Precision in cardiology: should all cases of myocardial infarction with ventricular septal rupture require early repair?

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Though the incidence of ventricular septal rupture (VSR) after myocardial infarction (MI) has reduced from 3%[1] to 0.2%[2] due to improvements in cardiac pharmacotherapy and intervention, the mortality rate still exceeds 87%[1] in medically managed patients. The median time period between MI onset to VSR detection was 16–24 h [2] It has been described to occur in a bimodal pattern —within 24 h and between 3 and 5 days after MI.[3] It is considered a surgical emergency as it causes cardiogenic shock and worsens the haemodynamics and rapidly culminates in death. The mortality rate in surgically treated patients varies between 20% and 60%.[4] [5]This heterogeneity is attributable to timing of surgery for VSR, cardiogenic shock and recurrence of VSR. Independent predictors of mortality include posterior VSR, cardiogenic shock, inferior MI and renal failure.

Because of the dismal prognosis associated with VSR, American College of Cardiology and American Heart Association recommends immediate surgical repair. But various studies illustrate the improved mortality rate when the surgery was done after haemodynamic stabilisation.[5] [6] In a largest study, the operative mortality rate was 54% when the surgery was done within 7 days and it reduced to 18% when the surgery was done after 7 days.[5] The mortality was quite high when the surgery was done in an emergency basis, especially within 6 h of MI.[5]

Thiele *et al*[6] described a higher mortality rate of 83% with early surgical repair of post-MI VSR and a lower mortality rate of 29% with delayed repair after initial medical stabilisation and haemodynamic support. The mortality seen with the use of intra-aortic balloon pump (IABP) was 56.5% in that study. Papalexopoulou *et al*[7] described the operative mortality in early repair group to be around 31–75% and in the late repair group to be around 0–18.4% and has suggested that pulmonic to systemic blood flow (Qp/Qs) ratio should be the determining factor for timing of surgery. With increased Qp/Qs ratio, the surgery has to be undertaken on an early basis.

The need for emergency surgical intervention in these patients to avoid potential haemodynamic collapse should always be weighed against the benefit of lower mortality rates observed with delayed repair.[5] The rationale for better outcome with delayed surgery is that necrotic myocardium undergoes fibrotic remodelling and the tensile strength is increased. But in some patients postponing surgery may result in multiorgan dysfunction, which is associated with 100% mortality. Hence, timing of surgery should be individualised as per haemodynamic and metabolic profile. Elderly age is associated with poor outcome even with surgical repair.[8] Concomitant coronary artery bypass grafting (CABG) was not associated with excess mortality[5] and its role in improving late survival is still a debate.[8] Most common cause of death in post-MI VSR-operated patients was persistent low cardiac output.[5]

In our institution, seven patients of post-MI VSR (figures 1 and 2) with cardiogenic shock were analysed and followed up (table 1). The study period was from January 2009 to April 2011. Informed and detailed consent was taken from all the patients. The study was approved and cleared by institute's ethics committee. All patients were initially managed with intensive medical treatment till the unstable haemodynamics settled and delayed surgical revascularisation and VSR closure was done. The primary outcome 30-day mortality was noted.

In our observation (n=7), four patients were men (57%) and three patients were women (43%). The mean age was 61.8 years. We observed a higher prevalence of anterior wall MI (n=5, 71.4%) and the mean time duration for presentation of VSR after symptom onset was 3.1±1.2 days (day 2–day 5). The mean LVEF was 32±5%. Six patients (85.7%) underwent IABP insertion followed by surgery in the same setting and one patient had prior stenting to culprit vessel left anterior descending (LAD) artery. The mean duration of timing of surgery was 16.8±6.1 days (range day 8–day 24). Coronary revascularisation with CABG and patch closure of ventricular septal defect (VSD) was done in six patients (85.8%). Overall 30-day mortality was 14.2% (n=1). The cause of death was persistent cardiogenic shock. One patient had small haemodynamically insignificant residual VSD, which was conservatively managed and the patient was doing well on follow-up with no progression of VSD size. The mean follow-up in survivors was 16 months and all these patients had near normal quality of life with New York Heart Association (NYHA) class I/II.

Not all patients require emergency revascularisation and closure of defect. Our observation emphasised the importance of intensive early medical stabilisation of acute coronary syndrome with cardiogenic shock, use of IABP for haemodynamic support and delayed revascularisation with patch closure of defect resulted in improved outcomes.

In a recent study of post-MI VSR patients by Rohn *et al*[9] (n=25), the mean age of patients was

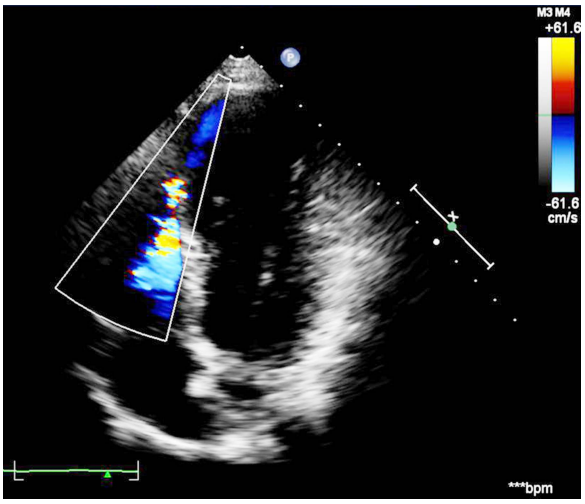

Figure 1 Apical four-chamber view colour Doppler imaging showing apical septal defect with left to right shunt.

