

## MANAGEMENT OF PATIENTS WITH ACUTE MYOCARDIAL INFARCTION COMPLICATED BY VENTRICULAR SEPTAL RUPTURE - AFIC STUDY

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### ABSTRACT

**Objective:** The aim of this study was to report management; peri-procedural and short term results of patients hospitalized with acute myocardial infarction (MI) complicated by ventricular septal rupture (VSR) considered high risk or unfit for surgical repair at AFIC-NIHD.

**Study Design:** Quasi experimental study

**Place and Duration of Study:** Adult and paediatric cardiology departments of Armed Forces Institute of Cardiology / National Institute of Heart Diseases (AFIC/NIHD) from 1<sup>st</sup> January 2012 to 31<sup>st</sup> August 2013.

**Patients and Methods:** We included 12 patients with post myocardial infarction VSR with mean age of 59 years (41-85 years), who underwent elective transcatheter closure. The entry criteria for trans-catheter closure after initial medical stabilization was 1) patients with ventricular septal rupture up to 20 mm size with significant left to right shunting ( $Q_p/Q_s > 1.5$ ) 2) defect anatomy and location thought to be suitable for device closure or otherwise considered high risk or unfit for surgical closure.

**Results:** The time from the onset of infarction to the index procedure ranged between 4 to 20 days (mean 10.83 days). There were ten patients in acute phase (2 weeks or less) and two presented in sub-acute phase (> 2 weeks). Ten patients were in NYHA class III and one each in class II and IV. A successful device implantation occurred in all patients except in one in whom second attempt failed. The defect size ranged 4-18 mm (mean 9.25 mm) and the devices ranging from 8-22 mm (mean 13.3 mm) were implanted. The procedure time ranged from 90-140 min (mean 105 min). In all patients  $Q_p/Q_s$  was more than 2 and decreased to less than two after the procedure. Six surviving patients are in NYHA class II and doing well. One patient died one hour after the procedure whereas one patient died twelve hour after the closure because of re-infarction. One patient developed another VSR leak 3 days after the procedure and device closure was attempted again but the device could not be deployed. He subsequently died awaiting surgery.

**Conclusion:** Primary trans-catheter closure of post-infarction ventricular septal rupture may be an alternative to surgery in patients with suitable anatomy and high risk or unfit for surgery.

**Keywords:** Ventricular septal rupture, Myocardial infarction, Trans-catheter closure.

### INTRODUCTION

Acquired ventricular septal defect (VSD) is one of the mechanical complications of acute myocardial infarction. The incidence in the pre-thrombolytic era was 1% to 3% and was 0.2% in GUSTO trial<sup>1</sup>. In one of the recent primary percutaneous coronary intervention studies the incidence was around 0.23%<sup>2</sup>. Development of a VSD correlates with delayed hospital admission after the infarction and may be triggered by undue physical activity<sup>3,4</sup>. In this study we

present our peri-procedural and short term results of primary closure in selected patients, of post-MI VSDs using the Amplatzer type septal occluder device.

### PATIENTS AND METHODS

This quasi experimental study was carried out at adult & paediatric cardiology department of Armed Forces Institute of Cardiology / National Institute of Heart Diseases Pakistan, 1<sup>st</sup> January 2012 to 31<sup>st</sup> August 2013.

Trans-catheter closure was considered in patients with significant left-to-right shunt (pulmonary/systemic flow  $\geq 1.5$ ), defect anatomy and location thought to be suitable for

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device closure. Defects in mid or distal septal region with size up to 20 mm were considered suitable for device closure. The size and location of each defect was assessed with trans-thoracic, echocardiography. Informed consent regarding the experimental nature of the procedure was obtained from each patient. None of the patients had primary surgical repair of the defect.

All patients were put on standard medical treatment for coronary artery disease including Aspirin, Clopidogrel, Nitrates, Angiotensin converting enzyme inhibitors, beta-blockers, statins and heparin. The myocardial infarction preceding the septal rupture was apical in 10 patients and mid septal in 2 patients. The time from the infarction onset to the procedure ranged from 5-20 days (mean 11.16). There were eight patients in an acute phase of infarction (two weeks or less) and the remaining four in subacute phase. Two patients in the acute phase of infarction were in less stable condition and required inotropic but no ventilatory support. The remaining ten patients were generally hemodynamically stable and in class III-IV according to the New York Heart Association. All the patients had a "simple" septal rupture with a direct through-and-through communication across the septum except in one patient who had splitting of septum longitudinally creating a cavity within the left ventricle which then communicated through the defect to right ventricle. The defect was localized in the apical segment in 10 patients, and in the mid segment of the septum in 2 patients. Pulmonary-to-systemic flow ratios were more than 2 in all patients. Coronary angiography was performed in all patients. All patients except one had triple vessel coronary artery disease who underwent successful angioplasty after device implantation. Right and left heart catheterization was repeated directly after the device implantation. Trans-thoracic echocardiograms with colour doppler flow mapping were repeated before discharge and at follow-up visits. The degree of residual shunt was assessed by echocardiography by measurement of the width of the doppler colour

flow jet through the ventricular septal defect. The patients were routinely maintained on aspirin for at least 6 months following the procedure. All the data was entered in SPSS 17 and descriptive analysis was done, student's test used to compare quantitative variables in various groups.

