Original Article

Clinical Presentation, Echocardiographic Findings, Treatment Options Available for Ventricular Septal Defect in Children: A Study in a Tertiary Care Military Hospital

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Abstract

Introduction: Ventricular Septal Defect (VSD) is the most common congenital heart defects. Early diagnosis, appropriate treatment and transcatheter VSD closure with newer devices in favorable cases, decrease the need for surgical interventions and mortality.

Objectives: To determine the clinical presentation, echocardiographic findings and the treatment options available for VSD in Paediatric Cardiology Department, Combined Military Hospital (CMH) Dhaka.

Methods: It was a cross sectional observational study carried out in the department of Paediatric Cardiology, CMH Dhaka. Forty six isolated ventricular septal defect cases were diagnosed by echocardiography. Clinical features, echocardiographic findings and treatment options of all 46 cases were observed and recorded in pre formed data sheet and statistical analysis was done in statistical software SPSS version 25.

Results: Among the 46 patients of VSD, majority 20(43.48%) were in age group 0-6 months. Most of them were male 24(52%). Common presenting features were dyspnea on exertion 23(50%), cough 30(65.20%), head sweating 23(50%), and feeding problem in 34(73.91%). VSD in 27(58.6%) patients were <5mm, 15(32.6%) were 5-10mm and 4(8.7%) had size >10mm. Most of the VSDs were perimembranous 31(67.39%). Among the 46 cases medical management was given to 20(43.5%), device closure was done in 10(21.7%) patients and surgical interventions done in 16(34.8 %) patients.

Conclusion: Most of the VSD patients presented at an earlier age some of them were undergone device closure and some require surgical interventions that were not suitable for device closure. Patients those presented lately developed pulmonary hypertension.

Key words: Ventricular Septal Defect (VSD), Pansystolic Murmur (PSM), Device closure.

Introduction

Congenital heart disease occurs in 0.5-0.8% live births and VSD is the most common cardiac defects and accounts for 25% of all congenital heart disease.[1-3] Clinical presentation of VSD is primarily dependent on the size of the defect. Large defects often go unrecognized in the newborn period where the smaller defects that restrict flow from the left to the right ventricle produce loud heart murmurs and thus are often recognized early in infancy.[2] With moderate to large VSD, delayed growth and development, exercise intolerance, repeated pulmonary infections and congestive heart failure (CHF) are relatively common during infancy.[4] The fatal complication of large VSD is CHF which usually occurs within first 6 months of life and may develop Eisenmenger syndrome later if remain untreated.[5,6]

Two-dimensional (2D) echo and Doppler color-flow mapping may be used to identify the type of defects in the ventricular septum also estimating shunt volume, measuring pressure gradient across the defect and early determination of development of pulmonary vascular disease.[1,7]

Most of the Small VSDs generally do not require medical or surgical management and end up in spontaneous closure. A moderate-sized defect may behave similarly to a large defect and require surgical or catheter-directed intervention. Complications like right bundle bunch block (RBBB), complete heart block and left anterior hemiblock may occur in surgical closure.[8] Nonsurgical VSD closure by transcatheter intervention using different types of device is advised in selected patients.[9]

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If the defect is not detected earlier and left untreated, the child may develop complications like CHF with growth failure, recurrent pneumonia, pulmonary hypertension, Eisenmenger syndrome and may die. As most of the patient's referral is delayed to the tertiary care center, the chances of development of complications are high and thus the mortality and morbidity increases.

Materials and Methods

This cross sectional observational study was conducted at the Department of Paediatric Cardiology in Combined Military Hospital (CMH) Dhaka from January 2018 to December 2018. Children less than 12 years of age with Doppler ECHO findings showed isolated VSD which was a defect in the ventricular wall were included in this study. A small VSD is a defect that is generally less than one-third the size of the aortic valve annulus, where moderate sized more than one- third to two-third the size and a large VSD is as large as equal to the aortic valve annulus. Patients more than 12 years of age and VSD with other congenital structural heart disease were excluded.

Forty six admitted patients with isolated VSD in Paediatric Cardiology department, CMH Dhaka were included in this study. Data were collected using a structured questionnaire which included baseline socio-demographic and clinical characteristics with ECHO findings.Treatments options like medical intervention and surgical interventions were applied as per categorize of the patients. Follow up was done clinically and with ECHO at 3 months intervals before intervention and at 1, 3, 6 and 12 months interval post intervention. The ethical approval of the study was obtained from ethical review committee of the office of Directorate General Medical Service (DGMS), Dhaka Cantonment. Informed written consent was taken from the parents before enrollment. Statistical analysis of data was performed using the statistical software SPSS version 25.

