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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Large Left Ventricular Outflow Tract Pseudoaneurysm Closed Percutaneously From a Novel Apical Approach

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ABSTRACT

An incidental finding of a large left ventricular outflow tract pseudoaneurysm in a 74-year-old man, with high surgical risk, was managed with a novel, fully percutaneous, left ventricular apical approach. The pseudoaneurysm defect and the apical puncture site were successfully closed with Amplatzer septal occluders with successful positioning, as demonstrated on cardiac computed tomography at 6 weeks follow-up. (**Level of Difficulty: Intermediate.**)
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HISTORY OF PRESENTATION

A 74-year-old man was found to have a 63 × 41 × 38-mm left ventricular (LV) outflow tract (LVOT) pseudoaneurysm (PSA) with a 7-mm neck following computed tomography angiogram (CTA) while he was investigated for chest pain (Figures 1 and 2). Forty years earlier, he had undergone homograft aortic valve replacement (AVR) for endocarditis, with reoperation 15 years later with a subcoronary aortic root homograft for severe aortic regurgitation. Five years before his current presentation, he underwent a third sternotomy for recurrent severe aortic regurgitation with a 23-mm Perimount bioprosthetic AVR (Edwards Lifesciences, Irvine, California). After discovery of the large LVOT PSA, transthoracic echocardiography showed normal function of the aortic bioprosthesis with persistent flow into the PSA (Figure 3). The CTA confirmed the location of the PSA neck to be immediately below the sewing ring of the bioprosthetic AVR, adjacent to the left coronary arteries. Due to the neck of the PSA being immediately beneath the AVR sewing ring and its extreme angulation, an antegrade approach through the mitral valve via a septal puncture and a retrograde approach through the AVR were felt to be technically

LEARNING OBJECTIVES

- Recognizing complications of cardiac surgical procedures such as LVOT PSA.
- In patients with prohibitive surgical risk and large LVOT PSA, percutaneous closure of the PSA is a feasible treatment option.
- If the anatomic characteristics of the LVOT PSA are unfavorable for percutaneous femoral approach, then a fully percutaneous apical approach should be considered.

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Informed consent was obtained for this case.

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ABBREVIATIONS AND ACRONYMS

ASO = Amplatzer septal occluder

AVR = aortic valve replacement

CTA = computed tomography angiogram

LV = left ventricular

LVOT = left ventricular outflow tract

PSA = pseudoaneurysm

challenging. A fully percutaneous approach from the left ventricular apex was planned, providing more support and direct access to the neck of the PSA.

MANAGEMENT

Under general anesthesia, a 6-F sheath was placed in the LV after puncturing the lateral apex between the ribs, avoiding the major epicardial coronary arteries, which were marked with guidewires (Figure 4). A 4-F JR 4 catheter was advanced into the PSA over a glidewire, and its position confirmed with a contrast injection under fluoroscopy (Figure 5). A Storq wire was then inserted into the PSA via the JR4 catheter so that a 6-F Amplatzer TorqVue 45° delivery system (Abbott Vascular, Santa Clara, California) could be safely advanced into position. A 4-mm Amplatzer septal occluder (ASO) (Abbott Vascular) was deployed in the PSA neck (Figure 6), obliterating flow within it. A second 4-mm ASO was deployed across the apical puncture after confirmation of position with angiography (Figure 7).

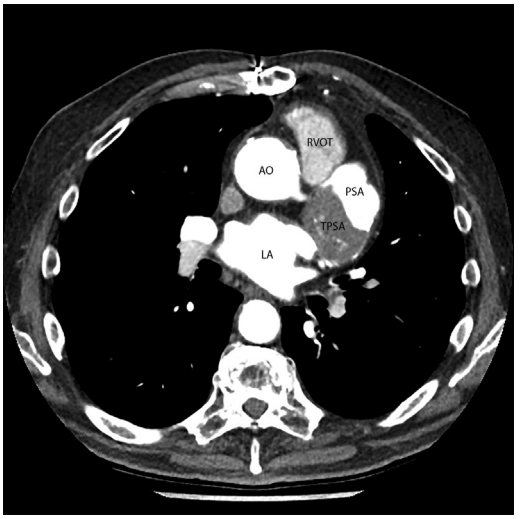
SEE PAGE 718

DISCUSSION

LVOT PSA is a rare complication of surgical aortic valve replacement that can be related to suturing technique or infective endocarditis. Although usually asymptomatic, life-threatening complications such a rupture, thrombosis, and coronary artery compression may occur, and surgery is usually the first-line therapeutic option unless the risk of further surgery is deemed prohibitive (1).

