True or False? A case of Left Ventricular Aneurysm with Review of Diagnostic Modalities

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Abstract

The preoperative differentiation of left ventricular aneurysm from pseudoaneurysm is a diagnostic challenge. This distinction is critical as the timing of surgical correction varies; elective for true aneurysm versus urgent for pseudoaneurysm. Our aim is to present a case report demonstrating these difficulties and to review imaging characteristics and the approach to distinguish the two entities.

Introduction

Free wall rupture of left ventricle contained by the pericardium, results in formation of a left ventricular (LV) pseudoaneurysm.[1] A true LV aneurysm, in contrast, is discrete thinning (<5mm) and resultant outpouching of the ventricular wall with wall motion abnormalities.[2, 3]Contrary to the benign course of an LV aneurysm, the natural course of a pseudoaneurysm is rupture leading to cardiac tamponade, shock, and death. Therefore, a pseudoaneurysm warrants an emergent surgery as compared to an elective surgical repair for LV aneurysm.[4, 5] Differentiating the two conditions preoperatively, despite the use of various cardiac imaging modalities, remains a challenge.[6]

Case presentation

A 44-year-old man with no known medical conditions presented with acute, painless, left monocular blurred vision. There was no history of smoking or illicit drug use. Physical examination indicated blood pressure of 200/135 mmHg, heart rate 86/min and unremarkable cardiopulmonary exam. Funduscopic examination showed left macular edema and left infratemporal hemorrhage consistent with branched retinal vein occlusion. Labs showed elevated Troponin I. Electrocardiogram showed pathologic Q-waves in inferolateral leads. Chest X-ray displayed a retro-cardiac opacity (Figure 1).

The patient was managed appropriately for hypertensive emergency. Transthoracic echocardiogram (TTE) showed an ejection fraction of 25-30% with dyskinesis and outpouching of basal inferior and basal-mid inferolateral wall concerning for possible pseudoaneurysm and thrombus (Figure 2). Cardiac magnetic resonance imaging (MRI) done for further diagnostic clarity, was remarkable for a pseudoaneurysm with a 4 cm neck and chronic thrombus (Figure 3). Cardiothoracic surgery was consulted for urgent resection of the pseudoaneurysm. As part of pre-operative planning, coronary angiography with left ventriculogram was done, which showed two-vessel disease (60% stenosis of proximal left anterior descending artery and 100% stenosis of distal right coronary artery) with collaterals and LV outpouching equivocal for pseudo vs true aneurysm (Figure 4). Neck of the aneurysm was not visualized.

Patient was scheduled for surgical resection of pseudoaneurysm. A large (10 x 15 mm) pericardial cystic sac was found just above the main pulmonary artery. It was resected at the neck. A 5 x 5 cm LV aneurysmal sac was located in the inferolateral wall, distal to the second obtuse marginal artery. The aneurysmal orifice at the neck was about 3 x 4 cm. The aneurysmal wall was very thin but not ruptured and was opened longitudinally to remove an organized thrombus. This was followed by aneurysmal sac repair and mitral valve replacement due to proximity of the aneurysmal neck to the posteromedial papillary muscle as well as the atrioventricular grove. Based on the intraoperative findings, the postoperative diagnosis was true LV aneurysm.

The patient had an uneventful post-surgical course, and was successfully discharged on goal-directed medical therapy for ischemic heart disease. He is functionally active and follows up with his primary cardiologist.

DISCUSSION

The differentiation of true versus pseudo aneurysm cannot be made on clinical grounds. Clinical symptoms, physical examination findings, electrocardiograms, and routine chest X-ray are neither sensitive nor specific for diagnosing left ventricular aneurysm, and cannot help distinguish true LV aneurysm from pseudoaneurysm. Advanced cardiac imaging modalities like TTE, cardiac MRI and angiography provide valuable clue but do not provide definite diagnosis in certain cases, as seen in our patient. Characteristics that favor each diagnosis are summarized below.

Two-dimensional echocardiography

It is the most common modality to diagnose LV aneurysms; however, the distinction between pseudoaneurysm and true LV aneurysm proves challenging with TTE. The echocardiographic characteristics most suggestive of pseudoaneurysm include a sharp discontinuity of the endocardial border at the base of the pseudoaneurysm, a saccular or globular contour of the aneurysm, and a narrow orifice compared with the aneurysm fundus diameter (represented by Omax/Dmax ratio). A ratio of 0.5 or less favors pseudoaneurysms, while a ratio between 0.9 and 1.0 is seen in true aneurysms.[7-10] However, this criterion lacks specificity.[11] Color flow Doppler has been used to detect turbulent flow through the neck of the pseudoaneurysm, but the absence of such flow does not confirm a true aneurysm, making this finding specific but not sensitive.