Results

A total number of 46 patients were enrolled during study period. Figure-1 shows age distribution of the study subjects (n=46). Maximum numbers of cases 20(43.48%) were in age group 0-6 months. Figure-2 shows male 24(52%) comprising the major percentage which is followed by female 22(48%). Among all the VSD patients, the common presenting features were dyspnea on exertion 23(50%), poor weight gain in 26(56.52%), head sweating 23(50%), cough in 30(65.20%) and feeding problem in 34(73.91%) (Table-I). Physical findings showed respiratory distress, tachycardia, fever and failure to thrive (FTT) were present in 35(76.08%), 23(50%), 10(21.7%), 18(39.13%), respectively (Table-I). Only 15(32.60%) were asymptomatic.

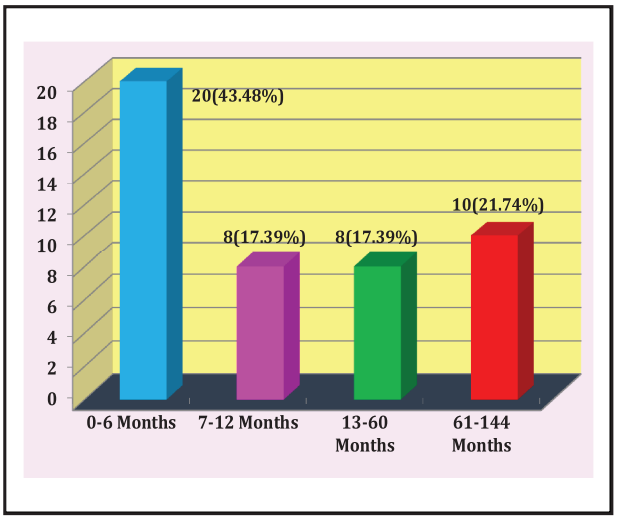

Figure-1: Age distribution of the study subjects (n=46)

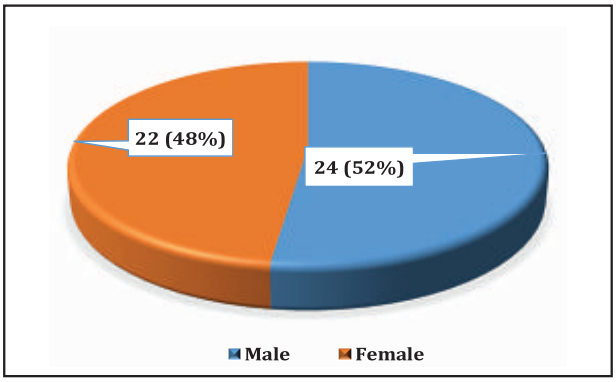

Figure-2: Sex Distribution in study population

Table-I: Common presenting features (n=46)

	Sign & Symptoms	Number	%
Symptoms	Head sweating	23	50.00
	Dyspnea on exertion	23	50.00
	Cough	30	65.20
	Feeding difficulty	34	73.91
	Poor weight gain	26	56.52
	Asymptomatic	15	32.60
Signs	Respiratory distress	35	76.08
	Tachycardia	23	50.00
	Fever	10	21.70
	Failure to thrive(FTT)	18	39.13

Table-II: Clinical findings–(precordial examination)

Findings	Number	%
Bulging of precordium	18	39.13
Cardiomegaly	15	32.60
Thrill	34	73.91
P_2 palpable	05	10.80
Loud P_2	08	17.39
Pansystolic murmur	34	73.91
Ejection systolic murmur	12	26.08

