

Surgical Management and Postoperative Outcomes of Ventricular Septal Rupture Following Acute Myocardial Infarction: A Case Series

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SOUHRN

Úvod: Ruptura komorového septa (ventricular septal rupture, VSR) představuje vzácnou, ale život ohrožující komplikaci akutního infarktu myokardu (AIM), s níž se lze setkat přibližně v 0,2 % případů po AIM. Chirurgická léčba jako definitivní řešení je spojena s vysokým rizikem úmrtí, zvláště pokud se provádí v naléhavých případech.

Cíl: V této studii představujeme případy pěti pacientů s VSR po AIM a hodnotíme chirurgickou léčbu a pooperační výsledky ve všeobecné nemocnici Dr. Soetomo General Hospital (Indonésie).

Metody: Provedli jsme retrospektivní analýzu případů pěti pacientů (mužů) ve věku 44 až 63 let, u nichž byla v letech 2023 a 2024 stanovena diagnóza VSR po AIM. Jejich demografické údaje, charakteristiky VSR, chirurgický výkon i pooperační výsledky byly systematicky zkontrolovány. Emergentní chirurgický výkon měl prioritu u hemodynamicky nestabilních pacientů, u nichž byl následně doplněn intenzivní pooperační péčí.

Výsledky: Rozsah VSR se pohyboval v rozmezí od 0,55 cm do 3,0 cm, přičemž většina z nich se vyskytla v oblasti srdečního hrotu. Přežili čtyři z pěti pacientů; u jednoho došlo k rozvoji fatálních komplikací včetně kardiogenního šoku, nesetrválé komorové tachykardie, nozokomiální (nemocniční) pneumonie a akutního poškození ledvin 10. pooperační den. Mezi pooperační komplikace patřily akutní poškození ledvin (u čtyř pacientů), kardiogenní šok a pleurální výpotek. Délka pobytu v nemocnici se pohybovala v rozmezí 8 až 16 dní, přičemž u jednoho pacienta bylo nutno použít intraaortální balonkovou kontrapulsaci.

Závěr: Časná chirurgická intervence je pro léčbu VSR po AIM naprosto zásadní, stejně jako je pro lepší výsledky léčby nezbytné pečlivé načasování výkonu a výběr pacienta. Intenzivní pooperační péče hraje zásadní úlohu při mírnění komplikací a rychlejším zotavení této vysoce rizikové populace.

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ABSTRACT

Introduction: Ventricular septal rupture (VSR) is a rare but life-threatening complication of acute myocardial infarction (AMI), occurring in approximately 0.2% of post-AMI cases. Surgical repair is the definitive treatment, it carries a high mortality risk, particularly when performed emergently.

Aim: To present a case series of five patients with VSR following AMI and evaluate their surgical management and postoperative outcomes at Dr. Soetomo General Hospital

Methods: A retrospective analysis was conducted on five male patients, aged 44 to 63 years, diagnosed with VSR post-AMI between 2023 and 2024. Patient demographics, VSR characteristics, surgical interventions, and postoperative outcomes were systematically reviewed. The management strategy prioritized emergent surgical repair in hemodynamically unstable patients, supplemented by intensive postoperative care.

Results: VSR sizes ranged from 0.55 cm to 3.0 cm, predominantly located in the apical region. Four of the five patients survived, while one patient experienced fatal complications, including cardiogenic shock, non-sustained ventricular tachycardia, hospital-acquired pneumonia, and acute kidney injury on postoperative day 10. Postoperative complications included acute kidney injury (in four patients), cardiogenic shock, and pleural effusion. Hospital stays varied from 8 to 16 days, with one patient requiring intra-aortic balloon pump support.

Conclusion: Early surgical intervention is critical in managing post-AMI VSR, with precise timing and careful patient selection essential for improving outcomes. Intensive postoperative management is pivotal in mitigating complications and enhancing recovery in this high-risk population.

