

# NATURAL AND MODIFIED HISTORY OF VENTRICULAR SEPTAL DEFECTS IN INFANTS

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## ABSTRACT

**Objective:** To evaluate the natural and modified history of isolated ventricular septal defects in the first two years of life.

**Settings:** Queen Alia Heart Institute, King Hussein Medical Center, Amman- Jordan.

**Patients and Methods:** We prospectively studied a total of 117 infants diagnosed as isolated ventricular septal defect between June 2001-December 2002. Infants aged less than three months, with isolated membranous or muscular ventricular septal defects were followed for two years. Infants with Down syndrome, other types of ventricular septal defect and those who had an additional hemodynamic significant heart defect were excluded.

**Results:** A total of 113 infants 62 males vs. 51 females (55% vs. 45%) were followed up for 24 months. The mean age at the time of diagnosis was 2.0 months $\pm$ 15 days (Range: 1 day-3.0 months). 67 patients had muscular (59.0%) and 46 had membranous ventricular septal defects (41.0%). There were 71 small (62.0%) and 42 moderate and large size defects (38.0%). 45 of muscular defects closed spontaneously, 6 were closed surgically and 16 remained open (59.0%, 8.0%, and 33.0% respectively). On the other hand 11 of membranous defects closed spontaneously surgical closure of the defect were needed in 16 infants and 19 membranous ventricular septal defects remained open by the end of the study (24.0 %, 35.0 % and 41.0% respectively). Regardless of type, 27(64.0%) of moderate and large size defects needed medical and/or surgical treatment in the first two years of life and 15 defects (36.0%) had their size decreased.

**Conclusion:** Infants with muscular ventricular septal defects have better prognosis and infants with moderate and large ventricular septal defects usually need medical and/or surgical treatment.

**KEY WORDS:** Ventricular Septal Defects, Natural history, Medical Therapy, Surgical Closure.

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## INTRODUCTION

Ventricular septal defect is the most common congenital cardiac abnormality found in children.<sup>1-4</sup> A definitive diagnosis and localization of ventricular septal defect by Doppler color flow mapping in infancy is important for prognosis, counseling and from surgical point of view.<sup>5</sup> The natural history of isolated ventricular septal defect showed that many of these either close or diminish in size spontaneously.<sup>6-8</sup> Many authors have reported increase in incidence of ventricular septal defect mainly of the ventricular musculature, and more precise numbers on their spontaneous closure. Diagnosis in early life is a prerequisite for early surgery in children with pulmonary hyperten-

sion at risk for the development of pulmonary obstructive disease. So the present study aimed to evaluate the prognosis of our patients with ventricular septal defect at their first two years of life.

## PATIENTS AND METHODS

Between: June 2001 to December 2002, we diagnosed a total of 117 infants with isolated ventricular septal defect as their primary cardiac lesion. All infants had been referred to pediatric cardiology clinic, Queen Alia heart institute, King Hussein Medical Center for cardiac evaluation. The causes of referral were: heart murmur found during routine neonatal examination, tiring on feeding, tachypnea, dyspnea, and poor weight gain. Infants included in the study are those who have isolated membranous or muscular ventricular septal defect and less than three months at the time of diagnosis. Infants with other types of ventricular septal defects, infants with Down syndrome and those who don't fulfill the inclusion criteria were excluded from the study.

All patients had a complete history and physical examination by pediatric cardiologist, performed at a mean age of two months  $\pm$  15 days (range 1 day-3 months). The echocardiogram examination was performed using Hewlett-Packard 5500 sonos. Two subcostal views, parasternal long-and short-axis, and apical four chamber-views, with 8 & 12-MHz transducer focused appropriately for the size of the infant were performed in all patients. Color Doppler flow mapping was also performed in each view and continuous-wave interrogation of flow velocity was obtained from abnormal jets.

VSDs were classified as muscular or membranous according to their location and relation to the tricuspid annulus and semilunar valves.<sup>9</sup> VSD size  $<0.5$  cm or VSD indexed for body surface area  $<1.8$  cm/m<sup>2</sup> was considered small VSD.<sup>10</sup>

Patients were followed at approximately 6, 9, 12, 18 and 24 months of age. The VSD was considered spontaneously closed if echocardiogram of the ventricular septum was

normal, and the characteristic murmur was no longer heard.

## RESULTS

A total of 117 neonates were included in the study 113 patients were followed up for 24 months and 4 were lost follow up and excluded from the study. There were 62 males and 51 females (55 % vs. 45%). The mean age at the time of diagnosis was two months  $\pm$  15 days (range 1 day- 3.0 months). 67 patients had muscular VSDs (59%) and 46 patients had membranous type VSD (41%).

During follow-up six patients of those with muscular defects (8.0 %) required surgical closure of the defect to control symptoms of heart failure and severe pulmonary hypertension. On the other hand among patients with membranous VSDs medical therapy and surgical closure of the VSD were clinically indicated in 16 patients (35.0 %).

The remaining VSDs were either closed spontaneously or decreased in size. In case of muscular VSDs, 45 had closed spontaneously (67.0%) and 16(24.0%) remained open but became of smaller size and none of these patients needed treatment during the period of follow up. Eleven infants (24.0%) with membranous defects had their defects closed spontaneously and in 19 defects remained open by the end of the study (41.0%). Medical therapy (furosemide and digoxin) were needed in five patients in this group.

