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Original Research Article

Post MI VSR – Clinical Characteristics, Interventions and Patient Outcomes in the Interventional Era

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Conflict of interest: Nil

Abstract

Introduction: VSR is a rare but devastating complication after acute MI. Objective is to study prevalence and clinical characteristics of post MI VSR patients. To find out role of Trans Catheter Device Closure at its impact in outcomes of VSR patients. To devise effective prevention and management strategies in VSR patients and to assess outcomes and long term survival analysis of VSR patients.

Materials & Methods: Population of study comprises of adult patients presenting to Department of Cardiology with VSR after acute MI for period from August 2017 to August 2022.

Results: Out of 54 cases of post MI VSR, 29 cases were male (53%), 25 were female (46%). The highest incidence occurred involving age group between 51-60 years.46 cases(85.2%) had AWMI and 8 cases (14.8%) had IWMI. Half of them were diabetic (46%), 37 out of them were hypertensive(68%). High incidence of VSR occurred with cases with median delay between 24-48hours. LV systolic function was between 31-49% among 76% of cases. preserved EF >50% in 24% of cases. RV dysfucntion was present in 16 (29%). Most of the rupture occurred on the second day of acute myocardial infarction (53%).Echo assessment by transthoracic approach using 2D inferred defects between 7mm to 10 mm (average 7.3mm) before device closure along with CAG, LV angiogram was done in stable patients (9.2%). The defect in any angiography varied between 7mm to 18mm (average 13mm). The device sizes used ranges between 18 to 28mm. 18mm size used in 3 cases in our study. 18 cases underwent coronary & LV angiogram. 46 cases had apical posterior (85%). 1 cases had basal position (1.8%), mid septal position in one case and inlet position in one case. 2 male patients had multiple VSRs with both apical and Basal positions. 5 cases underwent Device closure with Amplatzeroccluder device (ASD Device) with successful deployment after forming AV loop between RFA and RT IJV. The survival rate is 50% at 30 days. Surgical closure was done for 6 cases. 4 patients died during Post operative period and the mortality rate was 4/6 (66%). In hospital death were 41 cases among 54 cases(75.9%) which occurred around 2 - 7 days.

Conclusion: Post MI VSR is a lethal disorder and carries high mortality. The earlier the repair, the higher the mortality as sutures does not hold in friable tissue. Overall mortality is slightly lower for patients with anterior VSR compared to posterior VSR. Prognosis is

favourable if rupture size is small and patient is hemodynamically stable at time of surgical repair.

Keywords: Ventricular septal rupture, acute myocardial infarction, cardiogenic shock, ventricular septal rupture repair, device closure, Coronary angiogram.

Introduction

Ventricular septal rupture (VSR) is a rare (0.02% incidence) life-threatening mechanical complication secondary to acute myocardial infarction that usually occurs 2 to 8 days after infarction[1,2]. The mortality rate is high after developing VSR. Because of the Septal Rupture RV fails leading to elevated PA pressure. Hypoperfusion of multiorgan starts rapidly leading to vicious cycle culminating in death. Surgery carries high mortality even in advanced centres. Device closure can be done with less mortality 20% to 30% vs. 50 % to 60%[3]. Early thrombolysis and early PCI can avoid such a fatal complication of VSR.[4]

Materials & Methods:

Study population: Comprises of adult patients presenting to Department of Cardiology with VSR as a complication of acute myocardial infarction.

Study Period: August 2017 to August 2022 (5 Years).

Selected Patients for the study: All M.I patients with VSR as complications in house and referred cases were included in this study. Other mechanical complications like MR due to papillary muscle rupture and free wall rupture and Congenital heart disease like VSD were excluded from this study.

Statistical analyses of the data: Statistical analyses of the data are conducted using the software IBM SPSS 20.0 version. Mean and standard deviation was derived for all the parametric variables. Statistical inference was derived by using Chi-square test.