Keywords:
Acute myocardial infarction
Cardiac surgery
Coronary artery bypass grafting
Patch repair
Ventricular septal rupture

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Introduction

In 1847, Latham first identified ventricular septal rupture (VSR), which occurs in the interventricular septum that separates the right and left ventricles. This septum is composed of two primary sections: the muscular part and the membranous part. The muscular part makes up the bulk of the septum, located beneath the membranous part, and is thick, arising from the bulboventricular flange. Conversely, the membranous part is smaller and thinner, positioned above the muscular part, and is derived from neural crest cells. Ventricular septal rupture (VSR) is an infrequent but life-threatening complication of acute myocardial infarction (AMI), with an incidence of approximately 0.2% post-AMI. It typically presents within the first week following infarction, leading to acute left-to-right shunting, heart failure, and cardiogenic shock.¹ Despite advances in revascularization and medical therapy, surgical repair remains the definitive treatment, though it is associated with high mortality rates, especially when performed emergently.²

The management of VSR is challenging due to the hemodynamic instability of patients and the complexity of surgical repair. This case series reports five patients who underwent surgical intervention for VSR at Dr. Soetomo General Academic Hospital Surabaya between 2023 and 2024, detailing their presentations, surgical techniques, and outcomes.

Case description

This retrospective case series was conducted at Dr. Soetomo General Academic Hospital Surabaya between January 2023 and September 2024. Data were collected from medical records, including demographics, clinical presen-

tation, imaging findings, surgical approach, and postoperative outcomes. The inclusion criteria were diagnosis of VSR confirmed by echocardiography, the fact that the patients underwent surgical repair within the study period, aged 18 years or older. The exclusion criteria were VSR managed non-surgically, incomplete medical records. Surgical techniques used in these cases were surgeries under cardiopulmonary bypass, with defect closure performed using either pericardial or synthetic patches.

In this case series of five patients who underwent surgical repair for ventricular septal rupture (VSR), all patients were male, with ages ranging from 44 to 63 years (mean age of approximately 57.6 years). All patients profile and demographics are provided in **Table 1**. The majorities of the patients presented with typical symptoms of VSR following acute myocardial infarction (AMI), including chest pain, dyspnoea, and hypotension. In terms of AMI type, most of the cases were associated with apical infarctions, with one patient having an antero-septal infarction and another having a rupture at the border between the interventricular septum (IVS) and the right ventricular (RV) free wall. VSR was confirmed by transthoracic echocardiography in all cases, revealing defects varied significantly, from 0.55 cm to 3.0 cm in size. The Intraoperative findings are shown in **Figure 1**.

The postoperative outcomes of the five patients undergoing ventricular septal rupture (VSR) repair varied, with most experiencing significant complications, reflecting the high-risk nature of this surgical procedure. Four patients required preoperative vasopressor or intra-aortic balloon pump (IABP) support due to hemodynamic instability. Surgery was performed between 12 and 29 days after diagnosis, depending on the severity of the patients' conditions. Postoperative outcomes varied, with four out of five patients surviving, resulting in an 80% survival rate. However, one patient (patient 2) passed away on post-

Table 1 – Patient profile and demographics

No.	Age	Gender	Presentation before surgery	AMI type	VSR size (cm)	Timing of surgery after diagnosis (days)	Surgical technique	Complication	Outcome
1	44	Male	Chest pain, dyspnoea, hypotension (on support vasopressor)	Apical	3.0	29	CABG + patch repair	Low cardiac output, acute kidney injury	Discharged POD-8
2	63	Male	Chest pain, dyspnoea, hypotension (on support max. dose vasopressor)	Apical	0.55 and 1.0	20	CABG + patch repair + IABP	Cardiogenic shock, non-sustained VT, HAP, acute kidney injury	Passed away on POD-10
3	60	Male	Chest pain, dyspnoea	Apical, antero septal	1.2	27	CABG + patch repair	Right pleural effusion	Discharged POD-16
4	62	Male	Chest pain, hypotension (on support IABP and vasopressor)	Apical	2.5	12	CABG + patch repair	Acute kidney injury	Discharged POD-10
5	59	Male	Chest pain, dyspnoea, hypotension (on support IABP and vasopressor)	Border between IVS and RV free wall	2.5	16	Patch repair	Cardiogenic shock, acute kidney injury	Discharged POD-10