According to size and irrespective of type there were a total of 71(59.0%) infants with small VSDs and 42 (41.0 %) with moderate size or large VSDs. All patients with large and moderate VSDs required medical therapy (furosemide and digoxin) to control their symptoms of heart failure or pulmonary hypertension at some time after the age of four weeks. Surgical closure was clinically indicated and needed in 22 patients with moderate and large defects by the end of the study (52.0%). Medical therapy was necessary in 5 patients whose defects size became smaller but continued to have related symptoms and surgery was withheld at this stage (12.0%).

On the other hand we were able to discontinue medical therapy in the remaining 14 patients whose defect size had become much smaller (34.0%) and outgrew their symptoms. Only one of those with moderate VSDs at the time of diagnosis closed spontaneously by the end of the study while none of the larger VSDs (2.0%) closed spontaneously.

## DISCUSSION

The natural history of ventricular septal defects (VSDs) showed that these defects rarely close after the age of two years. In addition in the presence of a large ventricular septal defect early diagnosis and early successful surgical repair is the only way of preventing the development of pulmonary obstructive disease. Successful surgical repair of large and moderate ventricular septal defects in the first two years of life will result in complete recovery of left ventricular function and geometry to normal levels when compared to repair after age of two years. Hence first two years of life are crucial in a patient with isolated ventricular septal defects. The main objective of the present study was to evaluate the prognosis of isolated VSD in early life, particularly in relation to the type and size of the defect. We excluded infants with Down's syndrome because in these patients some major malformations with pulmonary hypertension may show no signs and may progress to irreversible pulmonary vascular disease before the heart defect has been recognized.<sup>11</sup> Exclusion criteria were established to find a population in which the VSD was supposed to be the main prognostic factor.

When VSDs were screened in non-selected population using echocardiography, muscular defects were most common,<sup>11-13</sup> and the relative distribution of muscular and perimembranous VSDs has changed from 20:80 in earlier studies.<sup>14,15</sup> The results of our study are in agreement with recent studies, as 59.0% of our patient had muscular type VSDs. Indeed in Sands et al population study only ten out of 173 had perimembranous defects (6.0%) and the remainder apical or muscular

lesions.<sup>16</sup> The case identifying method, using two-dimensional color-flow mapping, probably contributed to the higher frequency of muscular defects.<sup>17</sup>

Membranous ventricular septal defect often achieve partial closure with a layer of tissue underneath the tricuspid valve that form over the membranous ventricular septal defect and in case of muscular ventricular septal defect endothelial roughening leads to spontaneous closure.<sup>18-20</sup> Spontaneous closure of ventricular septal defect varies directly with their size and location. The overall spontaneous closure rate for muscular and membranous VSDs, in our study was 50.0%, and these findings are in conformity with the observation by other authors.<sup>5,17,20,21</sup>

Trowitzsch et al found a spontaneous closure rate of 37.9% for muscular defects and 4.7% for membranous defects within the first 13 months of life.<sup>12</sup> In another study, Wu et al. found the expected probability of developing spontaneous closure of membranous VSDs was 35%.<sup>17</sup> Our study has also showed that spontaneous closure of muscular VSDs is more frequent than that of perimembranous VSD (67.0% vs. 24.0%). In Shirali et al and Turner et al. studies on the natural history of VSD both found a significantly higher spontaneous closure rate for muscular defects.<sup>13,21</sup> Mehta et al who studied 124 neonates with VSD had founded the rate of closure of muscular VSD almost double that of perimembranous VSD 23% vs. 42% by the end of first year of life.<sup>22</sup> A much higher rate of spontaneous closure of muscular ventricular septal defects have been reported: In one of the studies,<sup>22</sup> 78% had closed by 6 months of age (A Sands, personal communication, 1998) and 76% had closed by one year in the second study.<sup>23</sup> The higher frequency and closure rate in muscular VSDs suggest that this is probably caused by improved diagnostic methods for finding these defects.

Medical and/or surgical therapy was needed in six patients with muscular VSDs (8%), while a higher percentage (46%) of those with perimembranous VSDs needed medical therapy and/or surgery during the two-year

period of follow-up. Turner et al. concluded that perimembranous VSDs are in many ways defects with a poor prognosis as in his study thirty nine per cent of membranous VSDs required surgical closure and only 29% closed spontaneously by 6 years of age. This compares with figures of 3% and 69%, respectively, for muscular VSDs.<sup>13</sup> Congestive heart failure developed in 2 of 46 patients with muscular VSD and in 12 of 47 patients with membranous VSD in another study (4.0% vs. 25.0%).<sup>24</sup>

The results showed that, 64 % of moderate size and large VSDs, required medical and/or surgical therapy in the first two years of life. Actually they are the membranous type defects in this group of patients that account for the majority of treated patients. On the other hand only one defect of the moderate size closed spontaneously and the remaining patients were either treated surgically or remained open but became of smaller size. Membranous VSDs usually account for most moderate and large defects that require medical or surgical treatment.<sup>13, 25</sup> In the study of Lin et al. 5 out of 25 patients, with membranous defects (20%) exhibited signs of heart failure and required digoxin therapy, in contrast, no patient with muscular defect developed symptoms of heart failure or required management.<sup>26</sup> In the second natural history study of congenital heart defects (NHS-2), 23% of moderate size VSDs, closed spontaneously while among the 14 who had severe VSDs on entry to the study, were managed medically. Only one VSD apparently closed spontaneously and eight patients (57.1%) developed eisenmenger syndrome<sup>27</sup> and in Turner et al. group of patients only one large ventricular septal defect closed spontaneously.<sup>13</sup>

### CONCLUSION

In infants muscular VSDs close spontaneously at a rate higher than perimembranous VSDs and carry a better prognosis in the first two years of life. Majority of moderate and large VSDs need medical and /or surgical treatment in infancy.

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