The Cardiothoracic Surgeon

CASE REPORT

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Left ventricular pseudoaneurysm repair utilizing P2 segment of mitral valve: a case report

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Abstract

Background: Left ventricular (LV) pseudoaneurysms are a rare occurrence typically seen after myocardial infarction (MI) or in patients with prior cardiac surgery and are associated with a significant risk of rupture and mortality. Management includes primary repair, epicardial patching, or percutaneous repair with occlusive devices.

Case presentation: This case report describes a 46-year-old male with a large LV pseudoaneurysm that was surgically patched with a segment of his mitral valve. To our knowledge, there has not been a documented repair utilizing a segment of the mitral valve.

Conclusions: The applicability of this technique is limited to cases with posteriorly located pseudoaneurysms near the mitral valve, thus allowing the P2 segment to be used as a patch. This is a novel approach to LV pseudoaneurysm repair, though careful consideration towards patient selection is warranted, as comorbid conditions may contribute to morbidity and mortality.

Keywords: Left ventricular pseudoaneurysm, Mitral regurgitation, Mitral valve replacement, Tricuspid regurgitation, Tricuspid endocarditis, Tricuspid valve replacement, Case report

Background

Left ventricular (LV) pseudoaneurysms are rare and typically occur after an inferior wall MI or following cardiac surgery, especially following mitral valve replacement [1]. Additional risk factors include endocarditis and chest trauma with LV pseudoaneurysms commonly found incidentally on imaging. In contrast to true aneurysms, LV pseudoaneurysm lacks the endocardial and myocardial layer and is contained instead by pericardium, scar tissue, or hematoma. Left untreated, LV pseudoaneurysm carries a 35–45% risk of rupture and a mortality rate of 20–48% [1].

Patients with LV pseudoaneurysm report symptoms of congestive heart failure (CHF), chest pain, and dyspnea; however, about 10% are asymptomatic [1]. Once diagnosed, multiple repair methods are available including primary repair, epicardial patching, or percutaneous repair with occlusive devices [2]. To our knowledge, a repair utilizing a segment of the mitral valve has not been described. We present a 46-year-old male patient with a large 4 cm LV pseudoaneurysm originating from a perforation beneath the leaflet of the posterior mitral annulus repaired with the P2 segment of the mitral valve.

Case presentation

A 46-year-old male with a past medical history of cervical spondylosis, recent gastrointestinal bleed, end-stage renal disease (ESRD) on hemodialysis, diabetes mellitus, hypertension, hyperlipidemia, and tricuspid endocarditis without history of intravenous drug use (IVDU) was evaluated by our cardiothoracic surgery service for an incidentally discovered left ventricular pseudoaneurysm. This is a peculiar presentation with an unclear etiology, given that the patient did not have a history of prior MI

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or cardiac surgery, nor did he report any of the typical symptoms of CHF, such as chest pain or dyspnea.

He initially presented to our institution with upper extremity weakness and imbalance and was found to have multilevel cervical spondylosis and central canal stenosis, prompting an elective cervical laminectomy with posterior spinal fusion. On post-op day (POD) 2, he experienced worsening hypoxia, and computed tomography angiography (CTA) scan of the chest was obtained out of concern for pulmonary embolism. The imaging incidentally revealed a large pericardiac mass (about 70 × 50 × 45 mm) located near the left atrioventricular groove.

A dedicated cardiac CTA was performed (Fig. 1) demonstrating an ovoid pseudoaneurysm anterior to the midportion of the posterior leaflet of the mitral valve in communication with the left ventricle surrounded by a thick pseudocapsule. The pseudoaneurysm was positioned laterally and inferiorly relative to the left atrium and posterior to the left ventricle. The total volume of the pseudoaneurysm was estimated to be 74 ml. Myxoid degeneration and thickening of the posterior mitral valve were noted. The posterior leaflet of the tricuspid valve exhibited calcifications with associated severe tricuspid regurgitation suspicious for residual vegetation secondary to known history of endocarditis. The patient did not report a history of IVDU commonly associated with tricuspid endocarditis.

