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Left Ventricular Pseudoaneurysm as a Complication of Myocardial Infarction; A Case Series and Review of the Literature

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Abstract

Introduction: Pseudoaneurysm may occur as a rare complication of myocardial infarction (MI) when a hemorrhagic process is covered by adherence of the visceral or parietal pericardium or of both, preventing the formation of cardiac tamponade. Pseudoaneurysm is prone to rupture because they are not easy to diagnose.

Case presentation: Here, we report three cases of left ventricular pseudo-aneurysm (LVP) that all were related to MI. Two patients were managed conservatively, one of them was lost to follow-up, and the other one expired one month later. One patient underwent surgery, but he expired during post-operation period.

Conclusions: High mortality rate of LVP emphasizes the importance of looking for it in cardiac evaluation of patients with history of MI. Due to available non-invasive modalities, the ability to differentiate LVP from other cardiac pathologies is improving. Still, the most recommended management of LVP is early surgery.

Key words: Case Reports; False Aneurysm; Myocardial Infarction; Post-Infarction Heart Rupture

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Introduction

Left ventricular pseudoaneurysm (LVP) is defined as a ventricular wall rupture covered by the pericardium layer. It is a rare but catastrophic complication of myocardial infarction (MI) occurring in approximately 4% of patients (1, 2). In contrast to true aneurysm, LVP does not contain all cardiac layers (including the myocardium), which leads to a greater risk of rupture than true aneurysm, so may needs early surgical intervention (3). However, differentiation between these entities is not always straight forward. It is likely that, appropriate employment of diagnostic modalities and correct diagnosis, and also proper management is still challenging (3, 4). In this paper, we are going to present three patients who presented with LVP after MI. Required consent was obtained from patients' first-degree relatives to generate this presentation.

Case presentation

Case 1

A 48-year-old man from a welfare center was admitted to the emergency department (ED) following syncope after acute onset of epigastric and retrosternal pain radiating to back associated with dyspnea. His past medical history was significant for an uncontrolled hypertension (HTN) and ischemic heart disease (IHD). He had undergone a percutaneous coronary intervention (PCI) on the proximal part of the right coronary artery last year. He was a 50 pack-year smoker and an opium-addicted individual. On physical examination (P/E), he was conscious and had a blood pressure of 95/55 mmHg. Cardiac auscultation revealed mid-systolic murmur and S4 gallop. The other findings of P/E were unremarkable. Transthoracic echocardiography (TTE) showed a pseudoaneurysm of posterior left ventricular (LV) wall and LV ejection fraction of 25%. For further evaluation, cardiac magnetic resonance imaging (CMRI) was done and confirmed the presence of an LVP with a large neck (44 mm) (Figures 1A-C). Despite strong recommendation, he refused surgical intervention and left the hospital against medical advice. Unfortunately, he was lost to follow-up.

Case 2

A 61-year-old man with a history of MI, diabetes mellitus (DM), HTN, and cerebrovascular accident (CVA) was referred to our clinic for pre-operation

Figure 1: Cardiac magnetic resonance imaging views of the case 1 revealed left ventricular pseudoaneurysm (67×71 mm) which is extended from basal to mid inferoseptal, and inferior left ventricular segments (A); A mural and semi-organized clot (31×66 mm) in left ventricular pseudoaneurysm (B). Gadolinium enhancement of the entire border of left ventricular pseudoaneurysm and transmural fibrosis in late gadolinium enhancement imaging (C)

consultation of surgical amputation of his diabetic foot. He was suffering from dyspnea (functional class III) but did not report chest pain. His cardiac P/E revealed prominent apical impulse and a decrescendo grade 3/6 systolic murmur at apex and left sternal border. TTE revealed a cystic lesion at posterior LV wall measured 35×20 mm with an orifice of 30 mm, and to- and-fro flow on Doppler mode, all of them suggesting pseudoaneurysm as the most probable diagnosis (Figure 2A, B). Moreover, it was fistulated to the posterior wall of left atrium (LA). Due to the high-risk profile of patient, he refused to undergo surgical correction of LVP and also amputation. Therefore, he was managed conservatively and expired one month later due to sepsis.

