

VSD CLOSURE FOLLOWING PULMONARY ARTERY BANDING IN CONGENITAL VSD WITH SIGNIFICANT PULMONARY HYPERTENSION

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ABSTRACT

Background: Pulmonary artery banding is a palliative surgical procedure used as a staged-approach to operative correction of congenital heart defects leading to right ventricular volume overload and pulmonary hypertension. This study was carried to find out effectiveness of two-stage procedure of VSD closure following PA-banding in congenital VSD and significant pulmonary hypertension.

Material & Methods: This descriptive study was carried out at Rehman Medical Institute, Peshawar, from January 2003 to March 2012. Record of patients having congenital VSD with significant pulmonary hypertension who underwent two-stage operation (PA-banding followed by VSD-closure), was studied.

Results: Forty-five patients with congenital VSD and severe pulmonary hypertension underwent PA-banding. Out of these, 33 patients had subsequent PA-debanding and VSD-closure. Male to female ratio was 2:1 (22 males: 11 females). Among these, 30(90.90%) patients had successful VSD-repair, while 3(9.09%) patients died. The median interval between PA-banding and VSD-closure was 2.05 years. The morbidity included one patient having MPA bleed during PA-banding which was immediately repaired and another patient had CVA post-VSD repair which improved during follow-up. Follow-up was available in 29/30 (96.67%) successfully repaired VSD patients. It ranged 2-5 years, with mean 2 years and 9 months. No recurrence was observed during the follow-up.

Conclusion: In congenital VSD associated with severe pulmonary hypertension, two-stage repair is safe and effective technique with acceptable morbidity and mortality.

KEY WORDS: Ventricular Septal Defect; Pulmonary hypertension; Pulmonary artery banding; Cardiac surgery.

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INTRODUCTION

Pulmonary artery (PA) banding is a technique of palliative surgical therapy used by congenital heart surgeons as a staged approach to operative correction of congenital heart defects leading to right ventricular (RV) volume overload and ultimate pulmonary hypertension. This technique was widely used in the past as an initial surgical intervention for children born with cardiac defects characterized by left-to-right shunting and pulmonary over circulation. In the last decade, early definitive intracardiac repair has largely replaced palliation with PA-banding.

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This trend has evolved because many centers have demonstrated improved outcome with primary corrective surgery as an initial intervention in the neonates with congenital heart defects. Although the use of PA-banding has recently significantly decreased, it continues to maintain a therapeutic role in certain subsets of patients with congenital heart disease. Muller & Dammann described the first successful operation for creating pulmonic stenosis in 1952. They advocated this operation for patients with a single ventricle or large VSD resulting functionally in two ventricles that act as one. The intent was to reduce pulmonary artery size by two thirds in order to decrease pulmonary blood flow by 50%.¹

The first operation took place in 1951 on a 5-months old infant. The chest was entered anteriorly through the second left interspace, and a U-clamp was placed to excise a segment of pulmonary artery. One cm umbilical tape was placed around the pul-

monary artery and sutured in place. The band was placed to prevent the pulmonary artery from growing larger than originally intended.² One hundred and one patients were banded between 1958 and 1970; fewer bands were placed in later years because early total correction was feasible for certain conditions. When analyzed by preoperative diagnoses, the data revealed that children with a single ventricle undergoing banding had a significantly lower 30-day mortality rate of 12% as compared to other preoperative diagnoses, including atrioventricular canal, truncus arteriosus and ventricular septal defect (VSD) at 30%.³ In the recent past, insertion of a valved patch in VSD repair, seems to be a promising technique to decrease morbidity and mortality in severe pulmonary arterial hypertension.^{4,5}

This study is a review of our surgical experience at Rehman Medical Institute, Peshawar regarding step-closure of VSD associated with severe PAH. The PA-Banding was done in these patients followed later on by VSD closure.

MATERIAL AND METHODS

The clinical record of all patients undergoing PA-Banding for subsequent VSD closure between January 2003 and March 2012 at Rehman Medical Institute, Peshawar was analyzed. The patients included had large congenital VSD with severe pulmonary hypertension. All the patients underwent PA-banding as preparatory procedure that was followed by an appropriate interval, after significant drop in PAH, by PA-debanding and definite repair of the VSD. Prior to the procedure, all patients underwent detailed echocardiographic assessment of their defects that provided essential information regarding the number, location, size and any associated anomaly as well as a measure of PAH. The PAH was measured preoperatively and confirmed intra-operatively. PAH $\geq 70/40$ mmHg was graded as severe and patients with severe PAH were included in this study.

Double silk ligature was used to band the PA while silk was in turn fixed to the adventitia of pulmonary artery by using Prolene / Ethibond in children. In adults we used Nylon tape. Successful PA-banding means that we are able to reduce PA pressures by $\geq 50\%$ maintaining acceptable level of arterial saturation and pressures, without compromising RV contractility and rhythm.

Criteria for ultimate repair were; patient weight ≥ 10 Kg, and significant drop in PAH post PA-Band. Every 6 months clinical and Echocardiographic evaluation of the patients was done to decide the proper time for ultimate repair. Median interval between PA-Banding and VSD closure was 2 years (range 1-4 years).

