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Percutaneous Device Closure of a Perimembranous Ventricular Septal Defect in a 2-Month-Old Infant

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Abstract

Ventricular Septal Defects (VSDs) are a common type of congenital heart disease, accounting for almost one-third of all cases. The perimembranous VSD (pmVSD) is the most common type of VSD. Surgical closure of VSD is widely performed but carries potential risks such as complete atrioventricular block, infection, and neurological issues. Catheter-based interventions for muscular VSDs have shown promising results since 1988 with the youngest patient being 8 months old infant, but data for perimembranous VSD closure is scarce.

Our primary goal in this case report is to discuss the successful percutaneous closure of a VSD in a 2-month-old infant. To the best of our knowledge, it is the youngest age recorded for a successful transcatheter pm VSD device closure.

Keywords: Perimembranous VSD • Device closure • Pediatric intervention • Congenital heart disease

Introduction

Ventricular septal defects are one of the most prevalent congenital heart conditions, constituting nearly a third of all cases. Among the various types of VSDs, the perimembranous VSD (pmVSD) is the most common. Percutaneous closure has been a successful treatment option for septal defects in children for quite some time [1]. However, in cases where the patient has lower body weight or poor vascular access, percutaneous device closure of VSD may not be feasible. This report showcases a successful device closure of a pmVSD using the Amplatzer duct occluder device II in a 2-month-old infant weighing 3 kg [2,3].

Case Presentation

A 2-month-old infant was referred to the cardiology OPD due to increased breathing efforts, increased heart rate, and failure to thrive. The baby was born through a cesarean section due to postdated pregnancy, with a birth weight of 2.65 kg, and was currently weighing 3 kg. The parents were consanguineous. His mother noticed that he had dyspnea during feeding and was irritable. A pan systolic murmur of grade 3/6 was found in the left parasternal area by physical examination. Chest X-ray was suggestive of mild cardiomegaly. Echocardiography showed 5.5 mm of perimembranous VSD with peak gradient across VSD of 32 mm of Hg with pulmonary artery systolic pressure of 10 mm of Hg.

Despite the de-congestive therapy, the patient did not have any symptomatic relief and was not gaining weight appropriately. Because of the failure to thrive, the case was discussed with a pediatric cardiovascular surgeon, and the percutaneous closure of the defect was planned.

Procedure

After well-informed written consent, the patient was sedated and intubated by the anesthesia team. The patient was loaded with a tablet of aspirin 5 mg/kg body weight on the prior night. Right Femoral Artery (RFA) and Right Femoral Vein (RFV) access were obtained with a 4 F sheath. A 4 F pigtail catheter was then inserted on PTFE guiding wire through RFA till the ascending aorta and placed inside the Left Ventricle (LV) and an LV shoot was taken in the Left Anterior Oblique (LAO) cranial view which showed VSD of size 5.2 mm, followed by removal of the pigtail (Figure 1A). A 4 F JR was inserted through RFA over the guiding wire and placed in the ascending aorta (Figure 1B). A Terumo wire passed through the JR catheter, VSD crossed and the wire progressed to the Right Ventricle (RV) to the Right Atrium (RA) to the Inferior Vena Cava (IVC). A

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Cocoon 6 F sheath was inserted through RFV, and a terumo wire was snared inside IVC with the help of an amplatz snare catheter. The Amplatz Duct Occluder Device (ADO II) of size 6 × 4 MM passed through the delivery sheath across VSD followed by the release of the LV rim of the device under fluoroscopy (Figure 1C and D). For confirmation of the proper device position LV shoot was taken (Figure 1E), followed by the release of the device from the delivery cable (Figure 1F).

After the procedure, the patient remained stable with echocardiography showing a properly placed VSD device in situ with no residual shunt across the device, no evidence of pericardial effusion; or any electrical disturbances on the ECG. However, due to a significant amount of blood loss, the patient received a blood transfusion and was closely monitored in the ICCU for 24 hours before being discharged.

