Does the placement of an Amplatzer septal occluder device confer benefit in patients with a post-infarction ventricular septal defect?

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Abstract

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was ‘Is the placement of an Amplatzer septal occluder device across a post-infarction ventricular septal defect a suitable alternative for patients not eligible for surgical repair?’ Altogether, 31 papers were found using the reported search, of which 17 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. We conclude that the insertion of an Amplatzer occluder device in patients with a post-infarction ventricular septal defect (VSD) not amenable to surgical repair can offer benefit in selected patients. Patients with cardiogenic shock frequently have an unfavourable outcome and closure should be considered cautiously. From the literature available, patients have a better outcome if the intervention is delayed by 2 weeks or more possibly due to the maturation of the VSD and recovery of myocardial function. In certain situations, device closure may be complicated by device dislocation or embolization, residual shunting or a tortuous course not amenable to device implantation. In such settings, surgical repair is the only option. In patients who proceed straight to surgical repair with no attempt at percutaneous closure, the overall mortality lies in the region of 43% and similar to percutaneous closure, there is an association observed between those operated within 7 days of the VSD occurrence and those greater than this time. Patients presenting in cardiogenic shock experienced an increased risk of death and if the timing of myocardial infarction to VSD closure could be delayed by 3 weeks, there was a statistically significant reduction in operative mortality. Percutaneous closure of a post-infarction VSD may avoid the requirement for surgical closure. However, in some cases, it provides time to allow the VSD to mature and the patient to stabilize and be optimized acting as a bridge to surgery to offer the best possible outcome for the patient.

Keywords: Myocardial infarction • Ventricular septal defect • Amplatzer device

INTRODUCTION

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

THREE-PART QUESTION

In patients not eligible for surgical repair of a post-infarction ventricular septal defect (VSD), is the placement of an Amplatzer occluder device a suitable alternative?

CLINICAL SCENARIO

You are called to provide a surgical opinion on a patient who has developed a post-infarction VSD. On the grounds of past medical history and haemodynamic compromise, it is deemed that immediate surgical closure would carry a high risk of mortality. The cardiologist mentions the ability to perform a percutaneous closure of the VSD using an Amplatzer occluder device and you question the value of this management strategy in this setting and resolve to review the literature.

