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Surgical treatment of post-infarction left ventricular pseudoaneurysm: Case series highlighting various surgical strategies

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HIGHLIGHTS

- Objective: Our experience with post-infarction left ventricular pseudoaneurysms (LVP) and surgical techniques in 13 patients.
- Various techniques: 1) direct pledgeted sutures; 2) single patch; 3) double-patch; 4) pericardial patch through the left atrium.
- Hospital mortality 4 (30.7%). Literature review: 306 patients with LVP undergoing surgery with 21.2% (65 deaths) mortality.
- In conclusion, this study revealed that surgical repair of LVP was associated with an acceptable surgical mortality rate.
- Cardiac rupture did not occur. Various techniques are available and should be considered according to the case presentation.

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ABSTRACT

Introduction and objective: The left ventricular pseudoaneurysm (LVP) is rare, the surgical experience is limited and its surgical treatment remains still a challenge with an elevated mortality. Herein, it is presented a retrospective analysis of our experience with acquired post infarct LVP over a10-year period.
Materials and methods: Between January 2006 through August 2016, a total of 13 patients underwent operation for post infarct pseudoaneurysm of the left ventricle. There were 10 men and 3 women and the mean age was 61 ± 7.6 years. 4 patients presented acute LVP. Two patients had preoperative intraortic balloon pump implantation.
Results: Various surgical techniques were used to obliterate the pseudoaneurysm such as direct pledgeted sutures buttressed by polytetrafluoroethylene felt, a Gore-Tex or Dacron patch, transatrial closure of LVP neck in submitral pseudoaneurysm, or linear closure in cases presenting associated postinfarct ventricular septal defect. Concomitant coronary artery bypasses were performed for significant stenoses in 12 patients, ventricular septal defect closure in 4 patients, mitral valve replacement in 3 and aortic valve replacement in 1 patient. Operative mortality was 30.8% (4 patients). Three of them were acute LVP. Three patients required the continuous hemodyalisis and 8 patients required intra-aortic balloon pump. At follow-up two deaths occurred at 1 and 3 years after surgery.
Conclusion: In conclusion, this study revealed that surgical repair of post infarct left ventricular pseudoaneurysm was associated with an acceptable surgical mortality rate, that cardiac rupture did not occur in surgically treated patients.

1. Introduction

Acquired pseudoaneurysm of the left ventricle is a rare disorder that usually occurs after transmural myocardial infarction or after cardiac surgery [1–3]. Myocardial infarction is the most common cause of false aneurysms of the left ventricle, followed by cardiac surgery, trauma [6], and infection [7]. Rupture of the free wall of the left ventricle due to myocardial infarction occurs in almost 4% of patients with infarcts and in 23% of those dying to myocardial infarction [4,5]. Acute pseudoaneurysms, a variant of myocardial rupture, are extremely unstable and bound to fatal rupture. Chronic pseudoaneurysms are usually detected because of symptoms, less

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often incidentally [1,3]. Pseudoaneurysms develop when cardiac rupture is contained by pericardial adhesions.

Pseudoaneurysms of the left ventricle have a strong tendency to rupture, leading to death if it is left surgically untreated. In particular, asymptomatic pseudoaneurysms that occur a few days after acute myocardial infarction are extremely unstable and tend to rupture [8]. The left ventricular pseudoaneurysms may be associated with other mechanical complications of the myocardial infarction such as ischemic mitral valve regurgitation [9] or interventricular septal defect [10]. The purpose of this article is to present a retrospective analysis of our surgical experience with post-infarction pseudoaneurysms.

2. Materials and methods

During the period from January 2006 through August 2016, a total of 13 consecutive patients underwent operation for pseudoaneurysm of the left ventricle in our universitary institutions. They were evaluated retrospectively. All patients with post infarction free-wall rupture and left ventricular true aneurysms were excluded from the study.

The study has been registered in Research registry under the number researchregistry2246 under the accordance of the declaration of Helsinki. Also the work has been reported in line with the PROCESS [11].

There were 10 men and 3 women and the mean age was 61 ± 7.6years. All of the left ventricular pseudoaneurysms were discovered after transmural myocardial infarction. The diameters of the pseudoaneurysms were calculated by using transthoracic echocardiography in all patients. The mean maximum diameter of the pseudoaneurysms was 4.2 ± 0.7 cm. They were categorized as acute when discovered within 2 weeks of myocardial infarction and as chronic when discovered more than 2 weeks after the event. In the chronic forms, the mean interval between myocardial infarction and diagnosis was 6.2 ± 3.3months. In acute forms, the mean interval between myocardial infarction and diagnosis was 4.8 ± 3.3days and immediate surgery was undertaken upon diagnosis was made. Two patients had preoperative intraortic balloon pump implantation. Preoperative clinical features of the patients are presented in Tables 1 and 3.

