

# Management of left ventricular pseudoaneurysm: A single-institution case series

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## ABSTRACT

**Introduction:** Left ventricular (LV) pseudoaneurysms are a rare and challenging clinical problem. Defined as a contained rupture of the left ventricular wall and most commonly caused by myocardial infarction (MI), patients generally present with chest pain, congestive heart failure, or dyspnea. **Diagnosis** is usually achieved through use of either echocardiography or angiography. **Management** is generally operative. **Case Series:** We sought to examine our experience in the management of LV pseudoaneurysms with the goal of describing the diverse presentation of this disease, along with our individualized management. We report a retrospective case series of four patients who presented to our center with LV pseudoaneurysm, all of which were managed operatively. All four patients underwent successful repair with 100% short-term survival. **Conclusion:** Early diagnosis and an individualized operative approach is critical in the management of left ventricular pseudoaneurysm.

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## INTRODUCTION

Left ventricular (LV) pseudoaneurysm is a rare phenomenon that occurs when rupture of the LV wall is contained by scar tissue or adherent pericardium and is most commonly caused by myocardial infarction, complications of cardiac surgery, or trauma [1–3]. Although its presentation can be highly variable, patients generally present with signs and symptoms of worsening heart failure, such as chest pain and/or dyspnea, and, occasionally, stroke [2]. It is most commonly diagnosed by transthoracic echocardiography (TTE), although angiography and cross-sectional imaging are also effective means of diagnosis. We present a case series of four patients with LV pseudoaneurysm, each of whom underwent operative repair.

## CASE SERIES

Our institutional database was queried for all cases of left ventricular aneurysm and pseudoaneurysm since

2000. This retrospective review protocol was approved by our institutional IRB, which waived the need for individual patient consent. Inpatient and outpatient records were reviewed and relevant preoperative, intraoperative, and postoperative data were collected. Four patients who underwent operation for LV pseudoaneurysm were identified. All were treated at our institution between March 2006 and April 2010. Their preoperative characteristics are summarized in Table 1.

### Case 1

A healthy 69-year-old male was presented to an outside facility complaining of vomiting, diarrhea, and shortness of breath. He was subsequently diagnosed with a ST-elevation myocardial infarction (STEMI) and a transthoracic echocardiography (TTE) revealed a mass suggestive of a cardiac tumor. Repeat echocardiography revealed an extrinsic mass compressing the right ventricle and coronary angiogram demonstrated a large left ventricular pseudoaneurysm, along with complete occlusion of the proximal posterior descending coronary artery.

The patient was taken emergently to the operating room due to worsening cardiogenic shock. Emergent cardiopulmonary bypass (CPB) was initiated via the left groin and, following sternotomy, intra-operative findings included a 6x4 cm defect of the inferoposterior portion of the left ventricular wall with adherent clot, which correlated with the mass seen on echo preoperatively. The clot was evacuated and adherent pericardium freed, with an underlay-type patch repair, using a series of 2–0 Tevdek mattress sutures passed sequentially through semicircular Teflon strips, the LV wall, and a Hemashield (Maquet, Rastatt, Germany) patch. This repair was buttressed with a running 4-0 prolene stitch passed serially through all layers of the repair, followed by application of BioGlue (CryoLife, Inc., Atlanta, GA).

The patient was weaned from CPB and his hemodynamics improved significantly following repair. The remainder of his hospital course was unremarkable and he discharged home on postoperative day-9 and is alive approximately 10 years postoperatively.

### Case 2

A 66-year-old male with a remote history of three-vessel coronary artery bypass grafting (CABG), and subsequent development of ischemic cardiomyopathy. Additionally, his medical history included stage IV rectal cancer with hepatic and pulmonary metastases. This patient underwent coronary angioplasty with placement of bare-metal stents four days prior to presenting with acute onset of chest pain with dizziness, weakness, and syncope. Workup revealed EKG changes consistent with STEMI, but a repeat cardiac catheterization was unchanged compared to his prior study following stent placement. Transthoracic echocardiography revealed

Table 1: Patient demographics (n = 4)

<b>Age, years</b>	61.25±8.5
<b>Sex</b>	
Male	3
Female	1
<b>Risk factors</b>	
Preoperative anticoagulation	1
Current smoker	3
Prior cardiac surgery	1
History of myocardial infarction	2
<b>Clinical presentation</b>	
Myocardial infarction	3
Significant coronary lesion(s)	4
Cardiogenic shock	1

Values reported as mean ± standard deviation, where appropriate.

apical akinesis and a transmural rupture of the left ventricular apex communicating with a contained 3 cm pericardial collection, thought to be a left ventricular pseudoaneurysm. The patient, a Jehovah's witness, refused blood transfusion and had recently received clopidogrel following his initial cardiac catheterization. Because of these factors, along with the concern for the bleeding risk associated with redo sternotomy the decision was made to delay surgery for 48 hours, with interval medical management including strict blood pressure control.