Additionally, he was found to have significant coronary artery disease with a total calcium score of 1590. A coronary catheterization was performed demonstrating a left ventricular ejection fraction of 60%, left-sided dominance, and nonobstructive coronary artery disease with the following areas of stenosis: 20% of the distal left main artery, 30–50% of the left anterior descending artery, 30–50% of the left posterior descending artery, and a nondominant right coronary artery with mild-moderate diffuse disease. Elevated left ventricular end-diastolic pressure of 26 mm Hg was noted without left ventricular wall motion abnormalities.

Transthoracic and transesophageal echocardiography (TTE, TEE) further characterized the pseudoaneurysm as a spherical 4.5–5 cm cavity with systolic and diastolic flow and no evidence of thrombus (Fig. 2A–C). Importantly, a fistulous connection from beneath the mitral annulus to the pseudoaneurysm was noted. The left ventricular ejection fraction was 55–60% on echocardiography. Trace mitral regurgitation was noted in addition to severe tricuspid regurgitation secondary to the large, calcified vegetation on the posterior leaflet of the tricuspid valve (Fig. 2D). After explaining the high risk of morbidity and mortality, the patient is elected to pursue surgical pseudoaneurysm repair, mitral valve replacement, and tricuspid valve replacement.

After induction of general anesthesia, a midline sternotomy was performed, and the pericardium was opened. Due to dense adhesions involving the pericardium, extensive dissection was required to free the anterior surface of the heart and expose the left ventricle. The patient was cannulated in standard fashion, and following heparinization, he was placed on cardiopulmonary bypass with arrest achieved by administration of del Nido cardioplegia.

We first opened the left atrium and placed a Cosgrove retractor to visualize the mitral valve. The fistulous connection inferior to the mitral annulus seen on preoperative echocardiography was not immediately visible. To further evaluate, an incision was made on the posterior wall of the left atrium and directly into the

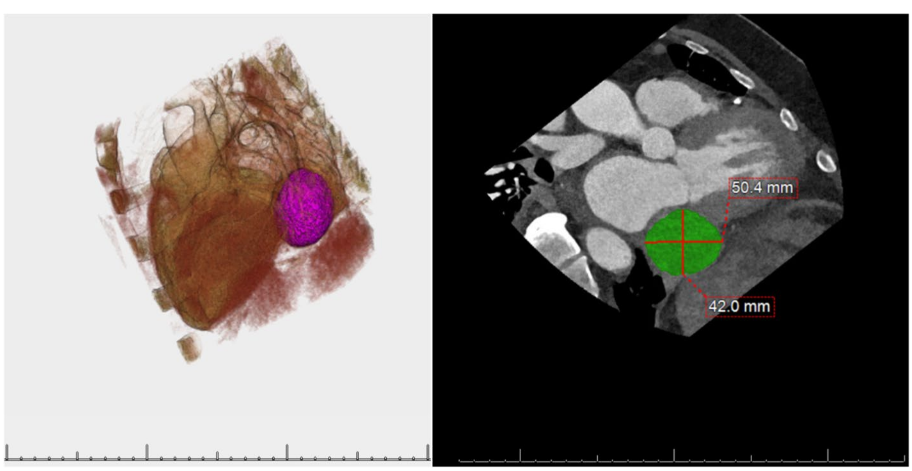

Fig. 1 Cardiac computed tomography with 3-dimensional rendering of left ventricular pseudoaneurysm (LVP) (left) and approximate size noted on axial view (right)

