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CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

CASE REPORT: HEART CARE TEAM/MULTIDISCIPLINARY TEAM LIVE

Percutaneous Treatment of a Left Ventricular Pseudoaneurysm Post-Aortic Valve Replacement

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ABSTRACT

Left ventricular outflow tract pseudoaneurysm is rare but serious complication after aortic valve replacement and may occur secondarily to endocarditis, suture dehiscence, or morphologic changes at the aortic annulus. We present a case of successful percutaneous closure of a left ventricular outflow tract pseudoaneurysm using various cardiovascular imaging modalities. (JACC Case Rep 2024;29:102434) © 2024 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/).

CASE PRESENTATION

A 38-year-old man with a history of aortic root repair for type-A aortic root dissection presented with exertional dyspnea 9 months after undergoing total aortic root and hemiarch replacement. Transthoracic echocardiogram showed aneurysmal tissue protruding from the aortic root into the left atrium, with an abnormal doppler jet consistent with a perforation. Computed tomography angiography (CTA) showed a large periaortic and perivalvular collection spanning approximately 14 × 9 × 15 cm with extraluminal extravasation into a left ventricular pseudoaneurysm (LVPA) that had 2 orifices measuring 7 mm and 8 mm in diameter, respectively (**Figure 1A**). A subsequent transesophageal echocardiography (TEE) confirmed that the LVPA was below the bioprosthetic aortic valve (Video 1).

After multidisciplinary heart team discussion, a percutaneous closure of LVPA was planned to avoid repeat sternotomy because the patient had history of sternal wound infection and dehiscence requiring wound debridement and prolonged antibiotic course after his prior aortic root repair surgery. Using the Syngo X system (Siemens Healthineers) the pre-procedural CTA data was 3-dimensional (3-D) volume-rendered to generate automatic segmentation to better visualize the left atrium, left ventricle (LV), left ventricular outflow tract, and aorta (**Figure 1B**). The 3-D imaging analysis helped delineate

LEARNING OBJECTIVES

- To recognize the role of various cardiac imaging modalities in the percutaneous closure of LVPA.
- To understand the variety of technical challenges in percutaneous closure of LVPA.

