Effect of Ventricular Septal Defect on the Growth Pattern of Children

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ABSTRACT:

BACKGROUND:

VSD is the most common cardiac malformation accounting for 25% of congenital heart disease. The VSDs are classified according to its haemodynamic effect into small, moderate and large. The VSD can affect the growth, which is defined as a progressive increase in size of the body as a whole or of its separate parts and can result in failure to thrive in affected patients.

AIM OF THE STUDY:

This study was done to demonstrate the effects of the VSD on weight, height and occiptofrontal circumference (OFC) of children as parameters of growth.

METHODS:

This is a prospective study of 50 patients with isolated VSD done in welfare Teaching hospital and Ibn Al-Bitar cardiac center during the period from January to July 2005. The diagnosis of VSD was done by clinical picture and confirmed by echocardiographic examination to study the effect of malnutrition and other factors on the growth another 50 patients without VSD were included as control group. For each patient the growth parameters (weight, height and head circumference) were measured.

RESULTS:

The age of the patients with VSD ranged from (14 days to 14 years). The male to female ratio was 1.1 to 1. In patients with VSD the weight of 20 patients (40%) were below 3rd centile in comparison with 3 patients in the control group and this is statistically significant ($P<0.001$), while the differences in the height of both groups was not statistically significant. The head circumference of 14 patients (28%) were below 2%, while, 3 patients (6%) only in control group and this difference was statistically significant ($P<0.005$). The effect of VSD on the growth parameters depended on the size of the VSD. There was a significant effect of moderate and large VSD on both weight and head circumference while small VSD had no such effect.

CONCLUSION:

From this study, we conclude that the weight is the most sensitive parameter for studying the effect of VSD on the growth parameters. The patients with moderate VSD, should be managed as serious as large VSD because of its adverse effect on growth.

KEY WORDS: VSD, Growth and Congenital Heart Disease

INTRODUCTION:

Ventricular septal defect (VSD) is the most common cardiac malformation account for 25% of congenital heart disease (CHD)[1]. The incidence of VSD in all live briths is approximatly 1.5 to 3.5 per 1000 term infants and 4.5 to 7 per 1000 premature infants[2], the lower prevalence in adults with CHD is in large part due to spontaneous closure of many defects[3]. VSD is slightly more common in females[4]. In the majority of patients with VSD (> 95%), the defect is unassociated with a chromosomal abnormality although VSD is the most common lesion in most chromosomal syndromes including the trisomy 13, trisomy 18, and trisomy 21 groups[5].

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A multifactorial etiology has been assumed in which interaction between hereditary predisposition and environmental influences results in the defect [6,7].

Pathophysiology of VSD: The pathophysiological effect of the VSD depend on the magnitude of the left to right shunt which is determined by [1]:

1. Physical size of the VSD.

2. Level of pulmonary vascular resistance (PVR). compared with systemic vascular vesistance. Defect size is expressed (echocardiografically) in terms of the size of the aortic root and classified into [8]: **1. Small:** there is a small left– to– right shunt, normal right heart pressures, and essentially normal work characteristics of the ventricles.

The mangnitude of the left–to– right shunt is directly related to the size of the defect, and there is no tendency for an increase in pulmonary vascular resistance.

2. Moderate : there is moderate to large left-to rught shunts with volume overload of the left atrium and ventricle and left ventricular hypertrophy.

3. Large VSD: in which there is large left-to right shunt ensue, with systemic pressures in both ventricles and frequently a small systemic right-to left shunt. When large defects with marked elevation of pulmonary vascular resistance the left ventricular pressure – volume work is normal in this situation. The shunt across the defect is predominantly right- to left.

Growth: Growth is defined as a progressive increase in the size of the body as awhole or of its separate parts. Different tissues and different regions of the body mature at different rates. Growth and development consist of highly complex series of changes in a manner which is always highly regulated and controlled. Some simple measurment are usually selected as indices of growth and development for practical use [9, 10] . The advantages and Disadvantages of different Anthropometric indicators [11] (weight for age , length / height for age) is shown in (Table 1).

Table 1: Advantages and Disadvantages of different Anthropometric indicators for growth monitoring projects.