Inclusion Criteria: All M.I patients with VSR as complications in house and referred cases

Exclusion Criteria:

- Other mechanical complications like MR due to papillary muscle rupture and free wall rupture.
- Congenital heart disease like VSD.

Results & Analysis: Out of 54 cases of post MI VSR, 29 cases were male (53%), 25 were female (46%). The highest incidence occurred involving age group between 51-60 years.46 cases(85.2%) had AWMI and 8 cases (14.8%) had IWMI. Half of them were diabetic (46%), 37 out of them were hypertensive(68%), one patient had CKD. smoking was risk factor in 25 cases (46%), 21 patients were alcoholic (38%). Stress was risk factor in 7 cases (12%) with respect to occupation (Eg - driver, teacher, and police). Elevated renal parameter and liver parameter were associated with high mortality rate, high incidence of VSR occurred with cases with median delay between 24-48 hours. LV systolic function was between 31-49% among 76% of cases. preserved EF >50% in 24% of cases. RV dysfunction was present in 16 (29%). Most of the rupture occurred on the second day of acute myocardial infarction (53%). Echo assessment by transthoracic approach using 2D inferred defects between 7mm to 10 mm (average 7.3mm) before device closure along with CAG, LV angiogram was done in stable patients (9.2%). The defect in any angiography varied between 7mm to 18mm (average 13mm). The

device sizes used ranges between 18 to 28mm. 18mm size used in 3 cases in our study. 18 cases underwent coronary & LV angiogram. 13 were male and 5 were females. IABP was used in one case, ECMO not available in our centre. culprit artery was almost 100% cut in almost all cases. PCI-POBA was done to one case with IWMI with RCA occlusion for a 54 years male patient. 46 cases had apical position (85%). 1 cases had basal position (1.8%), mid septal position in one case and inlet position in one case. 2 male patients had multiple VSRs with both apical and Basal positions. 5 cases underwent Device closure with Amplatzer occluder device (ASD Device) with successful deployment after forming AV loop between RFA and RT IJV. The survival rate is 50% at 30 days and the index case done at 2017 is coming for regular following with good quality life. Only 2 cases needed invasive ventilator support. LAD was the culprit in 8 cases (44 %) LAD + LCX were diseased in 1 case(5.5%). LAD and RCA were diseased in 4 cases(22%). TVD was present in 4 (22%) case one case had TVD plus Left main involvement. Surgical closure was done for 6 cases from 2017 to 2022. 4 patients died during Post operative period and the mortality rate was 4/6 (66%). In hospital death were 41 cases among 54 cases(75.9%) which occurred around 2 - 7 days. Longest stay of 96 days was reported for one case. Among 41 death cases, males were 23 (26%) and females were 18 (78%). High incidence of death occurred in age groups between 60-70 years. From 2017 to 2022, 6,57,870 OP cases were registered. 10,799 were admitted as IN patients. Among them 54 Cases were VSR Cases(0.5%). The mortality rate of IN patients for the same period was 8% (864 / 10,799). The death due to VSR constitutes to 4.75 % ie.41 out of 864 cases who died in hospital for period of 2017-2022.