**Table-1: Demographic features of patients with acute myocardial infarction complicated by ventricular septal rupture (n=12).**

| PATIENT'S PROFILE |          |          |            |          |          |          |
|-------------------|----------|----------|------------|----------|----------|----------|
| Patient           | 1        | 2        | 3          | 4        | 5        | 6        |
| Age               | 41       | 60       | 55         | 70       | 60       | 50       |
| Gender            | Male     | Male     | Male       | Male     | Male     | Male     |
| MI location       | Anterior | Anterior | Anterior   | Anterior | Anterior | Anterior |
| MI proced         | 7 days   | 5 days   | 6 days     | 4 days   | 14 days  | 10 days  |
| NYHA bef          | NYHA III | NYHA II  | NYHA IV    | NYHA III | NYHA III | NYHA III |
| Qp/Qs bef         | 2.5      | 2.7      | 2.5        | 2.8      | 2.4      | 2.6      |
| VSD locati        | Apical   | Apical   | Apical     | Apical   | Midsept  | Apical   |
| VSD diam          | 8 mm     | 10 mm    | 10 mm      | 10 mm    | 10       | 18 mm    |
| Device size       | 12 mm    | 14 mm    | 14         | 14 mm    | 14 mm    | 22 mm    |
| Qp/Qs aft         | 1.6      | 1.3      | 1.7        | 1.8      | 1.8      | <1.5     |
| Proce time        | 130 min  | 90 min   | 110        | 100 min  | 140 min  | 60 min   |
| F-up echo         | yes      | Nil      | Trivial    | Small    | Small    | Nil      |
| outcome           | Death    | Death    | Lost to Fu | Death    | Alive    | Alive    |

  

| Patient     | 7        | 8        | 9        | 10       | 11                      | 12       |
|-------------|----------|----------|----------|----------|-------------------------|----------|
| Age         | 57       | 60       | 55       | 65       | 55                      | 85       |
| Gender      | Female   | Male     | female   | Male     | Male                    | Male     |
| MI location | Anterior | Anterior | Anterior | Anterior | Anterior                | Anterior |
| MI proced   | 14 days  | 12 days  | 16 days  | 14 days  | 20 days                 | 10 days  |
| NYHA bef    | NYHA III | NYHA III | NYHA III | NYHA III | NYHA III                | NYHA III |
| Qp/Qs bef   | 2.5      | 2.7      | 2.5      | 2.8      | 2.4                     | 2.6      |
| VSD locati  | Apical   | Apical   | Apical   | Apical   | Midsept                 | Apical   |
| VSD diam    | 4 mm     | 6 mm     | 5 mm     | 5 mm     | 10                      | 15mm     |
| Device size | 8 mm     | 10 mm    | 8 mm     | 10 mm    | 14 mm                   | 20 mm    |
| Qp/Qs aft   | 1.6      | 1.3      | 1.7      | 1.8      | 1.8                     | <1.5     |
| Proce time  | 75 min   | 120 min  | 55 min   | 50 min   | 60 min                  | 120 min  |
| F-up echo   | yes      | Nil      | Trivial  | Small    | Small                   | Nil      |
| outcome     | Alive    | Alive    | Alive    | Alive    | Alive but died one week | Death    |

**RESULTS**

Twelve patients aged 41-85 (mean 59 years) underwent an attempted closure of post myocardial infarction VSDs. The amplatzer type family of sepal occluder device (double umbrella type devices) was used in all patients. In two patients atrial septal defect device was used because of unavailability of size in VSD devices. The device is a self expandable circular double-disc frame made of windings of Nitinol wire, with a central connecting waist. The discs extend the waist by 5 to 7 mm. The size of the occluder is