Cardiac MRI

It has emerged as a promising noninvasive method to differentiate LV pseudoaneurysm versus true aneurysm, to localize the aneurysm, and to distinguish among pericardium, thrombus, and myocardium in the aneurysm wall.[12] The detection of epicardial fat adjacent to an aneurysm cavity on MRI images virtually excludes pseudoaneurysm.[13] Delayed enhancement imaging can detect associated infarct as well as myocardial elements in the aneurysm wall indicative to true aneurysm. In contrast, the sac of a pseudoaneurysm that is devoid of myocardium does not enhance. More recently, delayed enhancement of the adjacent pericardium has been proposed as a useful finding to diagnose pseudoaneurysms with a sensitivity of 100% and specificity of 83.3% in one case series.[14] Interestingly, the case series also showed significantly higher left ventricular end-diastolic volume in patients with a pseudoaneurysm than in those with a true aneurysm.[14]

Coronary angiography with contrast ventriculography

Left ventriculography has been the gold standard modality to distinguish pseudoaneurysm from true LV aneurysm with a diagnostic accuracy of 85%.[11] The most useful combination of findings to confirm pseudoaneurysm includes a narrow orifice leading into a saccular aneurysm.[2, 15, 16] Moreover, contrary to a true LV aneurysm, the paraventricular cavity of a pseudoaneurysm lacks coronary arteries in its walls due to a disruption in myocardium.[15]

Radionuclide imaging

First pass radionuclide angiocardiography findings suggestive of a pseudoaneurysm include delayed filling with systolic blood expansion dyskinesis followed by prolonged retention of radioactivity in the pseudoaneurysm sac.[17-20] Whereas, a true LV aneurysm fills and empties simultaneously with LV. Equilibrium radionuclide ventriculography (technetium- 99m gated blood pool scanning) is also a noninvasive method that provides high accuracy in the diagnosis of LV aneurysm. Blood pool activity through the "bottle neck" of a pseudoaneurysm should exclude a true aneurysm.[21]Thallium-201 scintigraphy is also highly accurate for the detection of LV aneurysm. Using single-photon emission computed tomography (SPECT), thallium-201 imaging and the criterion of failure of convergence of LV walls toward the apex, Morton et al. reported a sensitivity and specificity of 94% and 97%, respectively.[22]Moreover, delayed redistribution thallium-201 scanning may help identify patients in whom ischemia may be responsible, at least in part, for LV aneurysm formation.

CONCLUSION

The distinction between true and pseudo-LV aneurysm is diagnostically challenging. Both types of aneurysms can cause nonspecific symptoms but most often are incidentally noted on cardiac imaging ordered for other purposes. When identified, it is important to distinguish accurately between a pseudoaneurysm and true aneurysm given the differing natural history and therapeutic strategies. Echocardiography, left ventriculography, contrast-enhanced cardiac MRI and radionuclide imaging all provide useful information (Table 1) but are not definitive for preoperative diagnosis. Surgical exploration and pathologic assessment are occasionally necessary to make a definitive diagnosis.

Figure 1. Chest X-ray showing a retro-cardiac opacity

*Image

Figure2. Transthoracic echocardiogram (parasternal long axis view) with color Doppler showing flow through the neck of the aneurysmal cavity (arrowhead)

*Image

Figure 3. Cardiac MRI showing outpouching of posterior left ventricular wall

*Image

Figure 4. Left heart catherization views of coronaries (A, B) and left ventricle (C)

*Image

A , Left anterior oblique view for right coronary artery;**B** , Right anterior oblique cranial view; **C** , left ventriculogram showing extravasation of the contrast in the aneurysmal cavity (arrowhead)

Table 1. Differences between Left ventricle Aneurysm and Pseudoaneurysm

Imaging Modalities	True LV aneurysm	LV Pseudoaneurysm
Two-dimensional Echocardiography	Wide orifice Omax/Dmax ratio between 0.9 and 1.0.	Narrow orifice Saccular or globular contour of the aneurysm Sharp discontinuity of the endocardial border at the base Omax/Dmax ratio of 0.5 or less More likely to have turbulent flow through the neck on color flow doppler
Cardiac MRI	Epicardial fat adjacent to the aneurysm cavity Delayed enhancement imaging can show infarct as well as myocardial elements in the aneurysm wall Delayed enhancement of adjacent pericardium is exceedingly rare	Absence of epicardial fat adjacent to aneurysm cavity Devoid of myocardium Delayed enhancement of the adjacent pericardium Higher left ventricular end-diastolic volume than in true aneurysm.

