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Repair of Post-Infarct Ventricular Septal Rupture with an Infarct-Exclusion Technique: Early Results

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ABSTRACT

Background. Ventricular septal rupture is a rare but life-threatening complication of acute myocardial infarction. The mortality rate with medical treatment is more than 90%, whereas the mortality rate after surgical repair varies between 19% and 60% in different studies. This study reviews our experience based on early closure of the septal rupture with an infarct-exclusion technique.

Methods. Eighteen consecutive patients who underwent post-infarct ventricular septal rupture operation between June 1, 2000, and November 1, 2005, were included in the study. There were 12 male and 6 female patients. Mean age was 65.72 ± 5.21 years. All patients had echocardiography and coronary angiography before the operation. Rupture was closed with an infarct-exclusion technique in all patients. Preoperative, operative, and postoperative information were collected from patient cohorts.

Results. The median time from myocardial infarction to diagnosis of the ventricular septal rupture was 4.22 ± 1.61 days. Fourteen of the patients had intra-aortic balloon pump support, and 5 had mechanic ventilator support preoperatively. Surgical repair was done 1 to 4 days after the diagnosis. Ten anterior and 8 posterior ventricular septal ruptures were found. Additional coronary artery bypass surgery was performed with a median of 1.27 ± 0.8 grafts in 15 (83.3%) patients. The mean postoperative mechanic ventilator support time was 34.13 ± 45.11 hours. Overall 30-day mortality was 16.7% with 3 patients. The mean intensive care unit stay was 3.3 ± 1.6 days. Postoperative transthoracic echocardiography showed minimal residual shunts in 4 patients.

Conclusion. Patch closure of the ventricular septal rupture with an infarct-exclusion technique provided acceptable results. Concomitant coronary artery bypass grafting might be beneficial to control additional risk of an associated coronary artery lesion. Prompt diagnosis followed by early surgical intervention is essential for patients with ventricular septal rupture.

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INTRODUCTION

Ventricular septal rupture (VSR) is a rare but serious complication of acute myocardial infarction (MI). Its estimated incidence is between 0.2% and 2% after MI [Crenshaw 2000]. It typically occurs in the first week after infarction with a mean time from symptom onset of 3 to 5 days [Topaz 1992].

Medical treatment of VSR is known not to be effective, with a 60% to 70% mortality rate within the first 2 weeks and less than 10% survival after 3 months [Madsen 1997]. Early surgical treatment is recommended to prevent hemodynamic deterioration from damaging other major organs [Deja 2000]. However, surgical repair was reported to be associated with high operative mortality when done during the acute phase of the MI [Estrada-Quintero 1992], and tended to present difficulties in managing fragile myocardium [Skillington 1990; Deja 2000].

The aim of this report was to present our experience based on early closure of the VSR with an infarct-exclusion technique.

METHODS

Patients

Eighteen patients with post-infarction VSR who underwent operation in our clinic between June 1, 2000, and November 1, 2005, were reviewed. Of the patients, 12 (66.6%) were male and 6 (33.4%) were female. The mean age was 65.72 ± 5.21 years, ranging from 52 to 74 years. Clinical and surgical data of the patients were collected from the hospital records. The study was approved by the local ethics committee. Preoperative characteristics of the patients are seen in Tables 1 and 2.

Diagnosis was established based on the transthoracic echocardiography and cardiac catheterization. The mean time from MI to diagnosis of the VSR was 4.22 ± 1.61 days, ranging from 2 to 8 days. Preoperative coronary angiography was performed for all patients; angiography showed single-vessel disease in 9 (50%) patients, double-vessel disease in 6 (33.3%) patients, and triple-vessel disease in 3 (16.6%)

Table 1. Preoperative Characteristics of the Patients with Ventricular Septal Rupture*

	No. of Patients	%
Sex		
Female	6	33.3
Male	12	66.7
Comorbidities		
Hypertension	8	44.4
Renal failure	4	22.2
Diabetes mellitus	5	27.7
COPD	5	27.7
Low EF, <30%	6	33.3
Previous MI	5	27.7
Coronary artery disease		
Single-vessel disease	9	50
Double-vessel disease	6	33.3
Triple-vessel disease	3	16.7
NYHA functional class		
II	2	11.1
III	5	27.7
IV	11	61.1
Location of VSR		
Anterior	10	55.5
Posterior	8	44.4
Preoperative condition		
IABP support	14	77.7
Ventilatory support	5	27.7
Inotropic agent	14	77.7

