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Case Report

Hybrid Perventricular Ventricular Septal Defect Device Closure in a 3-Months Old Infant with Severe Failure to Thrive

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ABSTRACT

We report a case of successful hybrid device closure of large mid muscular Ventricular Septal Defect (VSD) in an infant for the very first time in Pakistan. Increasing collaboration between pediatric cardiac interventionalists and congenital cardiac surgeons has resulted in introduction of various hybrid procedures in the management of Congenital Heart Diseases (CHD). Advantages of hybrid procedures include complex interventions by using minimally invasive methods, avoidance of cardiopulmonary bypass, shorter procedure and recovery time leading to subsequent decrease in complications. A large VSD in an infant carries an increased risk of morbidity including failure to thrive, congestive cardiac failure, and recurrent respiratory tract infections. Timely and safely the successful perventricular closure of large VSD using hybrid approach is a milestone in the management of VSDs in infants.

Keywords: Congenital Heart Diseases, Hybrid, Perventricular, Ventricular Septal Defect closure, Patent Ductus Arteriosus

How to Cite This Article: *Akhtar K, Imtiaz S, Rafique S, Kamal D, Ahmad K, Ara A, Sadiq N, Rehman MU. Hybrid Perventricular VSD Device Closure in a 3 Months Old Infant with Severe Failure to Thrive. Pak Armed Forces Med J 2023; 73(Suppl-3): S590-592. DOI: https://doi.org/10.51253/pafmj.v73iSUPPL-3.10662*

INTRODUCTION

Owing to the development of newer transcatheter and surgical skills, the survival of children with Congenital Heart Diseases (CHD) has drastically been improved over last few decades.[1] Increasing collaboration between pediatric cardiac interventionalists and congenital cardiac surgeons has resulted in introduction of various hybrid procedures in the management of CHD. Advantages of hybrid procedures include complex interventions by using minimally invasive methods, avoidance of cardiopulmonary bypass, shorter procedure and recovery time leading to subsequent decrease in complications.

Most of the times surgical closure of large Ventricular Septal Defect in infants is challenging due to weight of the child, location of the defect, difficult post operative recovery in Intensive care unit and residual defects.[2] Percutaneous trans-catheter device closure of VSD was started in 1988, and nowadays, a routinely practiced approach to management of small and moderate size VSDs of suitable anatomy in children and adults. However, few technical challenges have restricted the use of this approach in small infants.[3] These include high risk of vascular damage, delivery sheath sizes and its difficult manipulation in small hearts resulting in arrhythmias, hemodynamic instability and damage to valves or myocardium.[4] To overcome these problems, the first perventricular closure of a muscular VSD was perfor-med in a baby by Amin *et al.* in 1998.[5] Since then, the hybrid approach for VSD closures is being used internationally. At our centre, surgical closure of large VSDs in infants is being offered at weight of more than 6 kg, resulting in higher morbidity in this specific patient group. Congenital and structural heart depart-ments at Armed Forces Institute of Cardiology is the first one in Pakistan to attempt and execute successful hybrid closure of VSD in an infant, thereby opening doors to more minimally invasive hybrid procedures in future and improved survival rates in this particular population.

CASE REPORT

About 3 months old infant presented to us with history of recurrent respiratory tract infections and failure to thrive. On examination, she weighed 3.5kg (less than 3rd percentile for her age) with no dysmorphic features. Precordial examination revealed a grade 3/6 systolic murmur heard with maximum intensity at left lower sternal border and a 4/6 continuous murmur at left upper sternal area. On echocardiography, we found a large 8 mm midmuscular VSD (Figure-1) shunting left to right and a large Patent Ductus Arteriosus (PDA) shunting left to right with dilated pulmonary artery and left sided volume load.

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Medical management started with furosemide and high calorie formula milk along with mother feed. Considering severe failure to thrive and large volume left to right shunts, it was planned to close the shunts through hybrid approach. VSD location and size was found to be suitable for perventricular device closure along with PDA ligation. After preanesthesia evaluation, baby was taken to hybrid cath lab. Midline sternotomy was done. PDA was identified and ligated by card-iac surgeon. Right Ventricle (RV) free wall was exposed and puncture site was identified by pressing upon RV free wall was and epicardial echocardiography to ensure the site is as perpendicular to the VSD as possible. Pledgeted purse string sutures were placed around the identified puncture site (Figure-2a).

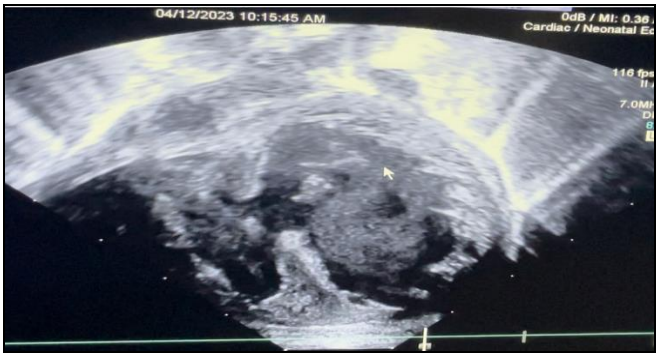

Figure-1: Echocardiography showing large midmuscular VSD

100 IU/kg I/V heparin was administered. RV was entered with 18 G cannula and 0.035" Radiofocus straight tip guidewire 150 cm (terumo) was entered through it. Under epicardial echo guidance, wire was advanced from RV through VSD to Left Ventricle (LV) cavity (Figure-2b).

