



**VENTRICULAR SEPTAL DEFECTS WITH NEAR SYSTEMIC PULMONARY PRESSURES -AN INSTITUTIONAL EXPERIENCE**

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**ABSTRACT**

Ventricular Septal Defects (VSD) with severe pulmonary hypertension (PHT) patients are the difficult ones to intervene as they carry increased risk of postoperative morbidity and mortality especially when pulmonary pressures are near to systemic pressures. We share our experience of 31 such cases managed by double flap technique and use of pulmonary vasodilators.

**KEYWORDS :** Ventricular Septal Defects , Pulmonary Hypertension , Double Flap technique.

**INTRODUCTION:**

Patients with VSD in which PHT is severe have traditionally thought to be inoperable because of the high risk of operation. Zhou et al reported the use of Unidirectional valve patch closure of cardiac septal defects with severe PHT. Excellent improvement in Functional state was noted. These results were corroborated by Ad et al. We share our experience of 31 such cases managed by double flap technique and use of pulmonary vasodilators.

**MATERIALS:**

- No of cases :31
- Duration of study: August 2012 to December 2017

**INCLUSION CRITERIA:**

- Primary diagnosis VSD without any coexisting pathology
- Echo showing bidirectional shunt with severe PHT
- Cardiac catheterization showing reversibility of PHT

**EXCLUSION CRITERIA:**

- Cases with sub systemic pulmonary pressures
- VSD with coexisting anomalies
- Eisenmengerised VSD

**METHODOLOGY :**

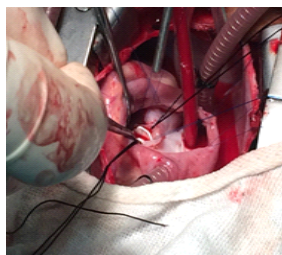
31 patients having VSD with severe PHT were included in the study.

**OUR PROTOCOL:**

The children were treated with preoperative oral sildenafil; Intraoperatively half the dose of phenoxybenzamine was given directly into the main pulmonary artery just before cross clamp. Intraoperatively double flap technique was followed (goretex-PTFE patch); Weaned off from bypass with infusion of phenoxybenzamine , milrinone , inotropic support ; Postoperatively electively ventilated for 24-72 hours ; Elective tracheostomy done if unable to wean from ventilator after 4 days; Followed up with oral Sildenafil / Bosentan and ECHO.



**Figure 2 Flap made using goretex patch and prolene sutures**



**Figure 3 Intraoperative image showing closure of VSD using the patch**



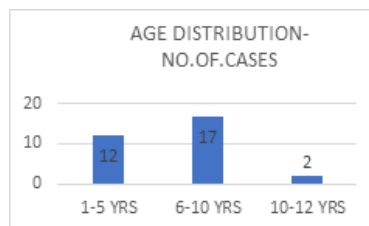
**Figure 4 Post bypass Aortic and PA pressures**

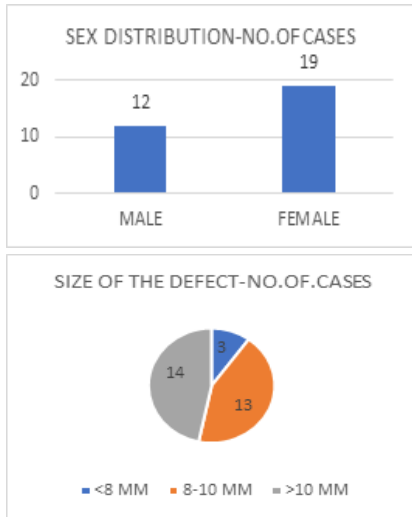


**Figure 1 pre bypass aortic and PA pressures**

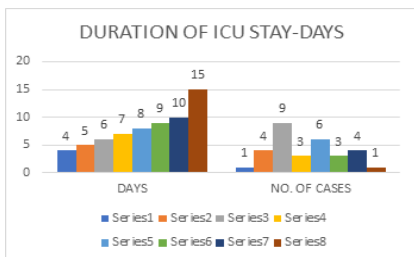
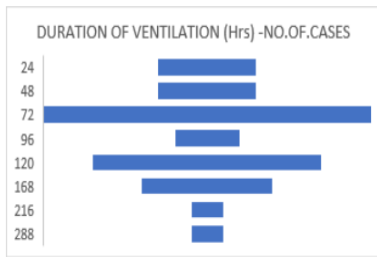
**RESULTS:**

Of the 31 children, 12 were in the age group of 1-5 years, 17 in the age group of 6-10 years, 2 in the age group of 11-12 years.

