The fifth heart chamber: Massive thrombotic left ventricular pseudoaneurysm followed by successful ventricular aneurysmectomy

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Abstract

Left ventricular pseudoaneurysm is a type of rare and lethal mechanical complication derived from rupture of the ventricular free wall but enclosed by the adherent pericardium or scar tissue. We present a rare case of a massive pseudoaneurysm with a large thrombotic burden. Echocardiography had a pivot role on early diagnosis of the pseudoaneurysm allowing for appropriate downstream diagnostic testing. Cardiac magnetic resonance confirmed a large pseudoaneurysm. Furthermore, late gadolinium enhancement imaging demonstrated large thrombotic burden within the pseudoaneurysm. Due to eminent risk of rupture and danger of an embolic event our patient underwent a successful ventricular aneurysectomy. The defect was closed with a 5cm patch of bovine pericardium. An echocardiogram day 6 post-op showed an intact patch repair with no residual pseudoaneurysm.

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A 65-year-old woman was admitted to our hospital with intermittent chest pain for 72 hours. Her medical history included percutaneous coronary intervention (PCI) to the right coronary artery (RCA), hypercholesterolemia, hypertension and a strong family history of myocardial infarction (MI)**.** Coronary angiogram showed an occluded left circumflex artery and severe ostial RCA stenosis. Two drug-eluting stents were placed, and good results were achieved with no procedural complications. We performed a pre-discharge echocardiogram**(Fig 1)** that showed moderate left ventricular (LV) impairment with no other significant abnormalities. The patient was then discharged under the care of her General Practitioner.

Subsequently, 3 weeks later, she was re-admitted with pulmonary oedema. Repeat PCI showed unobstructed coronary arteries. Nevertheless, transthoracic echocardiography revealed a huge echo-free space behind the posterior/infero-posterior LV wall, suggesting a pseudoaneurysm**(Fig 2)** . Importantly, this finding was not present on the pre-discharge echocardiogram 3 weeks before. Further imaging was performed for better anatomic delineation and possible surgical planning. Cardiac Magnetic Resonance (cMRI) confirmed a massive pseudoaneurysm extending from the basal to mid inferior and infero-lateral LV wall, measuring a maximum of 85 mm x 70 mm x 60 mm and communicating with the left ventricle via a 35 mm x 30 mm orifice, likely complicating an infero-lateral MI (**Fig 3**). Additionally, in the early phase after gadolinium injection there was a laminar thrombus within the superior and inferior aspects of the wall of the pseudoaneurysm **(Fig 4**).

Due to the significant risk of systemic embolization, pseudoaneurysm rupture and consequent cardiac tamponade, our patient was referred for consideration of surgical management. After careful review, our surgeons performed an urgent left ventricular aneurysmectomy. The pseudoaneurysm was opened and a large clot was evacuated (**Fig 5)** . The defect, which was located on the infero-lateral wall of the LV, was closed with a 5 cm patch of bovine pericardium to avoid potential distortion of the heart structures or excessive traction

on the edges of the defect (**Fig 6**). The patient recovered uneventfully. An echocardiogram day 6 post-op showed an intact patch repair with no residual pseudoaneurysm **(Fig 7**).

Discussion

Left ventricular pseudoaneurysm is a well-known sequela of MI, and over the years, many cases have been described in the medical literature[1-4]. Nevertheless, to our knowledge, this is the first case reporting a successful LV aneurysmectomy on a massive thrombotic LV pseudoaneurysm.

The example presented here is fascinating. Our patient was discharged post-MI and, in 3 weeks, developed a huge, life-threating LV pseudoaneurysm. This reinforces the fact that the diagnosis of mechanical complications post-MI, such as LV pseudoaneurysms, can be difficult. Patients often are either asymptomatic or present with non-specific symptoms attributable to other causes. In a series of 52 patients with pseudoaneurysms, 48% were diagnosed incidentally[5].

LV pseudoaneurysm is a type of rare and lethal mechanical complication derived from rupture of the ventricular free wall but enclosed by the adherent pericardium or scar tissue. A tear of the myocardial wall is seen in 4% of patients diagnosed with an MI[6]. However, pseudoaneurysm develops in only 0.2% of patients diagnosed with an MI[6]. They carry a substantial risk of rupture, which is considerably higher than that of a true aneurysm. Therefore, an urgent management is of prime importance in these patients. Although new diagnostic techniques help diagnose pseudoaneurysms early, the risk of rupture and consequent tamponade is still up to 30% to 45%[7]. In the presence of thrombus, they can be the source of emboli to vital organs, such as the brain and lungs[6].

In a recent systemic review, the most frequent cause of cardiac pseudoaneurysm is transmural MI (55%)[4]. Transmural infarcts cause pericarditis and pericardial thickening due to fibrosis, which can contain the leak. Other causes include cardiac surgery (33%), infection or trauma (7%). Most common symptoms of patients presented with pseudoaneurysm are chest pain and dyspnea. Sudden cardiac arrest, congestive cardiac failure, acute MI, syncope, tamponade, and embolism were other notable clinical presentations[1-4,8-10].