*COPD indicates chronic obstructive pulmonary disease; EF, ejection fraction; MI, myocardial infarction; NYHA, New York Heart Association; VSR, ventricular septal rupture; IABP, intra-aortic balloon counterpulsation.

patients. Coexisting pathologies were hypertension in 8 (44.4%) patients, diabetes in 5 (27.7%) patients, renal failure in 4 (22.2%) patients, and chronic obstructive pulmonary disease in 5 (27.7%) patients. The majority of the patients were in sinus rhythm.

According to the NYHA classification system, 2 (11.1%) patients were in class II, 5 (27.7%) in class III, and 11 (61.1%) in class IV. Fourteen of the patients had intra-aortic balloon pump (IABP) support for congestive heart failure. Five of the patients needed mechanic ventilator support in the preoperative period.

Surgical Management

All patients were operated on under general anesthesia and endotracheal intubation. Surgical intervention was performed via median sternotomy, and the standard cardiopulmonary bypass techniques under moderate degree hypothermia were used for all patients. Antegrade and continuous retrograde isothermic hyperkalemic blood cardioplegia was used for myocardial protection. The interventricular septum was approached by an incision through the infarcted area of the myocardium. The VSR and margins of the infarcted muscle were identified. A synthetic patch, approximately 5 ×_6 cm in diameter, was sutured to the noninfarcted endocardium of the interventricular septum and ventricular wall. The ventriculotomy was closed without infarctectomy by using 2 Teflon stripes to support the suture line. Coronary revascularization was performed if necessary.

Table 2. Preoperative, Operative, and Postoperative Data of the Patients with Ventricular Septal Rupture

	Mean ± Standard Deviation
Age, y	65.72 ± 5.21
Time from myocardial infarction to diagnosis, d	4.22 ± 1.61
Time from diagnosis to operation, d	1.66 ± 0.88
Time from myocardial infarction to operation, d	6 ± 1.59
Aortic cross-clamp time, min	52.55 ± 8.7
Total perfusion time, min	84.77 ± 7.35
Number of distal anastomoses	1.27 ± 0. 80
Intensive care unit stay, d	3.3 ± 1.6
Hospital stay, d	12.33 ± 3.64

RESULTS

Of the 18 patients operated on, 3 died within 30 days. The hospital mortality rate was 16.7%. The cause of death was low cardiac output syndrome in 2 patients and prolonged mechanical ventilator support and pneumonia in 1 patient. The median time from diagnosis of the VSR to surgery was 1.66 ± 0.88 days (range, 1-4 days) and the median time to surgery from MI was 6 ± 1.59 days (range, 4-11 days). Ten anterior and 8 posterior VSRs were found. Additional coronary artery bypass surgery (CABG) was performed with a median of 1.27 ± 0.80 grafts in 15 (83.3%) patients. Preoperative, operative, and postoperative data of the patients are seen in Table 2.

Inotropic support was needed for all patients, temporary epicardial pacing for 4 (22.2%) patients, and IABP support for 15 (83.3%) patients (14 of them were inserted preoperatively). Postoperative complications were hemodialysis for acute renal failure in 3 (16.7%) patients, stroke in 1 (5.5%) patient, and pulmonary complication in 3 (16.7%) patients. Table 3 summarizes the operative complications of the patients.

The mean postoperative intubation time was 34.13 ± 45.11 hours, ranging from 10 to 192 hours. The mean intensive care unit length of stay was 3.3 ± 1.7 days, ranging from 1 to 8 days. Early postoperative transthoracic echocardiography demonstrated minimal residual shunt in 4 patients, none of which necessitated surgical re-intervention. No surgical inter-

Table 3. Operative Complications of the Patients with Ventricular Septal Rupture

	No. of Patients	%
Death	3	16.7
Pulmonary complication	3	16.7
Renal failure (hemodialysis)	3	16.7
Stroke	1	5.5
Permanent pacemaker	1	5.5
Death	3	16.7

vention was needed for bleeding. The mean hospital length of stay was 12.33 ± 3.64 days, ranging from 8 to 20 days.