SEARCH STRATEGY

Medline 1950 to March 2013 using Ovid interface

[VSD.tw OR Ventricular adj1 septal adj1 defect$.tw OR exp Heart Septal Defects Ventricular/ OR Post-infarct$ ventricular septal defect$.tw OR Postinfarct$ ventricular septal defect$.mp OR exp Heart Rupture, Post-Infarction/ OR exp Ventricular Septal Rupture/] AND [exp Myocardial Infarction/ OR MI.mp.] AND [Amplatze$ adj1 device).tw OR sepal adj1 occlude$.adj1 device$.tw OR transcatheter adj1 closure adj1 device$.tw OR sepal adj1 closure adj1 device$.tw OR transcatheter adj1 occlude$.adj1 device$.tw OR VSD adj1 closure adj1 device$.tw OR VSD adj1 occlude$.adv1 device$).tw].
<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theile et al. (2009), Eur Heart J, Germany</strong> [2]</td>
<td>29 patients with post-infarction VSD between September 2003 and February 2008. Median age of 72 years (IQR: 67–79 years)</td>
<td>Success</td>
<td>25 successful</td>
<td>This is the largest study reported to date. All patients were managed in the acute phase of the illness and the mortality rate was 72% (highest in those with cardiogenic shock). Five patients subsequently underwent surgical repair following the primary transcatheter approach.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Device</td>
<td>7 ASDs</td>
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<tr>
<td></td>
<td></td>
<td>Survival</td>
<td>8 alive</td>
<td></td>
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<td></td>
<td></td>
<td>Complications</td>
<td>Dislocation of device</td>
<td></td>
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<td></td>
<td>AV-block</td>
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<td>Left ventricular rupture during device insertion</td>
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<td>Subsequent left ventricular rupture</td>
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<td></td>
<td>Infective endocarditis</td>
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<td></td>
<td></td>
<td>Residual shunt</td>
<td>Unquantified in 4 patients</td>
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<tr>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Median time 1 day (IQR: 1–3 days)</td>
<td></td>
</tr>
<tr>
<td><strong>Bialkowski et al. (2007), Rev Esp Cardiol, Poland</strong> [3]</td>
<td>17 patients with a primary post-infarction VSD between 2000 and 2006 aged between 53 and 81 years</td>
<td>Success</td>
<td>12 successfully deployed</td>
<td>The use of an Amplatzer septal occluder device is most successful in those patients who are managed in the chronic phase (more than 3 weeks). Five patients subsequently underwent surgical closure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Device</td>
<td>14 Amplatzer septal occlude devices ranging from 10 to 30 mm</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1 MVSDO 10 and 12 mm</td>
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<td></td>
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<td></td>
<td>2 PIMVSDO 22 mm</td>
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<tr>
<td></td>
<td></td>
<td>Survival</td>
<td>6 died</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complications</td>
<td>VF</td>
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<td></td>
<td></td>
<td></td>
<td>Multiorgan dysfunction</td>
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<td>Haemolysis</td>
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<td>AV block</td>
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<td></td>
<td>Kinking</td>
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<tr>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>1 None</td>
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<td></td>
<td></td>
<td></td>
<td>8 Small</td>
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<td></td>
<td></td>
<td></td>
<td>1 Moderate</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>2 Severe</td>
<td></td>
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<td></td>
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<td>Phase of treatment</td>
<td>3 within 2–3 weeks</td>
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<td>13 at 3.5–12 weeks</td>
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<td></td>
<td>1 at almost 1 year</td>
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<tr>
<td><strong>Assenza et al. (2013), Circ Cardiovasc Interv, USA</strong> [4]</td>
<td>12 patients (8 males) Mean age of 68 ± 6 years</td>
<td>Success</td>
<td>Successful deployment</td>
<td>Report of 12 patients with successful device deployment at a mean of 19 days. A severe residual shunt in 3 patients necessitated subsequent surgical closure. The remaining patients had either no-moderate shunting. Five patients died.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Device</td>
<td>Clamshell: 33%</td>
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<td></td>
<td></td>
<td></td>
<td>CardioSEAL: 33%</td>
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<td>StarFlex: 54%</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Survival</td>
<td>5 of 12 patients died</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complications</td>
<td>Device embolization: 1 patient</td>
<td></td>
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<td></td>
<td>Intraprocedural death (asystole): 1 patient</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>3 patients had a severe shunt requiring subsequent surgical closure</td>
<td></td>
</tr>
</tbody>
</table>

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Table 1: (Continued)

