

## CASE REPORT

# Role of Perioperative Transesophageal Echocardiography in Left Ventricular Apical Pseudoaneurysm Surgery

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## ABSTRACT

Left ventricular apical pseudoaneurysm following myocardial infarction is a rare entity and often fatal due to rupture of free wall, thus warranting an urgent surgery. Although transthoracic echocardiography (TTE) plays a significant role in the diagnosis of pseudoaneurysm, transesophageal echocardiography (TEE) remains an indispensable tool during perioperative period. In this report, we are describing a case of left ventricular apical pseudoaneurysm planned for an urgent surgery.

**Keywords:** Cardiopulmonary bypass, Left ventricular apical pseudoaneurysm, Myocardial infarction, Transesophageal echocardiography.

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## INTRODUCTION

Left ventricular free wall rupture following myocardial infarction remains the most dreadful complication. The advancement of diagnostic technology has dramatically decreased mortality and morbidity due to myocardial infarction.<sup>1</sup> Although left ventricular pseudoaneurysms are rare with the incidence of 0.1% following myocardial infarction, chance of rupture is more common due to lack of myocardial support, thus warranting urgent surgery. Current literature mentioned that 30 to 45% of left ventricular pseudoaneurysm has high chance for rupture.<sup>2-4</sup> Difference between true aneurysm and pseudoaneurysm is given in Table 1. Transthoracic echocardiography and

**Table 1:** Differences between true aneurysm and pseudoaneurysm

<i>True aneurysm</i>	<i>Pseudoaneurysm</i>
4–20% incidence following myocardial infarction	0.1% incidence following myocardial infarction
Wide base	Narrow base
Thinned out myocardium	Ruptured myocardium
Noncontractile	Dyskinetic
Low risk of free rupture	High risk of free rupture
No adherent pericardium	Contained by pericardium
More common in anterior wall and apex	More common in posterior and lateral wall

cardiac magnetic resonance imaging (MRI) have been shown to be important in formulating preoperative surgical plan but have limited role during the intraoperative period.<sup>5</sup> Two- (2D) and three-dimensional (3D) TEE remain superior to TTE in evaluating and delineating the pseudoaneurysm from true aneurysm.<sup>6</sup> In this report, we present a rare case of apical left ventricular pseudoaneurysm who underwent successful repair.

## CASE REPORT

A 52-year-old male with weight of 85 kg and height of 181 cm who had myocardial infarction 2 months back came to our hospital for a routine medical check-up. He had hypertension, type II diabetes mellitus, dyslipidemia, and gastroesophageal reflux. He was a known smoker and an alcoholic since 20 years. On examination, the pulse was regular with rate of 89/min and blood pressure was 128/78 mm Hg in his right upper limb. Electrocardiogram showed Q wave in the II, V3, V4, and V5 leads, implying an old anterolateral wall infarction. Chest X-ray was normal. The TTE showed distorted apical bulging region with no evidence of pericardial collection, suggesting left ventricular aneurysm. Patient's left ventricular ejection fraction (LVEF) by modified Simpson's method was 45%. Regional wall motion abnormality (RWMA) was observed in the left anterior descending (LAD) territory in para-sternal short axis view. Cardiac catheterization revealed 100% block in the LAD artery with normal right coronary artery and left circumflex arteries. Patient was planned for grafting of LAD artery and aneurysmal repair of left ventricle (LV).