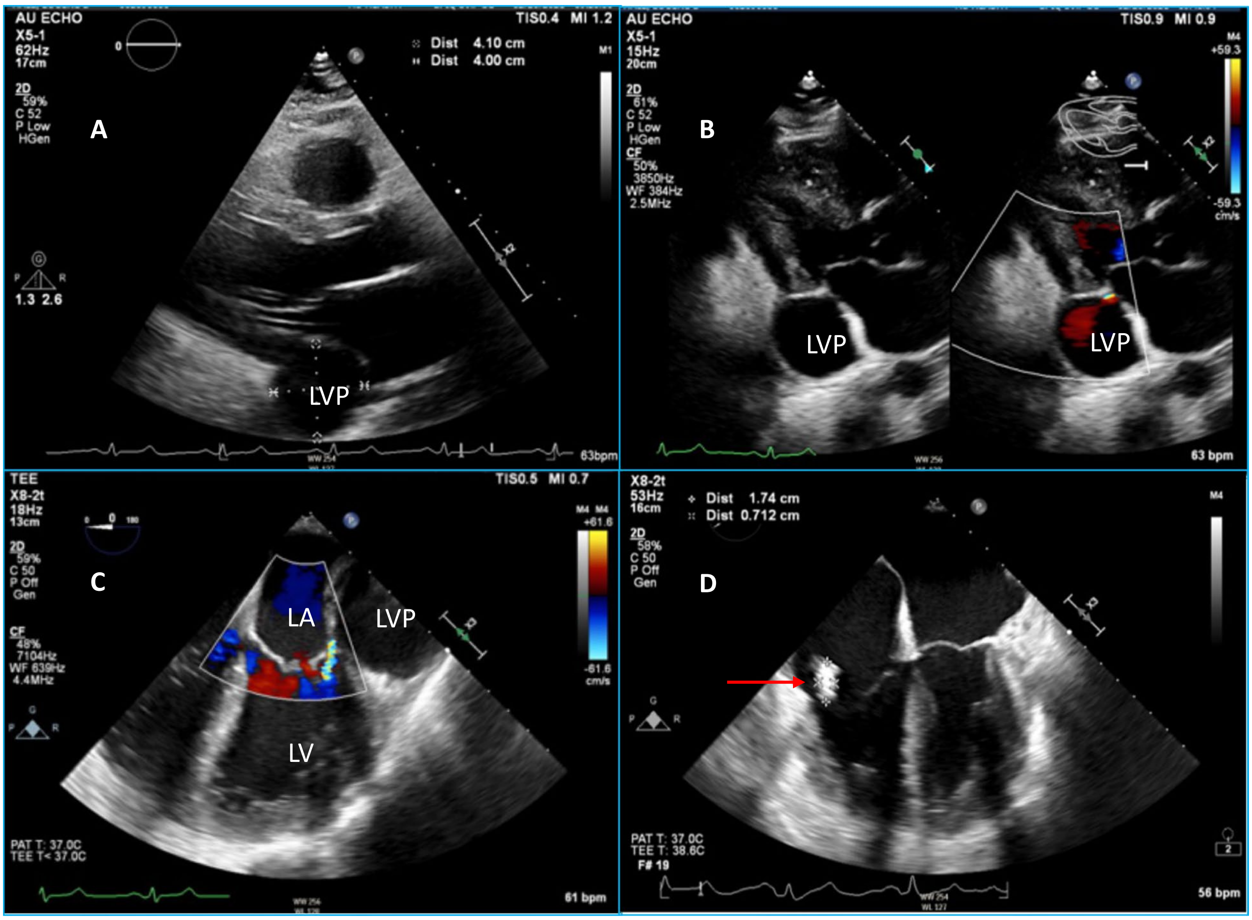

Fig. 2 **A** and **B** Preoperative TTE demonstrating left ventricular pseudoaneurysm (LVP). **C** Preoperative TEE demonstrating LVP. **D** Intraoperative TEE demonstrating tricuspid valve mass (red arrow)

pseudoaneurysm cavity with similar inability to visualize the fistula origin. The posterior leaflet of the mitral valve was brought into an occlusive position over the area of the fistula origin utilizing pledgeted 4-0 Prolene suture placed through the incised edge of pseudoaneurysm and the posterior leaflet (Fig. 3). This maneuver achieved occlusion of the pseudoaneurysm orifice through area tissue coverage. Additional sutures were then placed from P1 to P3 to further secure the leaflet in the occlusive position.

Following occlusion of the pseudoaneurysm orifice, the aneurysmal cavity was opened bluntly with a hemostat to allow communication with the pericardial space. The incision between the left atrium and pseudoaneurysm cavity was closed with running suture. In preparation for mitral valve replacement, the anterior leaflet was incised, and sutures were placed circumferentially around the annulus. Posterior stitches were then placed, incorporating a transposed anterior leaflet which was divided in two using chordal transfer. After sizing, a 27-mm Mosaic valve was secured in place and the left atrium closed in a double-layered fashion after de-airing.