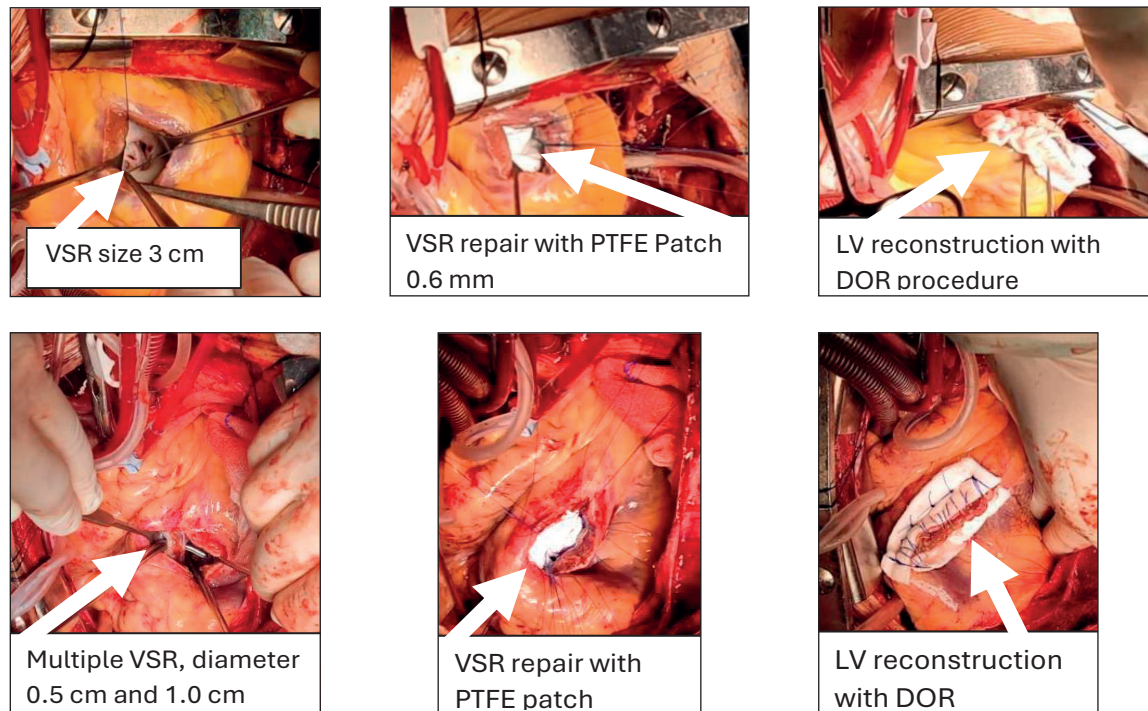


Fig. 1 – Intraoperative images of ventricular septal rupture (VSR) repair and left ventricular (LV) reconstruction.

operative day 10 due to complications including cardiogenic shock, non-sustained ventricular tachycardia (VT), hospital-acquired pneumonia (HAP), and acute kidney injury. The majority of the patients experienced serious postoperative complications. These included: 1) low cardiac output syndrome and acute kidney injury in patient 1; 2) cardiogenic shock, VT, hospital-acquired pneumonia, and acute kidney injury in Patient 2 (who did not survive); 3) right pleural effusion in patient 3; 4) acute kidney injury in patients 4 and 5. Hospital stays ranged from 8 to 16 days, with the longest being in a patient who experienced pleural effusion. In summary, while the majority of patients survived, the postoperative course was complicated by significant morbidities, including renal failure, respiratory complications, and hemodynamic instability. These findings highlight the high risk associated with VSR repair, underscoring the importance of comprehensive perioperative management and close monitoring of potential complications.

Discussion

This case series highlights the significant challenges and complexities involved in the surgical management of ventricular septal rupture (VSR) following acute myocardial infarction (AMI). The condition remains a serious complication of AMI, despite advancements in medical therapy and revascularization strategies. The five cases presented here demonstrate the wide spectrum of clinical presentations and the variable outcomes associated with VSR repair.³ All patients in this series were male, with a mean age of 57.6 years, which is consistent with the typical demographic profile of VSR patients as documented in

other studies.⁴ The majority of the cases involved apical infarctions, with one patient having an antero-septal infarction and another having a rupture near the interventricular septum and right ventricular free wall. These findings align with the known distribution of VSR locations following AMI, where apical and antero-septal regions are more prone to rupture due to high myocardial wall stress in these areas during infarction.⁵