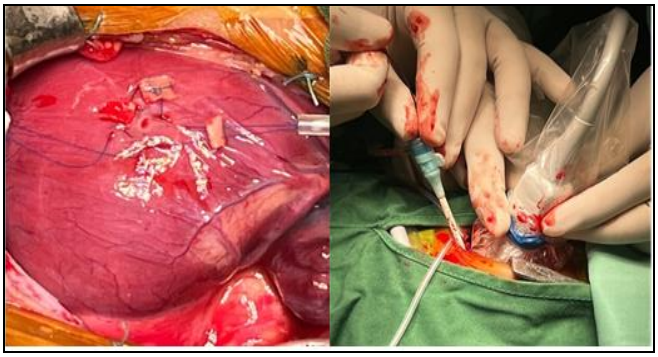

Figure-2(a:) Pledgetted purse string sutures Figure-2(b:) Introduction of sheath over terumo wire under epicardial echo guidance

The 8 Fr short sheath was introduced into LV over terumo wire (Figure-3a). Amplatzer 8 size VSD device was loaded and introduced into short sheath. Left disc was deployed into LV and while retracting the short sheath slowly, RV disc was deployed. Proper placement was ensured on epicardial echo specifically both AV valves & subvalvular apparatus were evaluated. Satisfactory VSD closure was observed post device release (Figure-3b).

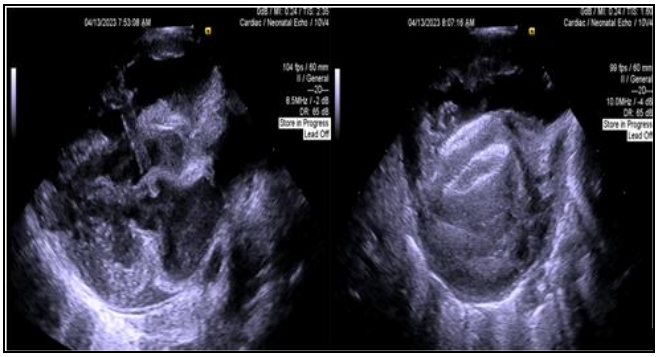

Figure-3a: Sheath in LV Figure-3b: Final deployment of device

Short sheath was removed and hemostasis was secured by cardiac surgeon followed by chest closure. Total procedure time was 1 hour. Patient remained hemodynamically stable throughout the procedure. Post procedure recovery was complicated by residual leak, pulmonary hypertension and intravascular hemolysis. Hematuria was observed in first 48 hours which was managed conservatively. Mechanical ventilation was required for 24 hours and pulmonary hypertension was managed with high flow oxygen, milrinone infusion and oral pulmonary vasodilators. She was discharged on 8th post procedure day. Follow up evaluation at 5 weeks revealed no residual leak across the device, normal pulmonary artery pressures and good biventricular function and a weight gain of 800gm.

DISCUSSION

Stage I palliation in hypoplastic left heart, hybrid VSD closure, hybrid pulmonary valve implantation in smaller children, coarctation of the aorta stenting, peroperative large collateral occlusion during Rastelli repair of pulmonary atresia with VSD to prevent flooding of the surgical field,[6] repair of paravalvular leaks,[7] and hybrid repair of pulmonary venous baffle obstruction after atrial switch,[8] are few examples of hybrid procedures being done internationally.

Hybrid VSD closure offers a minimally invasive alternative to traditional open-heart surgery, which can be particularly beneficial for infants who may not tolerate prolonged anaesthesia or bypass pump support.[9] Hybrid closure also avoids the need for a large

sternotomy incision, which can reduce pain and scarring, and decrease the risk of infection and bleeding.[10]

While hybrid closure can be a safe and effective option for selected patients, it does have some limitations and potential risks. For example, device migration or embolization can lead to surgery under cardiopulmonary bypass. Moreover, the procedure may not be feasible or appropriate for all cases, due to factors such as VSD location, size, morphology, or associated abnormalities.[5]

Proper patient selection and management are key factors for success in hybrid VSD closure. In our case, pre-procedure echocardiographic assessment & planning was the most important part. Transthoracic echocardiography revealed a large VSD posteriorly in the mid septum with lower margin highly mobile and flimsy, giving a bifid appearance due to a muscle band on RV side. Total septal thickness was 3mm. For a stable device position, we decided to deploy an ASD device with relatively large diameter of the retention discs, short length of the waist and right disc smaller than left one.

LIMITATIONS OF STUDY

Our procedure lacked trans-esophageal echo probe for infants. We had to use epicardial echo for which a relatively large sternal incision was given. For a successful new and novel procedure, a multidisciplinary team approach is necessary, involving pediatric cardiologists, cardiac surgeons, anesthesiologists, and nurses.

CONCLUSION

Hybrid device closure of large VSDs in infants is technically feasible and challenging with high success and acceptable complication rates.

ACKNOWLEDGEMENT

We are deeply indebted and grateful to Commandant AFIC/NIHD for his constant support and encouragement resulting in smooth completion of our project.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript:

KA, SI & SR: Study design, drafting the manuscript, approval of the final version to be published.

DK, KA & AA: Approval of the final version to be published.

NS & MUR: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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