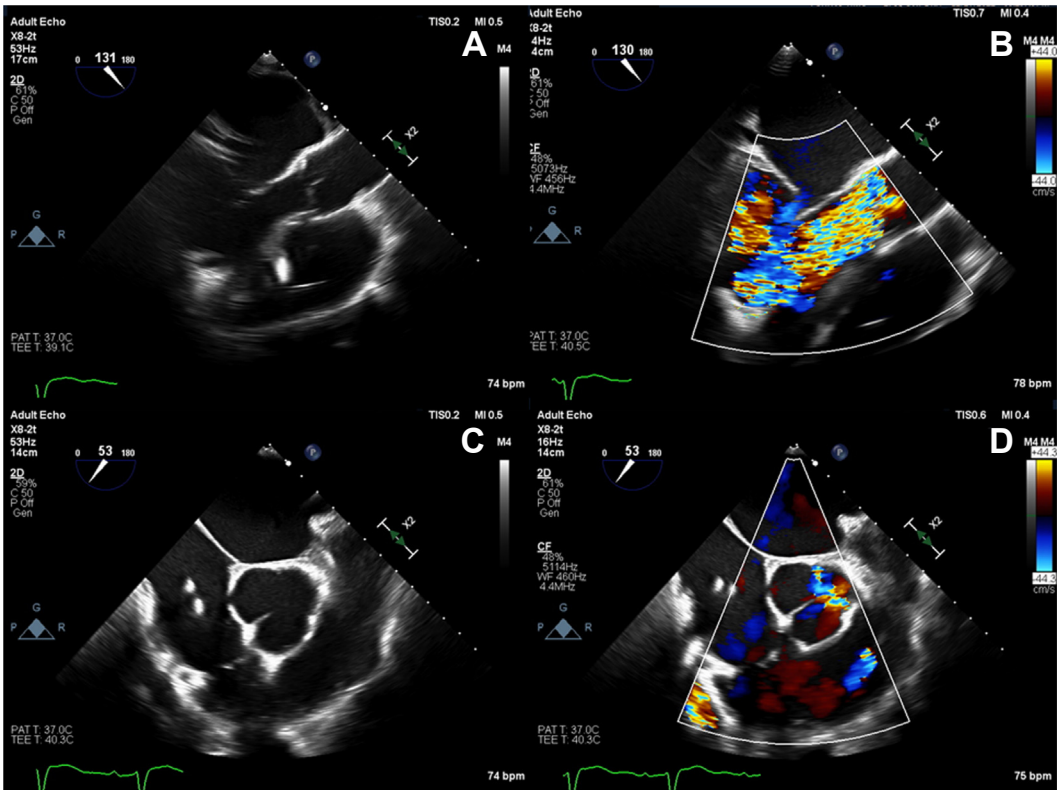

Figure 1 Two-dimensional TEE, midesophageal long-axis (*top row*) and short-axis (*bottom row*) views in diastole, without (*left*) and with (*right*) color-flow Doppler, demonstrates appropriate LVAD inflow cannula position **(A)**, severe AR **(B)**, poorly visualized aortic leaflets **(C)**, and lack of coaptation along the edge of the left coronary cusp **(D)**.

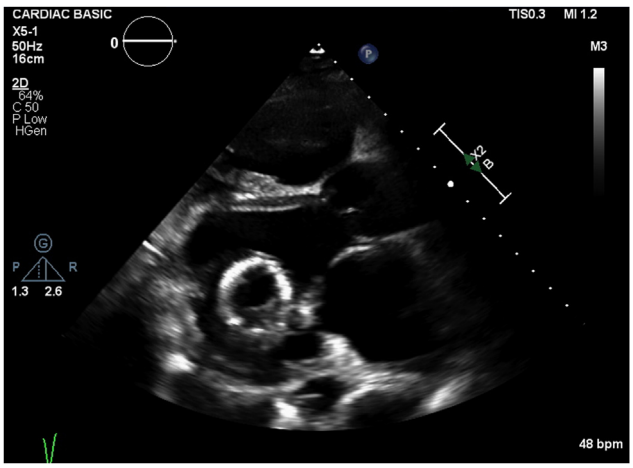

Figure 2 Two-dimensional TTE, parasternal long-axis view after valve deployment, demonstrates the embolized TAVI prosthesis within the LV.

