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Original Article

Surgical treatment of postinfarction ventricular septal defect: Lessons from our results

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Abstract

Aim: Post-infarction ventricular septal defect is the most serious complication resulting in high mortality. This occurs in 0.2 - 0.5% of cases. With conservative therapy, according to the reviewed literature, the mortality rate is approximately 90 - 100%. The only effective treatment for post-infarction ventricular septal defect is surgical repair.

Material and Methods: From 2002 to 2018, retrospective analysis was performed on 77 patients who underwent surgery for this pathology. The median age of the patients was 59.9±9.59 years. Out of these patients, 55 (72.2%) are men and 22 (27.7%) are women. 15 (16.6%) patients were smokers, 31 (34.4%) patients were diabetic and 70 (77.7%) patients had hypertension. The median fraction was 43.9±10.4%. One coronary artery in 18 (20%) patients, 2 blood vessels in 32 (35.5%) patients, and 3 blood vessel tears in 40 (44.4%) patients. In our study group, 14 (15.6%) patients underwent emergency surgery after hospitalization. Within the first three days - 21 (23.3%) patients, and then within the week - 19 (21.1%) patients. On average, after admission to the hospital the operation was performed within 7.8±7.7. 9 and (10%) patients were fitted with an intra-aortic balloon counter pulsator (IABP). Out of the 90 patients, 83 (92.2%) underwent surgery, and in 6 of the patients the peritoneal wall defect was removed by percutaneous means. Aorto-coronary bypass surgery was performed in parallel with 76 (91.6%) patients, the average number was 2.1±1.0 shunts. The left internal carotid artery was used in 6 (7.2%) patients. 1 (1.2%) patient had a mitral valve replacement. Left ventricular ventriculostomy was performed by the Daggett method in 45 (54.2%) patients and by the David method in 31 (37.3%) patients.

Results: The 30-day mortality in our group was 25.9%, and according to the literature, it occurs in 34-37%, although some authors mention 19-25%. Outcomes are influenced by factors such as cardiogenic shock and the ejection of the part of the heart. Also, in our group, survival rates are higher in patients who underwent long- term surgery two weeks after the onset of ventricular septal defect associated with the formation of fibrous tissue along the periphery of the necrotic site of myocardial infarction.

Conclusion: As for the concomitant coronary artery bypass grafting in our patients, no significant effect was observed in the early postoperative period.

Keywords: Rupture of the interventricular septum, heart failure, ventriculostomy, aneurysmectomy

INTRODUCTION

Ventricular septum rupture is a severe complication of acute myocardial infarction leading to death. Ventricular septum defect begins its development on the 2-8 days after myocardial infarction and in the absence of surgical repair, most of such patients die due to severe congestive heart failure within the period of a few hours to several days. With the implementation of widely spread thrombolytic therapy, the frequency of such complications has decreased from 1 – 3% to 0.3% (1). The process of ventricular septum rupture development usually begins 8-24 hours after acute myocardial infarction (AMI), and the frequency of such mechanical complications due to percutaneous coronary intervention is lower than that after fibrinolytic therapy (2).

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Non-surgical repair of post-myocardial infarction ventricular septum defect (post-MI VSD) has extremely negative outcomes. Historical surveys showed that 50% of patients die in the first week, 80% - within four weeks, and less than 10% survive after one year (3). In the GUSTO-I research, the 30-day mortality made up 47% in patients who had surgical repair against 94% in patients who underwent drug therapy (4). Thus, surgical repair of ventricular septum rupture (VSR) is the definitive treatment of choice. Depending on the extent of the disease of a coronary artery that feeds the ventricular septum, post-MI VSR is divided into anterior, apical, and posterior. The posterior VSR, in particular, may be followed by mitral valve regurgitation.

MATERIAL AND METHODS

This study covers the analysis of surgical treatment results in patients with infarcted ventricular septum defect operated in Central Clinical Hospital (CCH) in Baku, Azerbaijan, and in Amosov Institute of Cardiovascular Surgery of Ukraine. In these patients the following data were taken into account: clinical and demographic data, comorbidities, echocardiographic data, VSD location, applying balloon pump (IABP), surgical tactics, and outcomes of the disease.

