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Surgical Treatment of Postinfarction Left Ventricular Pseudoaneurysms

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ABSTRACT

Objective. Left ventricular pseudoaneurysm is a rare but serious complication of acute myocardial infarction. It is under debate whether surgical intervention is mandatory in asymptomatic patients. The aim of this report was to present our experience based on surgical treatment and midterm outcomes of patients with postinfarction left ventricular pseudoaneurysm.

Methods. Eight consecutive patients who underwent left ventricular pseudoaneurysm operation between January 1, 1995, and January 1, 2006, were included in the study. There were 5 male and 3 female patients. Mean age was 62.87 ± 5.03 years. All patients had echocardiography and coronary angiography before the operation. Two anterior and 6 posterior pseudoaneurysms were detected. Left ventricular pseudoaneurysm was repaired with a synthetic patch by the remodeling ventriculoplasty method of Dor in all patients. Coronary revascularization was performed if necessary. Preoperative, operative, and postoperative data were collected from the patient cohorts.

Results. The mean duration from myocardial infarction to diagnosis of the ventricular septal rupture was 13.5 ± 12 days. Additional coronary artery bypass surgery was performed with a median of 1.2 grafts in 5 patients (62.5%). The mean postoperative mechanic ventilator support time was 20.12 ± 29.22 hours. Overall 30-day mortality was 12.5% with 1 patient death. The mean intensive care unit stay was 3.75 ± 2.1 days. The late mortality rate was 12.5%. In the follow-up period (mean, 30.66 ± 16.86 months), of the 6 patients who were alive, 5 were in New York Heart Association class I or II and 1 was in class III because of pre-existing low left ventricular ejection fraction. Transthoracic echocardiography showed good left ventricular configurations without a false aneurysm together with increases in the ejection fractions.

Conclusion. Prompt diagnosis and early surgical intervention is essential for patients with large or expanding left ventricular pseudoaneurysms due to the high propensity of fatal rupture. Associated coronary artery bypass grafting may reduce early mortality of patients with left ventricular pseudoaneurysm by resuscitating the ischemic myocardium.

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INTRODUCTION

Left ventricular pseudoaneurysm is a rare but serious complication of transmural myocardial infarction (MI) [Hirasawa 2004]. It usually forms several weeks after the infarction on the inferior or posterolateral left ventricular wall when cardiac rupture is contained by adherent pericardium or scar tissue [Milojevic 2004]. But the treatment strategy of routinely indicated surgical repair in asymptomatic patients with left ventricular pseudoaneurysm is under debate. Considering the risk of secondary rupture or death, many authors advocated surgical intervention when left ventricular pseudoaneurysm was detected [Csapo 1997; Frances 1998; Pretre 2000]. However some authors reported that the long-term outcome of the left ventricular pseudoaneurysm appeared relatively benign, with a very low risk of fatal rupture [Moreno 2003]. The aim of this report was to evaluate our surgical results and midterm outcomes of the patients with left ventricular pseudoaneurysm.

METHODS

Patients

Eight patients with postinfarction left ventricular pseudoaneurysm who underwent operation in our clinic between January 1, 1995, and January 1, 2006, were reviewed. Clinical records were collected, including patients' demographics, clinical presentation, results of surgical repair, and results of the latest follow-up evaluation. The study was approved by the local ethics committee. There were 5 (62.5%) male and 3 (37.5%) female patients. The mean age was 62.45 ± 5.03 years, ranging from 56 to 72 years. Preoperative characteristics of the patients are provided in Tables 1 and 2.

Table 1. Preoperative Characteristics of Patients with Left Ventricular Pseudoaneurysm (N = 8)*

	No. of Patients	%
Sex		
Female	3	37.5
Male	5	62.5
Comorbid conditions		
Hypertension	4	50
Renal failure	1	12.5
Diabetes mellitus	3	37.5
COPD	2	25
Coronary artery diseases		
Single-vessel disease	4	50
Double-vessel disease	2	25
Triple-vessel disease	2	25
NYHA functional class		
II	2	25
III	3	37.5
IV	3	37.5

*COPD indicates chronic obstructive pulmonary disease; NYHA, New York Heart Association.