A repeat TTE the following day demonstrated interval expansion of the pseudoaneurysm, prompting emergent operation despite the risk of intra-operative bleeding. In the operating room, CPB via peripheral cannulation was initiated and a left anterolateral thoracotomy was made. A 6-cm focus of lobulated hemopericardium was noted and the site of LV wall rupture was confirmed with transesophageal echocardiography (TEE), which demonstrated a rupture of the LV apex. Pledged 2-0 prolene sutures were used to tack the pericardium to the LV wall proximal to the defect, isolating the ruptured segment and eliminating its potential for cardiac tamponade postoperatively. Finally, a sandwich-type repair of the LV rupture was performed using interrupted #1 prolene to approximate the septal and lateral LV wall edges between two PTFE felt strips. The patient was weaned from CPB, and the repair was reinforced with BioGlue and FloSeal (Baxter, Deerfield, IL). A dose of recombinant factor VIIa (FVIIa) was given to aid hemostasis. The chest was closed and he was taken to the intensive care unit on minimal inotropic support.

The remainder of his postoperative course was unremarkable, notable only for a nadir hemoglobin of 7.1 mg/dL, which was managed with iron supplementation

and erythropoietin injections. He discharged home on the ninth postoperative day in good condition and survived 15 months postoperatively.

### Case 3

A 47-year-old male with a history of developmental delay, obesity, and untreated hypertension who developed new-onset shortness of breath four days prior to presentation. He was initially diagnosed with congestive heart failure, but TTE revealed an 8x8 cm pseudoaneurysm involving the inferior and inferolateral walls of the left ventricle; total akinesis of the inferior LV wall was also noted. Coronary angiography demonstrated total occlusion of the second obtuse marginal branch of the circumflex coronary artery, along with a high-grade stenosis of the right main coronary artery.

The patient was taken emergently to the operating room and following sternotomy, a large amount of pericarditis was noted. Cardiopulmonary bypass via bicaval cannulation was initiated following a difficult dissection of the great vessels. The pseudoaneurysm, which was located on the lateral aspect of the LV, was 8 cm in greatest dimension as shown on TTE, and following debridement and evacuation of associated clot, left a defect 7x4 cm in size. A 1 mm thick composite mesh patch was cut to size and secured in an underlay-type configuration with several interrupted pledgeted 2-0 Ethibond sutures. The edges of the repair were then buttressed with bovine pericardium and a single running circumferential 4-0 prolene suture. The heart was filled and the repair was hemostatic. CoSeal (Baxter, Deerfield, IL) were applied. After completion of the repair, a single reversed saphenous vein graft to the distal right main coronary artery was also performed without issue. At the conclusion of the procedure, the patient required platelets, plasma, cryoprecipitate, and FVIIa to obtain adequate hemostasis. He transferred to the intensive care unit and discharged on the tenth postoperative day. He is alive and well nearly seven years postoperatively.

### Case 4

A 63-year-old female with history of hypertension, peripheral vascular disease, and multiple prior myocardial infarctions, the first of which was six years prior to presentation, and required placement of two drug-eluting stents in her distal right coronary artery. She presented to the emergency department complaining of chest pain, shortness of breath, and generalized fatigue. Electrocardiogram did not demonstrate acute ischemic changes but TTE revealed LVEF of 20% with mild to moderate mitral regurgitation and a 4x6 cm pseudoaneurysm of the posterior LV wall with associated mural thrombus. Coronary angiogram revealed in-stent total occlusion of her right coronary artery and severe stenosis of the left anterior descending (LAD) artery. Cardiac MRI was also obtained to assess myocardial

viability; this demonstrated viable myocardium in the anterior and lateral LV walls and the known pseudoaneurysm on the posterior lateral aspect of the LV.