Patients who developed multiple organ failure or who had died before the decision on the surgery was made were excluded from the research. Angiography was performed in all patients who were later operated on. All patients underwent surgery using a heart-lung machine with aortic compression, whereas, some patients were operated on the fibrillating heart without aorta clamping. Ventriculostomy of the left ventricle was performed through the myocardial infarction zone in front or behind depending on the affected area, respectively. The rupture was closed using a Dacron patch and 4/0 proline suture with single sutures. The left ventricle was sutured with a 3/0 prolene suture on Teflon pads. Concomitant CABG was performed in some patients with consideration to stenosis of coronary vessels. Patients who had received inotropic support before surgery and were operated on within 24 hours were considered urgent. Acute renal failure (ARF) was rated according to the KIDCO classification, that is, an increase in creatinine 1.5 times from basic values. In-hospital 30-day mortality was taken into account as the result of any mortality within 30 days after surgery. Additional variables were also considered, including the presence of cardiogenic shock, time for heart-lung machine connection, time of aortic clamping, ICU stay, and other complications involved such as revision for hemorrhage and re-rupture of the septum.

From 1998 to 2018, the post-MI VSD was operated on in 77 patients. 54 patients received a single–step aortocoronary bypass grafting (CABG). The average age of the patients was 59.6±9.58 years old. In the series, there were analyzed 55 men and 22 women. The majority of patients – 59 (76.6%) were in the NYHA grade III before surgery, with an average ejection fraction of 41.7%. Based on angiography, the patients mostly had single- and two-vessel CAD (39% and 36.4%, respectively). Three-vessel defect was found only in 24.6 % of cases. The most frequent stenoses were observed in LAD (76.6%), RCA (70%) was involved less frequently. LCX was even less frequently affected (28.6%). The average period from VSR diagnosis and its surgical repair made up 8.96 days.

Emergency surgery within 24 hours from the diagnosis was performed in eight patients (12.3%), four (50%) of whom died. Intra-aortic balloon pump was installed in 19 (24.7 %) patients, 8 (42.1%) of whom were delivered it pre-operatively (three of these patients were selected for endovascular intervention), and 11 (57.9 %) – intra-operatively and in the early postoperative period. A cardiogenic shock was observed in 8 (10.4 %) patients, 5 (62.5%) of whom died. Acute renal failure (ARF) developed in 4 (17.4%) patients in the pre-operative period, none of them died. Hence, renal replacement therapy was not required. Hemorrhage re-revision was performed in only one (1.3%) patient, who later recovered and was discharged in satisfactory condition. All patients were operated on with the use of standard heart-lung bypass, except for six (7.8%) patients, operated on the fibrillating heart without aortic clamp applied. Only one patient of those six died. According to the statistics, there was no significant difference in mortality rates in patients operated with heart-lung bypass machines against patients operated on the fibrillating heart (P-value 0.57). Pre-operative, intra-operative, and post-operative values comparison in survivors and non-survivors are shown in Table 1.

Table 1. Operative values comparison in survivors and non-survivors in patients with post-MI VSD

	Survivors N= 57	Non-survivors N= 20	P
Blood hypertension	26(45.6%)	12(60%)	0.95
Diabetes	9(15.8%)	10(50%)	0.78
Pre-operative IABP	1(1.8%)	4(20%)	0.055
Ejection fraction	45.1±9.2	43±1.58	0.010
Creatinine 2	-	4(20%)	0.37
Door-to-surgery time	8.1±6.9	7.5±0.8	0.97
Bypass surgery (number of patients)	42(73.7%)	12(60%)	0.26
Number of bypasses	2.23±1.2	2.16±0.6	0.34
Heart-lung bypass machine	172±55.7	234.9±73.1	0.89
Aortic compression	91.5±44.9	126±48.93	0.50
Anterior defect	34(59.6%)	12(60%)	0.43
Posterior defect	23(40.3%)	8(40%)	0.61
ICU time	7.95±11.01	7.5±6.2	0.21
Hospital stay	20.2±10.9	22.8±14.2	0.52

Univariate analysis of the comparisons has shown that the low ejection fraction in the pre-operative period (P-value 0.010)

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and cardiogenic shock requiring the IABP installation (P-value 0.031) are the risk factors that determine surgical mortality. Having analyzed both these risk factors, it was found out that only cardiogenic shock was an independent risk factor for operative mortality with an odds ratio of 2,17. As to the low ejection fraction, it turned out a concomitant factor for operative mortality. Additional revascularization of coronary arteries had no impact on the survival rate.

RESULTS

So far post-infarction ventricular septum defect has remained one of the most severe complications that cardiac surgeons have to face today. Although with the introduction of reperfusion therapy for acute myocardial infarction cases of VSD have decreased from 1-3% to 0.17-0.31%, for the last 20 years mortality in the groups of patients with post-infarction ventricular septum defect remains high (1). In our study, the 30-day operative mortality made up 25.9% which is much lower than reported in some other series with mortality ranging from 34% to 37%. Yet, some authors scored low death rates in the range of 19% to 25% (5). When comparing survived and deceased patients by univariate analysis, the presence of cardiogenic shock and low ejection fraction were identified as operative mortality predictors. It was evident in the works of Pang et al. (6) and Huang et al. (7), who specified that the preserved ejection fraction made a positive impact on early postoperative survival. Cardiogenic shock was, in part, caused by the decrease in the affected area contractility and the left-to-right bypass due to the defect.