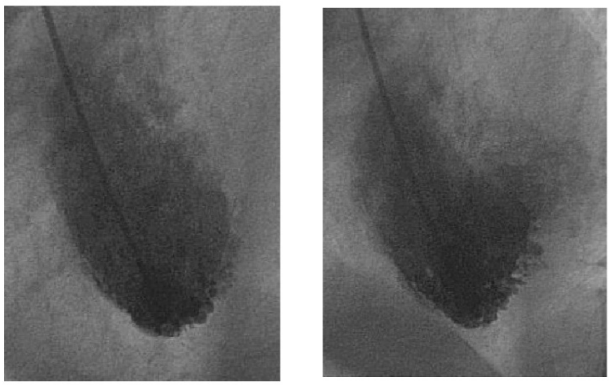
Diagnosis was established based on transthoracic echocardiography and cardiac catheterization (Figure). The mean time from MI to the diagnosis of left ventricular pseudoaneurysm was 13.5 ± 12.07 days, ranging from 3 to 40 days. Preoperative coronary angiography was performed for all patients; the results showed single-vessel disease in 4 patients, double-vessel disease in 2, and triple-vessel disease in 2. Coexisting pathologies were hypertension in 4 patients (50%), diabetes in 3 patients (37.5%), renal insufficiency in 1 patient (12.5%), and chronic obstructive pulmonary disease in 2 patients (25%). The majority of the patients were in sinus rhythm.

According to the New York Heart Association classification system, 2 patients (25%) were in class II, 3 in class III (37.5%), and 3 in class IV (32.5%). Three of the patients had inotropic support because of severe congestive heart failure.

The patients were followed-up at a mean of 30.66 ± 16.86 months, and echocardiographic evaluations of the left ventricular configurations and left ventricular ejection fractions (EF) were done.

Table 2. Preoperative and Operative Data of Patients with Left Ventricular Pseudoaneurysm (N = 8)

Mean age, y	62.87 ± 5.03
Mean preoperative left ventricular ejection fraction, %	31.87 ± 7.88
Mean postoperative left ventricular ejection fraction, %	35.83 ± 8.01
Mean time from myocardial infarction to diagnosis, d	13.5 ± 12.07
Mean time from diagnosis to operation, d	7.12 ± 3.55
Aortic cross clamp, min	63.5 ± 7.69
Total perfusion time, min	95.62 ± 13.56



Preoperative left ventriculography in the left anterior oblique projection showing a large left ventricular pseudoaneurysm.

Surgical Management

All patients were operated on under general anesthesia with endotracheal intubation. Surgical intervention was performed using median sternotomy and standard cardiopulmonary bypass techniques under moderate-degree hypothermia. Antegrade and continuous retrograde isothermic hyperkalemic blood cardioplegia was used for myocardial protection. Two anterior and 6 posterior pseudoaneurysms were detected. The aneurysmal sac was opened and the defect was repaired with a synthetic patch by the remodeling ventriculoplasty method of Dor in all patients. The ventricular wall was closed using 2 strips of teflon felt for reinforcement. Coronary revascularization was performed if necessary.

RESULTS

The mean time from diagnosis of the left ventricular pseudoaneurysm to surgery was 7.12 ± 3.55 days. Additional coronary artery bypass grafting (CABG) was performed with a median of 1.2 grafts in 5 patients (62.5%). Preoperative, operative, and postoperative data of the patients are presented in Table 2.

One of the 8 patients died within 30 days (hospital mortality rate, 12.5%). The cause of death was low cardiac output syndrome and multiorgan failure. Inotropic support in 7 patients (87.5%) and intra-aortic balloon pump support in 2 patients (25%) were needed in the postoperative period. Two patients (25%) needed temporary pacing. Postoperative

Table 3. Operative Complications*

	No. of Patients	%
Early death	1	12.5
Late death	1	12.5
Reoperation for bleeding	1	12.5
Pulmonary complication	2	25
IABP	2	25
Renal failure (hemodialysis)	1	12.5

*IABP indicates intra-aortic balloon counterpulsation.

