What is the best timing of surgery in patients with post-infarct ventricular septal rupture?

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Abstract

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was ‘in which patients with a post-infarct ventricular septal rupture (PIVSR) might immediate surgery give better results than delayed surgery in terms of mortality? Altogether, 88 papers were found using the reported search criteria, of which 6 represented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. The recommendations are based on outcomes from 3238 patients undergoing surgery for PIVSR. Mean age was 67.5 ± 8.8 (40–88 years). Left ventricular function was compromised in most patients with mean ejection fraction of 40%. All papers carried out univariate and/or multivariate analyses of variables that contributed to different in-hospital mortalities. Early surgery, i.e. from >3 days to within 4 weeks after MI, had an overall in-hospital mortality of 52.4%; delayed surgery, typically from 1 week to after 4 weeks post-myocardial infarction, had an overall operative in-hospital mortality of 7.56%. Most authors observe that a shorter time between rupture and surgery is an unfavourable predictor of outcome independent of haemodynamic status. The consensus was that nearly all patients with PIVSR, particularly if >15 mm diameter with a significant shunt and resultant haemodynamic deterioration, should undergo early surgical repair. The precise timing of surgery depends on patients’ haemodynamic status. Exclusion from surgery should be considered if life expectancy or quality is severely limited by another limiting underlying pathology. If the patient is in cardiogenic shock, due to pulmonary to systemic blood flow ratio shunt rather than infarct size, immediate surgery should follow resuscitation measures and cardiac support. If the patient is haemodynamically stable, surgery could be performed after 3–4 weeks of medical optimization with inotropic and mechanical cardiac support. If there is clinical deterioration, immediate surgery is indicated.

Keywords: Ventricular septal rupture • Post-myocardial infarction • Complications • Surgery • Timing

INTRODUCTION

A best evidence topic was constructed according to a structured protocol. This is fully described in ICVTS [1].

THREE-PART QUESTION

In which [patients with a post-infarct VSR] might [immediate surgery] give better results than [delayed surgery] in terms of [mortality]?

CLINICAL SCENARIO

You have been asked to review a 75-year old man with an inferior acute myocardial infarct (AMI). Coronary angiography demonstrated an occluded right coronary artery. He developed right-sided heart failure with a worsening metabolic acidosis. Echocardiogram demonstrates a 20-mm inferobasal post-infarct ventricular septal rupture (PIVSR). His systolic pressure is 120 mmHg on 10 µg/kg/min of dobutamine and an intra-aortic balloon pump (IABP). The electrocardiogram indicates a resolving AMI. The cardiologist would like to discuss the timing of surgery with you. You decide to look up the evidence on the topic.

SEARCH STRATEGY

A Medline search from 1948 to July 2012 was performed using (Objective, View and Interaction Design Interface) for Medline interface [ventricular septal rupture OR ventricular septal perforation] AND [mortality OR death] AND [immediate surgery OR delayed surgery OR surgery].

SEARCH OUTCOME

Eighty-eight papers were found using the reported search. Six papers were identified that provided the best evidence to answer the question (Table 1). The recommendations are based on operative outcomes of 3238 patients.
<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcome</th>
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</thead>
</table>
| Di Summa et al. (1997), J Cardiovasc Surg, Italy [2] | Single-centre experience over 6 years, n = 34 | Hospital mortality | Overall hospital mortality: 23.5% | Mortality in patients operated:  
- <7 days from diagnosis: 44.4% (18 of 34 patients)  
- >7 days from diagnosis: 0% (16 of 34 patients) (P = 0.001)  
Mortality predictors:  
- Shorter gap between onset of PIVSR and operation  
- Site of MI (inferior) | Authors advocate immediate cardiac support (IABP or ventricular assist device) to achieve haemodynamic stabilization and shaping of stronger cicatricial tissue before surgery  
Surgery often mandatory in early period due to haemodynamic and clinical deterioration |
- <4 weeks from PIVSR: 31% (150 of 179 patients)  
- >4 weeks from PIVSR: 0% in chronic PIVSR (29 of 179 patients) | Authors believe that surgical correction should be promptly offered to nearly all patients with PIVSR. Those who are haemodynamically stable (classed as chronic PIVSR) can have delayed surgery, associated with higher survival |
- ≤7 days from MI: 75%  
- >3 weeks from MI: 16%  
Mortality predictors:  
- Shorter time from MI to surgery (P = 0.003)  
- Cardiogenic shock (P = 0.031)  
- Pulmonary pressure (P = 0.03)  
- PIVSR diameter (P = 0.003) | Authors suggest attempting to delay surgery by stabilizing the patients in ICU with IABP and medical therapy  
Surgery should be performed immediately in patients in shock, unless there is a severe, life-shortening, underlying pathology |
| Mantovani et al. (2006), Int J Cardiol, Italy [5] | Single-centre experience over 9 years, n = 50 | Operative mortality | Overall operative mortality: 36% | Mortality in patients operated:  
- ≤3 days from PIVSR: 52%  
- >3 days from PIVSR: 11%  
Mortality predictors on univariate analysis:  
- Interval from rupture to surgery <3 days (P = 0.0055)  
- Emergency operation (P = 0.02)  
- Aortic cross-clamp time >100 min (P = 0.035) | The authors support early operation in all patients, including those in haemodynamic stability, even though their data show that delayed surgery is associated with improved survival |
| Coskun et al. (2009), J Cardiothorac Surg, Germany [6] | Single-centre experience over 15 years, n = 41 | Hospital mortality | Overall hospital mortality: 32% | Mortality in patients operated:  
- ≤3 days from MI: 100%  
- >36 days from MI: 0%  
Mortality predictors:  
- Shorter time between MI and surgery  
- Cardiogenic shock  
- Posterior PIVSR  
- LV dysfunction  
- Thrombolysis | Authors advocate for patient stabilization and delayed surgery (2 weeks after PIVSR)  
If the patient is in cardiogenic shock, urgent surgery is necessary |
RESULTS

