TRANSCATHETER CLOSURE OF LARGE PERSISTENT DUCTUS ARTERIOSUS WITH THE MUSCULAR VENTRICULAR SEPTAL DEFECT DEVICE

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ABSTRACT

Objective: To assess the efficacy of Ventricular Septal Defect device for occlusion of large Patent Ductus Arteriosis with high pulmonary artery pressure.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Armed Forces Institute of Cardiology Rawalpindi from May 2014 to Dec 2017.

Material and Methods: It was a descriptive cross-sectional study included seventy patients. Patients more than 2 months of age were included. Patients with large PDAs and systemic or near systemic pulmonary artery pressure underwent transcatheter closure using the VSD (SHSMA). Patients had weight less than 3kg were excluded. All patients were followed by echocardiogram 2 weeks and 6 months following the procedure.

Results: The mean echocardiographic and angiographic PDA diameter was 8.5 mm (1.8) (range 5-14 mm) and the mean VSD diameter was 11.4 (1.8) mm (range 9-16 mm). Successful device delivery and complete closure occurred in 55 patients (96.5% occlusion rate), Mean systolic pulmonary artery pressures was 65 mm Hg before procedure and 39 mm Hg immediately after the procedure. Fluoroscopy time was 9 min (range 5-25 min). Two devices embolized.

Conclusions: VSD device is very effective for closure of large PDAs along with high pulmonary artery pressure.

Keywords: Ventricular Septal Defect, Patent Ductus Arteriosis.

INTRODUCTION

Transcatheter closure of persistent patent ductus arteriosus (PDA) using various types of devices is a well established procedure. Somehow all patients with PDA are not suitable for this type of treatment, as these devices are not always appropriate for large pulmonary hypertensive ducts (PH-PDA). In the presence of high pulmonary artery pressure such devices are prone to embolisation into the aorta[1,2]. The muscular ventricular septal defect device has recently been used successfully for transcatheter closure of muscular ventricular septal defects[11,12]. This device is suitable for use with PH-PDA as its double disk tends to hold the device, minimising embolisation into the aorta. In this study we report the successful use of the muscular VSD device for treating PH-PDA.

The Memo Part VSD Occluder (LEPU Medical Technology, Beijing, China) has been described in detail in multiple studies[11,12]. This VSD device is a self centering and repositionable device constructed of 0.004 inch (0.1 mm) Nitinol wires, tightly woven into two flat round discs with a 7mm connecting waist. The left disc is 4 mm larger than the waist and the right disc is 3 mm larger than the waist. Prostheses are currently available in various sizes.

MATERIAL AND METHODS

It was a descriptive cross-sectional study conducted at Armed Forces Instititue of Cardiology from May 2014 to Dec 2017 included seventy patients. Patients more than 2 months of age and patients with large PDAs and systemic or near systemic pulmonary artery pressure underwent transcatheter closure using the VSD (SHSMA) were included. Patients had weight less than 3kg were excluded. All patients were followed by echocardiogram 2 weeks and 6 months following the procedure. Informed parental consent for the procedures was obtained

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from each patient. Data analysis was done on SPSS version-22. Descriptive statistics was applied to measure mean ± SD and frequency & percentages.

The technique of transcatheter closure of PDA using the VSD has been described in various studies. After percutaneous puncture of the femoral artery and vein, a complete haemodynamic evaluation was performed with pressure and saturation measurements taken in all cardiac chambers. A descending aortogram in anteroposterior and lateral projections was performed with a 5 or 6 French pigtail catheter to define the size and anatomy of the PDA (fig-1a). A 5 French JR catheter was advanced percutaneously from the venous side through the PDA into the descending aorta. Using an exchange 260 cm, 0.035 inch guide wire, the JR catheter was exchanged for various sizes of delivery sheaths advanced directly through the femoral vein and positioned in the proximal descending aorta.