Case 3

A 28-year-old male patient presented to our hospital with positional chest pain and shortness of breath without any significant past medical history except for usage of hormonal drugs. Initial evaluations revealed high troponin and D-dimer levels, and increased cardiothoracic ratio on the chest x-ray (CXR) (Figure 3A). Therefore, the

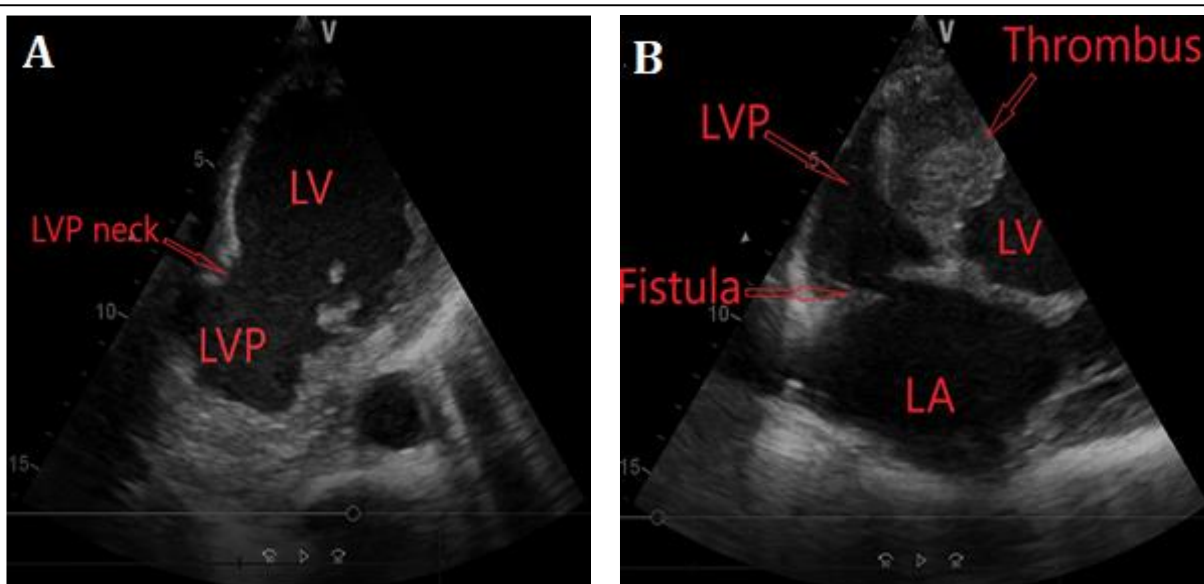

Figure 2: Echocardiography of the case 2 revealed pseudoaneurysm of posterior wall of left ventricle (A); Thrombus in left ventricular pseudoaneurysm, and fistula between left ventricular pseudoaneurysm and left atrium (B).

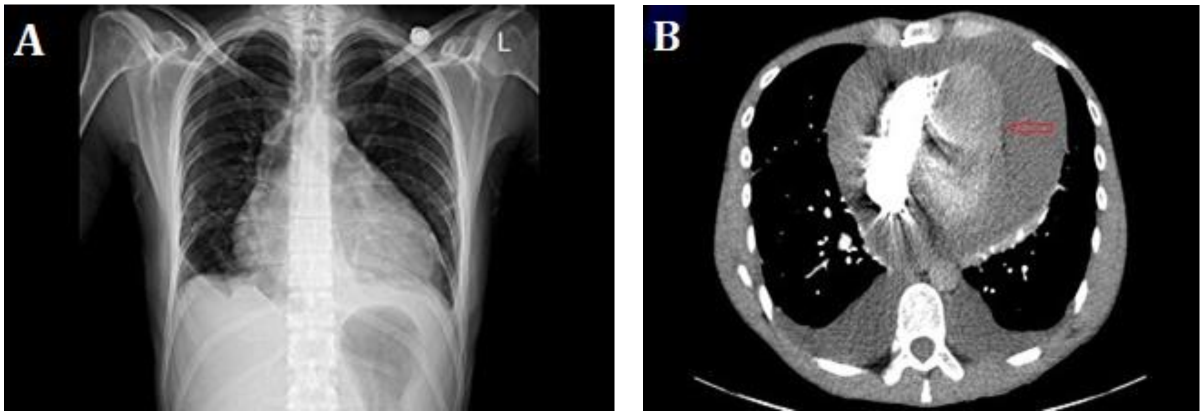

Figure 3: Anteroposterior plain chest x-ray of the case 3 (A); Axial view of contrast enhanced chest CT scan of the case 3