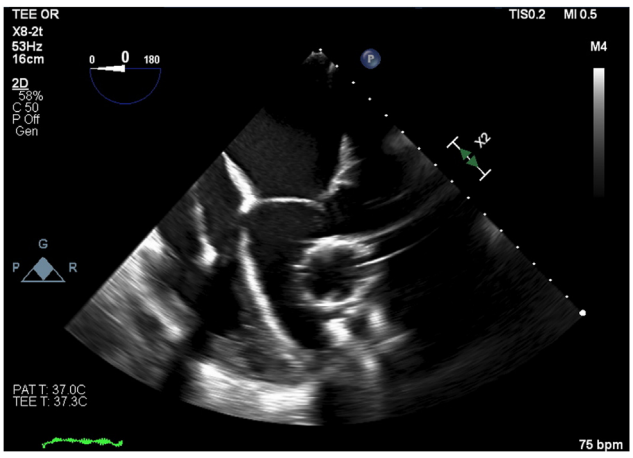

Figure 3 Two-dimensional TEE, midesophageal 4-chamber view, systolic frame, demonstrates the echo-bright, circular mass appearance of the balloon expandable valve adjacent to, and partially obstructing, the LVAD inflow cannula.

expandable valve was subsequently deployed in the aortic position and remained in stable position with mild paravalvular regurgitation (PVR). The first valve remained in the LV and occasionally settled over the LVAD inflow (Figures 3 and 4, Videos 2-4). This intermittently resulted in reduced LVAD flow, which caused LV dilation and discharge of the valve from the inflow cannula. The patient was transported urgently to the operating room with stable hemodynamic vital signs.

Once in the operating room, the patient was peripherally cannulated for cardiopulmonary bypass via the femoral artery and vein and a left anterior thoracotomy was performed to access the apex

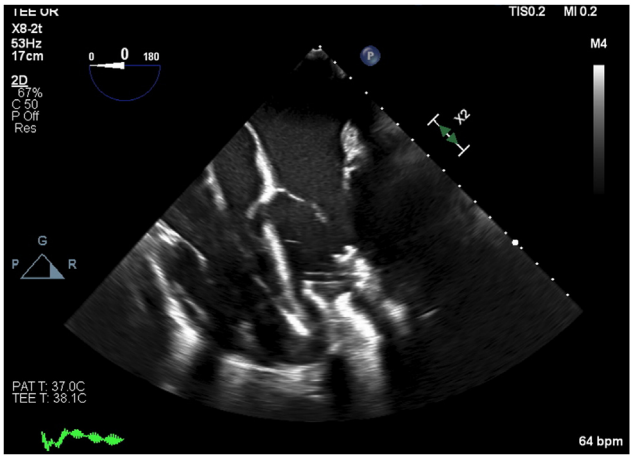

Figure 4 Intraprocedural two-dimensional TEE, midesophageal 4-chamber view, demonstrates the balloon expandable valve settled over the LVAD inflow cannula leading to obstruction of the LVAD flow.

of the LV. The LVAD was mobilized, and cardiopulmonary bypass was initiated. The LVAD pump was removed from the sewing ring, and forceps were used to deform the TAVI valve and remove it through the ventriculotomy. The LVAD was reinserted into the sewing ring and secured in place. The patient was then transitioned back to LVAD support, and the wound was closed. The patient was taken to the intensive care unit requiring multiple vasoactive medications. Postoperative TEE imaging revealed an unchanged LV function with good position and inflow velocities of the LVAD and a mildly dilated right ventricle with moderately depressed systolic function. The TAVI valve in the aortic position appeared to have slight rocking motion and worsening PVR by circumferential ratio that may represent slight dehiscence of the valve (Figure 5, Video 5). The patient was eventually weaned off vasoactive medications, downgraded from intensive care, and discharged home. The LVAD therapy was continued, and the patient required a percutaneous endoscopic gastrostomy tube for further feeding due to recurrent aspiration pneumonia. Multiple TTEs were performed prior to discharge, and the final TTE showed a mildly dilated LV with severely reduced systolic function with diffuse hypokinesis; the 29 mm TAVI valve had mild to moderate PVR, and the valve did not open in systole.