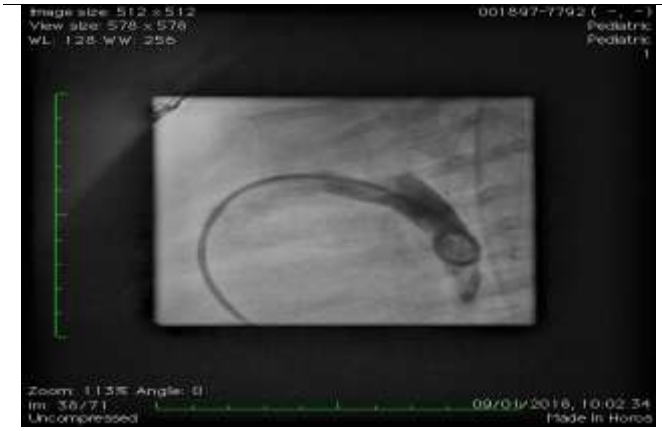

Figure-1a: Aortogram in left lateral position showing large tubular PDA.

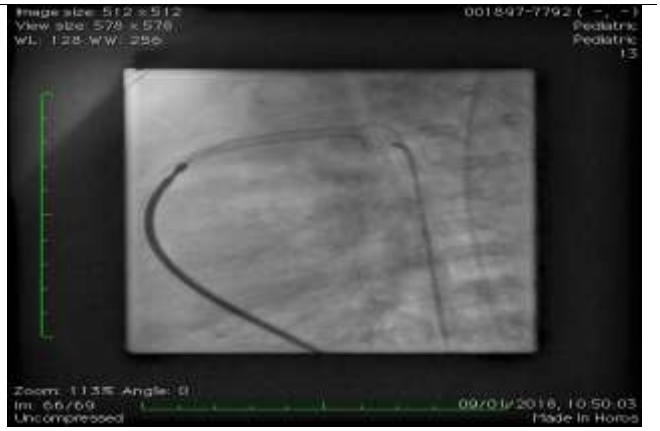

Figure-1b: Aortic end is released and pulled gently against PDA.

An appropriately sized occluder was screwed to the delivery cable, pulled into the loader, and introduced into the guiding sheath. Under fluoroscopic guidance, the occluder was advanced into the descending aorta, where the left disk was deployed and pulled gently against the orifice of the duct (fig-1b).

Correct position was confirmed by injection of contrast medium through the aortic catheter into the descending aorta. Using gentle tension on the delivery cable, the sheath was pulled back to deploy the rest of the device. With the device still attached to the delivery cable, cross sectional colour Doppler echocardiography, pulmonary arteriography (fig-2) and descending aortography (hand injection of contrast medium) were done to confirm proper device position and exclude left pulmonary or aortic obstruction[3-5]. Once optimal position was confirmed, VSD device was released by counter clockwise rotation of the delivery cable. A repeat aortogram (fig-3) and a complete haemodynamic evaluation were performed to check for residual shunts and change of pressures. Prophylactic antibiotics were not routinely given during the procedure. All patients were sent home 24 hours after the procedure on no drug treatment. Endocarditis prophylaxis was discontinued at the 12 month follow up visit if the duct was completely closed.

A chest x-ray and colour Doppler echo-cardiographic studies were performed on all patients at 24 hours, one month, and serially at 3-6 month intervals.

RESULTS

Seventy patients with clinical and echocardiographic findings of a large PDA and pulmonary hypertension underwent trans-catheter closure with the VSD device. Their median age was 8 years (range 2 months to 20 years) and their median body weight was 30 kg

(4 Kg to 65 kg). Ten patients had symptoms of heart failure and failure to thrive. On Doppler echocardiography there was evidence of bidirectional shunting through the PDA with left atrial and left ventricular enlargement.

According to Krichenko's PDA classification[13], Fourty five patients had type A, 20 had type C, and five had type E. The length of the duct varied between 7-9 mm .The mean duct diameter (pulmonary end) was 9.8 (1.7) mm (range 7-13 mm). The mean VSD diameter was 12mm. (The pulmonary to systemic flow ratio (Qp/Qs) varied between 2-3. All patients had systemic or near systemic systolic pulmonary artery pressure (mean 102 (11) mm Hg; mean systolic aortic pressure 109 (10) mm Hg). Device delivery was successful and associated with complete closure in all patients (100% closure rate). There was a significant fall (p<0.05) in mean systolic pulmonary artery pressure after the placement of the VSD device (to 50(5) mm Hg). Fluoroscopy time was 8.6 (4.1) minutes (range 4-16 minutes). One patient developed device embolization which was retrieved successfully and closed with 2 mm higher size[6,7].

There was fall in the mean systolic pulmonary artery pressure at the six months follow echocardiogram. No complications were observed in the early post procedural period or during the one year follow up. All patients had complete closure with no evidence of device recanalisation, migration, wire fracture, thrombo-embolism, or endocarditis. No obstruction of the left pulmonary artery or the aorta was noted.

