Original Article

Continuous versus interrupted technique of Ventricular Septal Defect (VSD) closure in total correction for Tetrology of Fallot Pertaining to Residal VSD

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Abstract

Objective: To analyze the outcome of continuous versus interrupted closure technique of ventricular septal defect (VSD) closure in Tetrology of Fallot with reference to postoperative residual VSD after total correction.

Methods: A randomised control study was conducted between January 2008 to December 2008 at The Department of Cardiac Surgery, National Institute of Cardiovascular Diseases (NICVD), Karachi.

The results of total correction (T.C) of VSD in patients with Tetralogy of Fallot, with emphasis on the suturing technique and eventually on the occurrence of residual ventricular septal defect(VSD) were analyzed. Transventricular as well as transatrial route was used to approach VSD. In thirty patients VSD was closed with 5/0 proline continuous double ended suture while in remaining 30(50%) patients VSD was closed with interrupted 5/0 prolene double ended sutures. Postoperative echocardiography was done in all patients as a routine on second postoperative day, to document residual VSD.

Results: The study included 60 (100%) patients with T.O.F. There were 20 (33.3%) females and 40 (66.6%) males with ages ranging between 04 to 18 years (mean 13.025 ± 2.123 years).

Postoperative echocardiography showed residual VSD in 05 (8.3%) patients at posteroinferior rim of VSD. Of these 05 cases, in four VSD had been closed with continuous 5/0 proline double ended sutures, and one had VSD closed with interrupted 5/0 double ended sutures.

Conclusion: Residual VSD is common with continuous suturing technique as compared to interrupted suturing technique. This is perhaps because of poor myocardium quality and higher RV pressures in our patients presenting at a late age. Small (less than 05 milimeter) residual VSD can be treated conservatively in haemodynamically stable patients (JPMA 60:253; 2010).

Introduction

Tetrology of Fallot is the most common cyanotic congenital heart defect.[1] The mortality rates for untreated TOF are progressive with patients age. With surgery (palliative shunts and corrective surgery) prognosis has improved. Total correction is performed by open heart surgery. Mortality is 3% in children and 2.5% to 8.5% in adults.[2] For closure of VSD transatrial and transventricular approaches can be used.[3-5] Conventionally, Ventricular Septal Defects (VSDs) are repaired with synthetic patch-Dacron (polyethylene terephthalate) or Goretex (expanded polytetrafluoroethylene). Nonabsorbable continuous or interrupted stitches can be used to close the VSD.[3]

Surgical correction of TOF can be carried out as early as the first year of life with low morbidity and mortality.[6-10] In recent years there has been a considerable increase in adult patients with congenital heart disease.[7] Although grown up children can cope well with complicated intra-cardiac repair procedure, total correction in older children and young adults is very challenging. The massive right ventricular hypertrophy completely obscures the morphology of defects hence making the exposure of VSD technically difficult. Therefore in majority of these patients, satisfactory repair through right atrium alone is a procedure requiring high expertise and frequently right ventriculotomy has to be undertaken.[3,5,8]

Amongst the myriad complications occurring after TC for TOF, residual VSD shares a percentage of 1% to 8% with catastrophic short and long-term consequences.[9] The techniques of VSD closure in TOF varies among different surgeons. Although remarkable results have been achieved in the western world, by employing continuous suturing technique for VSD closure in TOF, but the children operated upon are younger, within the first five years of life. In contrast to this a majority of our patients appear late for total correction usually in the second decade of life, as they are referred late. Hence their myocardium differs in architecture from those presenting early as well as the normal heart. The myocardium is hypertrophied, less resilient and friable.[10-13] This along with a high RV pressure at a late age, renders the myocardium more likely to give way after suturing. This study was undertaken to compare the results of Interrupted versus Continuous suture techniques for VSD closure with regards to residual VSD after total correction for Tetrology of Fallot in our patient population.

Patients and Methods

A randomized comparative study was conducted on patients with Tetralogy of Fallot undergoing Total Closure (TC) of VSD between January and December, 2008. The objective was to observe the frequency of failures as residual VSD. The study was approved by the Ethical Review Board of the institution. An informed consent was sought from all patients included in the study.

