

Outcomes of Posterior Wall Thickness, Interventricular Septal Thickness and LA diameter after Surgical Closure of Ventricular Septal Defect in Different Age Group

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Abstract

Background: Good outcome after surgical closure of ventricular septal defect is essential. **Objective:** The purpose of the present study was to see the improvement of posterior wall thickness, interventricular septal thickness and LA diameter after surgical closure of ventricular septal defect in different age group. **Methodology:** This prospective cohort studies was conducted in the Department of Cardiac Surgery at National Institute of Cardiovascular Disease (NICVD), Dhaka. Patient with surgical closure of VSD were enrolled into this study purposively and were divided into 3 groups according to the age. In group A (n=10), patients were within the age group of 2.0 to 6.0 years; age of group B (n=8) patients were 6.1-18.0 years and the group C (n=6) ages range was 18.1-42.0 years. Echocardiographic variables such as posterior wall thickness, interventricular septal thickness and LA diameter were taken preoperatively and at 1st and 3rd month of postoperative values. **Result:** Totally 24 patients were recruited for this study. The mean age was 12.60±12.09. After 1 month posterior wall thickness was increased by 12.07%, 7.02% and 5.26% in group A, group B and group C respectively. After 3 months left ventricular posterior wall thickness was decreased by 36.21%, 29.78% and 17.58% in group A, group B and group C respectively. After 1 month interventricular septal thickness was increased by 3.51%, 8.86% and 9.22% in group A, group B and group C respectively. After 3 months interventricular septal thickness was decreased by 31.58%, 25.00% and 16.67% in group A, group B and group C respectively. After 1 month LA diameter was increased by 4.81%, 4.28% and 4.75% in group A, group B and group C respectively. After 3 months LA diameter was decreased by 15.93%, 12.84% and 5.96% in group A, group B and group C respectively. **Conclusion:** Cardiac remodeling occurred after surgical closure of ventricular septal defect and remodeling were more significant in younger age group.

Keywords: Cardiac remodeling; ventricular septal defect; surgical closure; echocardiographic evaluation

Introduction:

Ventricular septal defect (VSD) is a common congenital heart defect in both children and adults¹. Management of this lesion has changed dramatically in the last 50 years². Catheter-based therapy for VSD closure, now in the clinical trial phase, is another step in the evolution of treatment for this disorder. Despite these advances, many patients with small VSDs require only sub acute bacterial endocarditis prophylaxis³.

It has been reported that the most common form of congenital heart disease in childhood is the VSD, occurring in 50% of all children with congenital heart disease and in 20% as an isolated lesion⁴. The incidence of VSDs has been increased dramatically with advances in imaging and screening of infants and these ranges from 1.56 to 53.2 per 1000 live births⁵. The ease of detection of small muscular

VSDs is reflected in the higher incidence rates. A large review of the literature estimated the median incidence of VSDs at 2829 per 1 million live births⁶. In the adult population, VSDs are the most common congenital heart defect excluding the bicuspid aortic valve⁷. Task Force 1 estimated the prevalence of simple VSDs in the adult population as 0.3 per 1000⁸. The number of adults in the United States with simple congenital heart lesions was estimated to be 368 800⁸. Another study by Hoffman et al⁹ also estimated the number of surviving adults by decade with either small or large VSDs.

Echocardiographic evaluation of VSDs is a noninvasive tool that accurately delineates the morphology and associated defects¹⁰. Hemodynamic evaluation of the defect, the presence of elevated pulmonary artery pressure, obstruction of the right ventricular outflow tract

double chamber physiology, insufficiency of the aortic valve, and distortion of the valve apparatus are all evaluated by echocardiography¹¹. When limitations in image quality of transthoracic echocardiography prevent evaluation of these aspects of the cardiovascular physiology, transesophageal imaging can be performed. Three-dimensional echocardiography has proved accurate for quantifying shunt and can provide accurate visualization of defects that otherwise are difficult to evaluate by 2-dimensional imaging alone.