70.2 years. The prevalence of acute heart failure mandating inotropic support was 72%. Cardiogenic shock was present in 52% of the patients and pulmonary arterial hypertension was seen in all the patients with mean systolic pulmonary artery pressure of 55±21.8 mm Hg. The mean LVEF was 42.8±12.9% and 12% of study subjects had severe LV systolic dysfunction with LVEF <30%. Majority of the patients (80%) had received IABP support preoperatively and most of them (84%) were operated on the day of admission. Other ventricular assist devices used were extracorporeal membrane oxygenation and Biomedicus centrifugal pumps. The overall operative mortality was 40%.[9]

Pang *et al*[10 11] studied the characteristics of 38 patients who had underwent surgery for post-MI VSR and have reported the 10-year follow-up. The mean age was 65.7 ± 9.4 years and majority were men (52.6%). The median interval from MI to VSR was 1 day. The VSR was anterior in 73.7% and posterior in 26.3% of patients. Around 98% of patients had preoperative IABP. Thirty-five patients (92.1%) underwent patch repair. The mean cardiopulmonary bypass time was 152 ± 52 min. CABG was performed in 19 patients (50%). The 30-day operative mortality was 39.5%. Emergency surgery, NYHA class, inotropic support, RV dysfunction, EuroSCORE II, intraoperative red cell transfusion, postoperative renal failure and renal replacement therapy were the predictors of operative mortality. Ten-year survival was 44.4 ± 8.4% and the factors determining long-term survival were RV dysfunction, LVEF and NYHA class at presentation. Concomitant CABG did not influence early or late survival.

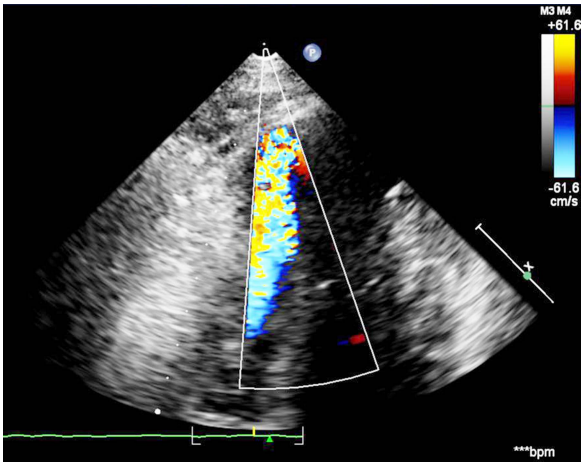

Figure 2 Parasternal long-axis apical view colour Doppler imaging showing apical septal defect with left to right shunt.

Table 1 Timing and outcomes of surgery in ventricular septal rupture in post-myocardial infarction

	Diagnosis	Day of presentation	Site of VSD	Day of surgery	Follow-up
Case 1	IWMI	D3	Mid-muscular	D16	15 months
Case 2	AWMI	D5	Apical	Not done	16 months
Case 3	AWMI	D4	Apical	D8	16 months
Case 4	IWMI	D2	Apical	D15	27 months
Case 5	AWMI	D2	Apical	D21	10 months
Case 6	AWMI	D3	Muscular	D24	12 months
Case 7	AWMI	D6	Apical	D16	Death

VSD, ventricular septal defect, AWMI, anterior wall myocardial infarction; IWMI, inferior wall myocardial infarction.

All patients can be given a good haemodynamic support with diuretics, afterload reducing agents, inotropes and IABP and dialysis if renal shutdown occurs. Most commonly reported haemodynamic support is with IABP. Haemodynamic support in the form of LV assist device has also been described in the literature. Gregoric *et al*[12] described a male patient with post-MI VSR, in whom TandemHeart was successfully used for 18 days before and after VSR surgical repair. Other rarely reported temporary LV unloading methods include occlusion of VSR with Swan-Ganz balloon catheter,[13] calibrated sizing balloon catheter.[14] extracorporeal membrane oxygenation, Biomedicus centrifugal pumps,[9] Abiomed BVS 5000 ventricular assist device[15] and Impella device.[16] The primary benefit of all these LV support devices is derived from LV unloading and reduction in left to right shunt through the VSR, thereby reducing shear stress and allowing more favourable substrate for healing and formation of fibrous tissue. Mechanical support device use can be complicated by pump failure due to aspiration of necrotic debris into the impeller pumps.[17] The pump can induce right to left shunt leading onto hypoxic brain damage.[18]

Percutaneous device closure can be done in high-risk unstable patients with small-sized VSD and in whom immediate revascularisation is not indicated or as an elective procedure at a later date in stable patients with small-sized VSD. Holzer *et al*[19] followed up 18 patients of postinfarct VSR with device closure and noted 30-day mortality of 41%. It allowed such patients to survive the immediate postoperative period with subsequent favourable prognosis but noted residual shunts. The more favourable VSR amenable to device closure are simple defects <15 mm with adequate rims and subacute or chronic VSR with onset duration >3.5 weeks.[20] The contraindications for transcatheter therapy include defect size >35 mm, basal VSD near mitral or aortic valves and apical VSD without sufficient margins.[21] Major residual shunting, LV rupture and device embolisation are the major complications and can occur in up to 41% of patients.[20]

If haemodynamic instability persists even after best medical stabilisation, VSD closure is to be promptly undertaken with or without CABG.

The incidence of residual defect after surgical repair of post-MI VSR was noted to be around 10–15%.[22] In the study

by Deja *et al*,[23] residual shunt was seen in 40% of patients, despite the mean time to surgical repair after rupture was 9 days. Redo open heart surgery in such patients through a repeat median sternotomy may be associated with high morbidity and mortality. The mortality rate of redo surgery for residual shunt was 29%.[23]In such patients, a modified procedure using beating heart technique and transatrial approach by right thoracotomy route has been described as a less invasive procedure.[22]

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Competing interests None.

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