Patients were subjected to transthoracic echocardiography for the diagnosis of TOF and to delineate the main central pulmonary vasculature. All TOF patients with hypoplastic main pulmonary artery and normal right and left pulmonary artery were included in the study.

Patients excluded were those with other associated cardiac abnormalities, with branch pulmonary artery stenosis and left anterior descending coronary artery arising from right coronary artery as a continuation of conus branch.

All Total Corrections were done under general anaesthesia with continuous invasive monitoring of ECG, arterial pressure, central venous pressure and oxygen saturation. Median sternotomy incision was made to reach pericardium. During pericardiotomy, the pericardial patch was harvested. Forty-seven patients had right S/P shunt which was functioning in 34 patients and non-functioning in remaining 13 patients. Functioning shunt was ligated before undertaking cardiopulmonary bypass (CPB).

All patients were put on CPB by aortic and bicaval venous cannulation. Moderate systemic hypothermia (core body temperature between 28-30 degree centrigrade) along with topical cooling was applied. Cold antegrade blood cardioplegia was given after aortic cross clamping. VSD was approached through the right ventricle in 54 patients. However right atrial approach was used in 6 patients under nine years of age as they had less right ventricular hypertrophy compared to the others. A synthetic patch (Dacron) was used to close the VSD in all patients.

In 30 (50%) patients VSD was closed with continuous 5/0 proline double ended suture. In remaining 30 (50%) patients VSD was closed with interrupted 5/o prolene double ended sutures. Infundibular muscular resection was performed in 58 patients. This was not necessitated in two patients both of whom fell under 10 years of age with minimal RV hypertrophy. In 44 patients right ventricular outflow tract (RVOT) was enlarged using transannular patch technique. Intraoperative transesophageal echocardiography (TEE) was not used as the facility was not available at our institute.

All patients were nursed in the intensive care unit postoperatively and all were routinely subjected to transthoracic echocardiography on 2nd postoperative day, as majority of the patients depict stability by this period. However, two patients needed transthoracic echocardiography (TTE) earlier because of intractable instability.

Data analysis was performed through SPSS version - 10 on computer. Qualitative data including sex, NYHA functional class, risk factors, drug history, ECG finding, x-ray finding, echocardiographic findings (pulmonary valve, VSD

and ASD) were presented by frequency and percentage; chi-square test was applied to compare the proportions of these variables at $p<0.05$ level of significance. Age was presented by mean +/- SD. Comparison was done between findings of pre-operative and postoperative echocardiographic documented reports.

Results

The study included 60 patients, 40(66.6%) males and 20 (33.3%) females with ages ranging between 04 to 18 years (mean 13.025 ± 2.123 years). The average ICU stay was 3 days (range 2 - 7 days).

The mean cardiopulmonary bypass time was 78 ± 27.1 minutes (range 60-110 minutes) and mean aortic cross clamp time was 41 ± 12.9 minutes (45-63 minutes).

Two (3.33%) patients died postoperatively; one was unable to be weaned off from the ventilator. He developed low output syndrome due to fulminant right ventricular failure and died on second postoperative day. The other patient developed respiratory failure owing to CPB induced acute respiratory distress syndrome (ARDS) and died on 5th postoperative day. In both these patients there was no residual VSD found on serial echocardiography.

For the remaining patients, echocardiography was carried out on second postoperative day. Residual VSD was documented in 05 (8.3%) patients. The size of residual VSD in these five patients was 03 mm and initially all were treated conservatively. Of the 05 patients, four were those in whom VSD was closed with continuous stitches while in one it was closed with interrupted stitches. In all patients leak was at postero-inferior area of the septal patch. One of these patients from the continuous group, deteriorated on the 5th post operative day and TTE showed an increase in the size of the residual VSD. He was re operated and residual defect was repaired with interrupted sutures. He then made an uneventful recovery. The remaining four patients were haemodynamically stable and were treated conservatively.

Follow-up was done in Outpatients Clinic weekly for one month then at monthly intervals .Mean follow-up time was 15.7 ± 2.16 weeks. One patient was lost to follow up. All patients were examined echocardiographically at three and six months interval.

No new VSD dehiscence was recorded. Residual VSD increased significantly in one patient from continuous group (of VSD closure technique) necessitating re-hospitalization 2 months postoperatively. He was too ill to be subjected to CPB and succumbed to his ailment. Infective endocarditis developed in one patient two months after the operation. This patient was re-admitted again and successfully treated with intravenous antibiotics and discharged after 10 days.