After unclamping the aorta and allowing the heart to beat, attention was then turned to management of the previously known tricuspid lesion. The caval tapes were snared, and the right atrium was opened with immediate visualization of the mass on the posterior leaflet of the tricuspid valve. The posterior leaflet was excised and sent for microbial culture. The valve was then replaced with a 31-mm Medtronic Mosaic valve and secured in place. Following valve replacement, the right atrium was closed in a double-layered fashion, and the patient was weaned from cardiopulmonary bypass and decannulated.

Following the operation, the patient was taken to the surgical intensive care unit and extubated on POD2. Mean arterial pressures remained low and required persistent vasopressor support due to presumed vasoplegia. On POD 3–4, the patient had a marked increase in lactic acidosis with TTE and cardiac CT demonstrating pericardial hematoma concerning for tamponade. The

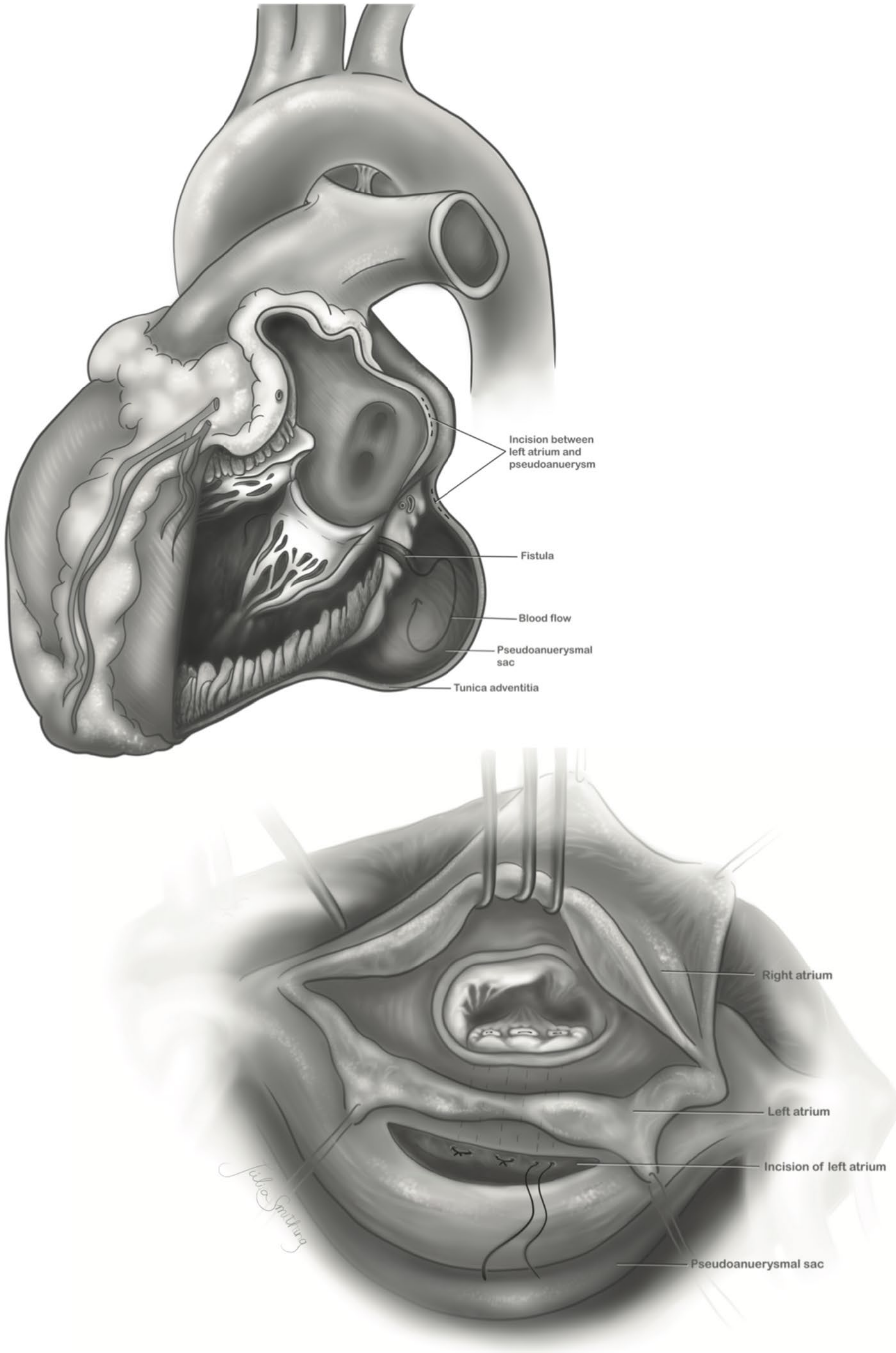

Fig. 3 Illustration of a partial cross-section view of the heart, depicting the left ventricular pseudoaneurysm (top left). Illustration of the surgeon's perspective of the heart with pledgeted sutures placed through the incised edge of pseudoaneurysm and the posterior leaflet of the mitral valve (bottom right)

patient was subsequently taken to the operating room for mediastinal exploration, washout, and evacuation of the pericardial hematoma, which was found to be concentrated inferiorly around the left ventricle. Intraoperative echocardiography demonstrated right heart failure. The patient's chest was left open utilizing negative pressure wound care dressing.

Following this operation, the patient demonstrated increased hemodynamic instability and worsening lactic acidosis. The patient developed clinically diagnosed mesenteric ischemia and shock liver due to a combination of both high-dose vasopressor use and worsening right heart failure. General and vascular surgical teams evaluated the patient and agreed with clinical diagnosis of mesenteric ischemia and determined the patient to be a poor candidate for further operative intervention. Comfort care measures were instituted on POD 9, and the patient expired shortly after.

Discussion

The patient in this case did not have the typical history of prior MI or cardiac surgery commonly associated with LV pseudoaneurysm and nor did he exhibit characteristic symptoms such as chest pain or dyspnea. It is also unlikely that the patient had a silent MI in the past based on his coronary catheterization results, as well as multiple electrocardiograms which did not reveal the presence of Q-waves typically seen in patients with prior MI. A potential risk factor was his history of tricuspid