It is very logical to assume that the degree of compensatory changes in the heart depends on the size and flow across the VSD, the relative compliance, pressure and resistance to flow in the ventricles and the greater the duration of this left to right shunt, greater the adaptive changes. Therefore, early intervention is very likely to halt the disease process and thereby the pathological changes and the magnitude of cardiac remodeling is expected to be more complete as a logical consequence. The purpose of the present study was to see the improvement of posterior wall thickness, interventricular septal thickness and LA diameter after surgical closure of ventricular septal defect in different age group.

Methodology:

This study was designed as prospective cohort study and was carried out from January 2014 to May 2014 for a period of five (5) months. This study was conducted in the Department of Cardiac Surgery at National Institute of Cardiovascular Disease (NICVD) Dhaka. All patients presented with isolated VSD who were surgically treated with the age group of 2 to 42 years of both sexes were included as study population. This study population was divided into 3 groups on the basis of preschool going child, school going child and adult which were designated as group A, group B and group C respectively. VSD patients with other associated cardiac diseases and patients with pulmonary artery systolic pressure (PASP) more than 60 mm of Hg was excluded from this study. The sampling technique was purposive sampling method. After getting written informed consent from adult and the guardians of the children, all data regarding demographic variables, echocardiographic variables were collected. M-mode and two-dimensional echocardiography recordings were performed using a phased-array echocardiographic Doppler system (Sonos 5500, Hewlett-Packard [Agilent], Andover, Massachusetts) equipped with a 3-7 MHz transducer. Echocardiography was done in left lateral recumbent position using standard parasternal short- and long-axis and apical views. Posterior wall thickness,

interventricular septal thickness and LA diameter were recorded by echocardiography. All patients were followed up 1 month and 3 months after postoperative days by echocardiography and compared with preoperative echocardiographic findings. Data were collected using a preformed data collection sheet. Baseline information was collected from the patient after exploration of different complaints and sign and symptoms of the cardiovascular diseases. Prior to the commencement of this study, the research protocol was approved by the ethical committee (Institutional Review Board) of BSMMU. Statistical analysis was performed by using window based computer software with Statistical Packages for Social Sciences (SPSS-12) (SPSS Inc, Chicago, IL, USA). Probability values <0.05 were considered as level of significance.

Results:

This prospective cohort study was carried out in the Department of Cardiac Surgery at National Institute of Cardiovascular Disease (NICVD), Dhaka. Total 24 VSD surgically treated patients were included who were divided into three groups according to age. Patients within the age group 2.0 to 6.0 years belonged to group A, 6.1 to 18.0 years belonged to group B and 18.1 to 42.0 years belonged to group C. This study was conducted on patients with age ranging from 2 to 42 years with a mean (SD) of all age group 12.60 ± 12.09 years (Table 1).

Table-I
Distribution of Patients by Age (n=24)

Age (years)	Frequency	Percent
Group A	10	41.7
Group B	8	33.3
Group C	6	25.0
Total	24	100.0
Mean \pm SD	12.60 ± 12.09 (2 – 42 years)	

In group A the mean (\pm SD) left ventricular posterior wall thickness was higher after 1 month of operation (6.50 ± 1.35 mm) than that of preoperative (5.80 ± 1.03 mm). It was significantly smaller after 3 months of operation (3.70 ± 0.67 mm) than that of preoperative (5.80 ± 1.03 mm) ($p < 0.05$). In group B the mean (\pm SD) left ventricular posterior wall thickness was higher after 1 month of operation (7.62 ± 0.91 mm) than that of preoperative (7.12 ± 1.24 mm). It was significantly smaller after 3 months of operation (5.00 ± 1.06 mm) than that of preoperative (7.12 ± 1.24 mm) ($p < 0.05$). In group C the mean (\pm SD) left ventricular posterior wall thickness was higher after 1 month of operation ($10.00 \pm$

0.89 mm) than that of preoperative (9.50 ± 0.83 mm) and it was significantly smaller after 3 months of operation (7.83 ± 1.16 mm) than that of preoperative (9.50 ± 0.83 mm) patients. After 1 month posterior wall thickness was increased by 12.07%, 7.02% and 5.26% in group A, group B and group C respectively. After 3 months left ventricular posterior wall thickness was decreased by 36.21%, 29.78% and 17.58% in group A, group B and group C respectively (Table 2).