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Patient group</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Marinakis et al. (2007), Acta Cardiol, Belgium [5]</td>
<td>8 patients (6 males) with post-MI VSD, aged 76.3 years average ± 6.2 years, 7 closed in acute phase (within 2 weeks of MI)</td>
<td>Success</td>
<td>Successfully deployed in 7 patients 1 unsuccessfully deployed due to severe residual shunt resulting from an evolving infarction</td>
<td>Report of 8 cases with successful VSD closure in 7 patients resulting in a small–moderate shunt. One patient survived (treated at 15 days post-infarction) and was alive and well at 38 months with no residual shunt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Patients treated at a mean of 19 days (IQR: 11–27 days)</td>
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<tr>
<td></td>
<td></td>
<td>Device</td>
<td>Amplatzer MVSDO</td>
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<tr>
<td></td>
<td></td>
<td>Survival</td>
<td>1 patient alive at 38 months follow-up 6 died 0–38 months post procedure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complications</td>
<td>Multiorgan failure, progressive myocardial infarction, gastrointestinal sepsis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>Small-to-moderate residual shunt in all patients</td>
<td></td>
</tr>
<tr>
<td>Szkatnik et al. (2003), Eur J Cardiothorac Surg, Poland [6]</td>
<td>6 patients mean age 60 years (range 51–71 years) One excluded owing to primary surgical intervention prior to transcatheter closure</td>
<td>Success</td>
<td>4 successfully deployed 1 unsuccessful</td>
<td>Transcatheter closure of post-infarction VSD should be undertaken in a delayed fashion with a period of 6 weeks or more. Two patients subsequently had surgery: one was performed immediately resulting in death 6 weeks later from pancytopenia and the other patient survived surgery and is well at 2 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Performed within 1 week in 6 patients</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Device</td>
<td>Amplatz atrial septal occluder 18, 19, 20, 24 Amplatz ventricular septal occluder 10, 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival</td>
<td>4 alive 1 died</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complications</td>
<td>Multiorgan failure Transient haemolysis due to residual shunt Increasing mitral incompetence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>2 Small 1 Trivial 1 None</td>
<td></td>
</tr>
<tr>
<td>Martinez et al. (2007), Catheter Cardiovasc Interv, USA [7]</td>
<td>5 patients with a post-infarction VSD. One patient was excluded owing to primary surgical intervention prior to transcatheter closure 5 patients had a post-traumatic/iatrogenic VSD and this group was excluded</td>
<td>Success</td>
<td>4 successfully deployed</td>
<td>Three patients having treatment survived with 1 patient succumbing to renal and central nervous system complications. No timing of VSD closure was given making it difficult to interpret outcome with delay in closure. No patients received subsequent surgical closure of VSD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>1 at 2 weeks 4 ≥ 6 weeks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Device</td>
<td>30 mm Amplatzer ASD occlude 10 and 20 mm PIMVSDO 12 mm MVSDO 16 mm Amplatzer PIMVSDO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival</td>
<td>1 died 1 NYHA Class II 2 NYHA Class I</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complications</td>
<td>Renal and central nervous system complications</td>
<td></td>
</tr>
</tbody>
</table>
Table 1: (Continued)

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
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<th>Key results</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>1 Moderate</td>
<td>2 Small</td>
<td>1 None</td>
</tr>
<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>3 days post MI for the patient who died 5 days post procedure. Timing not provided for other patients</td>
<td></td>
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</tr>
<tr>
<td><strong>Device</strong></td>
<td></td>
<td>Amplatzer post-infarction muscular VSD closure device 20 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Survival</strong></td>
<td></td>
<td>2 alive</td>
<td>1 died</td>
<td></td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
<td>Haemolysis requiring transfusion</td>
<td>Groin haematoma requiring transfusion</td>
<td>Arterial damage requiring SFA repair</td>
</tr>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>2 trivial</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>2 occurred after 50 days post-infarct</td>
<td>1 at 2 days post-infarct</td>
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</tr>
<tr>
<td><strong>Device used</strong></td>
<td></td>
<td>14 and 9 mm Amplatzer MVSDO</td>
<td></td>
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</tr>
<tr>
<td><strong>Survival</strong></td>
<td></td>
<td>1 died post procedure, 1 alive at 6 months follow-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>Not specified</td>
<td></td>
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</tr>
<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>1 patient treated at 10 days</td>
<td>1 patient treated more than 14 days</td>
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</tr>
<tr>
<td><strong>Device used</strong></td>
<td></td>
<td>10 mm Amplatzer septal occluder</td>
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<tr>
<td><strong>Survival</strong></td>
<td></td>
<td>Alive 1 month follow-up</td>
<td></td>
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</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
<td>None noted</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>Trivial residual shunt</td>
<td></td>
<td></td>
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<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>More than 14 days</td>
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</tbody>
</table>

**Ahmed et al. (2008), Heart Lung Circ, New Zealand [8]**

Case series (level IV)

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
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<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>2 of 3 successfully deployed</td>
<td>1 unable to cross defect</td>
<td></td>
</tr>
<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>Successful outcome in those patients who are stabilized in the acute phase and managed later relative to immediate or early closure</td>
<td></td>
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</tr>
<tr>
<td><strong>Device</strong></td>
<td></td>
<td>Amplatzer post-infarction muscular VSD closure device 20 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Survival</strong></td>
<td></td>
<td>2 alive</td>
<td>1 died</td>
<td></td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
<td>Haemolysis requiring transfusion</td>
<td>Groin haematoma requiring transfusion</td>
<td>Arterial damage requiring SFA repair</td>
</tr>
</tbody>
</table>