Transthoracic echocardiogram one year after implantation of the VSD device, showed complete closure and good position of the device with no evidence of aortic or pulmonary artery obstruction.

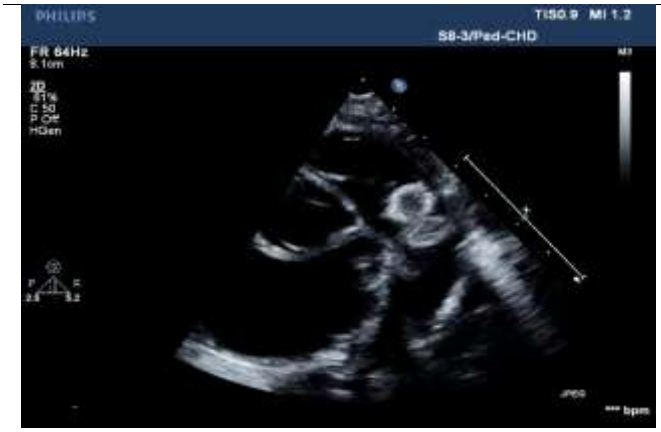

Figure-2: Echocardiogram of device placement while still attached to delivery cable.

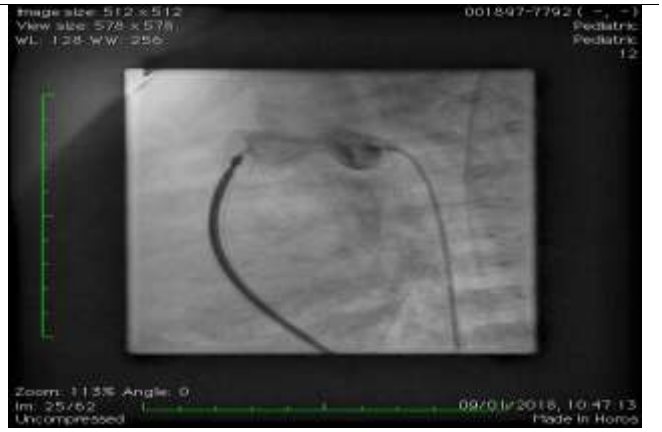

Figure-3: Aortogram to check final position of device before release.

DISCUSSION

PDA closure using the SHSMA VSD device has significantly improved the results of tans catheter closure of moderate to large sized ducts. Its major advantages over previous devices are the smaller delivery sheaths (7-9 French), easy to reposition the device before release, and a significantly lower rate of complications and residual shunts[8-10]. However, the duct occluder devices are not designed to maintain a stable position under high pressure. Therefore in the presence of high pulmonary artery pressure there is a real possibility of systemic embolization. Even with VSD device we had one case of device embolization but it was retrieved and a bigger device was deployed successfully[13,14].

This study shows the biggest number of patients treated with this modality with excellent results showing that trans catheter closure of large PH-PDAs is practicable, effective, and safe. Complete occlusion was obtained in all patients, with a significant fall in the pulmonary artery pressure and no complications during the

procedure or at the one year follow up. The device is muscular VSD device and its retention disk system ensures secure positioning in the pulmonary orifice of the duct and prevents device embolization into the systemic circulation in the presence of high pulmonary artery pressure. In addition, because of its construction from tightly woven Nitinol wire, this VSD device exerts an exaggerated stenting effect on the duct wall, giving it greater stability than the PDA device. Finally, this occluding device is available in various sizes, which makes it suitable for trans-catheter closure of very large ducts.

Our major estimation of device size was based on echocardiographic estimation of PDA in short axis medially angulated view. The selected device size was 2-3 mm larger than the echo estimated size. This method reduced the chances of device embolization and better positioning across the aorta and pulmonary artery.

Pulmonary artery pressures were measured in all patients before and after the device closure. The cases with severe pulmonary hypertension having bidirectional shunting and right ventricular dilatation on echocardiography were not subjected to device closure. These cases were supposed to have elevated pulmonary vascular resistance not amenable to device closure.

CONCLUSION

The SHSMA VSD device was found safe for the closure of large ducts having adequate ampulla. With the use of this device we can minimize the chances of embolization with efficient closure and no residual shunt across PDA.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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