Imaging Modalities	True LV aneurysm	LV Pseudoaneurysm
Coronary Angiography with Contrast Ventriculography	Coronary arteries can be appreciated in the walls Wide orifice of aneurysmal sac	Lacks coronary arteries in its walls due to a disruption in myocardium Narrow orifice leading into a saccular aneurysm
Radionuclide Imaging	Fills and empties simultaneously with LV	Delayed filling with systolic blood expansion dyskinesis followed by prolonged retention of radioactivity in the pseudoaneurysm sac. Failure of convergence of LV walls toward the apex Blood pool activity through 'bottle neck' of the sac

LV , Left ventricle; **Omax** , Maximal internal diameter of opening; **Dmax** , Maximal parallel internal diameter;**MRI** , Magnetic resonance imaging

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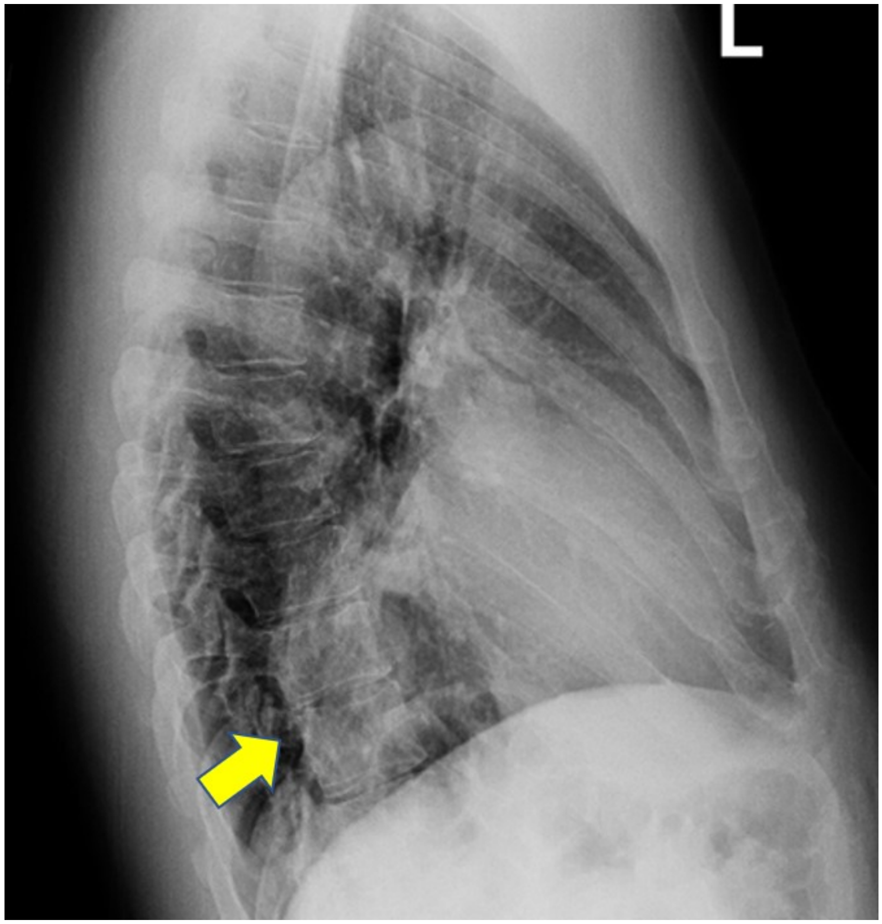
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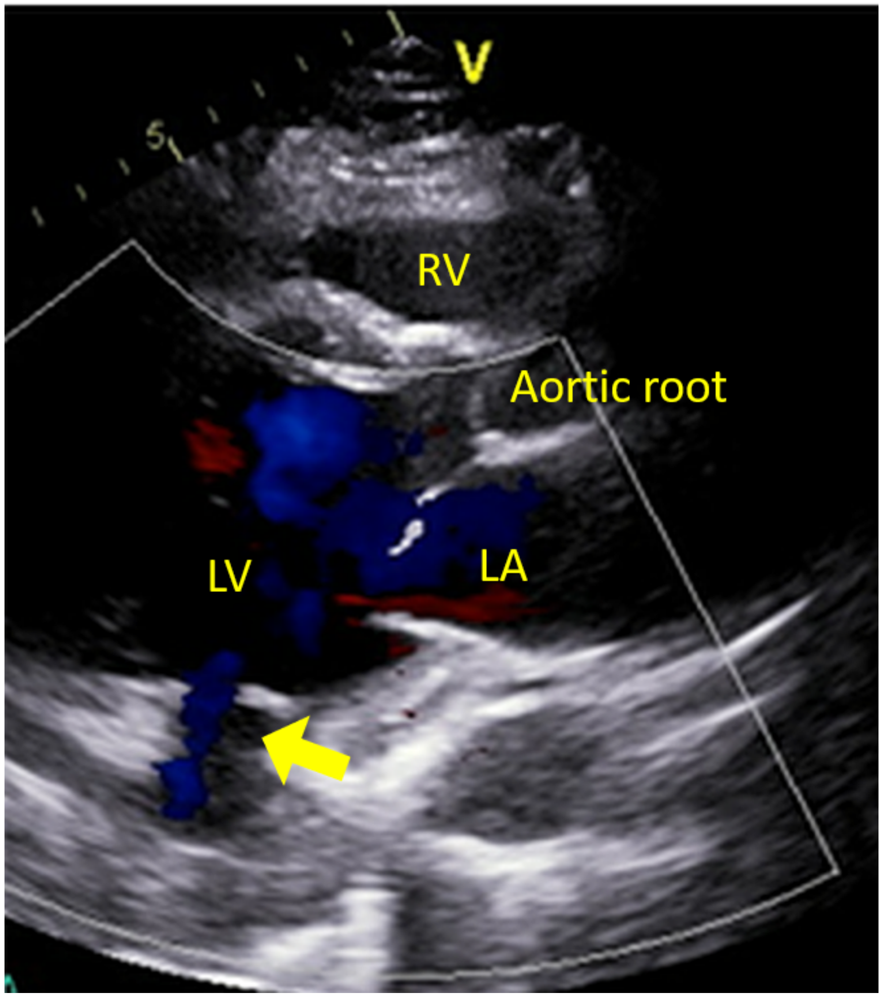

