

## SURGICAL CLOSURE OF VENTRICULAR SEPTAL DEFECT – EXPERIENCE AT ARMED FORCES INSTITUTE OF CARDIOLOGY

Kamal Saleem, Mehboob Sultan, Nadeem Sadiq

Armed Forces Institute of Cardiology & National Institute of Heart Diseases, Rawalpindi

### ABSTRACT

**Objective:** To evaluate the results of surgical closure of ventricular septal defect (VSD) with special focus on immediate complications and mortality.

**Study Design:** Quasi experimental study.

**Place and Duration of Study:** Pediatric cardiac surgical department of Armed Forces Institute of Cardiology / National Institute of Heart Diseases (AFIC/NIHD) from 1<sup>st</sup> January 2011 to 31<sup>st</sup> Dec 2012.

**Patients and Methods:** All patients undergoing surgical closure of VSD were included in the study. All patients underwent detailed pre-operative assessment including detailed examination, blood tests, chest x-ray, echocardiography and doppler. The surgery was performed under general anesthesia. VSD was closed using polytetrafluoroethylene (PTFE) patch with prolene interrupted sutures. Good post operative care was ensured. The patients were discharged on 7<sup>th</sup> post-operative day and advised follow up after one week.

**Results:** A total of 230 consecutive patients underwent VSD closure with male to female ratio of 2.2:1 and mean age was  $5.7 \pm 6.5$  years. Mean height was  $94.8 \pm 31.4$  cms and mean weight was  $15.3 \pm 12.6$  kgs. Per membranous VSDs were most common accounting for 67.4% of cases. Indications for surgery were moderate to large VSDs (77.8%), associated with other congenital heart diseases (CHDs) (8.3%), coronary cusp prolapse with or without aortic regurgitation (13.5%) and infective endocarditis (0.4%). In one case aortic valve replacement was also done for severe aortic regurgitation due to gross right coronary cusp prolapse. There were 10 (4.3%) deaths in study population and their mean age was  $3.5 \pm 5.5$  years. In 02(0.9%) patients, permanent pacemaker was also implanted.

**Conclusion:** Open heart surgery for VSD is safe with low mortality in experienced hands.

**Keywords:** Congenital heart defect, Permanent pace maker, Ventricular septal defect.

### INTRODUCTION

Ventricular septal defect (VSD) is the most common congenital heart disease (CHD), and accounts for about 20-25% of CHDs and in a recent article from India, echocardiographic based prevalence was 5.7 per 1000 live births<sup>1-3</sup>. VSDs are commonly classified into small, moderate and large defects by comparing the defect size with aortic root. Small defects (ascribed to Rogier after his initial description) carry good prognosis with high chances of spontaneous closure, whereas most of moderate and almost all of large VSDs need to be closed. Perimembranous ventricular septal defects are the commonest type of VSDs<sup>3,4</sup>. Large untreated

VSDs are complicated by congestive cardiac failure, severe pulmonary hypertension, recurrent pneumonia, failing to thrive, infective endocarditis, aortic valve prolapse and aortic regurgitation<sup>4,6-8</sup>. Historically, infants with a large VSD were initially palliated by pulmonary artery banding (PA band) to decrease the pulmonary blood flow<sup>9</sup>. In these cases, de-banding and VSD closure was done at later age. Nowadays, pulmonary artery banding is rarely used and primary closure even in young infants is preferred. Management of patients with VSDs depends upon characteristics of the defect, patient's age and symptoms, pulmonary vascular resistance, and any associated cardiac and non-cardiac defects<sup>9</sup>. Though percutaneous transcatheter closure of VSDs are now being practiced but are limited to mostly mid muscular defects<sup>10,11</sup>. Gold standard treatment for moderate

**Correspondence:** Dr Kamal Saleem, Advisor cardiac surgery, AFIC/NIHD Rawalpindi.

Email: kamals73@hotmail.com

Received: 05 Feb 2014; Accepted: 05 Mar 2014

/ large defects is surgical patch closure with high success rate and low complication rates<sup>12</sup>. Important post surgical complications include residual defects, varying degree of heart blocks & pulmonary hypertensive crisis<sup>13,14</sup>. Rare post operative complications include chylothorax, chylopericardium and constrictive pericarditis<sup>15</sup>.

The purpose of this study was to determine the indications, outcome and associated complications of surgical closures of VSDs (isolated or associated with ASD or PDA) over a period of 02 years at our institution.