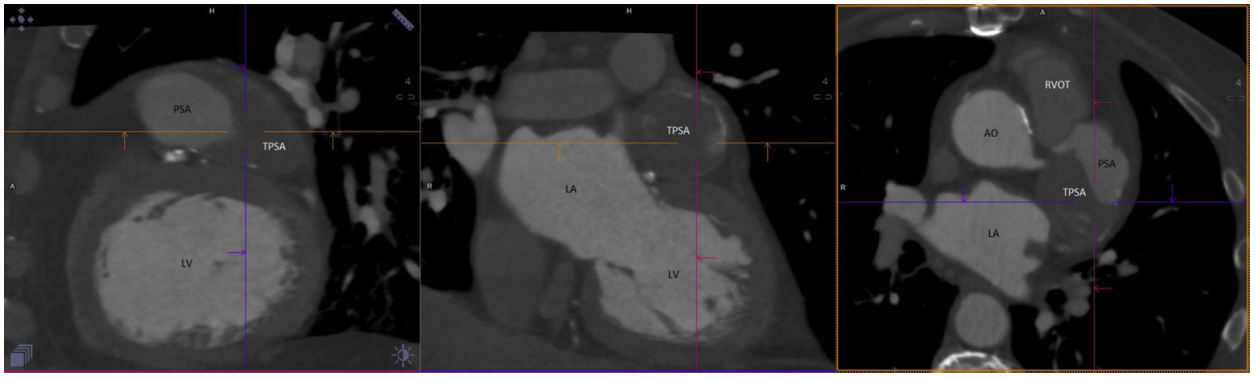
Transapical LV access for interventional procedures has been well described for a wide variety of structural interventions and is usually performed surgically, requiring thoracotomy (2). Percutaneous LV access was first reported as an invasive technique

FIGURE 1 CTA Showing Large LVOT PSA



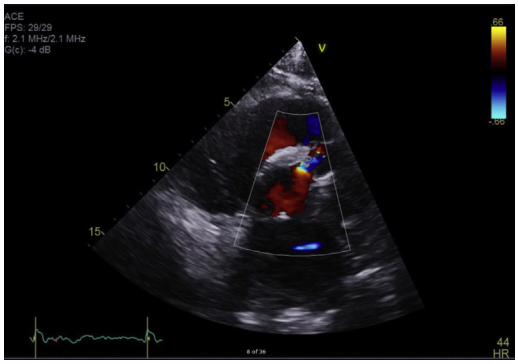
AO = aorta; CTA = computed tomography angiogram; LA = left atrium; LVOT = left ventricular outflow tract; PSA = pseudoaneurysm; RVOT = right ventricular outflow tract.

FIGURE 2 CTA Reformatted Showing PSA in Multiple Planes



LV = left ventricle; TPSA = thrombosed pseudoaneurysm; other abbreviations as in Figure 1.

FIGURE 3 Transthoracic Echocardiogram in Short-Axis Below Sewing Ring Showing Pseudoaneurysm Flow



for hemodynamic assessment (3). This has reduced in practice since standard left heart catheterization has been developed; however, the technique has become reinvigorated with the growth in structural interventional cardiology, especially the closure of ventricular septal defects, LVOT PSA, and paravalvular leaks (4).

Initial structural interventions using the LV apical approach as an access site had a high complication rate of up to 25% (5). Over time, with the wider use of pre-procedural imaging, transesophageal echocardiography, newer technology, and greater clinician experience, the complication rate has been reduced. In a recent retrospective registry analysis of

