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Timing of repair of ischemic ventricular septal rupture; results of early vs. late repair

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Abstract

Background: The optimal time to repair ischemic ventricular septal rupture (VSR) is debatable. We compared the outcomes, including operative mortality, between patients who underwent early vs. late VSR repair.

Methods: Twenty-eight patients presented with VSR were included in this study. Patients were grouped according to the timing of repair into two groups; the early repair group (n= 12) and the late repair group (n= 16). The primary endpoint was operative mortality.

Results: There was no difference in age, gender, and associated comorbidities between early and late repair. Anteroapical VSR was the most common type in both groups. There was no difference in the number of bypass grafts in both groups. Ischemic (95 (88- 142.5) vs. 137 (120- 147.5) min; P= 0.028) and cardiopulmonary bypass times (123.5 (115.5- 177.5) vs. 172.5 (152.5- 185) min; P= 0.023) were significantly shorter in patients who had delayed repair. Nine patients (75%) had operative mortality in the early repair group versus three patients (18.75%) in the late repair group (P= 0.006). There were no differences in blood loss, stroke, wound infection, ICU, and ward stay among the surviving patients.

Conclusion: Delayed repair of ischemic ventricular septal rupture could be associated with lower mortality in properly selected patients. Additionally, the delayed repair could decrease the ischemic and cardiopulmonary bypass times.

KEYWORDS

Ventricular septal rupture; Repair timing; Acute coronary syndromes

Introduction

Myocardial infarction (MI) is a leading cause of morbidity and mortality [1]. In acute coronary syndrome, percutaneous coronary intervention (PCI) is the primary treatment, and coronary artery bypass grafting (CABG) is preserved in patients with failed PCI or cases of mechanical MI complications [2]. Ischemic ventricular septal rupture (VSR) is a dreaded complication of acute MI [3], with an incidence of 1% [4] and a mortality rate of 87% if managed conservatively [5]. Consequently, surgical management of ischemic VSR is the treatment of choice to improve patients' outcomes [6]. The incidence of VSR has decreased recently because of the efficiency of rapid reperfusion strategy in patients with acute coronary syndromes [7]. VSR after anterior infarction is more frequently encountered than VSR associated with inferior MI [8].

There is no consensus about the best timing for ischemic VSR repair [9]. Several factors affect the decision to operate on patients with VSR, including the hemodynamic status and the defect

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size [10]. Early surgery could be associated with high mortality rates, and the risk of surgery should be weighed against the expected benefits of fixing VSR [11]. The objective of this study was to compare the outcomes of early vs. late VSR repair.

Patients and Methods

Design and patients

This study included 28 patients with VSR after acute MI who presented between 2006 and 2021 at a single tertiary referral center. All patients underwent patch closure combined with CABG. For all patients, an intra-aortic balloon pump was inserted before surgery. Patients who did not undergo surgical repair and those with preoperative neurological insults were excluded from the study. Additionally, patients with ruptured left ventricular ischemic aneurysms with apical VSR and those who underwent device closure of VSR were excluded.

Patients were grouped according to the timing of repair into two groups; the early repair group (n= 12) and the late repair group (n= 16). Patients with early repair had surgery within two weeks of VSR diagnosis, and late repair was performed after two weeks.

Data and endpoints:

All patients underwent CABG with VSR repair, either early or delayed repair. Both groups were compared regarding risk factors and baseline characteristics, including age, gender, presence or absence of diabetes and renal failure, and operative details, including the site of VSR, number of bypass grafts, and ischemic and cardiopulmonary bypass times.

Postoperative data were analyzed and compared between both groups regarding operative mortality, stroke occurrence, blood loss, wound infection, and ICU and ward stay in days.

Ethical consideration:

The local ethical committee approved the study, and the need for patient consent was waived.

Statistical analysis:

Integer data were compared using the t-test or Man-Whitney test depending on the normality distribution. Binary data were compared with Fisher's exact test. Data were presented as mean± standard deviation, median (Interquartile range), or numbers and percentages. Stata 16 was used for the analysis (Stata Corp- College Station- TX-USA), and a P-value of less than 0.05 was considered statistically significant.

Results

Preoperative and operative data:

Twelve patients had an early repair, and 16 patients had delayed repair. There was no difference in age, gender, and associated comorbidities between both groups. Anteroapical was the most common type in both groups. The group of early repairs had inferoseptal VSD, while the late repair group had posteroinferior VSD (P= 0.039).

There was no difference in the number of bypass grafts. Ischemic and cardiopulmonary bypass times were significantly shorter in patients with delayed repair as fibrous tissue formation makes the surgical stitches much easier with less ischemic and cardiopulmonary bypass. (Table 1)

Outcomes:

Nine patients (75%) had operative mortality in the early repair group versus three patients (18.75%) in the late repair group (P= 0.006). There were no differences in stroke, blood loss, wound infection, ICU, and ward sta among the surviving patients. (Table 2)

Discussion

The optimal timing of definitive surgical repair of VSR complicating acute myocardial infarction remains controversial. Several studies recommend that the timing of VSR repair should be individualized [12]. Current recommendations are to perform early surgery in patients with hemodynamic instability, cardiogenic shock, and no end-organ failure. Surgery can be delayed if there is any concern about tissue fragility and anatomy and the patients are hemodynamically stable. Delayed surgery has several advantages based on the pathological process. After MI, collagen deposition begins after 2-4 days,

Table 1: comparison of the preoperative and operative data of patients who had early versus late repair. Data were presented as mean, SD, or median (interquartile range), numbers, and percentages.