patient was admitted to cardiac care unit (CCU) with the initial diagnosis of myopericarditis and tamponade. TTE revealed mildly enlarged and distorted LV, and a small LV free wall perforation according to the findings on the Doppler mode, which was matched to the regional wall motion abnormality (RWMA), suggesting post-MI rupture and LVP. Furthermore, massive hyperechoic and non-homogeneous pericardial effusion, right ventricular collapse, and massive hypoechoic pleural effusion were reported on the chest computed tomography (CT) scan (Figure 3B). Consequently, he was prepared for emergent surgery with stable vital signs as soon as angiography confirmed MI, mid posterior perforation and pseudoaneurysm. In surgery, pericardial effusion was drained and the perforation was covered by pericardial patch. Although the surgery was successful, he died during the post-operation period.

Discussion

LVP is an aneurysmal cavity through ventricular free wall contained by thin (less than 5 mm) akinetic or dyskinetic adherent pericardium. It is connected to LV chamber through a narrow neck, whose diameter is less than 50% of the maximum diameter of the internal cavity. Female sex, age over 60, first MI experience, and severe single vessel coronary artery disease are risk factors for LVP formation (5). The prevalent etiologies of LVP include MI, cardiac surgery, trauma, infection and inferior MI as the most common cause (high occurrence within 48 hours or 2 weeks after acute MI). The most common location of LVP is on the posterior wall (43%), which is in line with the higher share of inferior MI in etiologies of LVP. On the other hand, true aneurysms are more commonly located on the anterior wall. The possible explanation for this observation may be the fact that anterior wall ruptures are more prone to tamponade, shock, and death; while ruptures in posterior wall would be contained by adherence of the pericardium (3, 6).

Up to 10% of LVP cases are asymptomatic, manifestations among other cases vary and include chest pain, dyspnea, arrhythmia, signs of congestive heart failure, embolism, and hypotension. LVP can also present with atypical symptoms such as cough and altered mental status that make the diagnosis more challenging. Sheikh WR et al. showed that new to-and-fro murmur is detected in 70% of patients in physical examination. In most cases, electrocardiography (ECG) showed non-specific changes in patients with LVP or only showed the ST-T changes due to acute MI. CXR revealed cardiomegaly or a mass appearance in the majority of cases, which is helpful (6).

Given that the signs and symptoms of LVP are neither specific nor sensitive enough, cardiac imaging modalities may play a remarkable role in its timely diagnosis. Table 1 presents the diagnostic modalities in terms of LVP diagnosis. Initial noninvasive evaluation using 2-dimensional TTE may help to find the LVP by detecting a to-and-fro Doppler flow and discontinuation of myocardium. Moreover, assessment of ejection fraction, RWMA, valvular functions, and other helpful indices should be done.

TEE provides better views of inferior LV wall and improves the accuracy of LVP diagnosis. This modality confers a very good overview of the anatomy of the LVP, which will be precious for pre-operation planning.

CMRI enables distinguishing of LVP from true aneurysm without radiation exposure with a sensitivity of 100% and a specificity of 83%. Moreover, CMRI is useful for diagnosing small LVPs, where the sensitivity of TTE is reduced.

Table 1: Findings of various modalities in terms of left ventricular pseudo-aneurysm diagnosis

ECG	Non-specific findings except for ST-T changes of acute MI
CXR	Cardiomegaly, a defined mass of ventricle wall
TTE (2D, 3D, Doppler)	To-and-fro Doppler flow, myocardium absence
TEE	Provides better view of inferior wall of LV
CMRI	No radiation, 100% sensitivity and 83% specificity, appropriate for small LVP
CCT	With radiation, defines anatomical and functional structure of heart
Angiography	Invasive, recommended as the best diagnostic modality

ECG: electrocardiography; CXR: chest X-ray; TTE: transthoracic echocardiography; TEE: tranesophageal echocardiography; CMRI: cardiac magnetic resonance imaging (CMRI); CCT: cardiac computed tomography; MI: myocardial infarction; LV: left ventricle.

