



## **Incidence of complete heart block requiring permanent pacemaker after surgical closure of ventricular septal defect: 2 years' experience in high volume center in Pakistan**

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### **Abstract**

**Background:** surgical closure of VSD is the most common pediatric cardiac operation performed all over the world. Permanent complete heart block (CHB) is a significant complication of VSD closure. The incidence of complete heart block after surgical closure was upto 25% in 1970s. It is now less than 1%. In this article we will provide the data of our institute and compare our results with other studies

**Patients and methods:** files of the patients who had surgical closure of VSD, from January 2021 to December 2023, were studied retrospectively. Great care was taken to avoid injury to the conduction system.

**Results:** 276 patients had VSD closure. 2 (0.7%) developed complete heart block that required permanent pacemaker.

**Conclusion:** The operating surgeon must have good knowledge of conduction system and should know how to avoid complete heart block. Using larger patch, using Dacron or pericardial pledgets instead of Teflon, and using transitional stitches can help avoiding the complete heart block. This does decrease the morbidity and hospital stay.

**Keywords:** ventricular septal defect, complete heart block, bundle of His, permanent pacemaker

### **Introduction:**

Ventricular septal defect (VSD) is the most common congenital heart defect. The surgical closure of VSD is the most common pediatric cardiac operation performed all over the world.<sup>1-2</sup> Perimembranous VSDs are most commonly repaired surgically<sup>3</sup>.

The AV node sits at the apex of the triangle of Koch, which is limited by the tendon of Todaro posteriorly, the orifice of the coronary sinus inferiorly, and the tricuspid valve annulus superiorly.





From the AV node, the common AV bundle of His goes within the the posteroinferior margin of the VSD, traverses the septum, and then courses along the left ventricular aspect of the septum. It then divides into a right bundle branches. <sup>4</sup> Permanent complete heart block (CHB) is a significant complication of VSD closure. It is post-operative heart block that does not spontaneously revert to the pre-operative rhythm (usually within 10 days of the operation). Treatment requires insertion of permanent pace maker. <sup>5</sup>

The incidence of complete heart block after surgical closure was upto 25% in 1970s , but with improved understanding of the anatomy of conduction system, the incidence of complete heart block has significantly dropped in the modern era. It is now less than 1%. <sup>6</sup>

In this article we will provide the data of our institute and compare our results with other studies.

### Patients and methods

Syudy design: It's a retrospective study.

Settings: department of pediatric cardiovascular surgery, Lahore, Pakistan.

Duration: January 2021 to December 2023.

Inclusion criteria: all the patients who had surgical closure of VSD in above mentioned duration.

After taking approval from the hospital ethical committee files of all the patients who underwent surgical closure of VSD were studied. Preoperative history, electrocardiograms, operation notes and post operative course were studied.

Exclusion criteria: Patients undergoing VSD closure in other congenital heart diseases like tetralogy of fallot, transposition of great arteries, and truncus arteriosus were excluded from the study.

Data were stored and analyzed in SPSS version 14. Mean  $\pm$  SD were calculated for quantitative variables . Frequencies and percentages were calculated for categorical variables . . All results were presented in the form of tables.

Surgical technique:

Peri membranous VSDs were closed through right atrium. Cardiopulmonary bypass was established with standard aortic cannulation and bicaval cannulation. Lowest temperature ranged from 32 to 30 C.

Most of the surgeons used interrupted 5/0 ploypropylene sutures with Teflon pledgets and patch of Dacron or bovine pericardium to close the VSD. One surgeon used continuous 5/0 polypropylene.

Strategy to prevent heart block:

The initial suture was placed at 3–4 o'clock. Sutures were then placed sequentially working in a clockwise direction with great care in the region of the conduction bundle at the posterior and inferior angle of the defect. Great care was taken when passing the needle, the needle didn't cross the full thickness of intervehtricular septum, as described by de leval, <sup>7</sup>. As sutures approached the tricuspid annulus, they were placed at least 2 or 3 mm inferior to the inferior margin of the VSD. The two transitional stitches at superior and postero inferior margins of the vsd were placed very similar to the technique described by Manning <sup>8</sup> and jonas <sup>9</sup>. Two pledgets ( made of Dacron , autologous or bovine pericardium) were used for the transition stitch, one lied against the muscle of the ventricular septum, while the second lied on the right atrial aspect of the septal leaflet of the tricuspid valve.