	Early repair (n= 12)	Late repair (n= 16)	P-value
Age (y)	65.08± 5.71	66.25± 5.74	0.599
Male	11 (91.67%)	12 (75%)	0.355
DM	11 (91.67%)	14 (87.50%)	>0.99
Renal failure	3 (25%)	2 (12.5%)	0.624
VSD site			
Antero-apical	9 (75%)	12 (75%)	
Infero-septal	3 (25%)	0	0.039
Postero-inferior	0	4 (24%)	
Number of bypass graft	2.67±0.49	2.69±0.48	0.911
Ischemic time (min)	137 (120- 147.5)	95 (88- 142.5)	0.028
CPB time (min)	172.5 (152.5- 185)	123.5 (115.5- 177.5)	0.023

completely replacing the necrotic tissue after 28 days [13]. Consequently, the success of delayed repair is of higher potential because of the increased tissue strength, which became well-differentiated from the surrounding healthy tissue. Patients can have a close follow-up in ICU to allow tissue healing and promote chances of definitive repair [14].

In our study, there was no significant difference between both groups regarding baseline characteristics, including age, gender, presence of diabetes, and renal failure. These results support that mortality following VSR closure was not affected by any difference in patients' risk factors and baseline characteristics. Moreover, there was a significant decrease in ischemic and cardiopulmonary bypass times in patients with delayed repair. These results agree with Di Summa and associates' study, which showed a significant difference in operative details (Ischemic and cardiopulmonary bypass times) between both groups. They also reported a difference in the primary endpoint of mortality between both groups. Patients who were operated on early (1± 1.41 days) after diagnosis of VSR had a high mortality rate (87.5%) compared to those who were operated on late (within one week), who had a mortality rate of 44.4 %. This percentage approached zero in those who were operated on later than one week [15].

In our study, there was a significant difference between both groups regarding the primary endpoint of mortality. Mortality was 18.75 % in those with late repair compared to 75 % in those with an early repair. Early surgery on unstable patients with acute myocardial injury could increase the risk of operative mortality [16]. Early surgery is technically challenging, and working on fragile tissues increases the risk of injury and recurrence of septal defects [17]. Delayed repair allows tissue regeneration and increases its strength. The short time between MI and VSR indicates poor collateral circulation [16].

Table 2: comparison of the postoperative outcomes of patients who had early versus late repair. Data were presented as mean, SD, or median (interquartile range), numbers, and percentages

	Early repair (n= 12)	Late repair (n= 16)	P-value
Operative mortality	9 (75%)	3 (18.75%)	0.006
Postoperative blood loss (L)	1.47±0.25	1.41±0.39	0.810
Stroke	2/3 (66.67%)	1/13 (7.69%)	0.071
Wound infection	2/3 (66.67%)	2/13 (15.38%)	0.136
ICU stay (days)	15 (6- 18)	8 (6- 8)	0.429
Ward stay (days)	35 (12- 39)	12 (11- 14)	0.161

Our results also were similar to Papalexopoulou and colleagues' study. They found that patients who had early repair (> 3 days to within 4 weeks) of VSR had 52.4% mortality, and delayed surgery from 1 week to 4 weeks had 7.56% mortality. Early surgery is recommended if the shunt is more than 15 mm with significant shunt and hemodynamic instability. If another underlying pathology strictly limits life expectancy, surgery should be deferred. Patients with cardiogenic shock should have early surgery after cardiac resuscitation. Hemodynamic stable patients could have surgery after 3-4 weeks, and immediate surgery is recommended if there is clinical deterioration [9].

Our results were concordant with that of the Cinq-Mars and associates' study. They reported a 30-day mortality of 65%, and the short- and long-term mortality predictors were older age and shorter time between MI and surgery [18]. Patients with early repair had a higher non-significant incidence of postoperative stroke than the delayed repair group. These results were similar to that found in Cerin and colleagues' work [10]. The operative mortality rate was 52%, and the risk factors for mortality were short time to surgery, ventricular septal defect diameter, and cardiogenic shock. The operative mortality was 75% in patients who had surgery after one week and 16% in patients who operated on after three weeks. They also reported a lower stroke rate in patients with delayed repair.

The same results were obtained from Malhotra and colleagues' study [16]. They reported a 76% mortality rate if the surgery was done in less than three days from VSR and a 26% mortality rate when surgery was performed after three days. From the results of these studies, it seems that the time between VSR and surgery was the main factor affecting operative mortality [16].

Anteroapical is the most common type of ischemic VSD presented as it depends on ischemia in LAD territory which affects the apical part of the septum. Besides, it is the easiest surgical approach as the incision is located lateral to LAD. The group of early repairs had inferoseptal VSD, while the late repair group had posteroinferior VSD (P= 0.039). Both types of ischemic VSD are located inferiorly in the septum, which is a highly complex surgery with higher mortality as the incision are located in the basal aspect of the heart, and it requires elevation of the posterior aspect and tilting of the heart on its longitudinal access so it will affect the venous return on CPB with higher mortality.

Study limitations

The study has several limitations. First, the study is retrospective, and patients were assigned to each treatment group according to their hemodynamics and clinical status. Second, the study has a limited number of patients; however, this is due to the early interventions and improved management of patients with acute coronary syndromes. Lastly, the study presents a single-center experience.

Conclusion

Delayed repair of ischemic ventricular septal rupture could be associated with lower mortality in properly selected patients. Additionally, the delayed repair could decrease the ischemic and cardiopulmonary bypass times.

Conflict of interest: Authors declare no conflict of interest.

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