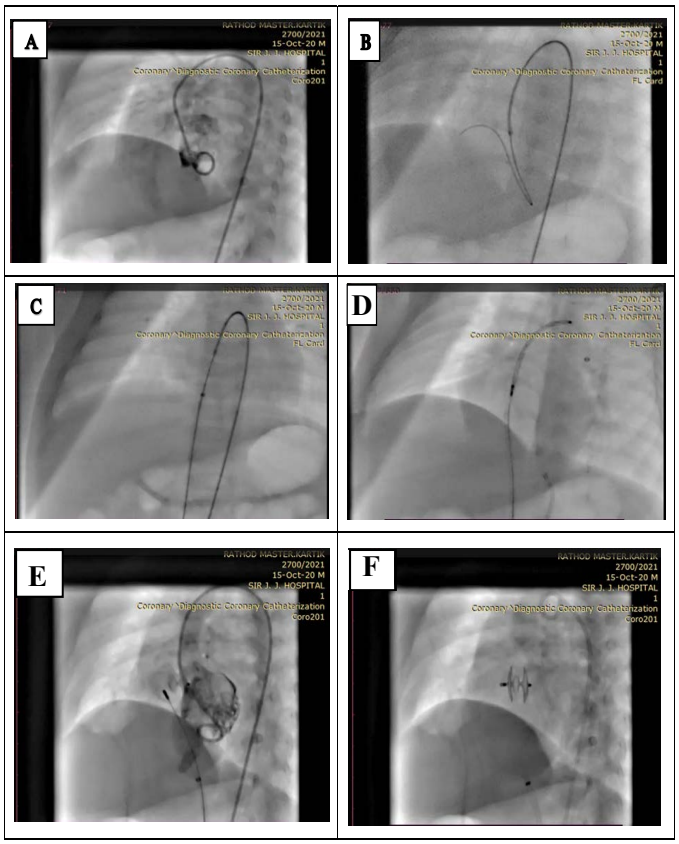

Figure 1A-F). Cinefluoroscopic images of steps of pmVSD device closure.

Follow up

After only four weeks, the child began to gain weight and showed an improvement in oral intake. All of his symptoms had completely resolved, and medications for congestive heart failure were stopped after six weeks. Follow-up echocardiography showed no residual shunt across the device and no evidence of aortic or tricuspid regurgitation, as well as no signs of pericardial effusion. Additionally, the ECG showed no abnormalities in conduction or rhythm.

We have been following the case for the last 2 years and the patient was doing well.

Discussion

Transcatheter closure of VSD has been performed successfully in older children for years.

To our knowledge, this is the youngest age at which a successful transcatheter pmVSD device closure has been performed, in an infant weighing only 3 kg.

The main challenges include local site puncture, selecting an appropriate size sheath, and delivering cables and devices of the proper size. Apart from this, percutaneous closure of Ventricular Septal Defect (VSD) carries certain risks, such as complete heart block, aortic insufficiency, and tricuspid insufficiency. To minimize these risks, appropriate devices should be selected according to the type, location, and size of the defect

As in our case, transcatheter retrograde closure of VSD with ADO II has been mentioned in the literature previously [4].

Percutaneous closure of Ventricular Septal Defects (VSDs) has been reported in the literature for children as small as 3.2 kg [5]. However, in cases where the child weighs less than 5 kg, the decision for device closure should be made with great care. The increased risk of residual shunts and procedure-related complications requires an experienced operator and a firm indication for this approach. In our case, the child was only 3 kg and there was no device-related complication during the procedure other than blood loss from the local site for which the patient needed blood transfusion.

Zartener et al., reported transvascular closure of single and multiple muscular ventricular septal defects in neonates and infants <20 kg in 17 patients, with a success rate of 88%, reducing the inter-ventricular shunt and improving the hemodynamic situation in 14 patients. A patient with the lowest weight of 2.2 kg had developed an acute AV block which led to the immediate removal of the device. One Amplatzer muscular VSD occluder could not be delivered due to the sharp bending of the delivery sheath in 2004 [6]. Device closure of perimembranous Ventricular Septal Defect (pmVSD) is more challenging due to its proximity to the aortic valve and the conduction system, as well as the device's lesser stability. Successful closure is more difficult at younger ages and lower weights.

According to a report by Diandong et al, the most common abnormality in heart rhythm and conduction after perimembranous VSD device closure is incomplete right bundle-branch block. The incidence of persistent abnormality in rhythm or conduction is 4.5%. Although complete AV block is the most serious complication, its occurrence has gradually decreased to 1% in recent years [7]. The occurrence of complete LBBB is of significance because it can cause abnormal contraction of the left ventricle, leading to deterioration of its function and potentially causing heart failure [8].

Patients need to be monitored for recurrence and late onset of complete AV block and LBBB. In our case, there was no sign of any conduction defect.

Conclusion

We believe that transcatheter therapy can be a relatively safer alternative to surgery in selected pmVSD, thereby reducing morbidity and mortality in such symptomatic infants with low birth weight. The emphasis should be on ensuring proper local site vascular access and selecting suitable sheaths, and device size. It is crucial to keep a close eye on any conduction or rhythm irregularities that may arise.

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