Doubly committed sub arterial VSDs were closed through main pulmonary artery.

Temporary epicardial pacing was routinely employed in all patients after separation from cardiopulmonary bypass. For patients with post-operative CHB, attempted cessation of this temporary pacing resulted in bradycardia and hypotension. Continuous ECG monitoring in the Intensive Care



Unit post-operatively showed CHB. Temporary pacing was then continued with the expectation of spontaneous resolution within 7–10 days.

**Results:** 276 patients underwent VSD closure from January 2021 to December 2023. Mean age was 11 months, mean weight was 7 kg. Pulmonary hypertension was the most common indication for VSD closure. Average cardiopulmonary bypass time was 48 minutes; average cross clamp time was 32 minutes.

AGE: age of the patients ranged from 3 months to 14 years with the mean of 11 months

WEIGHT: weight ranged from 2.5kg to 42 kg with mean of 7kg

INDICATION FOR SURGERY: table 1 shows the indications for surgery. Pulmonary hypertension was the most common indication for VSD closure.

Table 1 indication for surgery

Indications for surgery	n	%
Pulmonary hypertension	210	76%
Right coronary cusp prolapsed	23	8.5%
Aortic regurgitation	18	6.5%
Failure to thrive	4	1.5%
LV volume overload	4	1.5%

CARDIOPULMONARY BYPASS TIME: Cardiopulmonary bypass time ranged from 35 minutes to 285 minutes with the mean of 48 minutes

CROSS CLAMP TIME: cross clamp time ranged from 21 minutes to 200 minutes with the mean of 32 minutes

TYPES OF VSDs: type 2 VSD was the most common type of VSD. Detail is provided in table 2

Table 2 miscellaneous details

Total number of patients	276	
Age	3months - 14 years( mean 11 months)	
Weight	2.5 – 41 kg( mean 7kg)	
CPB time	35-285 (mean 48 minutes)	
Cross clamp time	21-200 minutes( mean 32minutes)	
Type 1 VSD	50	18.5%
Type 2 VSD	204	74%
Type 3VSD	11	4%



Type 4 VSD	11	4.0%
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2 patients (0.7%) developed complete heart block that didn't recover within 10 days after operation and required permanent pacemaker. None of them showed clinical or electrocardiographic (ECG) evidence of complete heart block before surgery. All were in sinus rhythm pre-operatively. Intra-operative rhythm was sinus as shown by continuous ECG monitoring until the institution of cardiopulmonary bypass. Both of the patients that required permanent pacemaker were having isolated perimembranous VSD. First patient was 8 months old and 2<sup>nd</sup> was 12 years old. Both of them had PPM implantation in the rectus sheath posterior to rectus abdominus muscle, with epicardial pacing leads through sub xyphoid incision on 10<sup>th</sup> post operative day. Both were discharged home on 13<sup>th</sup> post op day with instructions.

#### Discussion:

In the developed countries, the debate is the incidence of heart block after trans catheter device closure of the VSD. When compared with surgical results, relatively high incidence of complete heart block from the transcatheter approach for perimembranous VSDs has been a cause of great concern. 10 11, 12 but in developing countries there is still high incidence of complete heart block after surgical closure of VSD. 5,13 .

Tucker, 14 in his article studied patients from 51 centers in north America over the course of 20 years. Over all there was 1.1 % incidence of PPM insertion. A PPM placement is more likely in patients with Down syndrome. While an Iranian study 15 had 7.6% incidence of PPM implantation after VSD closure. Our study had 0.7% incidence of PPM insertion after VSD closure. Our results are comparable to the study done by schipper 16 which had 0.8% incidence of PPM insertion. As discussed by Sen O 17, the interrupted or continuous closure of VSD had no impact on the outcome, so was the case in our study. Those patients who had complete heart block requiring PPM insertion had prolonged hospital stay which increased the cost and morbidity. To avoid the heart block is the ideal strategy.

Comparison with other studies: table 3 shows the comparison with contemporary studies

Conclusion: The operating surgeon must have good knowledge of conduction system and should know how to avoid complete heart block. Using larger patch, using Dacron or pericardial pledgets instead of Teflon , and using transitional stitches can help avoiding the complete heart block. This does decrease the morbidity and hospital stay.

Table 3

Author	Year	CHB
Nigren 18	2000	8%
Gayner 19	2001	0%
Bol raap 20	2003	1%
Anderson 6	2005	0.7%
Rasool	2021	0.7%

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