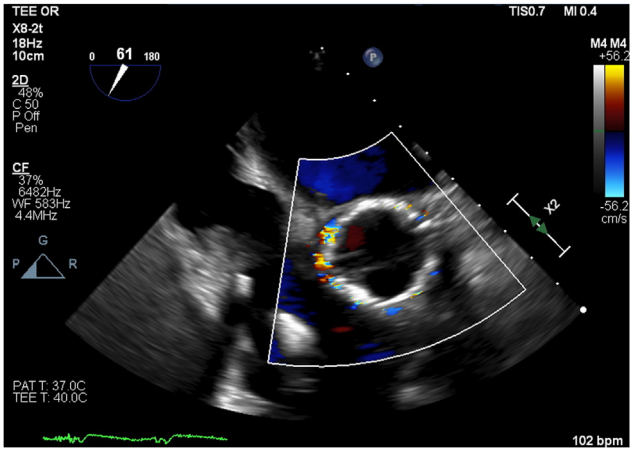

Figure 5 Postoperative two-dimensional TEE, midesophageal aortic valve short-axis view with color-flow Doppler, demonstrates marked PVR around the TAVI device.

DISCUSSION

Aortic regurgitation is one of the long-term complications of LVAD therapy and has a negative impact on survival.[3] Transcatheter aortic valve implantation is becoming a more commonly used treatment option, with newer valves developed for isolated AR.[6] There have been other case reports of device embolization in the LV outflow tract after patients were treated for AR with self-expanding valves as well as with balloon expandable valves.[7] Embolization was more common with the self-expanding valves compared with the balloon expandable valves.[8] The Edwards Sapiens 3 used in this case is a balloon expandable valve that has an additional outer cuff to enhance paravalvular sealing; however, our patient still experienced device embolization. Risk factors for device embolization include variations in anatomy (severe AR, horizontal aorta, dilated aortic root, and bicuspid aortic valve), use of self-expanding valves, and absence of calcification, which can cause insufficient anchoring and sealing of the valve, or it can occur due to the difficult technical aspects of the procedure.[8-11]

Once a device embolizes, the managing team must decide between a percutaneous or surgical approach for retrieval. Embolization accounts for most emergent cardiac surgical indications during TAVI.[12] Percutaneous retrieval involves using a guidewire to place through the device and then inflating a balloon distal to the device to then attempt to pull it back.[13] One could also attempt to use a snare and pull the valve back out of the patient or to fix the first prosthesis within the annulus of a second.[11,14] During our case, the embolized valve was successfully snared percutaneously but could not be removed. As a result, a thoracotomy was then required to remove the embolized valve. In the future, possible interventions to attempt to prevent embolization include the use of cardiac computed tomography for appropriate valve selection and sizing, very rapid pacing, positioning the TAVI valve slightly lower than in the AS for better anchoring, and oversizing the annulus of the bioprosthetic.[10,11,15] Despite all these maneuvers, we still encountered this unfortunate complication.

CONCLUSION

The use of TAVI for treatment of AR has become a successful alternative to surgical replacement in LVAD patients. Meticulous workup is required to determine the proper size and type of the valve used, and larger and balloon expandable valves are preferred. Preventing embolization is extremely important in this patient population due to the possibility of obstructing LVAD inflow. This case demonstrates the consequences of an embolized valve and the potential treatment modalities to rectify the situation.

CONSENT STATEMENT

Complete written informed consent was obtained from the patient (or appropriate parent, guardian, or power of attorney) for the publication of this study and accompanying images.

ETHICS STATEMENT

The authors declare that the work described has been carried out by The Code of Ethics of the World Medical Association (Declaration of

Helsinki) for experiments involving humans. Ethical approval was also obtained from the ethical review committee of the hospital.

FUNDING STATEMENT

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DISCLOSURE STATEMENT

The authors report no conflicts of interest.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2023.11.010.

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