determined by the diameter of the waist, which is made to fit the defect and vary from 04 to 40 mm. The device stents the actual defect and the occlusion are achieved partly by the thin polyester patch inserts, but mainly by in situ thrombosis and subsequent endothelialisation. All procedures were done under local anaesthesia and as a rule femoral arterial and venous approach was used for arterio-venous loop creation. Left ventricular angiogram was done in left anterior oblique view to outline the rent in the septum and the defect was crossed through a long hydrophilic Terumo wire (Terumo Inc) with its positioning in one of the pulmonary arteries followed by its snaring with the help of retriever (William Cook Europe) to extrude via the right femoral vein thus providing an arterial-venous continuous access. The device was chosen according to the defect size determined by echocardiography. Devices larger at least 4-6 mm than the maximal defect dimension were used. An introduction system with a long sheath of 12 French was passed from the femoral venous access through the defect into the left ventricle. The dilator was removed and the long wire was kept in place. The device screwed onto the delivery cable was loaded and introduced through the sheath. The distal disc was extruded in the left ventricle and the entire system withdrawn to appose the disc against the wall of the ventricular septum. The second disc was then deployed on the right side of the septum by withdrawing the sheath. After the placement, gentle pushing and pulling with the delivery cable proved the fixation of the device and its mechanical stability. Once echocardiographic studies confirmed proper position of the device, it was unscrewed by counter-clockwise rotation of the delivery cable.

A successful device implantation occurred in all patients except two. The defect size ranged from 4-18 mm (mean 9.25 mm) and the devices from 8 to 22 mm (mean 13.33 mm) were implanted. The procedure time ranged from 50 to 140 min (mean 92.5 min). Data of these patients

who had successful device implantation are presented in the table (Table-1).

In our study population, four patients died. In one patient another defect appeared a few days after the first procedure adjoining the previous one which was attempted with second procedure as his coronary lesion had already been dealt with during the initial procedure but the defect didn't hold the device as it would pull through the defect. This patient was then scheduled for surgery but died because of rapid deterioration awaiting surgery. Second patient died several hours later after successful closure because of re-infarction. Third patient died an hour after the procedure in the intensive care unit due to sudden cardiac arrest and fourth during the procedure after failed attempt. The residual leak was seen in four patients but it was trivial except in one patient which went on increasing as already mentioned. The residual leak was related to the additional defects in the region of the main hole. One patient developed 3<sup>rd</sup> degree atrio-ventricular block during the procedure and required temporary pacing. Six alive patients are under regular follow up. The criterion for follow up was assessment of functional status (NYHA class) and trans-thoracic echocardiographic evaluation of any residual leak or development of any new defect.

## DISCUSSION

Patients with post MI ventricular septal rupture may present in acute phase or chronic phase (> 2 weeks after the index event). Prognosis for post MI VSD is very poor with mortality rates as high as 50% at one week and 90% at two months with conservative medical management<sup>5</sup>. The Joint American Heart Association/American College of Cardiology (AHA/ACC) 2007 focused update recommend emergent repair of VSD with concurrent coronary artery bypass grafting as indicated irrespective of hemodynamic status as class I recommendation<sup>6-8</sup>. In-hospital mortality after surgery is significantly lower than with conservative management but remains as high as 47%<sup>6,9,10</sup>. Residual shunt may persist after surgery

in small number of patients and up to 11% may require a further surgical procedure. Surgical repair involves infarctectomy, aneurysmectomy and repair of ventricular septal perforation using trans-infarction approach by buttressing the defect with viable healthy muscle<sup>11</sup>. Trans-catheter occlusion has been attempted in both types of such patients and also in post-surgical candidates with significant residual shunt. Within the first week after the infarction, coagulation necrosis develops and lytic enzymes released by neutrophils cause the disintegration of necrotic myocardium which is followed by further necrosis, resorption and retraction of the infarcted tissue culminating in enlargement of the defect size. Within several weeks, the defect evolves into the chronic phase, the septum becomes fibrotic and the scar develops. In our series device closure was done in eight patients in acute phase and four in chronic phase. Three patients in acute phase and one patient in chronic phase died. This finding is in commensurate with other studies which failed to achieve improved survival with acute ventricular septal rupture in which primary closure with the umbrella type devices was performed. Main indication for selection of device closure was high risk surgery. The devices most commonly used for closure of ventricular septal rupture are amplatzer septal occluders but patch like devices have also been used but less commonly. The amplatzer is a self centering device and stents the actual defect. The occlusion is achieved by the central part of the occluder and is less affected by septal wall irregularities<sup>12</sup>. The self-expanding properties of the device are particularly useful in case of the defect enlargement. A special device suitable for post infarction ventricular septal rupture (VSR) has also been launched with slight modification of usual muscular ventricular septal defects VSD one. Our study provides no data that early closure of post-MI VSDs can improve survival.

## CONCLUSION

Cardiac surgery though remains gold standard for post-infarction repair of ventricular septal rupture, a significant proportion of patients are at too high risk for surgical repair because of their post-MI status and co-morbid, trans-catheter device closure of the defect may provide a stabilization and bridge to surgery. There is increasing evidence to use this modality as a definitive primary treatment for anatomically suitable patients and may also provide an alternative to repeat surgery for patients with residual shunts and patch dehiscence.

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