Interventricular septal thickness was measured preoperatively and postoperatively after 1 and 3 month. In group A mean (\pm SD) interventricular septal thickness of preoperative and postoperative after 1 and 3 month were 5.70 ± 0.48 mm, 5.90 ± 0.73 mm and 3.90 ± 0.73 mm respectively. In group B the mean (\pm SD) interventricular septal thickness of preoperatively and postoperative after 1 and 3 month were 7.00 ± 0.75 mm, 7.62 ± 1.18 mm and 5.25 ± 0.46 mm respectively. In group C the mean (\pm SD) interventricular septal thickness of preoperatively and postoperative after 1 and 3 month were 9.00 ± 1.09 mm, 9.83 ± 1.16 mm and 7.50 ± 1.51 mm respectively. After 1

month interventricular septal thickness was increased by 3.51%, 8.86% and 9.22% in group A, group B and group C respectively but after 3 months it was decreased by 31.58%, 25.00% and 16.67% in group A, group B and group C respectively (Table 3).

LA diameter was measured preoperatively and postoperatively after 1 and 3 month. In group A mean (\pm SD) LA diameter of preoperative and postoperative after 1 and 3 month were $27.00 (\pm 4.32)$ mm, $28.30 (\pm 4.42)$ mm and $22.70 (\pm 3.09)$ mm respectively. In group B the mean (\pm SD) LA diameter of preoperatively and postoperative after 1 and 3 month were $23.37 (\pm 2.38)$ mm, $24.37 (\pm 2.44)$ mm and 20.37 ± 3.02 mm respectively. In group C the mean (\pm SD) LA diameter of preoperatively and postoperative after 1 and 3 month were $28.00 (\pm 2.00)$ mm, $29.33 (\pm 2.33)$ mm and 26.33 ± 1.63 mm respectively. After 1 month LA diameter was increased by 4.81%, 4.28% and 4.75% in group A, group B and group C respectively but after 3 months decreased by 15.93%, 12.84% and 5.96% in group A, group B and group C respectively (Table 4).

Table-II

Preoperative and postoperative comparison of left ventricular posterior wall thickness (n=24)

Group	Posterior wall thickness (mm) (Mean \pm SD)			p-value (A vs C)	Changes in percentage	
	Preoperative [A]	Postoperative (after 1 mon) [B]	Postoperative (after 3 mon) [C]		After 1 month	After 3 months
Group A	5.80 ± 1.03	6.50 ± 1.35	3.70 ± 0.67	0.001	+12.07	-36.21
Group B	7.12 ± 1.24	7.62 ± 0.91	5.00 ± 1.06	0.001	+7.02	-29.78
Group C	9.50 ± 0.83	10.00 ± 0.89	7.83 ± 1.16	0.001	+5.26	-17.58

*One way ANOVA was done to measure the level of significance

Table-III

Preoperative and postoperative comparison of interventricular septal thickness (n=24)

Group	Interventricular septal thickness in mm (Mean \pm SD)			p-value (A vs C)	Changes in percentage	
	Preoperative [A]	Postoperative (after 1 mon) [B]	Postoperative (after 3 mon) [C]		After 1 month	After 3 months
Group A	5.70 ± 0.48	5.90 ± 0.73	3.90 ± 0.73	0.0001	+3.51	-31.58
Group B	7.00 ± 0.75	7.62 ± 1.18	5.25 ± 0.46	0.0001	+8.86	-25.00
Group C	9.00 ± 1.09	9.83 ± 1.16	7.50 ± 1.51	0.0001	+9.22	-16.67

*One way ANOVA was done to measure the level of significance

Table-IV
Preoperative and postoperative comparison of LA diameter (n=24)

