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Paravalvular Leak Closure After Self-Expanding Transcatheter Aortic Valve Replacement Using a Steerable Sheath

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ABSTRACT

We present the case of an 82-year-old woman with persistent fatigue, exertional dyspnea, and dizziness related to a paravalvular leak following a self-expanding transcatheter aortic valve replacement. Successful closure was performed using a steerable sheath to negotiate a vascular plug closure device through the self-expanding valve structure.

Case

An 82-year-old woman presented with persistent fatigue, dyspnea on exertion, and dizziness following transcatheter aortic valve replacement (TAVR) for severe aortic stenosis with an Evolut PRO 29 mm valve (Medtronic) and was found to have moderate-severe paravalvular leak (PVL). Postdilation balloon aortic valvuloplasty was performed 3 months following the TAVR without improvement. The patient was

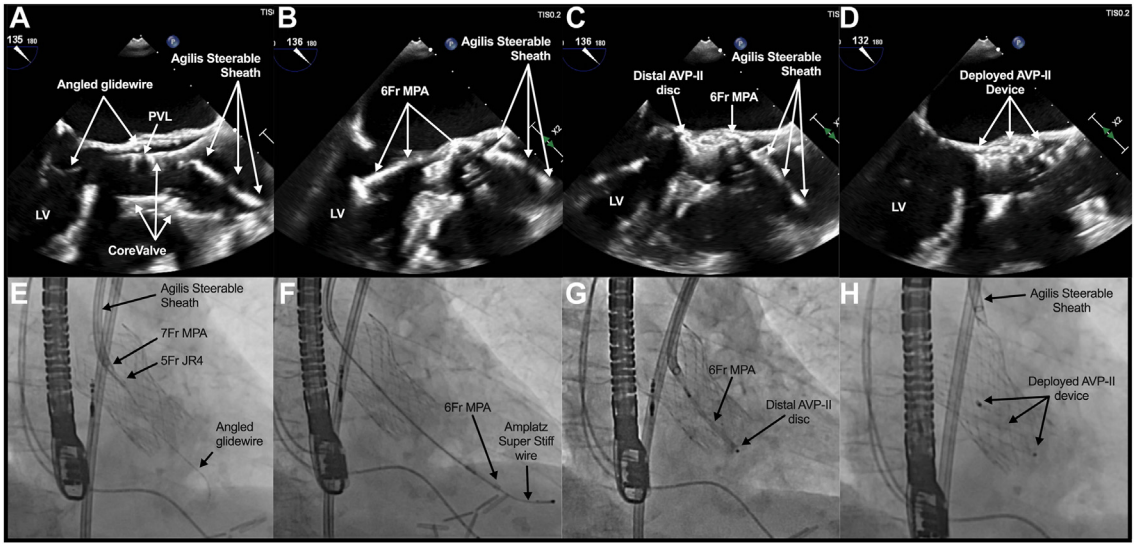

Figure 1.
Transthoracic and transesophageal echocardiography, and cardiac computed tomography imaging of the paravalvular leak (PVL) predeployment and postdeployment of the Amplatzer Vascular Plug II device. Images on the left (**A**, **C**, **E**, **G**) show the defect location adjacent to the left coronary sinus in a posterior location measuring 6 × 9 mm on computed tomography. Images on the right (**B**, **D**, **F**, **H**) show the Amplatzer Vascular Plug II device deployed and no residual aortic regurgitation on transthoracic echocardiography. AVP, Amplatzer Vascular Plug; JR4, Judkins Right 4; MPA, multipurpose.

Keywords: paravalvular leak; steerable sheath; transcatheter aortic valve replacement.
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referred for percutaneous PVL closure given persistent exertional dyspnea. Preprocedural investigations included transthoracic echocardiography, transesophageal echocardiography (TEE), and cardiac computed tomography (Figure 1), which confirmed severe PVL originating at the level of the aortic root relating to multiple calcific nodules located between the left and noncoronary cusps of the native aortic valve (Figure 1).

Using right femoral arterial access, a 7F multipurpose (MPA) catheter with an angled Glidewire (Terumo) crossed the struts easily but could not be passed through the PVL defect due to difficulties visualizing the wire position and the wire being caught behind bulky native valve leaflets. The MPA catheter was exchanged for a 5F JR-4 catheter telescoped through a 7F AL1 guide (double-coaxial "parent-child" configuration), but the same difficulties were encountered in passing the wire through the PVL defect. Given poor stability of the catheter system and inadequate visualization of the wire on TEE, we elected to use a steerable sheath for additional support and stability for wire placement and improved visualization on TEE.

The right femoral sheath was exchanged for an 8.5F 71 cm Agilis NxT steerable sheath catheter (Abbott) and the AL1 7F and 5F JR-4 double-coaxial system reinserted through the Agilis sheath. The TEE imaging guidance was kept focused on the location of the PVL defect and the Agilis sheath brought to the imaging plane (Figure 2). The PVL defect was crossed with the angled Glidewire into the left ventricle with the wire position confirmed on TEE and fluoroscopy. A 4F CXI support catheter (Cook Medical) successfully crossed the PVL defect and the angled Glidewire was exchanged for an Amplatz Super Stiff 0.035-inch 260 cm wire (Boston Scientific). The CXI support catheter was exchanged for a 6F MPA catheter into the left ventricle.