Table 4. Clinical Details*

Patient	Age	Sex	Location of Pseudoaneurysm	Associated CABG	Early Mortality	Late Mortality	Preoperative LVEF, %	Postoperative LVEF, %
1	64	F	Anterior	No	No	No	25	25
2	56	M	Posterior	Yes	No	No	30	35
3	68	F	Posterior	Yes	No	No	45	50
4	65	M	Posterior	Yes	No	No	20	—
5	60	M	Posterior	No	Yes	No	40	40
6	58	F	Posterior	No	No	No	25	30
7	72	M	Anterior	Yes	No	Yes	35	—
8	60	M	Posterior	Yes	No	No	35	35

*CABG indicates coronary artery bypass graft; LVEF, left ventricular ejection fraction.

complications were revision for bleeding in 1 patient (12.5%), hemodialysis for acute renal failure in 1 patient (12.5%), and prolonged mechanical ventilator support in 2 patients (25%). Table 3 summarizes the perioperative complications.

The mean postoperative intubation time was 20.12 ± 29.22 hours, ranging from 6 to 97 hours. The mean intensive care unit stay was 3.75 ± 2.1 days, ranging from 2 to 8 days. The mean hospital stay was 8.5 ± 2.44 days, ranging from 6 to 14 days.

The patients were followed-up at a mean of 30.66 ± 16.86 months, ranging from 30 to 50 months. One patient who had preoperative chronic renal failure died in the late postoperative period (late mortality rate, 12.5%). Postoperative transthoracic echocardiography showed good left ventricular configuration without a false aneurysm together with increases in EF (Table 4). Of the 6 patients who were alive after surgical repair, 5 were in New York Heart Association class I or II, and 1 was in class III because of pre-existing low left ventricular EF.

DISCUSSION

Pseudoaneurysm of the left ventricle is a rare complication of MI and forms when cardiac rupture is contained by the adherent pericardium or scar tissue. Free intrapericardial rupture usually results in cardiac tamponade [Frances 1998]. Etiological factors besides MI are previous surgical intervention, trauma, or infection [Frances 1998; Yeo 1998]. It has been reported that left ventricular pseudoaneurysm generally occurs after MI due to occlusion of the circumflex artery [Frances 1998]. Pathologists reported that ventricular ruptures occur in stages and progress from endocardium to pericardium [Stevenson 1989]. An inflammatory reaction of the pericardium might result in pericardial adhesions and the formation of a left ventricular pseudoaneurysm [Brown 1997; Frances 1998; Yeo 1998]. If an adherent thrombus or pericardial adhesions contain bleeding, a few patients are able to survive [Pretre 2000]. Anterior myocardial rupture may be more likely to result in hemopericardium, tamponade, and death [Milojevic 2004].

The symptoms of left ventricular pseudoaneurysm are often unspecific, and the diagnosis is generally accidental [Frances 1998; Yeo 1998]. The presence of a neck narrower than the aneurysmal cavity detected by echocardiography and/or left ventriculography is suggestive of a pseudoaneurysm [Brown 1997]. The salient feature that distinguishes a pseudoaneurysm from a true aneurysm is the discontinuity of the myocardium in the aneurysmal wall [Brown 1997]. In contrast to left ventricular pseudoaneurysms, only about 4% of true left ventricular aneurysms are located on the posterolateral or inferior wall [Koçak 2003]. It has been suggested that a posterior localization was indicative of a pseudoaneurysm rather than a true aneurysm. In our series, 2 anterior and 6 posterior pseudoaneurysms were seen. The diagnosis was established by echocardiography and left ventriculography and confirmed by pathological examination of the resected aneurysmal wall.