While some other studies defined the duration of aortic compression and the increased time of extracorporeal circulation as a predictor of early mortality, in the series we present, such an association was not observed (5,6). Moreover, the mortality rate did not change in our patients who operated on the fibrillating heart without aortic compression.

Based on the findings of some studies, the time interval between diagnosing the VSR and its surgical repair is the primary condition for success, that is, the best survival rate is observed after 2 weeks from the defect detection since within this period fibrosis and dense scar tissue are formed around (8). Thus, the frequency of plastic reconstruction recurrence is reduced. In this connection, many centers use mechanical support for hemodynamic stabilization. In our studies, according to the ACC / AHA recommendations, IABP was only used in 5 operated patients in the pre-operative period and 11 patients intra-operatively. The average period of delay before surgery made up 8.1±6.9 days and 7.5±0.8 days for survivors and non-survivors, respectively which was statistically insignificant (P-value = 0.97). There have been recorded in the literature that IABP improves survival, in our case (P-value = 0.055). However, according to a hindsight study based on the review of 2876 patients, among the patients with IABP installed in pre-operative and intra-operative periods, the mortality rate was higher [5]. Moreover, early recovery of VSR in less than seven days after MI led to higher mortality than in the case of surgery at a later date, more than seven days after MI (54.1% against 18.4%, p<0.01) (9).

As it had been noted that acute renal failure (ARF) requiring post-operative dialysis is an independent risk factor for mortality. In our series, there is not a single patient who received renal replacement therapy after surgery. In a like manner, other studies have found that ventricular dysfunction harms early and late survival. In our patients, no ventricular dysfunction was observed.

54 (70.1%) patients were delivered a single-step coronary artery bypass grafting (CABG). In the world practice, there is no unequivocal opinion on the above. From the point of view of Lundblad et al. (10), additional CABG reduces both early and late mortality. Similarly, Perotta et al. (11) report a decrease in mortality rate from 26.3% to 21.2% with CABG, respectively. On the other hand, some series of studies assert the improvement in the survival rate of patients with CABG in the long-term period, while revascularization of the coronary arteries insignificantly affects the early survival rate (12). Yet, in our study, we have not found any statistically significant impacts of concomitant aortic coronary bypass grafting both in the early and in the long-term periods.

Closing VSR with endovascular methods is increasingly recommended for patients at high risk of having surgery, both as the background initial treatment and a temporary measure to delay the surgery (13). It can also be used in patients with hemodynamically significant recurrent ventricular septum ruptures. The exception is large VSRs (D>15 mm), which are to be only repaired surgically.

Based on contemporary literature, 30-day mortality after endovascular intervention ranges from 28% to 65%, while in patients with cardiogenic shock mortality reaches 88% (5,13).

DISCUSSION

Ventricular assistive devices can be a useful adjunct in the elimination distress of one or both ventricles in the postoperative period. Above that, their use in the preoperative period makes it possible to postpone the surgery time. Ventricular assistive devices allow better nourishment of peripheral organs and restore the dormant myocardium. A similar approach was used by LaTorre et al. (14), who mentioned the application of İmpella auxiliary pump in patients with posterior VSR. In this series of studies, low ejection fraction and the presence of cardiogenic shock were identified as independent risk factors for early mortality. However, based on multiple analyses using logarithmic calculations, cardiogenic shock was recognized as an independent risk factor, whereas the low ejection fraction was defined as a concomitant variable of the risk factor for mortality. It means that patients having cardiogenic shock with a lower ejection fraction are more likely to die (5,6,12). Our findings confirm cardiogenic shock as an independent risk factor (should we revascularize the

affected coronary arteries in cardiogenic shock?), which goes in line with the world data, and makes up 81%. Yet, we have scant hindsight data that is statistically insignificant.

CONCLUSION

Our findings show that surgical mortality is significantly higher in patients with low ejection fraction in the preoperative period and those with cardiogenic shock, in particular.

In hemodynamically unstable patients, early administration of IABP may enhance the results of surgery.

Although additional CABG has no significant effect in both early or long-term periods, we have believed that for patients with low operational risk and with multivessel coronary artery disease cardiac revascularization should be performed.

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Study Association: This study is not associated with any thesis or dissertation work.

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