### **PATIENTS AND METHODS**

This quasi-experimental study was carried out at paediatric cardiac surgical department of Armed Forces Institute of Cardiology / National Institute of Heart Diseases Pakistan (AFIC - NIHD), from 1<sup>st</sup> Jan 2011 to 31<sup>st</sup> Dec 2012. All patients, who underwent surgical closure of VSD during study period, were included. Patients with primary diagnosis of VSD were included and associated lesions were restricted to atrial septal defect (ASD), patent ductus arteriosus (PDA), coronary cusp prolapse and sub aortic membrane. Cases with complex CHDs like tetralogy of Fallot & VSD associated with any form of right ventricular (RV) outflow obstruction, transposition of great arteries, tricuspid atresia and truncus arteriosus were excluded. All patients underwent detailed pre-operative assessment including detailed history, physical examination, blood complete picture, chest X-ray and detailed 2-D echocardiography/doppler study. The 2-D echocardiography was done by paediatric cardiologist to determine the anatomical location, size, pressure gradient (PG) across the defect, pulmonary artery pressures, presence of left atrial & ventricular volume over load and presence of any associated cardiac anomalies. M-Mode measurements of left atrial and left ventricular end-diastolic and end-systolic dimensions were made in the para-sternal long axis view. Diagnostic cardiac catheterization was performed in children with nonrestrictive

moderate to large VSD, over two year of age (for Down syndrome, more than one year of age). Patients with pulmonary vascular resistance of less than 08 woods unit square meters were offered surgery.

All patients were admitted at least 48 hours before surgery for completion of investigations. After written consent and pre-anaesthesia assessment, patients were taken to operation theater with at least six hours of nil per mouth. General anaesthesia (GA) followed by median sternotomy was performed. After pericardiotomy and aortic / bi-caval cannulation, cardio-pulmonary bypass was established. Aortic root clamped and followed by cardioplegia. In majority of cases, right atriotomy done to reveal the anatomy. VSD was closed using polytetrafluoroethylene (PTFE) patch with prolene interrupted sutures. After ensuring complete closure of VSD (along with ASD closure & PDA interruption, where indicated), wound was closed and hemostasis ensured. Post operative care included ventilator support, inotropic supports, fluids and electrolyte management. As per protocol, patients were usually discharged on 7<sup>th</sup> post operative day and followed up outdoor after one week.

The variables like patient's age, gender, residence, size and type of VSD and procedural details, height and weight, main pulmonary artery systolic pressure, age at operation, use of deep hypothermia, use of cold cardioplegia, aortic cross-clamp time, right ventricular incision, peri-operative complications, residual lesions were recorded. Major complications, including death, heart blocks, sepsis, major bleeding, reopening, significant residual leak, valvular damage and thrombo-embolism were recorded.

Data had been analyzed using statistical package for social sciences (SPSS) version 17. Mean and standard deviation (SD) were calculated for quantitative variables. Frequency and percentages were calculated for qualitative variables.

## RESULTS

Two hundred and thirty consecutive patients underwent VSD closures during study period at our institution with male to female ratio of 2.2:1, mean age was  $5.7 \pm 6.5$  years, mean height was  $94.8 \pm 31.4$  cms and mean weight was  $15.3 \pm 12.6$  kgs. Mean stay in intensive care unit was  $74.9 \pm 63.8$  hours, mean duration of ventilation was  $19.5 \pm 31.5$  hours and mean duration of inotropic support was  $42.9 \pm 54.8$  hours. Isolated perimembranous type VSDs were most common accounting for 67.4% of cases. Associated lesions included ASD (5.2%), PDA (6.5%), Aortic cusp prolapse (13.5%), moderate to severe aortic regurgitation (03%) and two (0.9%) cases of associated sub aortic membrane. Indications for surgery were: Moderate to large VSD (77.8%), associated with other CHDs (8.3%), Coronary cusp prolapse (13.5%) and infective endocarditis (0.4%). In 14 (6.1%) cases, PDA was also interrupted whereas in 12 (5.2%) cases surgical ASD closure was also performed. In two (0.9%) cases, there was sub-aortic membrane which was resected during surgery. In one (0.4%) case aortic valve replacement (AVR) was also done due to severe aortic regurgitation (AR) due to gross right coronary cusp prolapse. In post operative course, 37(16.1%) cases were given no inotropic drugs, whereas 193 (83.9%) patients required dopamine. In 31(13.5%) cases, additional support was also required. Pulmonary vasodilator (Sildenafil) was given in 85 (37%) cases.