Table 1
Preoperative characteristics of patients with left ventricular pseudoaneurysm.

Variables	Nr/%
Mean age (years)	61 ± 7.6
Male	10 (77%)
Mean NYHA functional class	3.1 ± 1.2
Left main trunk	5 (38.5%)
Mean LVEF (%)	37.7 ± 8.5
Mitral regurgitation grade	2.2 ± 1.3
LVEDD (mm)	68 ± 24
LVESD (mm)	44.5 ± 19
Preoperative PAP	49 ± 18
Mean maximal diameter of the LVP(cm)	4.2 ± 0.7
Acute pseudoaneurysm	4 (30.8%)
Diabetes mellitus	8 (61.5%)
Hypertension	10 (77%)
Smoking	11 (85%)
COPD	9 (69%)
Peripheral vascular disease	2 (15.4%)
CVD	1 (7.7%)
Preoperative IABP	2 (15.4%)
Chronic renal failure	1 (7.7%)

Legend: NYHA-New York Heart Association, LVEF-Left Ventricular Ejection Fraction, LVEDD-Left Ventricular End-Diastolic Diameter, LVESD-Left Ventricular End-Systolic Diameter, Papa-Pulmonary Artery Pressure, LVP-Left Ventricular Pseudoaneurysm, COPD-Chronic Obstructive Pulmonary Disease, CVD-Cerebrovascular Disease, IABP-Intra Aortic Ballon Pump.

2.1. Diagnostic testing

Diagnostic investigation of ventricular pseudoaneurysm included contrast ventriculography in 10 patients (77%), transesophageal echocardiography in 9 (69%), transthoracic echocardiography in 13 (100%). On cross-sectional echocardiography the diagnosis was aided by a sharp discontinuity of the endocardium at the site where the pseudoaneurysm communicated with the left ventricle. On contrast ventriculography, a paraventricular mass with a narrow neck was typically seen. However in three patients, the ventriculography demonstrated left ventricular aneurysm (Fig. 1A) as in our first patient (Table 3). The transthoracic echocardiography revealed the presence of a left ventricular pseudoaneurysm (Fig. 1B) with the respective schematic presentation (Fig. 1C), which was diagnosed intraoperatively as a chronic left ventricular pseudoaneurysm with almost total absence of the posterior wall of the left ventricle (Fig. 3A).

2.2. Surgical techniques

All patients underwent midline sternotomy and cardiopulmonary bypass. Five patients underwent emergent operation because of signs of cardiovascular collapse or imminent cardiac rupture (cardiac tamponade). Cardiopulmonary bypass was instituted through the femoral vessels in 4 of them. Complete dissection of the heart was performed after cross-clamping the aorta, in an effort to avoid systemic embolization. In all other patients, ascending aorta and double venous or double-stage venous cannulation in patients undergoing interventricular septal defect or mitral valve replacement was performed. Antegrade cold blood cardioplegia was delivered after the aorta was clamped. With the anatomy identified, especially location and extent of the myocardial infarction, the decision about surgical technique was made. The dissection was initially limited to the anterior surface of the heart. Complete dissection of the heart and repair of the pseudoaneurysm was performed after cross-clamping the aorta. Ventricular fibrillation was electrically induced during repair of the pseudoaneurysm. The heart was then gently mobilized from pericardium and loose adhesions were taken down. In 4 patients the pseudoaneurysm was opened incidentally during the dissection. The bleeding site was identified and controlled by finger compression.

Various techniques were used to obliterate the pseudoaneurysm.

Surgical procedure 1. In 4 patients whose defect had a small neck with densely fibrotic edges, primary repair was performed using pledgeted sutures buttressed by polytetrafluoroethylene (PTFE) felt (Fig. 2).

*Surgical procedure 2.*In 3 patients with a defect located close to the basal part of the left ventricle, the ventricular defect was closed with a patch of Gore-Tex (W.L. Gore and Associates, Flagstaff, AZ,®) to avoid potential distortion of the heart structures or excessive traction on the edges of the defect (Fig. 3). The capsule of the pseudoaneurysm was not resected but rather was used as a second layer over the patch for reinforcing the reconstructed ventricular wall and for hemostasis. The same technique consisting in patch closure of the left ventricular pseudoaneurysm without associated linear closure but only supported with Bioglue was employed in another patient (Fig. 4).

Surgical procedure 3. In 2 other patients with severe mitral valve regurgitation, the neck of the pseudoaneurysm was closed through the left atrium using a patch of autologous pericardium (Fig. 5).

Surgical procedure 4. In another patient with post infarct interventricular septal defect and left ventricular pseudoaneurysm (Fig. 6A and B), a double patch Dacron (Terumo, Somerset, NJ,®) was employed to close the left ventricular pseudoaneurysm internally and externally the left ventricle (Fig. 7).