In the operating room, sternotomy was performed, CPB was initiated via central cannulation, and moderate adhesions within the pericardium were taken down. A single reversed saphenous vein graft was anastomosed to a diagonal branch of the right coronary artery. A thin-walled pseudoaneurysm sac, 5x4 cm, was found, the center of which was contained only by pericardial adhesions. This sac, along with associated thrombus, was debrided to viable-appearing myocardium, creating a defect 5x6 cm in size. Eighteen pledgeted interrupted 2-0 braided polyester sutures were placed circumferentially inside-out around the neck of the pseudoaneurysm, which were then used to secure a Hemashield patch in an onlay fashion. The edges of the pseudoaneurysm were then imbricated between two strips of PTFE felt, secured by multiple interrupted 2-0 polypropylene sutures in a horizontal mattress fashion. BioGlue was then applied to the PTFE strips with good hemostasis noted. Following this, a left internal mammary artery to LAD graft, as well as a single proximal anastomosis for the right-sided graft was performed. The patient was weaned from cardiopulmonary bypass without issues and transfusion was not required. She transferred to the intensive care unit and discharged home on the sixth postoperative day. She is alive and well over six years postoperatively.

## DISCUSSION

Left ventricular pseudoaneurysm is an exceedingly rare phenomenon. Imaging is critical in diagnosis because of its protean clinical presentation. This is achieved most commonly with transthoracic or transesophageal echocardiography, but cardiac MRI is useful because of its ability to differentiate between LV aneurysm and pseudoaneurysm and to provide precise morphologic definition of the abnormality in question. Cardiac computed tomography scan and direct left ventriculography are also able to diagnose LV pseudoaneurysm, but both involve patient radiation exposure and ventriculography carries the risk thrombus dislodgement or other disruption of the pseudoaneurysm cavity [1]. Identification mandates emergent repair due to the high associated risk of free LV rupture [4, 5]. Most commonly consists of patch closure, using either felt or autologous or xenogeneic pericardium, although primary repair is sometimes successful [1, 4].

Atik et al. reported a series of 30 cases of LV pseudoaneurysm following acute MI, 27% of them were New York Heart Association (NYHA) Class IV. All underwent repair via median sternotomy and CPB; peripheral cannulation was used in four of these cases. Seventeen percent of patients underwent reinforced primary repair and the remainder underwent either bovine or autologous pericardial or synthetic patch

repair. Seventy percent of patients underwent at least one concomitant procedure, the most common being coronary artery bypass grafting and mitral valve repair/replacement. The most common complications in this cohort were in-hospital death (20%), re-exploration for bleeding (20%), prolonged need for mechanical ventilation (27%), and need for postoperative intra-aortic balloon pump support (23%) [4].

Review of 290 cases of LV pseudoaneurysm by Frances et al. demonstrated the most common causes of post-surgical LV pseudoaneurysm included mitral and aortic valve procedures and LV aneurysm repair [2]. Trezzi et al. reported a single case of LV pseudoaneurysm caused by complications of periventricular ventricular septal defect closure device and subsequent open repair [6]. Repair of a recurrent LV pseudoaneurysm following an initial failed repair has also been described [7].

In our series all LV pseudoaneurysms were due to acute or subacute myocardial infarction and all underwent repair within 48 hours of diagnosis, summarized in Table 2. Repair in the single patient who had undergone previous cardiac surgery was performed via left anterolateral thoracotomy; median sternotomy was otherwise the approach of choice. The repair technique was individualized to patient pathology, with three patients receiving a patch underlay-type repair and the fourth a buttressed primary repair. Transfusion was required for hemostasis in two cases.

Table 2: Intraoperative variables (n = 4)

<b>Cannulation site</b>	
Central	2
Peripheral	2
<b>Operative approach</b>	
Sternotomy	3
Left thoracotomy	1
<b>Repair type</b>	
Patch	3
Primary	1
<b>Other</b>	
Transfusion	2
Concurrent CABG	2
Concurrent valve intervention	0
CPB time, minutes	161.25±62.3
Aortic cross-clamp time, minutes	144.33±30.73
Estimated blood loss, mL	825±303.11

Values reported as mean ± Standard deviation, where appropriate.  
 CABG Coronary artery bypass grafting, CPB Cardiopulmonary bypass

## CONCLUSION

Left ventricular pseudoaneurysms are a complex problem that generally presents in patients with acute myocardial infarction or following cardiac surgery, frequently with superimposed medical comorbidities. Successful repair can be achieved with the appropriate resources, but the operative approach must be individualized to minimize bleeding and the potential for complications in this delicate cohort.

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## Author Contributions

John R. Spratt – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Christopher T. Holley – Substantial contributions to conception and design, Acquisition of data, Revising it critically for important intellectual content, Final approval of the version to be published

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## Guarantor

The corresponding author is the guarantor of submission.

## Conflict of Interest

Authors declare no conflict of interest.

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