Di Summa et al. [2] operated on 34 patients. The mean time from AMI to PIVSR was 5.24 days, with 93% of patients having New York Heart Association (NYHA) III/IV symptoms. The mean duration of time from PIVSR diagnosis to surgery was 10 ± 17.7 days. Hospital mortality was 23.5%. Patients operated on very early (1 ± 1.41 days) had significantly worse outcomes with a 87.5% mortality (P = 0.001). When patients were operated on within 1 week from diagnosis, mortality reached 44.4%, compared with the 0% in patients operated on later. The reason for the mortality was haemodynamic compromise in the setting of emergency surgery. Predictors of mortality included a short gap between onset of PIVSR and operation and also an inferior infarct. The authors recommend immediate cardiac support (IABP or ventricular assist device) to achieve haemodynamic stabilization and shaping of stronger cicatricial tissue before surgery. This is often not feasible as surgery commonly becomes mandatory in the early period due to haemodynamic and clinical deterioration.

Dalrymple-Hay et al. [3] operated on 179 patients. Operative mortality was 26.7%, ranging from 31% in PIVSR repaired in less than 4 weeks to 0% after 4 weeks. In the early surgery group, 73% of patients were operated on the day of rupture and 16% within 2 days. The median time from infarct to repair in the late surgery group was 65 days. On Cox proportional hazard modeling, there was no relationship between preoperative condition and survival. Thus, the authors believe that surgical correction should be promptly offered to nearly all patients with PIVSR no matter how unstable they are. They agree with Di Summa et al. [2] that patients who are haemodynamically stable (classed as chronic PIVSR) can have delayed surgery, which is associated with higher survival.

Cerin et al. [4] evaluated 58 patients who underwent PIVSR repair, 93% of whom were in NYHA classes III and IV. Diagnosis of PIVSR occurred after a mean time of 4 ± 3 days after AMI and the mean period from AMI to surgery was 14 ± 12 days. Operative mortality was 52% and it was associated with a shorter time from AMI to surgery (P = 0.003), cardiogenic shock (P = 0.031), raised systolic pulmonary artery pressure (P = 0.03) and PIVSR diameter (P = 0.003). Mortality in patients who had surgical repair in the first week following AMI reached 75%, whereas in those operated on 3 weeks after AMI, mortality was 16%. Similarly, these authors suggest attempting to delay surgery by stabilizing the patients in critical care with IABP and medical therapy. Surgery should, however, be performed immediately in patients in shock, unless there is a severe, life-shortening, underlying pathology.

Mantovani et al. [5] reviewed 50 patients who had operative repair for PIVSR. Median time between PIVSR and repair was 2 days. Overall operative mortality was 36%. Mortality in patients operated on within the first 3 days from PIVSR was 52% compared with 11% in those operated on after that 76% of cases were performed within 1 week and 14% after 30 days from PIVSR. On univariate analysis, mortality was associated with emergency operation (P = 0.02) and a shorter than 3 days interval from rupture to surgery (P = 0.0055). The authors support early operation in all patients, including those in haemodynamic stability, even though their data show that delayed surgery is associated with improved survival.

Coskun et al. [6] analysed 41 patients. Mean time from AMI to rupture PIVSR was 8.7 days, and from rupture to surgery, it was 23.1 days. Hospital mortality was 32% and it was associated with shorter time between AMI and surgery. Mortality was 100% in patients operated on within 3 days and 0% in those operated on after 36 days. The authors thus advocate for patient stabilization and delayed surgery (2 weeks after PIVSR). If the patient is in cardiogenic shock, urgent surgery is usually necessary.