Indicators	Advantages	Disadvantages
1- Weight for Age	Good basic indicator, combining acute and chronic malnutrition . Sensitive to small changes. Measure is objective and repeatable. Measure is not time consuming.	Not sensitive to astunted child who is growing well . or to the very tall child who may be malnuorished . Mother in some countries have objected to hanging their children from the scale during weighing.
2- Length / Height for Age	Good indicator of past nutrition problems. Measure is objective. Rarly are mothers reluctant to have child measured because of appearance of the boord.	In growth monitoring projects it should be supplemented by an other indicator like weight for – age. Or weight for height because change in height occur relatively slowly. Requires two different techniques if programs include all preschoolers : recumbent (lying down) length (children 0-2 years) and standing height (children 3-5 years). Requires two persons to take the measure

Failure to thrive is present when there is declination of growth from an established pattern, or when the patient's height and weight plot consistently below the 3rd centile [12].

When the OFC was below 2nd Centile (-2SD) then it indicate a severe and chronic failure to thrive. These children need serial OFC measurment and developmental assessment, because studies have shown that children malnourished during the first two years of life become intellectually retarded [13].

The rate of growth at any age is the result of interaction of genetic and environmental factors, and there are several factors can affect growth of the patient with VSD [9].

AIMS OF THE STUDY:

This study conducted to show the effects of VSD on weight, height and occipitofrontal circumference of children as parameters of growth.

PATIENTS AND METHODS :

Fifty patients (27 females, 23 males) their ages ranged (14 days to 14 years) were studied prospectively for the period from January to July. 2004. Only patients with isolated VSD were included in this study. They were collected from children's welfare Teaching Hospital – Medical city and Ibn – AL Bittar cardiac center. The diagnosis of our patients depend on clinical picture and confirmed by echocardiographic examination. The echocardiographic examination (two – dimensional and Doppler) done by 3 and 5 MHz sector probe and the patient on supine or left decubitus position. The pulmonary artery pressure assessed by Doppler study depending on the pressure gradient through the VSD and compared with the systemic pressure of the patient.

In these patients the growth parameters (weight, height and head circumference) were measured, the weight for young patients, seca scales (maximum weight scale 16 kg, minimum weight scale 10 gm) was used. For older patients, AVERY scale was used. While the height is measured by standing the patient on the foot plate of the stadiometer, with heels togather and head in the Frankfort plan (i.e. with the lower border of the orbit in the same horizontal plan as the external auditory meatus). The top of the stadiometer being Counter – balanced, rested lightly on the patient's head. The patient then stretched upward fully, aided by relaxing the shoulders and by applying gentle pressure on the mastoid processes.

The height was read to the last completed millimeter, this technique minimizes variation in posture due to tiredness or boredom, which may otherwise amount to 10 mm or even 20 mm

differences. Supine length was measured with the child lying on his back, with the child's head in the Frankfort plane and applied gentle lengthwise pressure to bring the top of his head in to contact with the fixed headboard with the child's feet toes pointing directly upwards, and, also pulling gently to stretch the child, brought the moveable foot-board to rest firmly against the child's heels.

The head circumference (OFC) was measured by tape measure, the measurements were expressed as centiles when plotted on weight for age, height for age, using Tanner white house growth chart[14], OFC for age using Nellhaus chart[15] .

To reduce the effect of malnutrition, 50 healthy children of the same ages were used for comparison attending out patient clinic for simple illnesses in children's welfare Teaching Hospital – medical city and each examined for weight, height and OFC and the measurements were expressed also on the same centile charts (Ht, for age, Wt for age and OFC for age).

The following statistical methods were used:

1. Descriptive statistics (Mean , Standard error mean. (S. E.) , Graphics).

2. Statistical tests (t – test , Chi – square test) .

3. Multiple correlation (R). The collected sample consisted of 2 groups (patients and control), each group consisted of 50 patients. To exclude the effect of age factor on growth, it was equivalent the two groups using t – test for two independent samples and reaching to the results that there is no statistically significant difference between the ages of the two groups (p-value = 0.109)* .

* p-value > 0.05 means no significant difference, p-value ≤ 0.05 means significant difference, p-value ≤ 0.01 means highly significant difference.

RESULTS:

1. Age: Both patients and control are distributed according to the age (Table 2).

Twenty-one patients (42%) from the collected sample (50 patients) are less than 1 year.

Table 2: Distribution of patients and control according to the age.

Age group / year	Control	Patients
< 1	15 (30%)	21 (42%)
1-3	6 (12%)	8 (16%)
3-5	6 (12%)	9 (18%)
5-7	8 (16%)	4 (8%)
7-9	10 (20%)	4 (8%)
≥ 9	5 (10%)	4 (8%)
Total	50 100%	50 100%

1. Sex: among the studied group there was 23 male and 27 female and the male to female ratio was 1 : 1.7 and this difference is not statically significant (p-value>0.05).