Table 2: Treatment options of left ventricular pseudo-aneurysm

Surgical	**ST** recommended
	STL higher probability for re-rupture in hospital; has limitations in massive active bleeding
PTC	Depends on expert's skill Contraindications: 1. Left atrial thrombus **2** unpleasant heart anatomy **3**. active endocarditis
Conservative	Higher mortality rate than surgical management LVP size less than 3 cm Considered in surgical high-risk patients

ST: suture-based; STL: suture-less; PTC: percutaneous trans-catheter closure

Although these features make CMRI the best imaging modality for our purpose, its limited availability and high cost are major drawbacks. Another non-invasive modality, cardiac CT scan, provides high quality visualization of the LV anatomical and functional structures such as coronary arteries and bypass grafts through radiation and using intravenous dye contrast. Cardiac CT scan and CMRI obviate the requirement of invasive coronary angiography (CAG) (6, 7). CAG has been traditionally recommended as the best available modality for diagnosing LVP. A saccular aneurysm with narrow neck and lack of surrounding coronary arteries is a typical finding of LVP on CAG. CAG and subsequent PCI is beneficial in terms of morbidity and mortality due to acute MI, as it lowers the risk of LVP and rupture occurrence compared with thrombolytic or pharmacological treatment (8).

Studies reported risk of LVP rupture to be 30% to 45% with mortality rate of 50% for conservative managements and 23% for surgical managements. Therefore, current evidence suggests early surgical repair rather than conservative managements as the treatment of choice. On the contrary, true aneurysm includes pericardium, myocardium and endocardium layers with broad neck and smooth margins, which lead to a lower risk of rupture and death. Hence, conservative therapy can be considered. Distinguishing these two entities is of paramount importance for treatment selection and prognostic implications (3, 9, 10). Table 2 Treatment options of LVP. Whenever the diagnosis of LVP is established, the benefit of the emergent surgery of high-risk patients outweighs the risk of surgery. Risk factors of rupture have not been clearly specified but potential predictors include large size, posterolateral location, and poor collateral arteries (9). Due to the unknown timing of LVP formation after MI, most of them have been diagnosed incidentally, like our reported cases, and have similar risk of rupture (11).

Alapati et al. suggested that although patients with chronic LVP smaller than 3 cm or patients with high risk of surgery can be managed conservatively, it is not preferred over surgery unless indicated otherwise (4). Notably, surgery reduced the mortality rate to 25% compared to 48% for conservative therapy (10). Matteucci et al. categorized surgical treatments of LVP into suture-based technique and sutureless technique. Accordingly, the majority of procedures applied sutures whereas only about one quarter of patients undergo sutureless procedures. Different kinds of available patches are Dacron, Teflon, and pericardium, which can be used by suture-based technique or with biological glues or synthetic cyanoacrylate monomers. Lower efficacy in the presence of active bleeding and higher risk of in-hospital re-rupture are limitations of suture-less technique in comparison with suture-based technique; nonetheless, in-hospital mortality rates were similar in both approaches (12).

Some studies showed successful percutaneous transcatheter closure (PTC) of LV wall rupture. It was done with coils and vascular plug or septal occlusion devices through transfemoral artery or vein or via trans septal or trans apical access, which may be considered in high-risk patients instead of surgery. Left atrial thrombus, unpleasent heart

anatomy, and active endocarditis are contraindications of PTC and complications are the same as other common cardiac procedures such as bleeding, hematoma, and arrhythmia (13-15). Since the PTC is a new alternative procedure and there is limited experience with it, future studies are warranted for confirming its long-term efficacy. Recent studies suggest serial follow-up echocardiography after LVP treatment via surgery or PTC approaches (16).
Patients who undergo conservative therapy and refuse to undergo surgery and interventional procedures should receive heart failure and hypertension treatments for decreasing the wall stress and anticoagulants for preventing thrombus risk (17).

Conclusions

LVP is a rare complication of MI but has a high mortality risk, which emphasizes the importance of looking for it in cardiac evaluation of patients with positive MI history. Due to available non-invasive modalities, the ability to differentiate LVP from other cardiac pathologies is improving. Still, the most recommended management of LVP is early suture-based technique surgery. However, suture-less technique surgery or PTC can also be used in special conditions.

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Authors' contribution

HA, AZN and SKS were involved in the conception or design of the work, investigation, and critically revised the manuscript. AA, ZK, and NZ collected data and drafted the manuscript. All gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

Conflict of interest

None declared.

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