In terms of preoperative presentation, all patients exhibited common symptoms of VSR, including chest pain, dyspnoea, and hypotension, which are indicative of heart failure and hemodynamic instability. Four out of five patients required preoperative support with inotropic agents or vasopressors due to severe hemodynamic compromise, with two of these patients also needing intra-aortic balloon pump (IABP) support. This demonstrates the critical instability that many VSR patients face before surgery. The timing of surgery after diagnosis varied between 12 and 29 days, reflecting the need for individualized decisions based on the patient's clinical stability and optimization before surgery. The variability in timing also highlights the dilemma in managing VSR, where earlier intervention is necessary for unstable patients but delaying surgery may allow for myocardial stabilization and reduce the risk of complications.⁶

The outcomes from this case series reinforce the high-risk nature of VSR repair, with four out of five patients surviving, resulting in an 80% survival rate. This survival rate is slightly higher than historical averages, which report mortality rates ranging from 20% to 60%, depending on patient stability and the timing of surgery.⁷ However, significant postoperative complications were common, with acute kidney injury occurring in four of the five patients. Other complications included low cardiac output

syndrome, cardiogenic shock, and pleural effusion. The patient who did not survive (patient 2) experienced cardiogenic shock, non-sustained ventricular tachycardia (VT), hospital-acquired pneumonia (HAP), and acute kidney injury, illustrating the vulnerability of patients even after surgical correction of the VSR.

The length of hospital stay ranged from 8 to 16 days, with longer stays associated with more severe complications such as pleural effusion and cardiogenic shock. This variation in recovery times further highlights the complexity of managing postoperative care in VSR patients³. Intensive monitoring and management of potential complications, such as renal failure and hemodynamic instability, are essential for improving patient outcomes. The timely use of mechanical circulatory support, such as IABP, in some patients proved critical in stabilizing these high-risk patients perioperatively.

Surgical techniques were consistent across all cases, with the use of cardiopulmonary bypass and patch repair being the standard approach. In three patients, concomitant coronary artery bypass grafting (CABG) was performed, a reflection of the significant coronary artery disease often associated with these patients. Combined CABG and VSR repair are not uncommon, particularly when significant coronary occlusion has contributed to the infarction and rupture. The timing of surgery remains a key point of debate. While delayed surgery is often preferred to allow for myocardial stabilization, emergent surgery may be the only option in critically unstable patients, as seen in patient 2, who ultimately succumbed to complications despite timely intervention.

This case series has several limitations that should be acknowledged. First, the small sample size, comprising only five patients, restricts the generalizability of the findings; a larger cohort would provide more robust data on the outcomes and complications of VSR surgery, better reflecting the variability in patient presentations and responses to treatment. Additionally, as a single-centre study conducted at Dr. Soetomo General Academic Hospital, the results may be influenced by the specific protocols, surgical techniques, and postoperative care practices at that institution, highlighting the need for multicentre studies to validate these findings in different settings. Furthermore, the retrospective design relies on the accuracy and completeness of medical records, leaving room for potential biases due to incomplete documentation or missing data. The focus on short-term postoperative outcomes also limits insights into long-term survival and quality of life post-discharge, making long-term follow-up essential for assessing the durability of VSR repairs. Lastly, the variability in the size and location of the VSRs, along with differing preoperative hemodynamic stability and comorbidities, complicates the ability to draw definitive conclusions regarding the factors that most significantly influence outcomes; a more homogeneous patient population might provide clearer insights.

Conclusion

In conclusion, the management of VSR remains a formidable challenge, even with modern surgical techniques and postoperative care. This case series demonstrates that while the majority of patients can survive VSR repair, the procedure is associated with significant morbidity, particularly renal and respiratory complications. The results underscore the need for individualized surgical strategies, early intervention when necessary, and comprehensive postoperative care to optimize patient outcomes. Future research should focus on identifying the optimal timing for surgical repair and exploring new treatment modalities to further reduce the high risk of mortality and complications associated with VSR.

Conflict of interest

Nothing to declare from all authors.

Funding

Nothing to declare from all authors.

Ethical statement

This case series was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Dr. Soetomo General Hospital Surabaya, Indonesia.

Informed consent

Informed consent was obtained from all patients included in this case series. The study was conducted in accordance with ethical standards and institutional guidelines.

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