2. Size of VSD: The size of the VSDs were distributed equally among the patient. There was 16 patients (32%) had small VSDs and 17 patients (34%) with moderate VSDs and 17 patients (34%) with large VSDs (Table 3).

Table 3: Patients distribution according to the size of VSD.

Size of VSD	No. of Patients	Percentage
Small	16	32.0
Moderate	17	34.0
Large	17	34.0
Total	50	100.0

3. Effect of VSD on growth:

a. Weight: Twenty patients (40%) with VSD were below 3rd Centile for their weight, while it was only 3 (6%) for age matched control group, which is highly statically significant (p-value <0.001) (Table 4).

Table 4: The distribution of number of VSD patients and control according to their weight Centile.

Centile Wt. / Group	Below 3rd	3rd-10th	Above 10th-25th	Above 25th-50th	Above 50th	Total
Patients	20 40%	12 24%	5 10%	10 20%	3 6%	50 100%
Control	3 6%	13 26%	12 24%	9 18%	13 26%	50 100%

P-Value < 0.001

b. Height: There were 12 patients (24%) below 3rd centile and 38 patients (76%) above this centile, while 6 patients (12%) from control group was below 3rd centile and this is not statistically significant (p-value > 0.05) (Table 5).

Table 5: The distribution of number of VSD patients and control according to their height Centile.

Centile Ht. / Group	Below 3rd	3rd-10th	Above 10th-25th	Above 25th-50th	Above 50th	Total
Patients	12 24%	8 16%	12 24%	12 24%	6 12%	50 100%
Control	6 12%	12 24%	10 20%	8 16%	14 28%	50 100%

P-value > 0.05

c. Occipito frontal circumference

Fourteen patients (28%) of patients with VSD their OFC were below (2%), while 3 patients (6%) of age matched control group were below (2%) using Chi-square test (p-value<0.05) (i.e. significant difference) (Table 6).

Table 6: The distribution of number of VSD patients and Control according to their OFC Centile.

Centile OFC / Group	Below 2%	On 2%	2-50%	On 50%	50-98%	On 98%	Total
Patients	14 28%	86 12%	19 38%	7 14%	3 6%	1 2%	50 100%
Control	3 6%	5 10%	32 64%	2 4%	7 14%	1 2%	50 100%

P-value < 0.05

6. Effect of VSD size on parameters of growth (Wt.,Ht., and OFC):

a-Effect of VSD size on Weight.

The percentage of patients who are below 3rd Centile for weight were (52.9%) for moderate VSD, (47.1%) for large VSD, while it was (18.8%) for small VSD.

Using Chi-square test there was a significant difference (p-value <0.05) in relation of VSD size and weight. (Table 7).

Table 7: The distribution of patients according to the VSD sizes and its effects on the Centile weights.

Centile Wt. / VSD size	Below 3rd	3rd-10th	Above 10th-25th	Above 25th-50th	Above 50th	Total
Small	3 18.8%	3 18.8%	1 6.3%	6 37.5%	3 18.8%	16 100%
Moderate	9 52.9%	2 11.8%	3 17.6%	3 17.6%	0 0%	17 100%
Large	8 47.1%	7 41.2%	1 5.9%	1 5.9%	0 0%	17 100%
Total	20 40.0%	12 24.0%	5 10.0%	10 20.0%	3 6.0%	50 100%

b-Effect of VSD size on Height.

There was no significant difference (p-value>0.05) between the VSD size and their effect on height Centile. (Table 8).

Table 8: The distribution of patients with VSD according to the VSD sizes in relation to the heights Centile.

Centile Ht. / VSD size	Below 3rd	3rd-10th	Above 10th-25th	Above 25th-50th	Above 50th	Total
Small	2 12.5%	2 12.5%	3 18.8%	6 37.5%	3 18.8%	16 100%
Moderate	6 35.3%	2 11.8%	4 23.5%	2 11.8%	3 17.6%	17 100%
Large	4 23.5%	4 23.5%	5 29.4%	4 23.5%	0 0%	17 100%
Total	12 24.0%	8 16.0%	12 24.0%	12 24.0%	6 12.0%	50 100%

c-Effect of VSD size on OFC.

There was not significant difference (p-value>0.05) between the size of VSD and their effect on OFC Centile. (Table 9).

Table 9: The distribution of patients with VSD according to the VSD sizes in relation to the OFC Centile.