Diagnosis of LV pseudoaneurysm depends on finding the discontinuity of the cavity surrounding the myocardium through imaging or interventional methods. Echocardiography proves to be a very valuable modality in this differential diagnosis because of its wide availability and routine use during the initial assessment of patients with signs and symptoms, such as chest pain, murmur and heart failure. The echocardiographic features typical of pseudoaneurysms include a sharp discontinuity of the endocardial image at the site of communication of the pseudoaneurysm with the LV cavity and an orifice that is relatively narrow in comparison with the diameter of the pseudoaneurysm[11]. A neck smaller than the aneurysmal cavity is strongly suggestive of a pseudoaneurysm, especially in cases in which colour Doppler shows a "to and fro" flow at the neck (**Fig 8**).

Thrombus formation within the LV pseudoaneurysm is poorly documented in the literature. From our findings, transthoracic echocardiography demonstrates a very low sensitivity in detection of intra-pseudoaneurysm thrombus. This may be attributed to the geometric challenges and relatively poor spatial resolution when imaging the LV pseudoaneurysm with standard echocardiography. Cardiac MRI using long TI late gadolinium enhancement (LGE) imaging is currently considered the gold standard for detection of intra-cardiac thrombus[10]. It has been demonstrated to be superior to echocardiography for the detection of small and mural thrombi, which are often adherent to LV aneurysms and pseudoaneurysms[10]. Thrombi can organize over time with gradual replacement by fibrin and collagen. However, in our case, we saw thrombus formation within the pseudoaneurysm in the space of 3 weeks. One prior study reported that an organized thrombus within the pseudoaneurysm can show inhomogeneous LGE[9]. Nevertheless, this study was performed with a pulse sequence with poor temporal and spatial resolution and limited T1-weighting as compared with current LGE imaging. A more recent study reporting a giant LV pseudoaneurysm with a large thrombus burden offered rare insights into the natural history of intra-cardiac thrombus[12]. The relatively increased LGE signal in the "oldest" portion farthest from the neck, consistent with contrast uptake, was suggestive of relative organization of this portion of the thrombus. The "signal gradient" between the

"freshest – closest to the pseudoaneurysm neck" and the "oldest – farthest from the neck" portions of the thrombus demonstrated the gradual transition between unorganized and organized thrombus [12].

Our case highlights two main learning points: i) Mechanical complications post-MI, such as LV pseudoaneurysm, can develop very rapidly. On the case presented today, 3 weeks was enough time to develop a life-threatening complication. Echocardiography was vital to quickly evaluate and diagnose LV pseudoaneurysm, allowing for appropriate further downstream diagnostic testing; ii) Thrombus formation within the LV pseudoaneurysm is poorly documented in the literature, and standard echocardiography demonstrates very poor sensitivity in its detection. This may be attributed to the geometric challenges and relatively poor spatial resolution when imaging the LV pseudoaneurysm with standard echocardiography. The use of a contrast agent could significantly improve the diagnostic accuracy of detecting thrombus within the pseudoaneurysm.

In summary, we believe our patient was fortunate enough to have received a fresh lease on life. Early diagnosis and prompt treatment are paramount as they will determine how far this lease will extend, and echocardiography played a vital role in this process.

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Fig 1 : Echocardiogram pre-discharge – three chamber view. Red arrows show no evidence of pseudoaneurysm within the infero-lateral wall.

Fig 2 : Re-admission echo four chamber (left) and three chamber (right) views demonstrating a large pseudoaneurysm behind the posterior/infero-posterior LV wall. It communicates with the LV via a 36mm orifice i.e. neck of the pseudoaneurysm. **LV** – Left Ventricle; **RV** – Right Ventricle; **LA** – Left Atrium;**RA** – Right Atrium; **Ao** – Aorta; **PSA** – Pseudoaneurysm; **Dotted line** – Depicts pseudoaneurysm neck.

Fig 3 : Cardiac MRI images confirming a massive pseudoaneurysm extending from the basal to mid inferior and infero-lateral LV wall, measuring around 85mm x 70mm x 60mm. **LV** – Left Ventricle;**LA** – Left Atrium; **PSA** – Pseudoaneurysm

Fig 4: Late gadolinium enhancement MRI. Arrows demonstrate high thrombotic burden within the superior and inferior aspects of the pseudoaneurysm wall. **LV** – Left Ventricle; **LA** – Left Atrium; **PSA** – Pseudoaneurysm

Fig 5 : Large thrombus evacuated within the pseudoaneurysm – red arrows.

Fig 6: Pseudoaneurysm defect, located within the infero-lateral LV wall, was closed with a 5cm patch of bovine pericardium.

Fig 7 : Six days post left ventricular aneurysmectomy. Arrows show an intact patch repair.

Fig 8 : Colour Doppler shows a "to and fro" flow at the neck of the pseudoaneurysm