Based on TEE measurement of the defect as 8 × 5 mm, a 10 × 7 mm Amplatzer Vascular Plug II occluder device (Abbott) was selected and passed to the distal tip of the MPA catheter. The distal disc was optimally positioned at the left ventricular orifice of the PVL defect with fluoroscopy and TEE guidance. The remainder of the device was deployed across the defect and released with immediate improvement in hemodynamics and trace residual aortic regurgitation on TEE. The catheters were removed, and the right femoral arterial access was closed with a single Perclose ProStyle Suture-Mediated Closure System (Abbott).

Blood pressure the day after the procedure was 124/96 mm Hg (pulse pressure 28 mm Hg). The patient noted immediate improvement in symptom status (NYHA III function status preprocedure to NYHA I postprocedure). Echocardiography and computed tomography imaging showed resolution of the PVL on day 1 after the procedure (Figure 1), and the patient was discharged without complication.

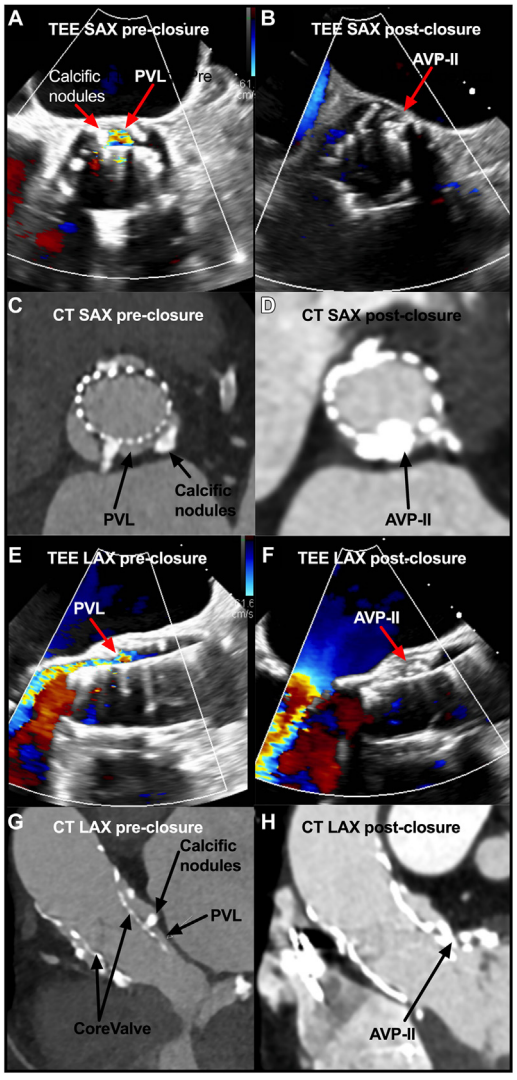

Figure 2.
Intraprocedural imaging of paravalvular leak (PVL) closure using the Agilis steerable sheath. Transesophageal echocardiography (TEE) (panels **A**-**D**) and corresponding fluoroscopy images (panels **E**-**H**) are shown in the top and bottom panels, respectively. Panels **A** and **E** demonstrate the angled Glidewire traversing the struts and the PVL defect with support from the Agilis steerable sheath and a 5F JR-4 catheter telescoped through a 7F multipurpose catheter. Panels **B** and **F** show a 6F multipurpose catheter passed into the left ventricle over an Amplatz Super Stiff wire. Panels **C** and **G** demonstrate optimal positioning of the distal disc of the Amplatz Vascular Plug II device on the left ventricular side of the defect orifice. Panels **D** and **H** demonstrate final positioning of the device following deployment. AVP, Amplatzer Vascular Plug; LAX, long axis; SAX, short axis.

Discussion

We report, to our knowledge, the first aortic PVL closure undertaken using an Agilis steerable sheath, which allowed accurate positioning of the traversing wire and visualization on TEE imaging. The Agilis steerable sheath is commonly used in transeptal punctures and PVL closure procedures for the mitral valve, but is not commonly used via arterial access sites.[1] Advantages of this approach include much greater control and stability for catheter placement in turn leading to more accurate wire direction through the PVL defect. Additionally, the sheath was substantially easier to visualize on TEE. The case also highlights the use of smaller profile catheters to exchange the crossing wire for the Super Stiff support wire using the 4F CXI support catheter (more frequently used for peripheral vascular procedures). The 6F MPA catheter was able to successfully cross the PVL, but an alternative would include a 90-cm 5F sheath with the added support and taper of the dilator if this had been unsuccessful.

The main limitations of this approach include sheath length and complication risk. In taller patients, these systems may not be capable of reaching the valve (although alternate access such as brachial or axillary could be considered in that case). Similarly, given the larger sheath diameter and stiffness of the Agilis system, there may be a greater risk for air embolism, thrombus formation, and aortic complications including dissection.

Conclusions

PVL closure is an uncommon complication following TAVR, and placement of a vascular closure device through the bulky structure of self-expanding valves can be difficult. The use of a steerable sheath can provide additional support and maneuverability in these cases to facilitate traversing the defect and PVL closure.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethics statement and patient consent

All research was carried out with the appropriate ethical guidelines, and patient consent was obtained.

Reference

1. Calvert PA, Northridge DB, Malik IS, et al. Percutaneous device closure of paravalvular leak: combined experience from the United Kingdom and Ireland. *Circulation.* 2016; 134(13):934–944. https://doi.org/10.1161/CIRCULATIONAHA.116.022684