There were 10 (4.3%) deaths in study population and nine (3.9%) were males. Their mean age was  $3.5 \pm 5.5$  years, mean weight was  $10.9 \pm 8.9$  kgs whereas mean height was  $81.5 \pm 20.9$  cms. Mean stay in intensive care unit was  $128.6 \pm 147.4$  hours, mean duration of ventilation was  $67.4 \pm 110.9$  hours and mean duration of inotropic support was  $76.3 \pm 138.5$  hours. All occurred in first two weeks and causes of deaths were pulmonary hypertension, sepsis, low output cardiac state.

In 60 (26.1%) cases, atrial fibrillation while in 22 (9.6%) cases ventricular tachycardia was encountered. In 43 (18.7%) cases, complete heart block occurred needing temporary pacing whereas in 02 (0.9%) patients, permanent pacemaker was implanted.

Re-opening in 35(15.2%) cases due to bleeding, post cardiectomy pericardial effusion in 15(6.5%) cases and significant residual leaks in 05(2.2%) cases.

## DISCUSSION

Surgical closure of VSD is definitely a gold standard treatment for all types of VSDs, when closure is indicated<sup>12</sup>. In this study, we are reporting about 96% survival for 230 cases, which were operated for VSD at our institution over two calendar years. Mean age in our patients was  $5.7 \pm 6.5$  years and ranged from 03 months to 35 years, quite similar to 7.4 years as reported by Vaidyanathan et al<sup>5</sup>. This finding is remarkable, when considering the fact that in developed countries, primary VSD closure is usually done much earlier and this contradiction needs further elaboration. In our country, due to poor health structure & lack of awareness, parents usually report late to hospitals and secondly there are only few centres in our country with facilities of paediatric cardiac surgery. Another unfortunate fact is that many of our doctors as well as parents believe in the fact that many of heart holes close spontaneously. Many such patients either become inoperable with severe pulmonary hypertension, or may progressively develop infundibular bands / coronary cusp prolapse. We strongly feel that in our country, immediate attention should be paid to major health reforms as well as community education. Every child with pathological heart murmur should be followed with paediatric cardiologist.

Historically, infants with a large VSD were initially palliated by pulmonary artery banding (PA band) followed by de-banding and VSD closure at later age<sup>9</sup>. Nowadays, pulmonary artery banding is rarely used and primary closure even in young infants is preferred. VSDs are

usually classified into four sub-types and in our study perimembranous type VSDs were the most common accounting for 67.4% of cases. Male patients dominated our study population as also reported by another study from our country<sup>3</sup>. In our study, main indications for surgery isolated moderate to large VSD with left ventricular volume overload, VSD associated with other CHDs, coronary cusp prolapse with or without aortic regurgitation and a single case of infective endocarditis due to restrictive perimembranous VSD. We used median sternotomy for VSD closure in our study population, though in literature, approach through right thoracotomy is also being reported<sup>16</sup>. In 6.5% cases, PDA was also interrupted whereas in 5.2% cases surgical ASD closure was also performed. In two (0.9%) cases, there was sub-aortic membrane which was resected during surgery. In one case AVR was also done due to severe AR due to gross right coronary cusp prolapse.

In our cohort, right heart catheterization was performed in 50 (21.7%) cases, which documented reversible pulmonary vascular resistance with high flow 100% oxygen inhalation. We used pulmonary vascular resistance (PVR) of less than 08 woods units after oxygen inhalation to be cut off limit for offering cardiac open heart surgery. Those patients with high post operative PVR, managed in intensive care with minimal pain or obnoxious stimuli, ventilation & pulmonary vasodilators. We used sildenafil in our patients with satisfactory response. In cases with high PVR, leaving an atrial communication or double flap VSD patch closure to decrease the morbidity and mortality associated with the closure of large VSD in high risk cases may be attractive options<sup>17,18</sup>. In our study population, the mortality rate was 2.3%. Importantly their age, height, weight was significantly less than those, who survived. And for obvious reasons, their stay in intensive care and hours of ventilation were significantly more than survivor group, the same finding is endorsed by Vaidyanathan et al as well<sup>5</sup>. In 43 (18.7%) cases, complete heart block occurred

needing temporary pacing whereas in 02 (0.9%) patients, permanent pacemaker was implanted. Post cardiectomy pericardial effusion occurred in 15 (6.5%) cases and significant residual leaks in 05 cases. The issue of significant residual patch leak was more common with continuous sutures of patch closure of VSDs<sup>19</sup>.

Limitations of our study: Being a single center study, with no randomization and no follow-up.

## CONCLUSION

Open heart surgery for ventricular septal defect is safe with low mortality and morbidity in experienced hands.