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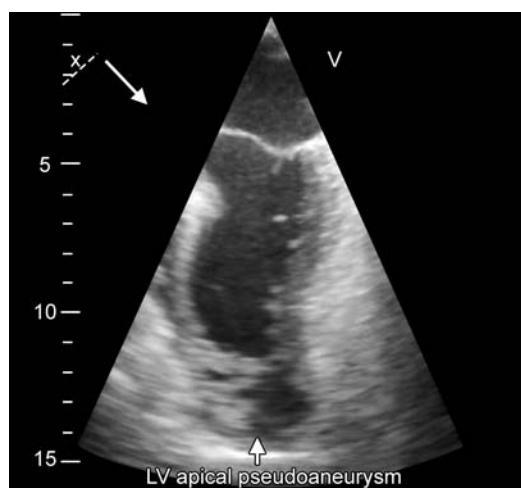
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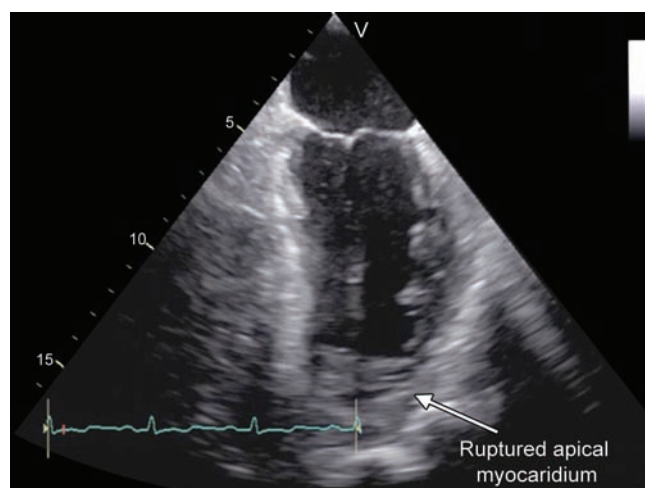
In order to allay the patient's anxiety, alprazolam (0.25 mg) was given orally a night before planned surgery. In addition to all standard American Society of Anesthesiology monitors, TEE monitoring was planned. Anesthesia was induced with fentanyl 2 µg/kg, ketamine 0.25 mg/kg, and propofol 1 mg/kg. Endotracheal intubation was facilitated with vecuronium 0.1 mg/kg. TEE was performed with GE Healthcare Vivid E9 machine (Norway) after induction using 6VT probe. Surprisingly, TEE (2D and 3D) showed an apical pseudoaneurysm communicating with LV through narrow base formed by ruptured myocardium of left ventricular apex (Figs 1 to 4) which was not appreciated by TTE. According to Becker and van Mantgem<sup>7</sup> classification, our patient had type III LV rupture. Regional wall motion abnormality in LAD region was reconfirmed by TEE in transgastric mid-papillary short axis view. In 17-segmental model, 13, 14, 15, and 16 segments had dyskinesia in TEE. Left ventricular ejection fraction, by modified Simpson's method, was calculated to be 45% with no valvular

regurgitation correlated with TTE. A grade III atheroma in the arch and descending thoracic aorta and a grade II atheroma in the ascending aorta were also observed in TEE. Hence, surgery plan was changed to Dor procedure and grafting of LAD.

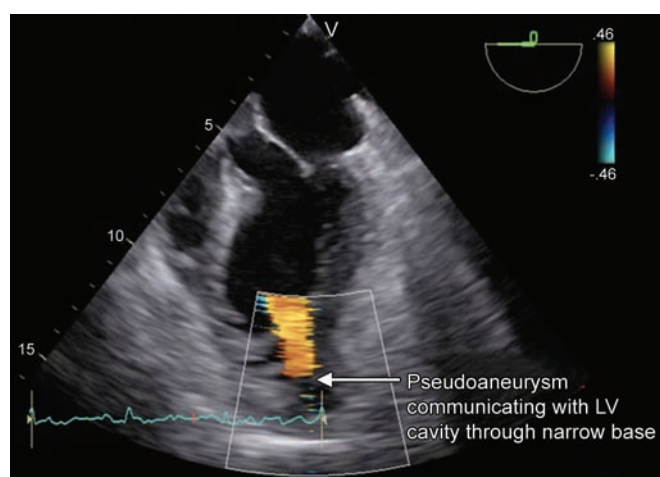
Femoral vessels were exposed and cannulated before sternotomy after adequate anticoagulation in order to establish extracorporeal circulation in case any untoward incident happens during sternotomy and pericardial dissection. After midline sternotomy, pericardium was opened carefully, leaving the apical adherent pericardium intact. The femoral cannulae were clamped. Cardiopulmonary bypass (CPB) was established using aortic and dual-stage venous cannulation. The pseudoaneurysm was dissected following cardiac arrest and excluded from left ventricular cavity (Figs 5 and 6) and the neck region was closed with pericardium. Thrombotic and necrotic tissue, present in the aneurysmal region, was excised. Grafting in the LAD region was abandoned because of poor target vessel. Aortic cross clamp was



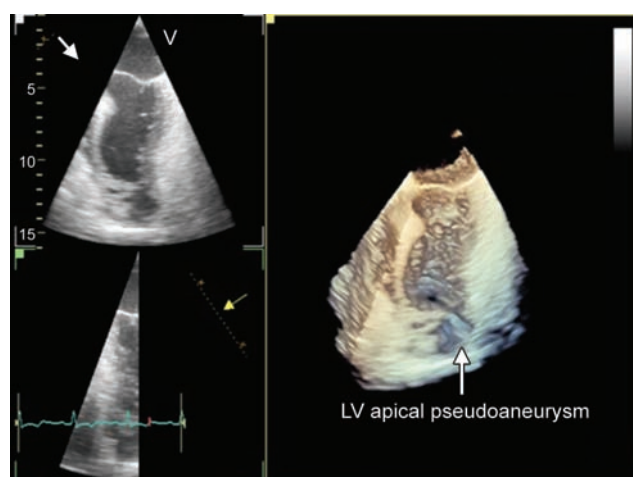
**Fig. 1:** Mid-esophageal four-chamber view showing left ventricular apical pseudoaneurysm