**Parsi et al. (2001), J Interv Cardiol, Germany [9]**

Case reports (level IV)

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>2 trivial</td>
<td></td>
<td></td>
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<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>2 occurred after 50 days post-infarct</td>
<td>1 at 2 days post-infarct</td>
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<tr>
<td><strong>Device used</strong></td>
<td></td>
<td>14 and 9 mm Amplatzer MVSDO</td>
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<tr>
<td><strong>Survival</strong></td>
<td></td>
<td>1 died post procedure, 1 alive at 6 months follow-up</td>
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</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>Not specified</td>
<td></td>
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</tr>
<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>1 patient treated at 10 days</td>
<td>1 patient treated more than 14 days</td>
<td></td>
</tr>
<tr>
<td><strong>Device used</strong></td>
<td></td>
<td>10 mm Amplatzer septal occluder</td>
<td></td>
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</tr>
<tr>
<td><strong>Survival</strong></td>
<td></td>
<td>Alive 1 month follow-up</td>
<td></td>
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</tr>
<tr>
<td><strong>Complications</strong></td>
<td></td>
<td>None noted</td>
<td></td>
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</tr>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>Trivial residual shunt</td>
<td></td>
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<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>More than 14 days</td>
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</table>

**Mullasari et al. (2001), Catheter Cardiovasc Interv, India [10]**

Case report (level IV)

<table>
<thead>
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<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residual shunt</strong></td>
<td></td>
<td>Successfully deployed</td>
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</tr>
<tr>
<td><strong>Phase of treatment</strong></td>
<td></td>
<td>Report of a single case with successful VSD closure resulting in a trivial residual shunt. No complications were recorded and the patient was alive and well at 1 month of follow-up</td>
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<table>
<thead>
<tr>
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<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schiele et al. (2003), Catheter Cardiovasc Interv, Germany [11]</td>
<td>1 patient aged 75 years</td>
<td>Success</td>
<td>Successfully deployed</td>
<td>Report of a single case with successful VSD closure resulting in a minimal residual shunt. Following the procedure, a gradual deterioration of left ventricular function ensued resulting in death of the patient</td>
</tr>
<tr>
<td>Martinez et al. (2006), J Am Soc Echocardiogr, USA [12]</td>
<td>1 patient aged 84 years with a post-infarction VSD</td>
<td>Success</td>
<td>Successfully deployed</td>
<td>Report of a single case with successful VSD closure resulting in a minimal residual shunt. No complications were recorded and symptomatic improvement was observed and the patient survived the procedure</td>
</tr>
<tr>
<td>Perez-David et al. (2007), J Am Soc Echocardiogr, Spain [13]</td>
<td>1 patient aged 71 years with a post-infarction VSD</td>
<td>Success</td>
<td>Successfully deployed</td>
<td>Report of a single case carried out in the acute phase of MI with successful VSD closure and a minor residual shunt. No complications were recorded and the patient subsequently showed symptomatic improvement and was alive at 3 months of follow-up</td>
</tr>
<tr>
<td>Giombolini et al. (2008), J Cardiovasc Med, Italy [14]</td>
<td>1 patient aged 86 presenting with a post-infarction VSD 22 days post MI</td>
<td>Success</td>
<td>Successfully deployed</td>
<td>Report of a single case with successful VSD closure resulting in a minimal residual shunt. This was complicated by the development of a transient complete heart block, which developed into a persistent first-degree heart block. The patient succumbed 3 days post procedure to progressive renal failure</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viana-Tejedor et al. (2008), J Invasive Cardiol, Spain [16]</td>
<td>Case report (level IV)</td>
<td>1 patient aged 77 years with a post-infarction VSD</td>
<td>Residual shunt</td>
<td>Residual shunt of 12% on oximetry</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Three days post-infarction</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Success</td>
<td>Device successfully deployed</td>
<td>Report of a single case with successful VSD closure resulting in a minor residual shunt complicated by severe tricuspid regurgitation and moderate impairment of biventricular function. Patient subsequently died secondary to cardiogenic shock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Device</td>
<td>35 mm Amplatzer interatrial septal device</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Survival</td>
<td>Died 2 days post admission (cardiogenic shock and cardiac arrest)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Complications</td>
<td>Severe tricuspid regurgitation</td>
<td>Moderately impaired biventricular function</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>Minor residual shunt</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Not specified</td>
<td></td>
</tr>
<tr>
<td>Moreno et al. (2011), J Invasive Cardiol, Portugal [17]</td>
<td>Case report (level IV)</td>
<td>1 patient aged 71 years with a post-infarction VSD</td>
<td>Success</td>
<td>Unsuccessful deployment</td>
<td>Amplatzer device failed to deploy owing to a serpiginous course, however, device left as reduced shunt with a view to surgical closure. Patient proceeded to develop multiorgan failure Day 1 post procedure and died</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Device</td>
<td>24 mm Amplatzer muscular VSD occlude</td>
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<td></td>
<td></td>
<td>Device</td>
<td>26 mm Amplatzer atrial septal occluder</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Survival</td>
<td>Death Day 1 post procedure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Complications</td>
<td>Third-degree AV block</td>
<td>Multiorgan failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>Unquantified persisting shunt</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Day 6 post-infarction</td>
<td></td>
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<tr>
<td>Kar et al. (2012), J Invasive Cardiol, USA [18]</td>
<td>Case report (level IV)</td>
<td>1 patient with a post-infarction VSD aged 52 years</td>
<td>Success</td>
<td>Two of three devices successfully deployed</td>
<td>Successful initial closure with two attempts. Eight weeks later, the patient developed a recurrent VSD that was successfully treated with a third Amplatzer device with a successful outcome</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Device</td>
<td>VSD Amplatzer Occluder Device (16 mm, 12 mm, another 12 mm deployed 8 weeks later)</td>
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<td></td>
<td></td>
<td></td>
<td>Survival</td>
<td>Alive</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Complications</td>
<td>Congestive cardiac failure</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Residual shunt</td>
<td>Significant shunt after first deployment</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Phase of treatment</td>
<td>Initial treatment at 8 days</td>
<td>Repeat intervention at 8 weeks</td>
</tr>
</tbody>
</table>