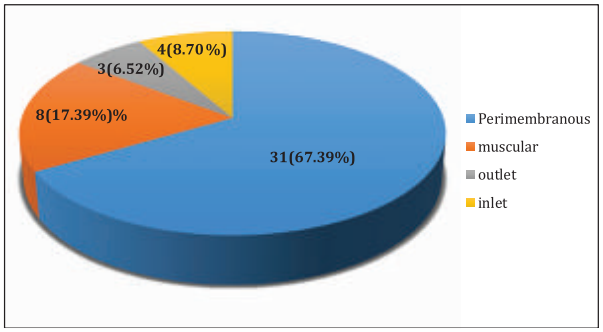

Figure-3: Types of VSD

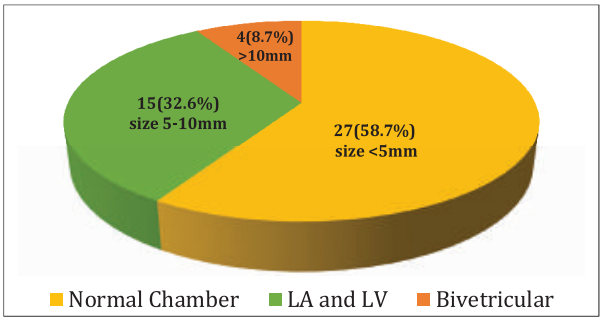

Figure-4: Chamber dilatation in the study (n=46)

Figure-4 shows that 32.6% had left atrial and left ventricular hypertrophy. Biventricular hypertrophy and normal chamber diameter were present in 8.7% and 58.6% respectively. Among the 46 cases, small size VSD has normal chamber dimension 27(58.7%) and chamber dilatation was found in moderate and large size VSDs.

Table-III: QP:QS (pulmonary flow:systemic flow) ratio pattern in the study (n=46)

QP:QS	Number	%
<1.5:1	26	56.5
1.5-2:1	15	32.6
>2:1	5	10.9

Table-III shows QP:QS ratio of the patients which were calculated echocardiographically. In 26(56.5%) of the patient's ratio was <1.5:1, then 1.5-2:1 were present in 15(32.6%) and only 5(10.9%) had ratio >2:1.

Table-IV: Treatment options for VSD patients

Treatment Options	Number	%
Medical Management	20	43.48
Intervention (Device Closure)	10	21.74
Surgical Intervention (Abroad)	16	34.78
Total	46	100.00

Table-V: Types of VSD closed by device (n=10)

Types of VSD	Number	Device used (%)
Perimembranous	08	MFO (80%)
Muscular VSD	02	Muscular VSD device (20%)

Table-V shows that perimembranous VSD were closed by MFO (Multi function Occluder) device and muscular VSD were closed by Muscular VSD device.

In this study, the treatment depends on type, location, size of the VSD, pulmonary flow (QP): systemic flow (QS) ratio (Table-III), age of the patients and presence of symptoms (Figure-1 and Table-I). Among the medically managed patients 28(60%) received treatment of heart failure, 12(26%) treatment of pneumonia, 5(10%) received specific treatment for pulmonary HTN and all 46(100%) patients were received nutritional management.

Criteria for device closure were age more than 4 years perimembranous and muscular VSD small to moderate in size with good rims. Devices used for VSD closure were MFO device in 08 patients (80%) and Muscular VSD Device in 02 patients (20%) (Table-V). Surgical closure was done in 16(34.78%) cases abroad and candidates were mainly large sized VSDs (Table-IV). All the device closure, postsurgical, medically treated patients were in regular follow up in the department of Paediatric Cardiology, CMH Dhaka as per institutional protocol.

Discussion

Congenital heart disease occurs in approximately 0.8 per cent of live births, but in a much higher percentage in premature infants(approximately 2%).[9] VSD is the most commonly encountered lesion reported in the most cardiac centers and Perimembranous (PM) VSD accounts for 70-80% of all case.[10-16] It may occur as a primary anomaly with or without additional major associated cardiac defects.[12] An isolated VSD accounts for more than 20% of all congenital heart diseases.[13]

In this study maximum number of cases presented in early age group 0-6 months 43.48% (Figure-1). Findings are consistent with results of another study. In their study, majority of the cases (54.3%) presented in infancy and 65.7% had their 1st symptom below the age of 1 year.[14]

In this study, male were 24(52%) comprising the major percentage of the patients, which is followed by female 22(48%) (Figure-2). Similar sex ratio was found in a study in Pakistan by Boughman JA et al where females were 440(34.5%) and males were 836(66.5%).[15] Dissimilarity of sex ratio was found in a study conducted by Arora R et al where female male sex ratio was 1.04:1.[16] This dissimilarity was found in this study due to social, cultural and religious background where male child are thought to be more valuable. So they are getting more attention and brought to hospital earlier than female child.