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ABBREVIATIONS AND ACRONYMS

3-D = 3-dimensional

CTA = computed tomography angiography

LV = left ventricle

LVPA = left ventricular pseudoaneurysm

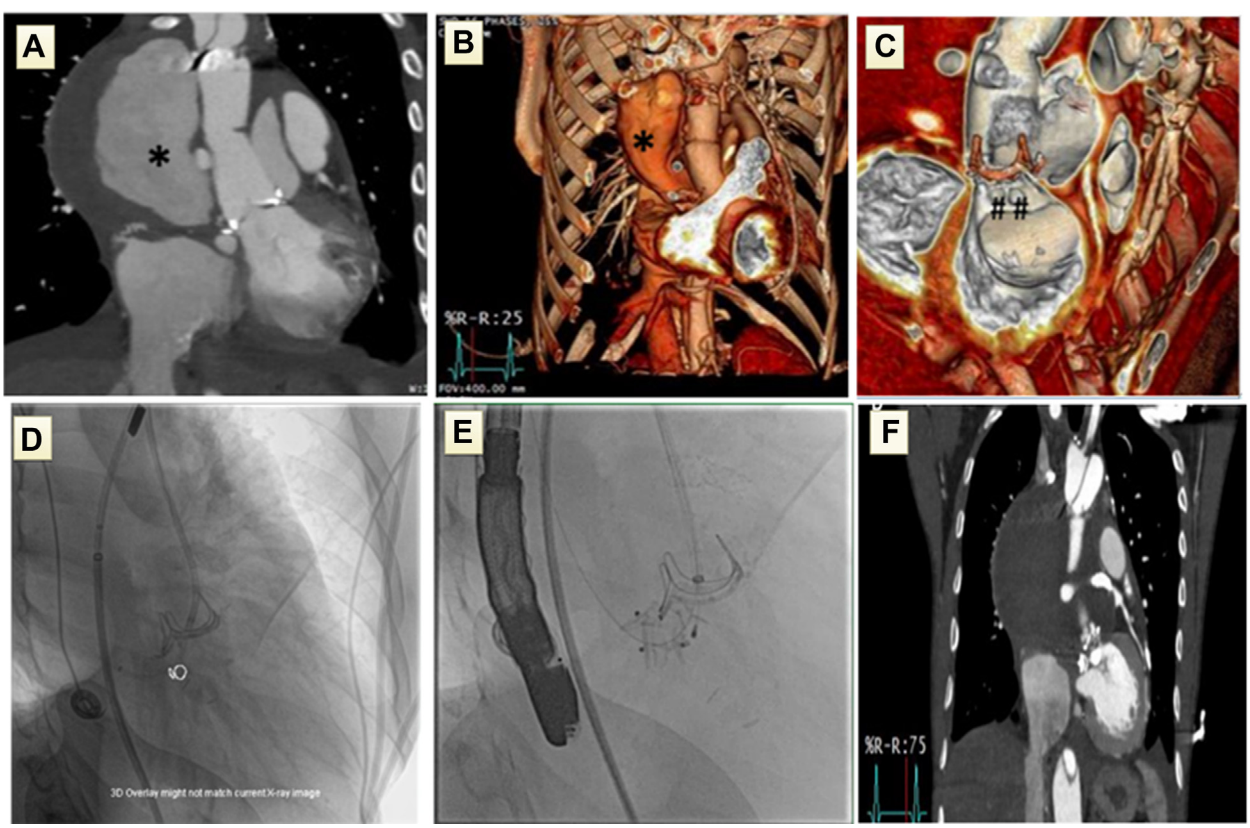
TEE = transesophageal echocardiography

the precise location of subvalvular orifices of LVPA and aided in preprocedural landmarking (Figure 1C). Based on the dimensions of the LVPA orifices, Amplatzer Vascular Plug 2 devices (10 mm and 12 mm) were selected for LVPA closure.

By retrograde transfemoral approach, LV entry was established using an AL1 diagnostic catheter, which was then exchanged for 8-F hockey stick guide catheter (Cordis Corp). Two fluoroscopic orthogonal views were obtained at 2 different angles. CTA images were coregistered and overlaid onto the live fluoroscopic views, which provided a live roadmap such that any rotations of the C-arm were congruent with the computed tomography. The procedure was also simultaneously monitored using TEE. Due to increased tortuosity, 8-F hockey stick guide catheter had to be exchanged over 0.035 angled stiff glidewire for 7-F shuttle sheath system to successfully access the LVPA orifice (Figure 1D). Next, 2 Amplatzer Vascular Plug 2 plugs were successfully deployed (Figure 1E). Postdeployement TEE demonstrated trace residual flow through the defects, with early signs of clot formation and stagnation (Video 2), without significant aortic regurgitation. Follow-up CTA showed a significant reduction in the size of the LVPA with no contrast extravasation (Figure 1F). The patient tolerated the procedure well and was stable at 6-month follow-up.

Thus, in patients with prohibitive surgical risk, percutaneous closure of LVPA is a feasible treatment option. Relative location of multiple orifices can make closure challenging. For our case, fluoroscopic and TEE guidance allowed successful wiring and equipment delivery.

FIGURE 1 Details of Percutaneous Repair of LVPA



(A) Cardiac CTA showing large periaortic and perivalvular collection (*). (B) 3-D volume-rendered image of LVPA autosegmented from CTA slices. (C) 3-D volume-rendered image with LVPA orifices marked with #. (D) CT-fusion imaging showing the LVPA orifice on fluoroscopy with a guide extender through one of the entry sites. (E) Placement of 2 AVP 2 devices under fluoroscopy through a 7-F shuttle catheter. (F) Postoperative CTA showing no contrast extravasation into the LVPA sac. 3-D = 3-dimensional; AVP 2 = Amplatzer Vascular Plug 2; CT = computed tomography; CTA = computed tomography angiography; LVPA = left ventricular pseudoaneurysm.

QUESTION 1: WHAT IS A LVPA? WHAT ARE THE VARIOUS CAUSES AND COMPLICATIONS ASSOCIATED WITH IT?