ASD: atrial septal defect; AV-block: atrioventricular block; IQR: interquartile range; MI: myocardial infarction; MVSDO: Muscular ventricular septal device occluder; NYHA: New York Heart Association; PIMVSDO: post-infarction muscular ventricular septal device occluder; SFA: superficial femoral artery; VF: ventricular fibrillation; VSD: ventricular septal defect.
SEARCH OUTCOME

Thirty-one papers were found using the reported search. From these, 17 papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

RESULTS

Thiele et al. [2] reported the largest series of 29 patients with a median age of 72 years. Sixteen patients (55%) were in cardiogenic shock and all had an intra-aortic balloon pump (IABP). Twenty-five patients had successful device placement with 3 patients having unsuccessful device implantation with subsequent death and 1 patient proceeded to surgery following unsuccessful device closure. The median time from VSD occurrence to closure was 1 day and 31% (8 patients) were alive at a median follow-up of 730 days. Patients presenting with cardiogenic shock had a higher 30-day mortality relative to those not in cardiogenic shock (62 vs 9%, respectively; P < 0.001). There was an unquantified residual shunt in 4 patients. Five patients proceeded to surgical closure for either dislocation of the Amplatzer device (3 patients) or residual shunting (2 patients). One of the 3 patients undergoing surgery for device dislocation died.

Bialkowski et al. [3] assessed 17 patients with a median age of 66 years. Five patients had an IABP and 11 (65%) survived. The majority of patients were managed 3.5–12 weeks following VSD occurrence. Of these, 5 underwent surgical closure. Of the 3 patients managed in the acute phase, 1 died due to pericardial tamponade and 2 proceeded to surgical repair. Of the patients who had a residual shunt, the majority were classified as small and required no further intervention.