In the present study, the common presenting features were dyspnea on exertion 23(50%), poor weight gain 26 (56.52%), head sweating 23(50%) cough 30(65.20%) and feeding problem 34(73.91%). Physical findings showed

respiratory distress, tachycardia, fever and FTT were present 35(76.08%), 23(50%), 10(21.7%) and 18(39.13%) cases respectively. Only 15(32.60%) were asymptomatic (Table-I). In a previous study Ratanachu-ek S et al showed that more than half of the patients in their study had feeding problems (58%). Among others normal were 57%, malnutrition 40% (underweight 28%, wasting 22%, stunting 16%) and over-nutrition was 3%.[17].

The precordium examination revealed PSM and ESM was 34(73.91%) and 12(26.08%) respectively. This ESM is due to equalization of pressure of both ventricles of heart. Among them 34(73.91%) were having thrill, cardiomegaly in 15(32.6%) patient, bulging of precordium in 18(39.13%) patient, loud P2 in 8(17.39%), and P2 palpable in 5(10.8%) (Table-II).

In this study, ventricular septal defect was measured by echocardiography where the majorities 27(58.7%) were small in size (<5mm). A study was conducted by Turner SW et al where out of 68 patient, 72% patient had small VSD, 20% moderate and 7% large in size.[12] This study results were similar to this study. Dissimilar results were found in study conducted by Chaudhry TA et el where moderate sized VSD were most common and that was 34.7%.[1] Another study was conducted among 70 cases in Assam showed majority (44.3%) of the VSD cases were small and moderate and large VSD which were 30% and 25.7% respectively.[14]

Considering type of defects, majority of the VSDs were perimembranous 31(67.39%), followed by muscular 8(17.39%), outlet 3(6.52%) and inlet VSD 4(8.70%). In a previous study by Rafiq I et al where 79.3% were perimembranous type, 9.8% were muscular type and 54.2% inlet VSD.[9] These studies results are similar to this study. In this study, left to right shunt and bi-directional shunt were present in 85% and 15% patient respectively. Dilated left atrium and left ventricle found in 15(32.6%) and only 4(8.7%) had biventricular dilatation, normal chamber diameter was present in 27(58.6%) (Figure-4). QP:QS ratio of the patients were calculated echocardiographically. Most of the patients having QP:QS<1.5:1 (Table-III).

The treatment of the VSD patients depend on type, location, size of the VSD, QP:QS ratio, pulmonary arterial pressure, age of the patient and presence of symptoms. Medical management was given to majority 20(43.48%) of the patient and the patients were kept under follow up. Symptomatic patients those who came lately after evaluation selected for transcatheter interventions if found suitable or send for surgical closure. Among the medically managed patients 60% received treatment of heart failure, 26% treated for pneumonia, 10% received selective pulmonary vasodilator for pulmonary hypertension and all patients were received nutritional management. Device closure was done on 10(21.74%) patient and surgical intervention on 16(34.78%) in abroad (Table-IV) and kept under regular follow up in this hospital. In 20 (43.48%) patients VSD was seen closed spontaneously on follow up, among them 6(30%) were small perimembranous and 14(70%) was small muscular VSD.

Among 46 patients, total 10(21.74%) had undergone device closure. Device closure candidates criteria were age more than 4 years, pattern of VSD were small to moderate sized Perimembranous and muscular VSD with good rims, which was almost similar to a study conducted by Butera G el al.[18] Transcatheter device closure has a lower incidence of complications but faster recovery, shorter hospital stay and lower medical expenses.[19] Devices used for VSD closure were MFO device in 8 patients (80%) and Muscular VSD Device in 2 patients (20%), (Table-V). In a Chinese study, sub aortic VSD's were also closed with ADO-II Device[20]. Surgical closure were done in mainly large sized, sub aortic VSD, inlet/outlet VSDs. All the device closure, postsurgical and medically treated patients were in regular follow up in the department of Paediatric Cardiology. Few patients those presented lately developed complications like severe pulmonary hypertension, heart failure and infective endocarditis which were treated conservatively before definitive treatment.

Conclusion

Early diagnosis and initiation of appropriate treatment significantly reduce the complications and mortality. VSD closure by transcatheter intervention with different types of device is safe, cost effective, reliable methods and gaining popularity day by day. However surgical closure of VSD is still an option for large sized defects where transcatheter intervention is contraindicated. So early diagnosis and referral to appropriate center for complete management can reduce the mortality with morbidity and ensure the better life to the little hearts.

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