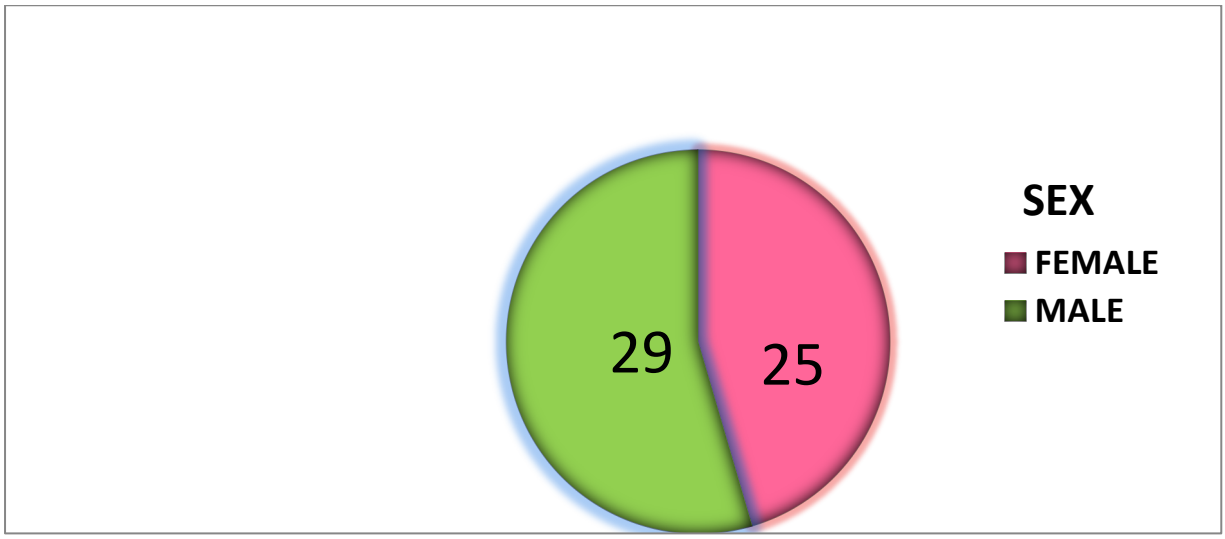

Figure 1: Sex Ratio

Total Number of VSR Cases – 54

Male - Female Ratio - 5.4:4.6

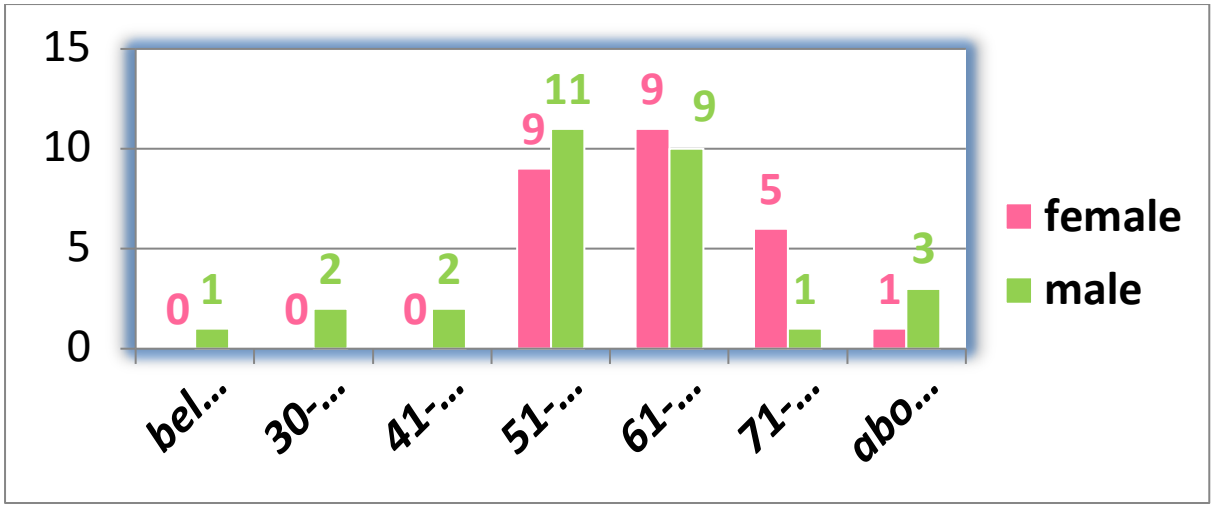

Figure 2: VSR Age Distribution

Among 54 cases, most of the cases are between 51 to 60 years of age

Table 1: Co-Morbidities & Associated Conditions

Conditions	Female	Male	Total
DM	15	10	25
HT	20	17	37
CKD	0	1	1
CML	1	0	1
Old CVA	0	0	0
SMOKING	0	25	25
ALCOHOL	0	21	21

Common risk factors for coronary artery disease are diabetes mellitus, hypertension and smoking.