Group	LA diameter in mm (Mean±SD)			p-value (A vs C)	Changes in percentage	
	Preoperative [A]	Postoperative (after 1 mon) [B]	Postoperative (after 3 mon) [C]		After 1 month	After 3 months
Group A	27.00±4.32	28.30±4.42	22.70±3.09	0.001	+4.81	-15.93
Group B	23.37±2.38	24.37±2.44	20.37±3.02	0.001	+4.28	-12.84
Group C	28.00±2.00	29.33±2.33	26.33±1.63	0.001	+4.75	-5.96

*One way ANOVA was done to measure the level of significance

Discussion:

Ventricular septal defect (VSD) is a common congenital anomaly which requires early closure by various methods¹². In this study 24 patients of different age group who had undergone ventricular septal defect closure by surgery were enrolled. Echocardiographic evaluation was done before operation and 1 month and 3 months after surgical closure of VSD in different age group.

This study was conducted in the Department of cardiac surgery, NICVD. The enrolled patients were divided into three groups as 2.0- 6.0 years (n=10) in group A, other were 6.1-18.0 years (n=8) in group B and 18.1-42.0 years (n=6) in group C, after data collection. The age of the enrolled patients ranged from 2 to 42 years, with a mean age of all group 12.60±12.09 years, majority of patients in the range of 2.0-6.0 years (41.7 %), other were 6.1-18.0 years (33.3%) and 18.1-42.0 years (25%).

Left ventricular posterior wall thickness increased from preoperative values to 1st month of postoperative values in three groups. After 1 month it was increased by 12.07%, 7.02% and 5.26% in group A, group B and group C respectively. It was significantly declined from preoperative to 3rd month of postoperative values in all groups. After 3 months left ventricular posterior wall thickness was decreased by 36.21%, 29.78% and 17.58% in group A, group B and group C respectively. This study was consistent with the other studies¹³⁻¹⁴, where posterior wall thickness was reduced after surgical closure of VSD. However in that study no comparative study among different age groups was made.

Interventricular septal thickness increased from preoperative to 1st month of postoperative values in all groups. After 1 month interventricular septal thickness was increased by 3.51%, 8.86% and 9.22% in group A, group B and group C respectively. It was significantly declined from preoperative values to 3rd month of postoperative values in all groups and it was seen that

interventricular septal thickness was decreased by 31.58%, 25.00% and 16.67% in group A, group B and group C respectively after 3 months. This study was consistent with the other studies¹⁵⁻¹⁷, where interventricular septal thickness was reducing after surgical closure of VSD. However no comparative study among different age groups was made.

LA diameter increased from preoperative values to 1st month of postoperative values in all groups. After 1 month it was increased by 4.81%, 4.28% and 4.75% in group A, group B and group C respectively. LA diameter was significantly declined from preoperative values to 3rd month of postoperative values in all groups and it was seen that after 3 months LA diameter was decreased by 15.93%, 12.84% and 5.96% in group A, group B and group C respectively. This study was consistent with the study done by Yuan et al¹⁴, where LA diameter was reducing one year after closure of VSD. However in that study no comparative study among different age groups was made. From this study it is evident that favorable left ventricular morphological changes occur when early surgical closure of VSD is done in relatively younger group of patients.

There are some limitations of the study. The sample size is smaller and it is a short term study. There are very papers existed on comparison between different age groups in terms of echocardiographic findings after surgical closure of VSD. Therefore, head to head comparison with other studies could not be done. A large, multicentric long term study can elucidate the optimum age for surgical closure of VSD in term of echocardiographic evidences of cardiac remodeling

Conclusion:

Comparison of degree of remodeling at 3rd months between group A, group B and group C is significant in left ventricular posterior wall thickness, interventricular septal thickness, LA diameter. Cardiac remodeling observed after surgical closure of VSD in each age group. It has been

observed that cardiac remodeling was better in group A compared to other age groups B and C. This study observed that cardiac remodeling occurred after surgical closure of ventricular septal defect and remodeling were more significant in younger age group.

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