Discussion

TOF is a congenital cardiac malformation characterized by underdevelopment of the right ventricular infundibulum with anterior and leftward displacement of the infundibular (conal, outlet) septum and its parietal extension. Displacement (malalignment) of the infundibular septum is associated with right ventricular outflow (pulmonary) stenosis and a large ventricular septal defect (VSD).[14]

The mortality rates for untreated Tetralogy of Fallot are progressive with patient's age. Prognosis has improved with treatment including palliative shunts and corrective surgery. With better understanding of the pathophysiology of TOF, surgical techniques, and improved myocardial preservation and postoperative care, mortality for total correction has decreased in all age groups from 1% to 5%.[11-13]

Generally, repair is performed on babies with TOF around 4 to 6 months of age or sooner if spells occur.[3,15-20] Initial Palliation may be required for some patients before the total correction specially those presenting late or have very small left ventricle (LV) or pulmonary tree.

VSDs in total correction may be closed through transatrial or transventricular approach.[3,5] Using synthetic patch (Dacron or polytetrafluoroethylene [PTFE]) sewn to the rightward aspect of the VSD with nonabsorbable monofilament suture taking care to avoid placing deep sutures in the area of conduction tissue to prevent postoperative heart block. There was no such complication in our study. There is no difference in operative mortality rates between transventricular and transatrial approaches.[21] We could use transatrial approach in 06 of our patients while remaining 56 patients had right ventricular (transventricular) approach.[3,5,8]

Common postoperative complications are residual VSD, residual pulmonary stenosis, tricuspid or pulmonary valve regurgitation, disturbances of heart rhythm and infective endocarditis. Residual VSD was reported in 1% to 8% in the early series.[9,15,22,23] In the current era, residual VSDs are expected to occur in less than 5% of Tetralogy repairs. Suturing techniques may play a significant role in occurrence of residual VSD. Studies have shown good results with both techniques of VSD closure (continuous or interrupted). In our study we found that with continuous suturing technique of VSD closure in TOF residual VSD occurred more frequently as compared to VSD closure with interrupted stitches. Residual VSD may result from insufficient intraoperative exposure or suture disruption with patch dehiscence.[9,14,24] Significant residual shunting is most commonly observed in muscular defects (particularly with multiple defects) in which trabeculations decrease visualization of the full extent of the VSD(s).We however did not encounter any muscular type VSD.

Studies have shown reoperation rates of 3.3% to 16.5%.The most frequent indications for reoperation are bleeding, residual VSD, residual RVOT obstruction, pulmonary regurgitation, severe tricuspid valve regurgitation, stenosis of the pulmonary artery or its branches, signs of right ventricular dysfunction and significant left to right shunt (Qp/Qs > 1.5).[9,25] Four patients in our study were reopened due to excessive bleeding.

For patients presenting with residual VSD or right ventricular outflow tract obstruction (RVOTO) after correction of TOF, reoperation should be considered if progressive right ventricular failure and clinical deterioration develop. Residual VSDs are poorly tolerated in patients with TOF because these individuals cannot tolerate an acutely imposed volume overload. A residual VSD with a 2:1 shunt or an RVOTO of greater than 60 mm Hg is an urgent indication for reoperation. Surgery can be performed with low risk and can result in improvement. Patients with small(less than 05 mm size) residual VSD who are haemodynamically stable can be treated conservatively.[9] One patient in our study from continuous technique of VSD closure group, required re-operation for residual VSD while the remaining 4 patients settled without redo surgery.

Active prosthetic patch infection is a rare, but serious condition which may require the replacement of the patch. Abscess formation may occur at the tricuspid annulus involving the septal patch, and the leaflet and/or annulus may require reconstruction using an autologous pericardial patch. One patient from our study of the group with continuous suturing technique for closure of VSD, developed infective endocarditis. He responded to conservative therapy with antibiotics.

Conclusion

Residual VSD is common with continuous suturing repair technique as compared to interrupted suturing technique of VSD closure. This is perhaps because of poor myocardium quality and higher RV pressures in our late presenting patients compared to Western population of patients. Small(less than 05 mm size) residual VSD can be treated conservatively if haemodynamically stable.

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