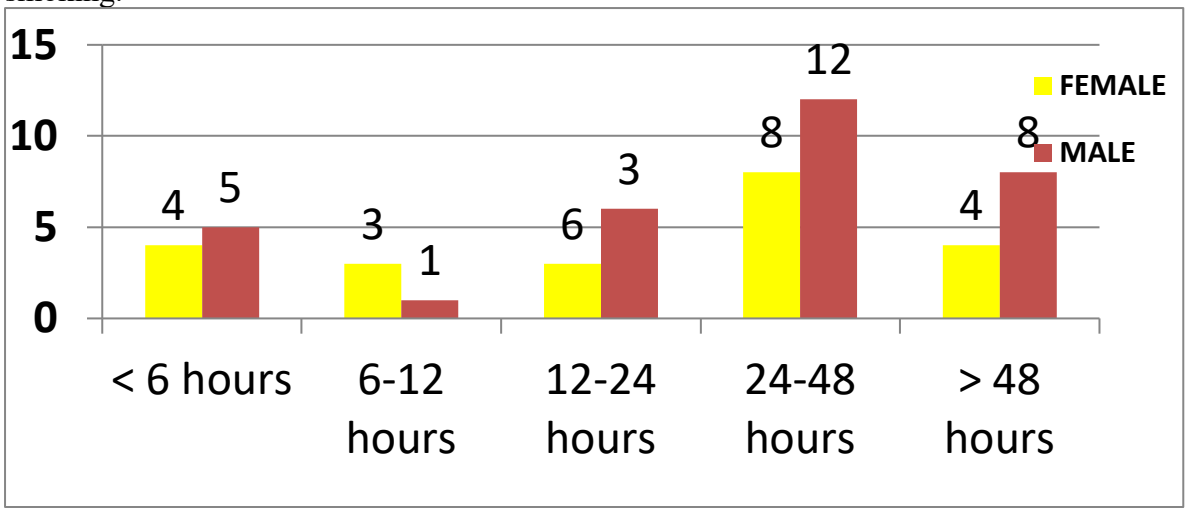

Figure 3: Median Delay

Median delay was between 1 to 2 days

Table 2: LV Systolic Function

EF (%)	No. of Patient	Percentage (%)
< 30	2	3.7
31- 49	46	85.2
> 50	6	11.1

85.2% of patients with post MI VSR had ejection fraction between 31 and 49%

Table 3: Echo & Cath Size - Comparison

S. No.	Size of VSR / Echo	Size of Cath	Size of ASD Device	Status
1	7-9 mm	7-9 mm	22 mm	Device closure done
2	9 mm	10 mm	18 mm	Device closure done
3	8-9 mm	8 mm	18 mm	Device closure done
4	10 mm	16 mm	28 mm	Device closure done
5	4-5 mm	18 mm	18 mm	Attempted

Average VSR / Echo Size = 8.8mm	Average VSR / Cath Size = 13mm	Average ASD Device Size = 20 mm

Table 4: Vessels with Coronary Artery Disease

Culprit Artery	Male	Female	Total
LAD(*)	5	3	8
LAD + RCA	2	2	4
LAD + LCX	1	0	1
LAD + RCA + LCX	4	0	4
LM + LAD + RCA + LCX	1	0	1
TOTAL	13	5	18

LAD was the culprit for apical VSR 44.4%

Table 5: Position of VSR

Position	Female	Male	Total
APICAL	24	22	46
BASAL	1	3	4
MID SEPTAL	0	1	1
INLET VSR	0	1	1
APICAL & BASAL	0	2	2

Among 54 cases of VSR, 46 were single and in apical position, 2 patients had double VSR in apical and basal position