We closed the VSD, mostly through RA (mem-

branous/ inflow) or transpulmonic (sub-arterial/ outflow), using Dacron patch with interrupted and continuous Prolene stitches. We de-band the PA, with application of autologous pericardial patch to restore the diameter of the PA.

In all the patients the PA-banding was done using thoracotomy approach. At appropriate interval the PA-debanding and definitive VSD-repair was done after significant drop in pulmonary hypertension, using the sternotomy approach.

RESULTS

Total 45 patients with congenital VSD and severe pulmonary artery hypertension due to large left to right shunt underwent PA-banding during the study period. Thirty-three patients underwent subsequent PA-debanding and VSD closure. Male-to-female ratio of patients was 2:1 (22 males: 11 females).

At the time of PA-banding 15/33 patients (45.45%) were of age one year or below, while 18/33 patients (54.55%) were >1 year age. The eldest patient was 11 years of age, and the youngest 2 months at the time of PA-Banding. At the time of subsequent VSD-closure, in 22/33 patients (66.67%) the VSD was closed at <5 years of age and in 11/33 (33.33%) at >5 years of age. The youngest patient was 2 years of age and the eldest 15 years at the time of ultimate VSD repair. The Median interval between PA-banding and VSD closure was 2.05 years, the shortest interval being one year and the longest 4 years.

In 3/33 patients (9.09%) there was associated small ASD and in 2/33 patients (6.06%) there was associated PDA.

In 30 patients (90.90%) the VSD closure was successful following the PA-banding. The morbidity included one patient had MPA bleed during PA-banding which was immediately repaired and another patient having CVA post-ultimate VSD repair which improved during the follow-up period.

Three (9.09%) patients died. One patient after PA-banding, while other 2 after subsequent VSD closure in the ICU, one due to pulmonary hypertensive crises; and other with PA-band SBE when debridement and repair was tried.

Follow-up was available in 29/30 (96.67%) successfully repaired VSD patients. It ranged 2-5 years, with a mean of 2 years and 9 months with a good symptomatic relief and improved quality of life. No recurrence has been observed as yet in the follow-up of our study group.

DISCUSSION

In the case of VSD, pulmonary artery banding increases resistance to blood flow through the pulmonary artery. Pressure increases in the right

ventricle and prevents excess shunting from left to right. The operation consists of a thoracotomy to expose the pulmonary artery. A constrictive band is then sutured around the pulmonary artery. The PA band reduces the diameter of the PA and thereby restricts the amount of blood pumped into the lungs. The operation reduces the blood flow from 1/2 to 1/3 of the previous volume. PA blood pressure distal to the band is reduced as a result of the volume restriction. Pulmonary artery pressure reductions of 50% to 70% are usually sought. Following at suitable interval when the pulmonary artery hypertension and the pulmonary vascular resistance were overcome, the definitive repair of VSD(s) was carried out by putting a synthetic patch at the defect. This operation consists of median sternotomy and open heart approach on CPB. Surgical right atrial or right ventricular approaches provide suboptimal visualization of the defects due to heavy RV trabeculations. Left ventriculotomy can provide better exposure; however, it is associated with apical aneurysms, and with ventricular dysfunction sometimes necessitating heart transplantation.⁶⁻¹³

PA banding was once indicated in most patients with congenital heart defects with excessive pulmonary blood flow, and it contributed to improved outcome of various cardiac anomalies. However, the diagnostic subset of patients with excessive pulmonary blood flow has recently been treated by one stage operation, with satisfactory results.¹⁴

Still it is a fact that in our part of the world where the presentation is late and the patients already have high PAH, our study favors two stage procedures for VSD in these patients. Currently, early primary repair is the treatment of first choice for congenital cardiac defects. Palliative operations play a smaller role and are indicated in fewer patients. Isolated ventricular septal defect has been treated by primary repair with a very low operative mortality rate. However, we still prefer to perform PA-banding for patients with multiple or apical muscular ventricular septal defects, and also for patients with ventricular septal defect with complex extra cardiac congenital anomalies.¹⁵

At University of Virginia Health Sciences Center, PA-Banding revisited showed actuarial survival at 10 years of 92%.³ Novick, et al reported Flap valve double patch closure of VSD having hospital deaths 7.7% and late mortality 8.9%.¹⁶ Afrasiabi, et al reported valved-patch for VSD with PAH, having early post-operative mortality of 12.5%.⁴ In our study we found mortality of 9% for two-stage closure of VSD following PA-Banding.

Limitation of our study was that pulmonary vascular resistance could not be calculated. Normally patients with large VSDs present early to specialized units but in our region due to limited Pediatric Cardiology services for cardiac catheterization and logistic

problems we get patients with congenital cardiac defects in much later phase of the disease.

CONCLUSION

In patients having congenital VSD associated with severe pulmonary artery hypertension, two-stage repair is safe and effective technique with acceptable morbidity and mortality. However, larger controlled trials are needed to establish the effectiveness of this procedure more precisely.

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<p style="text-align: center;">CONFLICT OF INTEREST Authors declare no conflict of interest. GRANT SUPPORT AND FINANCIAL DISCLOSURE None declared.</p>
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