endocarditis; however, this patient had negative blood cultures during his hospitalization, and culture of the tricuspid mass did not reveal any organismal growth. It is possible that the patient had already cleared his infection prior to presentation, and that there was residual scar tissue and calcification resulting in the present tricuspid valvular mass. Additionally, there is no documented history of prior hemodialysis catheterization via internal jugular vein that could in theory contribute to cardiac injury and subsequent pseudoaneurysm formation.

The decision for surgical intervention was based on two factors: pseudoaneurysm size and the lack of baseline imaging from prior to the hospitalization. Pseudoaneurysms generally are at higher risk of rupture at larger sizes. As this pseudoaneurysm was quite large when discovered, a significant risk of rupture was assumed. Without baseline imaging, the rate of expansion or long-term stability of the pseudoaneurysm was unknown due to the incidental nature of its discovery. If this patient was to have had a smaller pseudoaneurysm of less than 3 cm, serial imaging monitoring for expansion would have been a viable course of action, and urgent surgical intervention could have been avoided [3].

True aneurysms are considered to have a more stable integrity due to intact myocardium and typically warrant elective surgery, whereas LV pseudoaneurysms have a greater risk of rupture and thus require urgent surgery, especially if tamponade is suspected [4]. The most common repair methods involve bovine or Dacron patch, though primary repair and percutaneous techniques are also utilized [2, 4, 5]. The size and location of the pseudoaneurysm are considered prior to choosing the surgical repair method. In this case, the pseudoaneurysm was very large, and visualization was difficult due to its posterior location.

Conclusions

We describe a unique approach by utilizing the P2 segment of the mitral valve and rotating it to close the pseudoaneurysm orifice. For future practice, this method may be done in circumstances in which the pseudoaneurysm is both posteriorly located and near the mitral valve so that the P2 segment may be used as a patch. Although this patient ultimately did not survive, this novel technique may prove useful in similar situations requiring a unique approach to LV pseudoaneurysm repair.

Abbreviations

LV: Left ventricular; MI: Myocardial infarction; CHF: Congestive heart failure; ESRD: End-stage renal disease; IVDU: Intravenous drug use; POD: Post-op day; CTA: Computed tomography angiography; TTE: Transthoracic echocardiography; TEE: Transesophageal echocardiography.

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Authors' contributions

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