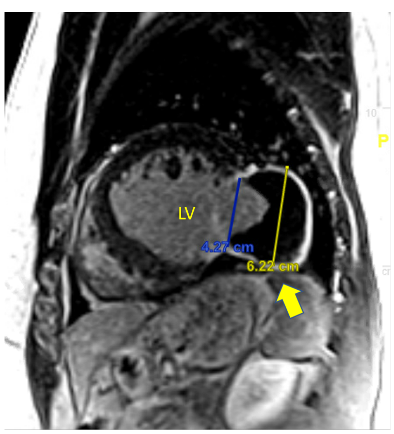

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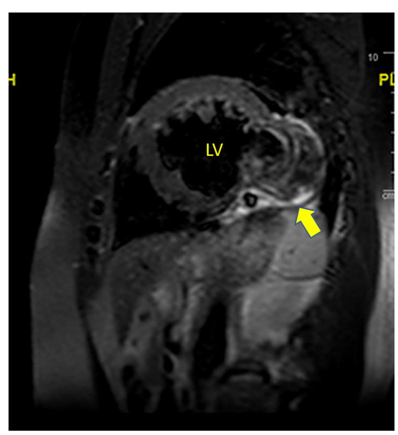

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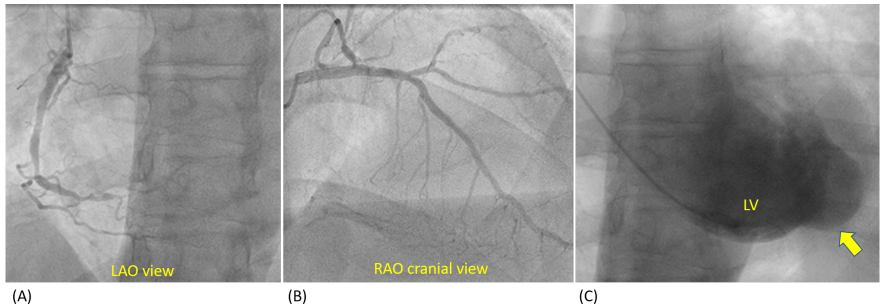
LAO view
RAO cranial view
LV
(A)
(B)
(C)