Unlike true aneurysms, which have a resistant fibrotic wall, pseudoaneurysms initially consist of loose tissues and have an excessively high propensity for secondary rupture [Pretre 2000]; therefore, most clinicians recommend surgical repair as soon as possible when the diagnosis is established, irrespective of chronicity [Frances 1998; Yeo 1999; Pretre 2000]. But some investigators have advocated conservative management with good long-term results. Yeo and colleagues found that a large number of postinfarction pseudoaneurysms had a wide neck, and cardiac rupture was uncommon in patients who were treated conservatively [Yeo 1999]. In another study, Moreno and colleagues found that the outcome of 10 conservatively treated patients with left ventricular pseudoaneurysm was relatively good, with a mortality rate of 26% and an incidence of cardiac death of 11% at 4 years [Moreno 2003]. Asymptomatic small pseudoaneurysms (<3 cm in diameter) have a more stable course, and the patients with small pseudoaneurysms are candidates for conservative treatment and regular echocardiographic or magnetic resonance assessments [Komeda 1993; Brown 1997; Frances 1998; Yeo 1998; Pretre 2000]. The timing of surgery is dependent upon the age of the MI. Within the first 2 to 3 months after coronary infarction, surgery is urgently recommended after coronary angiography and ventriculography because of the unpredictability of a rupture. When the diagnosis is made several months or years after MI, the urgency of the operation is not determined as much by the risk of rupture, but rather by symptoms and the severity of the coronary artery disease [Komeda 1993].

Surgical resection is the treatment of choice for patients in whom a pseudoaneurysm is detected within 3 months after

MI, for patients with other indications for cardiac surgery, and for symptomatic patients with ventricular tachycardia or recurrent embolism related to the pseudoaneurysm [Komeda 1993; Varvarigos 2005]. In addition to being associated with left ventricular failure, systemic embolism, and recurrent ventricular tachyarrhythmias, false aneurysms have a propensity to rupture. Approximately 45% of false aneurysms caused by coronary artery disease will rupture. Even small undiagnosed aneurysms can rupture and cause sudden death. Therefore once a diagnosis of a false aneurysm is made, operative management is recommended unless serious extenuating circumstances exist [Rittenhouse 1979]. Low EF and advanced age are not absolute contraindications for surgical ventricular restoration in both cardiac aneurysms and pseudoaneurysms in symptomatic patients [Varvarigos 2005]. We also recommend surgery as the treatment of choice. We think that surgery should be considered unless the patient refuses operation.

Chronic anterior false aneurysms can usually be closed primarily if the neck is fibrotic. However, primary closure of the neck of a posterior false aneurysm may exacerbate mitral regurgitation, and therefore probably should be accompanied by reconstruction with a patch of Dacron graft or glutaraldehyde-fixed bovine pericardium [Komeda 1993]. We agree with this recommendation. We closed the pseudoaneurysm sac with a synthetic patch by remodeling ventriculoplasty.

Postoperative mortality after surgical repair of a left ventricular pseudoaneurysm ranges from 13% to 29% [Komeda 1993; Figueras 2001]. However, most cardiologists consider this relatively high mortality rate acceptable because of the 30% to 45% risk of fatal rupture [Komeda 1993]. Embolization of thrombotic material, induced by stagnant pattern of blood flow, has also been reported with large pseudoaneurysms [Frances 1998; Yeo 1998]. Moreno and colleagues found a high incidence of ischemic stroke (32.5% at 4 years) in conservatively treated patients [Moreno 2003]. In our series, resection of the pseudoaneurysm and closure of the ventricular wall was achieved in all patients, and if necessary, associated CABG was performed for resuscitating the ischemic myocardium.

The mortality rate for postinfarction left ventricular pseudoaneurysms was 28% in Pretre's series [2000] and 23% in Komeda's series [1993]. In our limited study population, the hospital mortality rate was 12.5%. The mean intubation time, length of ICU stay, and length of hospital stay were all in acceptable ranges. The late mortality rate was 12.5%. All of the survivors recovered quickly without a major complication. In the follow-up period, good left ventricular configurations without a false aneurysm together with increases in EF were detected.

In conclusion, left ventricular pseudoaneurysm is an unusual but important complication of acute MI. Prompt diagnosis and early surgical intervention is essential for patients with large or expanding left ventricular pseudoaneurysm. According to our acceptable results, it might be advocated that surgical intervention is a safe and effective treatment of choice. Associated CABG may reduce early mortality of the patients with left ventricular pseudoaneurysm by resuscitating the ischemic myocardium.

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