Finally, Arnaoutakis et al. [7] analysed national data from 2876 patients whose operative mortality was 54.1% if they were operated on within 7 days from AMI and 18.4% if the repair took place after that. As the time interval between AMI and PIVSR repair became longer, the odds of dying became progressively lower (<6 h: odds ratio [OR] = 6.18; 6–24 h: OR = 5.53; 1–7 days: OR = 4.59; 8–21 days: OR = 2.37, all P < 0.01). According to the authors, it may be beneficial for

Table 1. (Continued)

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<td>National data over 11 years n = 2876</td>
<td>30-day/in-hospital mortality</td>
<td>Operative mortality if repair:  - Within 7 days from AMI: 54.1%  - More than 7 days from AMI: 18.4%</td>
<td>Progressively higher odds of dying with shorter time interval between AMI and PIVSR repair: (&lt;6 h: OR = 6.18; 6–24 h: OR = 5.53; 1–7 days: OR = 4.59; 8–21 days: OR = 2.37, all P &lt; 0.01)</td>
</tr>
<tr>
<td>National data (level 3)</td>
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<td>Haemodynamically stable patients with multiple risk factors for operative death, but without multiple organ failure should have delayed operation</td>
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</tbody>
</table>

AMI: acute myocardial infarct; RV: right ventricular; LV: left ventricular; PIVSR: post-infarct ventricular septal rupture; MI: myocardial infarction; IABP: intra-aortic balloon pump; NYHA: New York Heart Association; CBP: cardiopulmonary bypass; ICU: intensive care unit; LVEF: left ventricular ejection fraction.

A lower-risk elective procedure can then be performed at a later date allowing myocardial scar tissue to form facilitating PIVSR repair.
haemodynamically stable patients with multiple risk factors for operative death, but without multiple organ failure, to have delayed surgery. A lower-risk elective procedure can then be performed at a later time, allowing myocardial scar tissue to form, facilitating PIVSR repair.

CLINICAL BOTTOM LINE

The timing of surgical repair depends on patients’ haemodynamic status. If the patient is in cardiogenic shock, due to pulmonary to systemic blood flow ratio shunt rather than infarct size, immediate surgery should follow resuscitation measures and cardiac support. If the patient is haemodynamically stable, surgery could be performed after 3–4 weeks of medical optimization with inotropic and mechanical cardiac support. If there is clinical deterioration, immediate surgery is indicated.

Conflict of interest: none declared.

REFERENCES


eComment. Percutaneous closure of post-myocardial infarction septal defect

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We read with great interest the paper by Papalexopoulou et al. regarding the best timing for surgery in patients with post-infarct ventricular septal rupture [1]. After carefully reviewing the literature, the authors conclude that the best strategy is to delay the surgery by 3–4 weeks if the haemodynamic status of the patient allows. However, current guidelines advocate immediate surgical closure of the ventricular septal defect (VSD) irrespective of the patient’s haemodynamic status to circumvent further haemodynamic decline [2].

First described by Lock et al. in 1988, the transcatheter closure of VSD has gained a widespread use, and devices originally intended to close the patent foramen ovale or atrial septal defects, have been modified for closure of muscular VSD. This less-invasive interventional approach allows, in the majority of cases, rapid haemodynamic stabilization by reducing the left-to-right shunt [3]. Anatomical considerations, best depicted by echocardiography, represent a major limitation of this procedure. Large VSDs exceeding 35 mm, apical VSDs without suitable rim or basal VSDs in the vicinity of mitral apparatus or the aortic valve represent a contraindication to the percutaneous closure with Amplatzer devices [4]. Another important drawback is the limited number of centres with sufficient expertise in performing these challenging procedures, because percutaneous closure of an acute postinfarct VSD remains one of the most demanding procedures in interventional cardiology.

Costache et al. used an Amplatzer occluder as a bridge-to-surgical procedure in a 79-year-old woman in cardiogenic shock secondary to a post-infarct VSD [5]. The combined approach enabled them to perform surgery on a more stable patient. Recently, Thiele et al. [4] evaluated, in a prospective study, the outcomes of primary interventional closure of postinfarction VSD in an acute setting as an alternative to surgical closure. The overall 30-day mortality of this less-invasive approach was 35%. Not surprisingly, the mortality rate was higher in patients with cardiogenic shock. Major complications occurred in 41% and these included free ventricular wall rupture, device embolization or dislocation and residual left-to-right shunting.

Despite advances in medical and surgical care intervention, mortality of postinfarction VSD remains high, especially in patients with haemodynamic compromise. Future multicentre studies are warranted to identify patients best suited for surgical or interventional closure, in the era of evolving alternative technologies.

Conflict of interest: none declared.

References


eComment. The use of mechanical assistance devices in post-infarction ventricular septal defects

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We read with great interest the paper by Papalexopoulou et al. regarding the best timing for surgery in patients with post-infarct ventricular septal defects (PVSD) [1]. As outlined by the authors, the patients’ haemodynamic status, particularly when the pulmonary-to-systemic (Qp/Qs) shunt ratio is high, dictates the timing of surgery. The majority of patients, up to 89% in the presented series, were operated later (0–18.4%). It is intuitive that if feasible, reparative surgery should follow resuscitation measures and cardiac support (MCS), used up to 76% preoperatively in the presented series.

In a relatively recent era, the good results of MCS other than IABP as a bridge-to-transplantation support, has led clinicians to extend their use to patients with acute cardiogenic shock related to PVSD. Although promising, the early experience with PVSD patients was not as good as expected. Meyns et al. [2] reported sudden