FIGURE 4 Coronary Wires and Apical Puncture

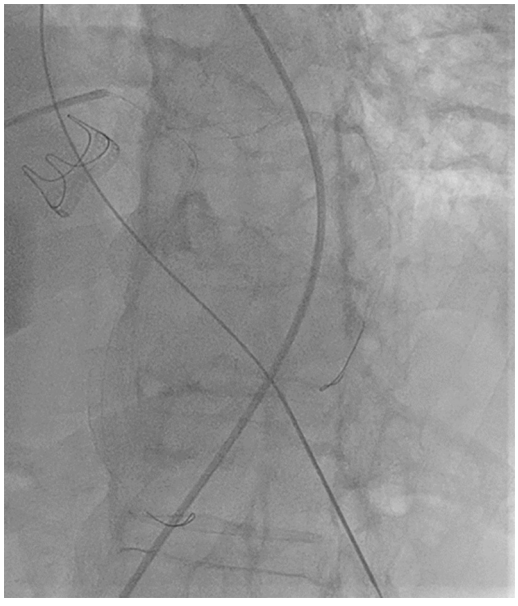


FIGURE 5 JR 4 Catheter Into Pseudoaneurysm Under Fluoroscopy

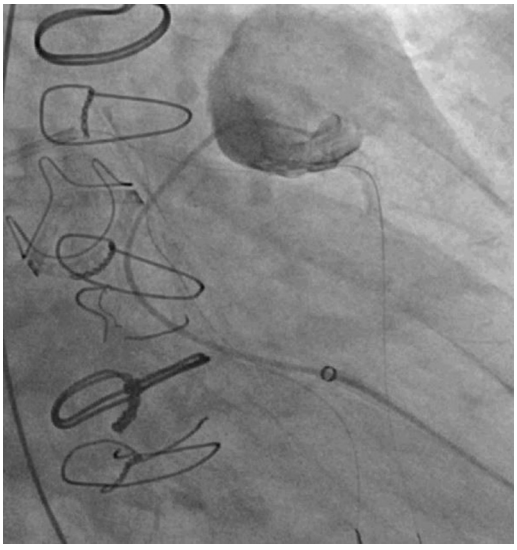
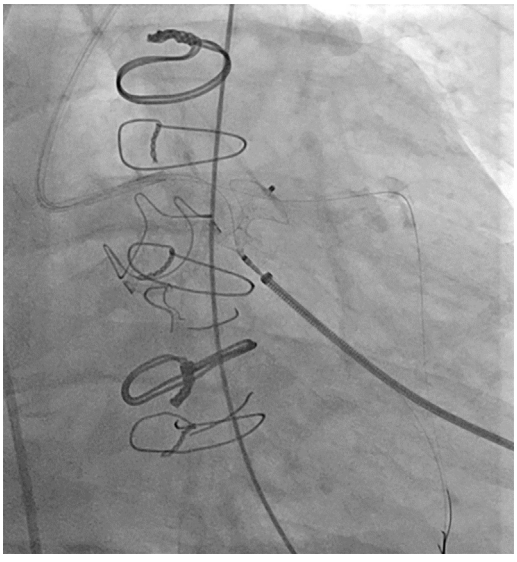
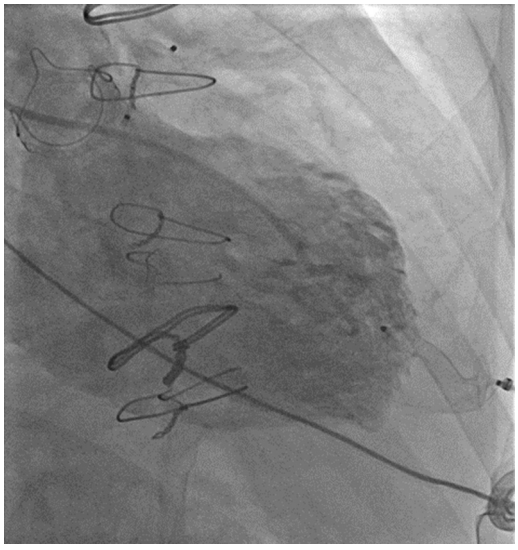


FIGURE 6 4-mm Amplatzer Septal Occluder Deployed in the Neck of the Pseudoaneurysm



JACC: CASE REPORTS, VOL. 1, NO. 5, 2019
DECEMBER 18, 2019:713–7

FIGURE 7 Second Amplatzer Septal Occluder Deployed Across the Apical Puncture and Position Confirmed With Angiography



13 patients treated via a percutaneous transapical approach by Venturini et al. (6), they showed this technique could be achieved safely with shorter procedure times (compared with conventional arterial or venous access), a low complication rate and no procedure related mortality. Jelnin et al. (7) showed their complication rate of percutaneous apical puncture was relatively low at 7%. Care must be taken when performing direct apical puncture to avoid the coronary arteries, lung parenchyma, and the neurovascular bundle in the intercostal space.

In our patient, a transfermoral retrograde approach through the AVR was thought to be technically challenging due to the angulation of the LVOT PSA neck and its position immediately beneath the AVR sewing ring. An apical access was preferred to facilitate easier access into the LVOT PSA neck with a more stable platform to deliver the ASO.

This fully percutaneous apical approach may be associated with less morbidity and a shorter hospitalization in appropriately selected patients compared with a surgical apical approach requiring thoracotomy.

FOLLOW-UP

The patient made an uneventful recovery with no neurological or cardiovascular complications. Transthoracic echocardiography day 1 post-procedure showed a trace of aortic regurgitation and no flow into the PSA. The patient was discharged home 2 days post-procedure. Follow-up CTA showed complete thrombosis of the PSA (**Figure 8**) and stable device position of the ASO (**Figure 9**).

CONCLUSIONS

In patients not suitable for surgical repair of LVOT PSA, and if a transfemoral approach is unattractive, direct apical puncture provides easy access and can be achieved with a fully percutaneous approach.