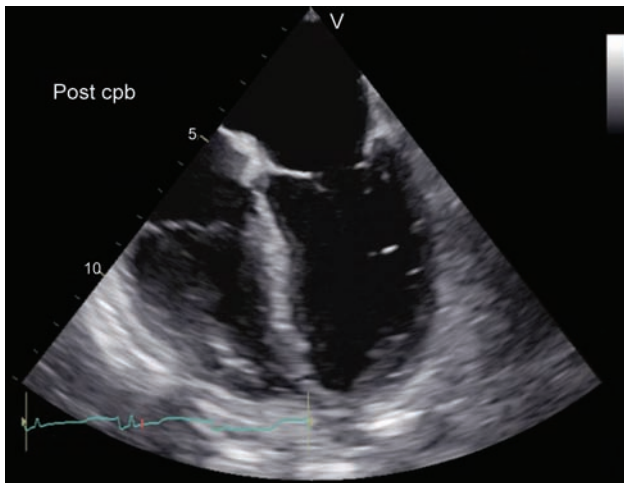
**Fig. 2:** Mid-esophageal two-chamber view showing left ventricular apical pseudoaneurysm



**Fig. 3:** Mid-esophageal four-chamber view with color Doppler showing communication of apical pseudoaneurysm with LV



**Fig. 4:** Three-dimensional image showing left ventricular apical pseudoaneurysm

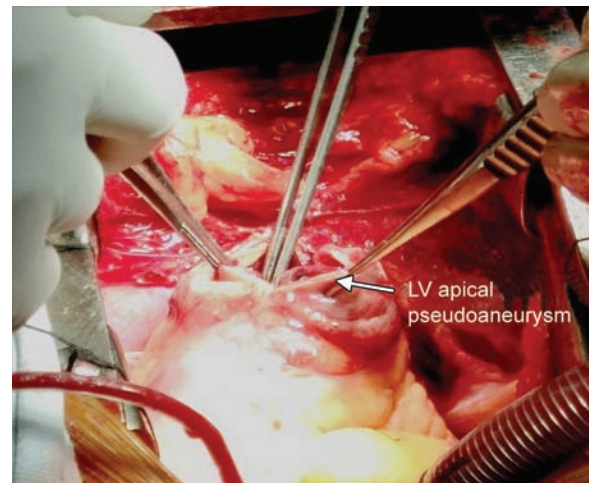


**Fig. 5:** Mid-esophageal four-chamber view after surgical repair of left ventricular apical pseudoaneurysm

removed after 48 minutes. The patient was successfully weaned off from CPB using milrinone (loading dose of 50 µg/kg on CPB followed by infusion at the rate of 0.3 µg/kg/min). Post-CPB TEE revealed an LVEF of 50% and trivial mitral regurgitation with adequate repair of aneurysmal area. The improved LVEF may be attributed to inotropic use and exclusion of necrotic area. The RWMA persisted in the LAD region in post-CPB period. Patient was shifted to surgical intensive care unit and extubated after 5 hours of mechanical ventilation. Postoperative pain was controlled with morphine infusion. After uneventful postoperative period, patient was shifted to ward on postoperative day 3 and discharged from hospital on postoperative day 5.

## DISCUSSION

Left ventricular apical pseudoaneurysm contained by pericardium is a rare complication following acute myocardial infarction. The pseudoaneurysm following transmural infarction has high mortality of up to 20%.<sup>8</sup> Other etiologies for pseudoaneurysm include cardiac surgery, trauma, and infection.<sup>9,10</sup> Pseudoaneurysm is usually associated with pericarditis which results in visceral and parietal pericardial adhesion, thus preventing development of hemopericardium and resultant cardiac tamponade. The pseudoaneurysmal wall contains dense fibrous tissue that lacks myocardial fibers and coronary vessels and has a narrow communication between the aneurysmal and ventricular cavity. A true aneurysm, in contrast, results in focal convex deformation of the heart, has wide communication between the aneurysmal and ventricular cavity, contains myocardial fibers, and is lined by the endothelium.<sup>11</sup> In our case, LV was communicating with pseudoaneurysm via a narrow neck formed by the ruptured apical myocardium as visualized in TEE.