Centile OFC / VSD size	Below 2%	On 2%	2-50%	On 50%	50-98%	On 98%	Total
Small	3 18.8%	1 6.3%	5 31.3%	3 18.8%	3 18.8%	1 6.3%	16 100%
Moderate	4 23.5%	3 17.6%	8 47.1%	2 11.8%	0 0%	0 0%	17 100%
Large	7 41.2%	2 11.8%	6 35.3%	2 11.8%	0 0%	0 0%	17 100%
Total	14 28.0%	6 12.0%	19 38.0%	7 14.0%	3 6.0%	1 2.0%	50 100%

8. Failure to thrive in Patients with VSD:

Out of 50 patients less than 5 years of age with VSD, 8 patients (16%) had both weight and height below 3rd centile (i.e. failure to thrive), while 4 patients (8%) had severe failure to thrive (Wt, Ht below 3rd centile and OFC below 2%).

Finally, to study the effect of the variables (age, sex and VSD size) on each growth parameter (weight, height, and OFC), Multiple correlation (R) had been used which was equal to (0.92, 0.97 and 0.82 respectively), meaning that the growth is highly affected by these variables (age, sex and VSD size).

DISCUSSION:

In this study the incidence of isolated VSD among females is 54% with a ratio of female: male is 1.17: 1 and the difference is not-significant (p-value > 0.05), and this is compatible (agree with) other studies that VSD is slightly more common in female, with the experience of Hoffman and Rudolph [4] (56% female, 44% male) with a ratio of 1.27: 1, while in the Ceylon study [16] the ratio was 1:1. In this study, (40%) of children studied were below the 3rd Centile for weight, (24%) were below 3rd Centile for height, (28%) were below 2% for Centile OFC (i.e. weight is affected by VSD more than OFC and the later affected more than height), and this agree with Aziz study [16] who found that (46.8%) of children studied were below the 3rd Centile for weight and (25.5%) were below the 3rd Centile for height, while in study done by Feldt, 1969 in USA [17], (14%) of patient with VSD were below 3rd Centile for weight (Table 10), and this is because of better care and early surgical intervention.

Table 10: Comparison between this study, Aziz study, and the study don by Feldt:

Study	This study Iraq-2004	Aziz study Iraq-1995[16]	Feldt study USA-1969[17]
Percentage of patients below 3rd Centile for weight	40%	46.8%	14%

In this study (40%) of patients with VSD were below 3rd Centile for their weights, while it was only (6%) for age matched control group, which is highly significant (p-value <0.001) Table (4).

This confirm that the VSD and its sequelae is the main cause of failure to thrive in these patients. There was no significant difference between VSD patients and age matched control group regarding height Centile (Table 5).

This indicate that the weight is a very sensitive indicator for growth especially in patients under age of 6 months (42%), (Table 3).

This is because the illness is too early to affect the height, and this in agreement with Aziz study [16] who found that weight is more severely affected than height. There was a significant difference between VSD patients and age matched control group regarding OFC Centile Table (6), 14 patients (28%), their OFC were below 2% while it is only (6%) for age matched control group. We could not find previous study for comparison. This study reveals that the weight is greatly affected by the moderate size VSD (52.9% below 3rd Centile), then large VSD (47.1% below 3rd Centile) and less affected by small VSD (18.8% below 3rd Centile), and this was explained on the basis that large VSD was associated with elevated PVR which limit the magnitude of the left to right shunt while it is extremely unusual for patient with moderate VSD to have marked elevation of PVR [19].

Moderate and large VSD can lead to heart failure, which will increase tissue hypoxia and the possibility of chest infections [20].

There was no significant difference (p-value > 0.05) between the size of VSD and its effect on both height and OFC Centile.

Failure to thrive were seen in 8 patients (16%) whom were below 5 years, while Severe failure to thrive was seen in 4 patients (8%) that were less than 5 years, (i.e. 8% of VSD patients were at risk of neurodevelopmental delay and intellectual retardation because the maximum brain growth and increase in head circumference is during the early years of life[13].

In a study done in children welfare Hospital-medical City out of 100 children 2% were VSD [21],Probably the cause of failure to thrive is related to the size of VSD particularly with moderate to large as malnutrition has been excluded.

CONCLUSION:

1. Both weight and OFC were affected significantly by the presence of VSD, while height had not similarly affected.
2. Weight is the most sensitive parameter for the study of the effect of VSD on growth.
3. Growth is affected by moderate VSD as in large VSD, hens moderate VSD should be managed as large VSD.

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