Assenza et al. [4] analysed 12 patients with a mean age of 68 years. Cardiogenic shock was present in 7 patients (58%) at the time of closure, which was performed at a median of 19 days following admission. The majority of patients had a trivial–moderate residual shunt. Five patients (42%) died resulting from multiorgan failure. Three patients subsequently proceeded to surgical repair owing to a persisting shunt, one on the same day as the attempted percutaneous closure, one at 1 month and one at 4 months post-attempted percutaneous VSD closure.

Marinakis et al. [5] reported on 8 patients with a mean age of 76 years. Shock was present in 50% of patients and 75% had an IABP. Closure was performed in all patients within 1 week except in 2: one was closed at 15 days and the other had the VSD for 6 years. Seven patients had successful device deployment and 6 patients died within 30 days. The only survivor underwent closure at 15 days post-infarction and was alive at 38 months with no residual shunt. A small-to-moderate shunt was present in all and no patient required surgical closure.

Six patients with a mean age of 60 years were reported by Szkutnik et al. [6]. Four patients had successful device deployment. All were closed at 6 weeks or longer, except one performed 2 weeks post-VSD development. A residual shunt was present in all but one. Of the 2 patients who died (33%), one had closure at 6 weeks and one had immediate surgery following inability to cross the defect. One other patient required surgical closure performed with success at 2 weeks.

Martinez et al. [7] analysed 4 patients aged between 51 and 88 years. Three patients survived with one requiring the deployment of a second device 4 months later due to a residual shunt. The timing of the procedures was not provided except for the patient who had closure performed 3 days post-VSD occurrence resulting in death 5 days later. No subsequent surgical closure was necessary.

Three patients aged between 66 and 75 years were studied by Ahmed et al. [8]. Two of the three Amplatzer devices were successfully deployed with trivial shunts documented. Two patients survived, both of whom had treatment 50 days after the infarct and none required surgical closure.

Parsi et al. [9] reported on 2 patients aged 75 and 78 years with successful device deployment. One patient treated 14 days post-infarction was well at 6 months; one patient treated at 10 days post-infarction died due to cardiogenic shock.

There were nine case reports of patients with a post-infarction VSD who underwent primary transcatheter closure with an Amplatzer device [10–18]. Successful device deployment was reported in all but one in whom the long and tortuous VSD course would not allow closure leading to death owing to multiorgan failure and another 3 patients died due to renal failure; gradual left ventricular impairment and cardiogenic shock. All but one patient had evidence of a residual shunt. Five patients were treated in the acute phase of which 3 survived. Three patients were managed in the chronic phase (14 days or more) of which 2 survived. No patient required surgical repair.

Arnaoutakis et al. [19] reported on 2876 patients with a post-infarction VSD who proceeded straight to surgical repair. The overall mortality rate in this large cohort was 42.9% and it was found that surgical repair within 7 days was met with a higher operative mortality rate compared with delayed intervention after 7 days (54.1 vs 18.4%, respectively). Similar to percutaneous transcatheter closure, surgical closure in the presence of cardiogenic shock was found to be independently associated with a greater odds ratio of operative death and if the timing from MI to VSD repair was more than 21 days, there was a lower odds of operative mortality (P < 0.01).

CLINICAL BOTTOM LINE

The insertion of an Amplatzer occluder device in patients with a post-infarction VSD can offer benefit in selected patients. Patients with cardiogenic shock frequently have an unfavourable outcome and closure should be considered cautiously. From the literature available, patients have a better outcome if the intervention is delayed by 2 weeks or more possibly due to the maturation of the VSD and recovery of myocardial function. The mortality rate associated with the repair of a post-infarction VSD is one of the highest of all cardiac surgical procedures and the placement of an Amplatzer septal occluder device may allow complete closure of the defect. However, it can also act as a bridge to surgical repair following a period of stabilization and patient optimization to offer the best possible outcome in this frequently fatal condition.

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Conflict of interest: none declared.

REFERENCES