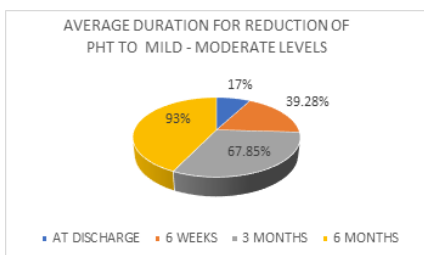
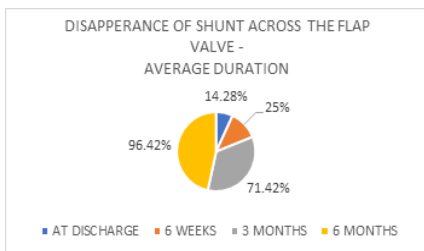




Average duration of ventilation was 114 hours. 13 children needed tracheostomy and the average duration of ICU stay was 7-8 days.



Complications encountered were PHT crisis, Right ventricular failure, Heart block, Reintubation. Mortality was encountered in 3 cases the cause being right ventricular failure, septicaemia. All the remaining 28 children were stable during follow up.



Shunt across the flap valve disappeared in 27 children by 6 months and PHT regressed to mild / moderate levels in 25 children in the same duration.

**CONCLUSION:**

Ventricular Septal defects with severe pulmonary hypertension can be effectively managed by double flap patch closure surgical technique along with judicious use of pulmonary vasodilators. The protocol followed in our institution using double flap technique, pulmonary vasodilators, ventilatory support for the management of patients with VSD/PHT may be used as an alternative to the use of nitric oxide in the effective postoperative management of this subgroup of patients

**DISCUSSION:**

Two main determinants of the Pressure gradient across VSD and Shunt volume across VSD are 1. Size of defect 2. Pulmonary vascular resistance.

**Pulmonary Vascular Resistance Index**

- < 4 units/BSA --- Normal
- 4-5 --- Mildly elevated
- 5-8 --- Moderately elevated
- >8 --- Severely elevated

When the index is > 8 pulmonary vasodilator challenge is performed (hyperventilation / 100% Fio2 / Nitric oxide / Pulmonary vasodilators) and if the index falls to <= 7, the response is considered favourable and surgery is advised.

**HEATH - EDWARD CLASSIFICATION**

Pulmonary Vascular resistance in patients with VSD is correlated with histologic severity of the Hypertensive pulmonary vascular disease classified by Heath et al. Histologic reversibility of Pulmonary vascular disease after closure of VSD has not been documented. Presumably pulmonary vascular disease of grade 3 or greater severity is not reversible.

- **Grade I** - hypertrophy of the media of small muscular arteries and arterioles.
- **Grade II** - intimal cellular proliferation in addition to medial hypertrophy.
- **Grade III** - progressive intimal proliferation and concentric fibrosis.
- **Grade IV** - "plexiform lesions"
- **Grade V** - angiomatous and cavernous lesions and hyalinization of intimal fibrosis.
- **Grade VI** - necrotizing arteritis.

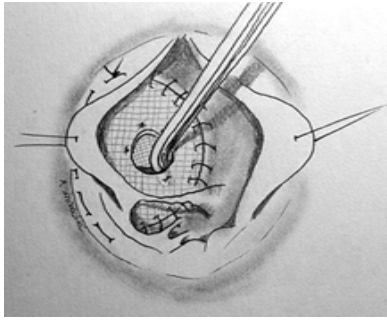
Surgical correction has to be done before irreversible damage to pulmonary vasculature occurs. The primary investigations include 1. Echocardiogram - To assess the site & size of VSD, the direction of the shunt and to assess the PHT severity.

**2. Cardiac catheterisation**

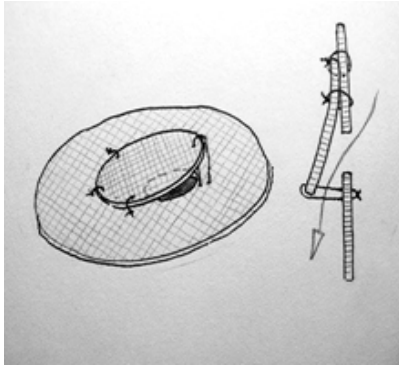
a) To assess RA, RV, PA & Aorta pressures b) To ascertain the shunt fraction & Shunt diameter c) To determine PVRI & to assess the reversibility of PHT with the use of 100% oxygen & vasodilators.

VSD in Patients with pulmonary hypertension may benefit from repair using Flap valve technique - flap opens right to left if right ventricular pressure exceeds left ventricular pressure in severe PHT, the right ventricle will decompress to the left ventricle, supporting the systemic cardiac output. It is inferred that as the PHT decreases late postoperatively, the flap valve

will close by cicatrix.



**Figure 1** Novak`s double flap technique



**Figure 2** flap valve opening should be into LV directed towards the apex

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