A LVPA is a thin-walled sac formed as a result of full-thickness rupture of LV wall, contained by overlying pericardium or scar tissue. It is a rare complication after myocardial infarction, surgical valve replacement, cardiac surgery, or aortic surgery. It may occur secondarily to valve endocarditis, suture dehiscence, or morphologic changes at the aortic annulus. The clinical presentation may range from asymptomatic, incidental finding to symptomatic heart failure, chest pain, or dyspnea due to compression of surrounding mediastinal structures. Untreated cases may potentially cause fatal complications like cardiac tamponade due to rupture, thromboembolic events, or coronary artery compression.[1,2]

QUESTION 2: WHAT ARE VARIOUS TREATMENT OPTIONS AND WHAT CLINICAL SCENARIOS OR CONDITIONS TYPICALLY LEAD TO THE CONSIDERATION OF PERCUTANEOUS CLOSURE FOR A LVPA?

Traditionally surgical closure was considered the treatment of choice, but surgical repair has been associated with high morbidity and mortality. Prior studies have reported the associated mortality rate between 20% and 36%.[3,4] Conservative medical management is associated with a mortality rate of 48%.[5] More recently alternative percutaneous closure techniques using vascular coils, plugs, or occluder devices delivered via retrograde, transapical, or trans-septal approaches have been described in a few case reports.[2,6-9] Percutaneous closure is specifically preferred in high-surgical risk patients with significant comorbidities or in scenarios when a patient defers repeat sternotomy due to personal preference or has a prior history of surgical site infections.

QUESTION 3: WHICH IMAGING MODALITIES ARE COMMONLY USED TO DIAGNOSE AND GUIDE THE INTERVENTION FOR A LVPA?

Transthoracic echocardiogram and TEE could help define the initial anatomic location of the defect as well as its relative position compared with other cardiac structures. Preprocedure CTA may provide more precise data to generate 3-D volume-rendered images that may guide in-procedural landmarking. Additionally, CTA fluoroscopy fusion imaging may be used under TEE guidance to guide intervention in real-time and improve outcomes.

QUESTION 4: WHAT ARE THE PROCEDURAL STEPS FOR PERCUTANEOUS CLOSURE OF THE PSEUDOANEURYSM?

Based on the location, size, and anatomy of the defect, the heart team may plan to access the pseudoaneursym via trans-septal, transapical, or retrograde approach through aorta. In our case, retrograde femoral approach was used. After ultrasound-guided micropuncture, an 8-F pinnacle short sheath was placed in common femoral artery. Next, a 5-F pigtail catheter was advanced till the aortic root to ensure maintenance of true lumen access and to avoid dissection propagation. Then, the pigtail catheter was exchanged over 0.035 exchange guidewire for AL1 diagnostic catheter, which was used to cross the aortic valve to access entry into the LV. Next, the AL1 diagnostic catheter was exchanged over J wire for 8-F hockey stick guide. At this point chest fluoroscopy images were obtained at 2 different angles. Using live TEE guidance and CTA fluoro fusion imaging, 0.014 run through wires were advanced through the LVPA ostia entering the LVPA cavity. 8-F guide extenders were to be used to deliver the Amplatzer vascular plugs, however, due to increased tortuosity, the hockey stick catheter had to be exchanged over 0.035 angled stuff glidewire with 7-F 90-cm shuttle sheath system. which was eventually used to deploy the Amplatzer plugs.

QUESTION 5: WHAT FOLLOW-UP ASSESSMENT IS TYPICALLY RECOMMENDED POSTINTERVENTION?

After successful closure of the defect, TEE would typically show stagnant blood with early signs of clot formation and no residual flow across the orifices of the LVPA or around the occluding device. Follow-up CTA should show reduction in size of the defect and no contrast extravasation into the LVPA cavity. In cases with prior bioprosthetic aortic valve, one must assess for aortic regurgitation after procedure completion because instrumentation may potentially cause accidental injuries to the valve apparatus.

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KEY WORDS left ventricular outflow tract, percutaneous repair, pseudoaneurysm

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