## REFERENCES

1. Akhtar K, Maadullah, Ahmed W. Profile of congenital heart disease and correlation to risk adjustment for surgery; an Echocardiographic study. *J Coll Physicians Surg Pak* 2008;18:334-7.
2. Sawant SP, Amin AS, Bhat M. Prevalence, pattern and outcome of congenital heart disease in Bhabha Atomic Research Centre Hospital, Mumbai. *Indian J Pediatr*. 2013;80:286-91.
3. Chaudhry TA, Younas M, Baig A. Ventricular septal defect and associated complications. *J Pak Med Assoc* 2011;61:1001-4.
4. Kazmi U, Sadiq M, Hyder SN. Pattern of ventricular septal defects and associated complications. *J Coll Physicians Surg Pak Jun* 2009; 19(6):342-5.
5. Vaidyanathan B, Roth SJ, Rao SG, Gauvreau K, Shivaprakasha K, Kumar RK. Outcome of ventricular septal defect repair in a developing country. *J Pediatr*. 2002;140(6):736-41.
6. Bhatt M, Roth SJ, Kumar RK, Gauvreau K, Nair SG, Chengode S et al. Management of infants with large, unrepaired ventricular septal defects and respiratory infection requiring mechanical ventilation. *J Thorac Cardiovasc Surg*. 2004;127(5):1466-73.
7. Shaikh AH, Hanif B, Khan GU, Hasan K. Supracristal ventricular septal defect with severe right coronary cusp prolapse. *J Pak Med Assoc Jun* 2011;61(6):506-7.
8. Nasir JA, Haider N, Ali L, Waqar T, Khan A, Shah S et al. Outcome of surgery for aortic regurgitation associated with ventricular septal defect. *J Rawal Med Coll Jan - Jun* 2011;15(1):10-2.
9. Emanuela A, PCarlo N, Simone T, Guido O, Gaetano G. Pulmonary artery banding. *Multimedia Manual Cardio-Thoracic Surgery* 2012;10:1093
10. Zartner P, Christians C, Stelter JC, Hraška V, Schneider MB. Transvascular closure of single and multiple muscular ventricular septal defects in neonates and infants <20 kg. *Catheter CardiovascInterv*. 2013 Aug 31. doi: 10.1002/ccd.25177. [Epub ahead of print]
11. Diab KA, Cao QL, Mora BN, Hijazi ZM. Device closure of muscular ventricular septal defects in infants less than one year of age using the Amplatzer devices: feasibility and outcome. *Catheter CardiovascInterv*. 2007 Jul 1;70(1):90-7.
12. BolRaap G, Meijboom FJ, Kappetein AP, Galema TW, Yap SC, Bogers AJ. Long-term follow-up and quality of life after closure of ventricular septal defect in adults. *Eur J Cardiothorac Surg*. 2007 Aug;32(2):215-9.
13. Haider Z, Anjum J, Cheema MA. The Effect of Residual Ventricular Septal Defects on Early Clinical Outcome: Initial Experience. *J Coll Physicians Surg Pak Sep* 2000;10(9):325-8.
14. Saleem K, Ahmad SA, Rashid A, Khan AA, Zameer M, Naqvi S et al. Outcome of ventricular septal defect closure. *J Coll Physicians Surg Pak*. 2004 Jun;14(6):351-4.

15. Gowani SA, Khowaja AA, Khan A, Fatimi SH. Chylopericardium - a rare complication after ventricular septal defect repairJ Pak Med Assoc Apr 2008;58(4):218-9.
  16. Li J, Liu Y, Yu C, Cui B, Du M. Comparison of incisions and outcomes for closure of ventricular septal defects. Ann Thorac Surg. 2008 Jan;85(1):199-203.
  17. Khan IU, Ahmed I, Mufti WA, Rashid A, Khan AA, Ahmed SA et al. Ventricular septal defect in infants and children with increased pulmonary vascular resistance and pulmonary hypertension - surgical management: leaving an atrial level communication. J Ayub Med Coll Abbottabad Oct - Dec 2006;18(4):21-5.
  18. Janjua AM, Saleem K, Khan I, Rashid A, Khan AA, Hussain A. Double flap patch closure of vsd with elevated pulmonary vascular resistance: an experience at AFIC/NIHD. J Coll Physicians Surg Pak Apr 2011;21(4):197-201
  19. Tanveer R, Khan AR, Siddiqi TA, Siddique S, Nasreen A, Salman et al. Continuous versus interrupted technique of ventricular septal defect (VSD) closure in total correction for Tetralogy of Fallot pertaining to residual VSD. J Pak Med Assoc Apr 2010;60(4):253-6.
- .....