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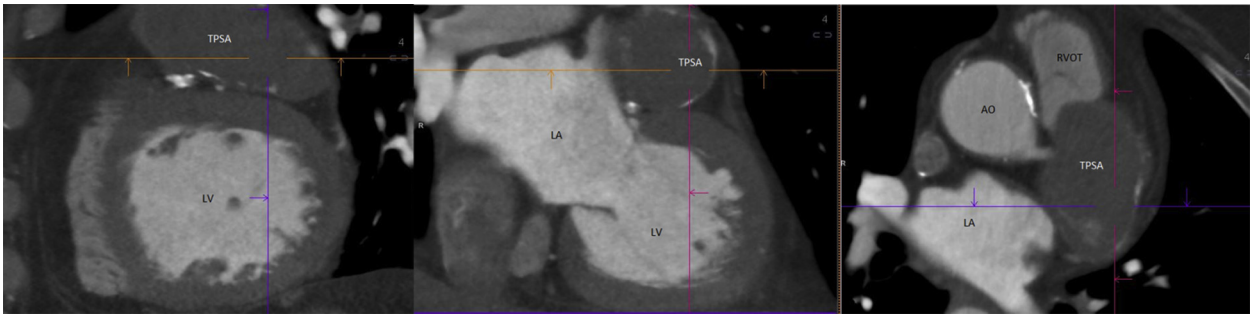
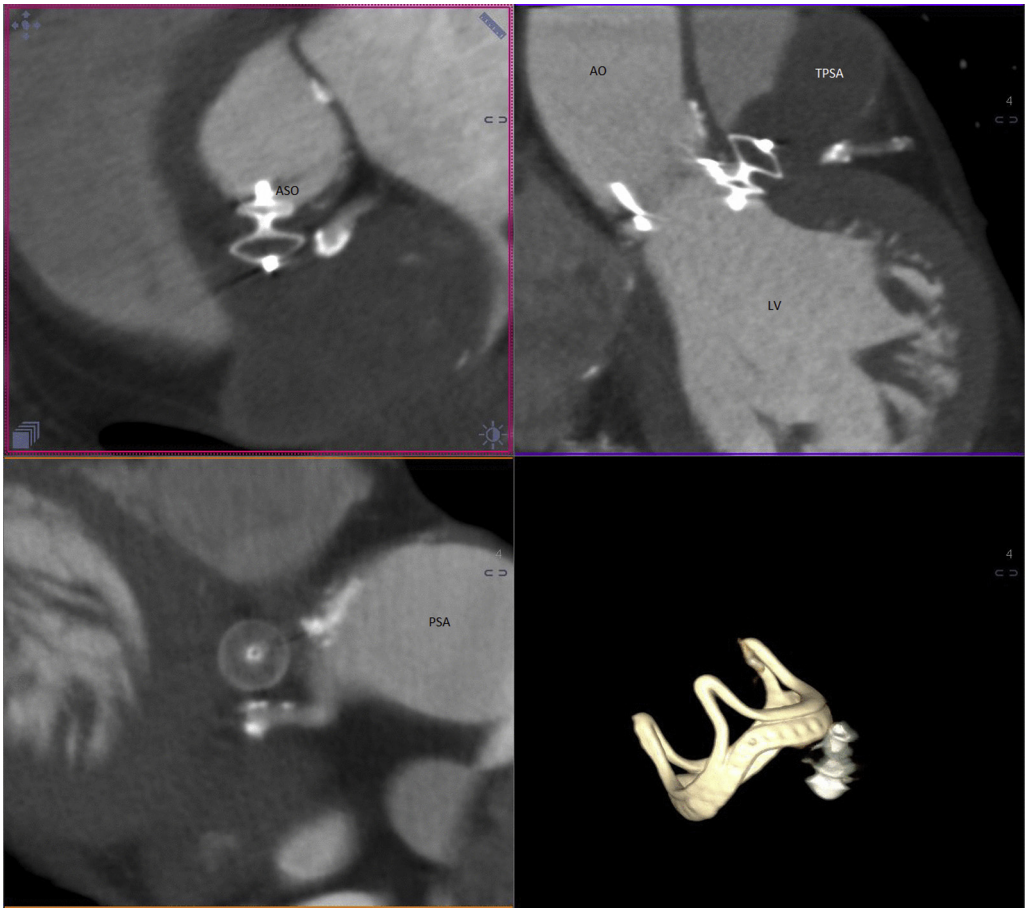
FIGURE 8 Follow-Up CTA at 6 Weeks Showed Complete Thrombosis of the PSA



Abbreviations as in **Figures 1 and 2**.

FIGURE 9 **Reformatted CTA 6 Weeks Post-PSA Closure Showing Stable Device Positions and 3D Render of ASO in Relation to Perimount Bioprosthetic AVR**



PSA = pseudoaneurysm; other abbreviations as in Figures 1, 2, and 6.

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KEY WORDS **apical puncture, left ventricular outflow tract, pseudoaneurysm**