DISCUSSION

Postinfarction VSR is an uncommon pathology with a reported incidence of 0.2% to 2% [Topaz 1992; Crenshaw 2000]. Advanced age, anterior infarct location, and female sex were found to be the most important predictors of VSR. Hypertension and no previous MI or angina were found to be risk factors for VSR [Becker 1996; Crenshaw 2000]. It is the common opinion that VSR occurs most frequently in patients with single-vessel disease and poor collateral flow with their first anterior infarction [Madsen 1997]. In our series, only 27% of the patients had previous MI, and 50% of them were found to have single-vessel disease.

The mortality rate with only medical treatment is extremely high, more than 90% in patients with VSR, whereas the mortality rate after surgical repair varies between 19% and 60% in different studies [David 1998; Birnbaum 2002; Barker 2003]. Only 7% of the patients survive up to the first year from diagnosis [Killen 1997]. Surgical intervention is essential for these patients. But the ideal time of surgical treatment for VSR is under debate. Labrousse and coworkers reported that a shorter interval between the perforation of the septum and the surgical repair was an important risk factor, with no death in patients operated on after the fifteenth day [Labrousse 2002]. Jeppsson and colleagues declared that urgent repair (within 3 days after diagnosis) is an independent predictor of 30-day mortality. They reported that the necrotic muscle had been replaced by fibrous tissue, thereby delaying the surgery that might have been helpful for suturing the myocardium [Jeppsson 2005]. But it seems unethical to delay such patients, because heart failure or other organ dysfunctions may develop, and the patients may die unless surgically treated. In our series, median time from diagnosis to operation was 1.66 days. Mortality rate was acceptable at 16.7%. Like other authors [David 1995; Pretre 1999], we are of the opinion that patients with VSR should be operated on urgently if they are in a hemodynamically stable condition and immediately if they are in cardiogenic shock.

Some surgeons believe that coronary angiography is not necessary in patients with cardiogenic shock [Deville 1991]. Jeppsson and coworkers reported that concomitant CABG was associated with worse mid-term survival in patients surviving the immediate postoperative period [Jeppsson 2005]. Cox et al found that failure to treat associated coronary artery disease was a risk factor for late death [Cox 1996]. Some surgeons have found that concomitant myocardial revascularization in patients with multivessel disease decreases operative mortality and improves long-term survival [Komeda 1990; David 1995; Barker 2003]. In our series, no mortality or morbidity was found to be related to coronary angiography. Furthermore, acceptable results were provided with surgery for VSR associated with CABG. Therefore, preoperative coronary angiography should be recommended and, if necessary, CABG should be performed for resuscitating the ischemic myocardium.

Traditional surgical technique for patients with VSR consisted of infarctectomy and reconstruction of the interventricular septum and left and right ventricular walls. The operative mortality rate was found to be high with these techniques [Cummings 1989; Deville 1991]. David and colleagues defined a new technique with a 13.6% mortality rate in which the infarcted septum and ventricular walls were excluded rather than excised [David 1995]. In our series, VSR was closed with an infarct-exclusion technique for all patients. The hospital mortality rate was 16.7%. An approach through the infarcted area of the left ventricle without secondary right ventricular incision and to perform infarct exclusion with a large synthetic patch without myocardial excision may be helpful to restore left ventricular geometry without deteriorating the right ventricular function. The reported incidence of residual septal defect ranges from 10% to 40% of patients [Pretre 1999; Deja 2000; Jeppsson 2005]. Labrousse et al reported that the use of the double-patch technique and glue avoided recurrence of the VSR, and an 11% recurrence rate was found with the single-patch technique [Labrousse 2002]. Even though all operations were performed with infarct exclusion with the single-patch technique, there has been no residual shunting in our series. The mean intubation time, intensive care unit length of stay, and hospital length of stay were all in acceptable ranges. All of the survivors recovered quickly without a major complication. In the follow-up period, neither new aneurysmal formation nor recurrence of VSR has been detected.

In conclusion, it might be advocated that prompt diagnosis and early surgical intervention is essential to decrease the mortality from VSR and to prevent the other organs from being affected. Associated CABG may reduce early mortality of the patients with VSR by resuscitating the ischemic myocardium.

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