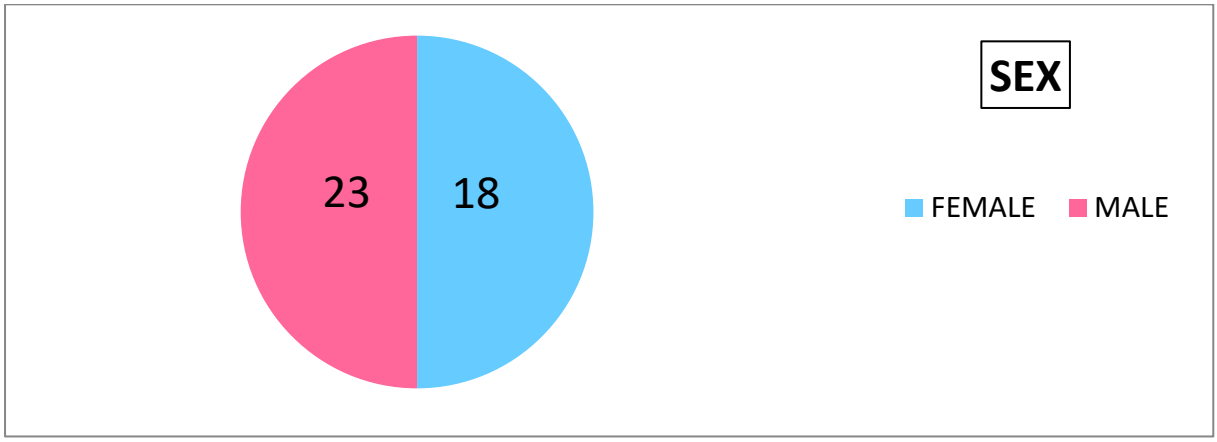

Figure 4: Post Mi VSR Death - Sex Distribution

Male to Female Ratio of Death Cases Following Post Mi Vsr Is 5.6:4.4

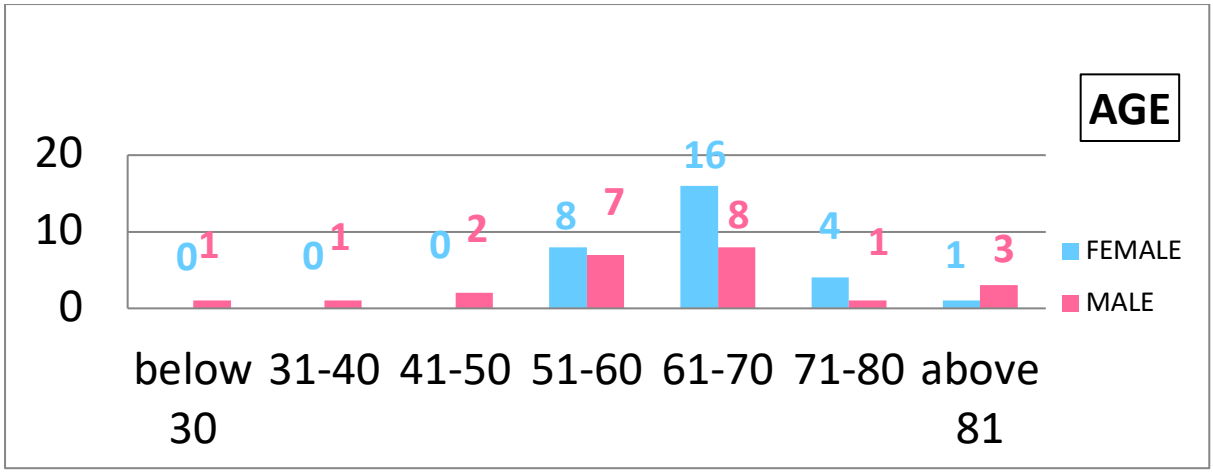

Figure 5: Post Mi VSR Death - Age Distribution

Most of the death occurred in age group of 61 to 70 years

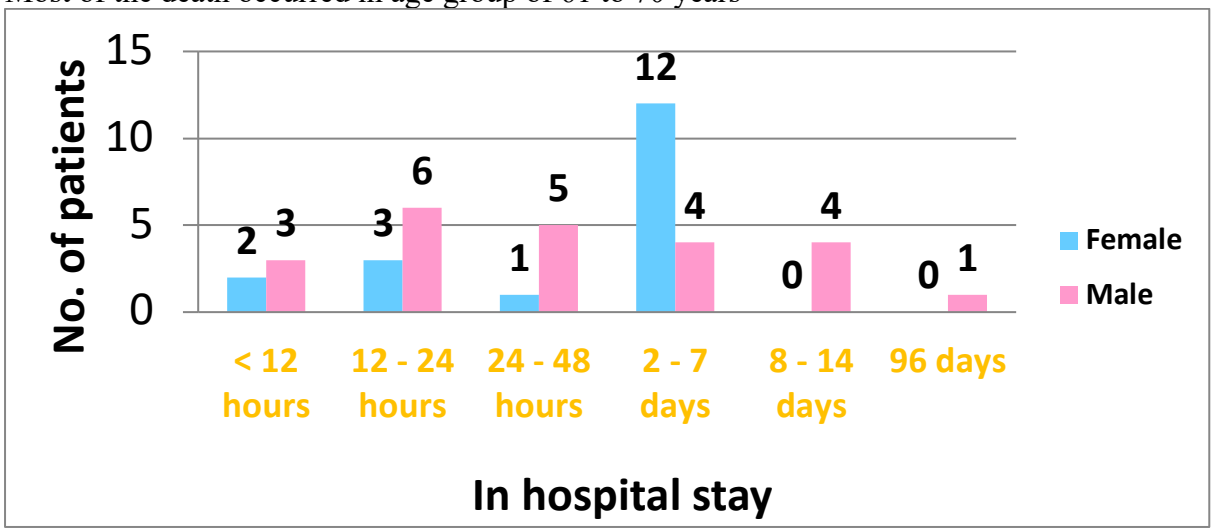

Figure 6: In Hospital Death= 41

Most of the in hospital death occurred between 2 to 7 days

Table 6: Outcomes

Total No. of VSR	Female	Male	Total
No. of Patients	25	29	54
Ama	4	3	7
In Hospital Death	18	23	41
Survived	3	3	6

Discussions

Our study results support the use of Device for reducing the mortality rate of Post MI VSR in comparison with surgical closure. The high mortality is due to sudden increase in pulmonary artery pressure leading to RV failure and multi organ failure due to vicious cycle. Comorbid conditions like DM, HT, pre-existing CAD and old Cerebrovascular events will increase the risk of going for cardiogenic shock[2].

Such patients are poor candidates for both procedures. The mortality rate is very high. According to available literature evidences Post MI VSR survival without any procedures is 94% (GUSTO-I) Post MI VSR device closure success rate is 80% with survival rate of 12%[5]. Post MI VSR surgical closure success rate is 45.9%

according to STS trial[6] & survival rate is 53% according to GUSTO -I trial[5]. Success rate is high with device closure between 4 - 15 days (62%)[5,6]. Elective surgery > 21 days is highly successful with survival rate 90% (STS trial: n513)[6].

Recent data from CT surgeons experience says that > 2800 surgery performed in North America between 1999 to 2006. There in mortality rate at 30 days is 42.9%[6]. They found that worsening Renal function and need for dialysis is a strong predictor of bad prognosis and cardio vascular death. 8/2800 patients developed residual defects which were managed by device closure[7]. This approach of hybrid procedure may be needed for larger defects in which a higher rate of device dislodgement and technical failure may be anticipated.