**Fig. 6:** Surgical repair of left ventricular apical pseudoaneurysm

Clinical presentation of pseudoaneurysm widely varies, which ranges from asymptomatic to sudden cardiac death, which signifies the necessity of rapid and prompt intervention soon after diagnosis is made. Untreated pseudoaneurysm can cause arrhythmias, embolism, congestive cardiac failure, and even sudden death due to massive hemopericardium and cardiac tamponade.<sup>9,12</sup>

Elderly patients, female sex, 6th decade of life, preexisting systemic hypertension, absence of previous episode of angina pectoris or infarction, symptoms of pericarditis, ST-T wave changes, peak values of creatine kinase-MB fraction more than 150 IU/L, absence of a mural thrombus, absence of collateral vessels in the area of infarction, and therapy in the form of thrombolysis given more than 7 hours after the onset of chest pain are the risk factors for free wall rupture.<sup>13</sup> Our patient was in his 6th decade of life, smoker, hypertensive, and had absent flow in LAD with no collateral vessels. Hence, our patient had high risk for developing an aneurysm rupture.

Multimodal cardiac imaging is necessary in accurate and definitive delineation of pseudoaneurysm, which helps in perioperative management. In our case, TTE is able to identify the LV aneurysmal region, but distinguishing true aneurysm from pseudoaneurysm warrants detailed assessment. Poor window associated with obesity, chronic obstructive pulmonary disease, smoker, and suboptimal positioning cause difficulty in assessing the pseudoaneurysm, especially in the apical region with TTE.<sup>14</sup> Although left ventricular apex lies near to the field of TTE window, TEE clarified the diagnosis in our case due to poor TTE window, as our patient was a smoker and obese. Furthermore, TEE helped in clearly delineating the exact location of the pseudoaneurysm and communication of the pseudoaneurysm with left ventricular cavity in the perioperative period to guide the surgeon, which was not clearly visualized in

TTE. Use of high-frequency transducer than TTE and focused imaging on the region of interest in TEE helps in locating the mural thrombus, which is common in pseudoaneurysm of the LV. Examination with TEE further clarifies the function of LV, involvement of mitral valves, and associated ventricular septal rupture and its location. Atherosclerotic plaques in the aorta is common in coronary artery disease patients, in which TEE is far more superior to TTE in identifying the exact location of atheroma, thus guiding the surgeon in aortic cannulation. Real-time monitoring by TEE throughout surgery helps in assessing cardiac function and maintaining hemodynamic stability during manipulation of heart. The 3D TEE technology further improves the visualization of pseudoaneurysm by delineating the dimensions, location, and communication with LV cavity. The 3D echocardiography is more useful in its presurgical assessment and for estimating diastolic volume evaluation of pseudoaneurysm in left ventricle.<sup>15</sup> The TEE is also superior to TTE in identifying the thrombus within the pseudoaneurysm, and thus helps in avoiding excessive manipulation of heart during pre-CPB period.<sup>5</sup>

Intraoperative epicardial echocardiography with high-frequency probe provides optimal window for anterior structures like aorta, aortic valve, pulmonary valve, and pulmonary arteries.<sup>16</sup> However, difficulty in obtaining two-chamber view for assessing left ventricular apical region and interruption of surgery for epicardial echocardiography are the major limitations in consistently using this technique in left ventricular pseudoaneurysm surgery.

Cardiac MRI, a noninvasive modality, is a valuable tool which provides valuable details of the pseudoaneurysm with its 3D technology, which aids in the surgical management. Lack of real-time assessment with cardiac MRI during intraoperative period limits its role in perioperative set-up, which makes TEE more reliable and helpful.<sup>17</sup> The most accurate diagnostic method of diagnosing left ventricular pseudoaneurysm is left ventriculography. The major limitation of this technique is its invasive nature and use of contrast agents.<sup>9</sup>

Optimal management of pseudoaneurysm remains controversial because of wide spectrum of clinical presentations. Emergency surgery is required in patients with cardiogenic shock. Patients with stable hemodynamic need a planned but urgent surgery.<sup>18,19</sup>

## CONCLUSION

Transesophageal echocardiography remains a valuable diagnostic modality in diagnosing and distinguishing pseudoaneurysm from true aneurysm, especially in the perioperative period. The ability in assessing ventricular

function, identifying valvular pathologies and thrombus during intraoperative period makes TEE an indispensable tool in perioperative management of pseudoaneurysm surgery.

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