Technically our practice is to perform VSR closure once the patients are stable irrespective of age of acute myocardial infarction. If we wait for systemic perfusion to improve, the viscious cycle may set in leading the deterioration and death. Even though there is a chance for further extension of tear due to AV loop formation by exchange length stiff wire across Right femoral artery ->Aorta -> LV -> defect -> RV - >RA - Right Internal Jugular vein. There is a chance for free wall rupture following deployment of the device via Antegrade route due to manipulation of hardware like wire, sheath and device discs[8].

Fatal arrhythmias like VT, VF can worsen the hemodynamic status. In spite of the successful deployment of device, (possible in 90% of cases) sudden pulmonary edema can occur due to sudden after load mismatch[8]. Balloon sizing should not be done for obvious reason like extention of defect and free wall rupture. Location of the defect is also very important because of its close proximity to important structures which can be diagnosed by angiography, with multiplanar imaging and TEE which was not used in our study. Residual defect after deployment of ASD device may be there which can be managed later by additional device closure.

The position of the defect may be important because the discs on either side (Larger LV disc & smaller RV disc) may not find space to expand fully. Cobra head defect can occur due to deviation of IVS towards RV free wall and severely reduced RV cavity size[9]. The wiring may be difficult in small serpiginous tracts type of VSR[9]. But in our study we were successful in almost all cases.

Snaring was little difficult but we could do it with 3 - 4 attempts usually in SVC or RA and rarely in main pulmonary artery. In our series, we used ASD (amplatzer occluder device) of varying size from 18 to 28 mm. The ratio between defect by angiography and device size was 1:1.5 in almost all cases for fear of pull-through effect leading to dislodgement into RV. Then AV loop has to be formed again leading to prolonged procedure time and usage of excess contrast which will worsen the hemodynamic status[15]. Such things happened in few cases in our series. Amplatzer occluder devices are stiff and waists are narrow leading to cobra effect and myocardial damage[11].

The optimal timing of device closure and surgery remains elusive. With advent of LV assist devices, ECMO and Tandem Heart, the device closure and surgery may be delayed up to 1 - 2 weeks with good outcomes. But there are few case reports only in the literature. With stable hemodynamics, delayed surgery gives great results. If the patient is not suitable and fit for surgery device closure after 2 weeks gives greater results. In unstable patients we were unsuccessful because of our limitations and lack of facility for LVAD, ECMO[12,13].

The results are good if the defect size is less than 15mm. Challenges to device closure for inferior defects are due to a

lack of a circumferential septal rim. Challenges for basal defects are because of proximity to tricuspid valvular structures. For successful Transcutaneous device closure patient selection, defect characterization and device selection are prerequisites[11]. Shock trial says the mortality rate is 80% following surgical closure among patient with cardiogenic shock[14]. In our series the mortality rate is lower than available data (66%).

Outcome:

Limitations of Study: This is a study for long period of 5 years from 2017 to 2022.Our sample size is small. Handful of cases only underwent device closure and surgical closure. Non-availability of LVAD and ECMO resulted in higher mortality. Risk stratification and scoring system are not followed in our series. Since patients were sick due to hemodynamic instability we could not subject them for multimodality imaging. Nonavailability of Echo navigation resulted in prolonged procedure time and contrast load.

The limited number of study population precluded any meaningful multivariate analysis to identify independent predictors of mortality. Mostly bystanders were not giving consent for coronary angiogram, ventricular angiography followed by device closure or surgery after knowing the bad prognosis.

Conclusion:

Mortality remains high for patients presenting with PIVSD, regardless of treatment modality. In our observational study, catheter based interventional modalities appeared substantially better than the historically reported open surgical repair.

Catheter based device closure was associated with lower unadjusted in-hospital mortality, despite increased risk of complications. Heart team decision making remains key in the management of this condition. Transcatheter VSR closure using ASD occluders is a feasible approach to septal occluding systems

Ethical Approval: This study was approved by the Institutional Ethics Committee.

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