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Evaluation of Ventricular Septal Defect Patients Attending Pediatrics Cardiac Clinic at Al-Hawari General Hospital, Benghazi-Libya

Mohanad Abdulhadi Saleh Lawgali[1*], Rasmia, H. Feituri[1], Faiaz Ragab Salem Halies[1], Amina M. Beayou[1] and Marium Mohamed Mustafa[1]

[1]Department of Pediatrics, Faculty of Medicine, University of Benghazi, Benghazi, Libya.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: To see the natural history and outcome of isolated ventricular septal defects in the VSD patients who follow al- Hawari pediatric cardiac clinic to evaluate the current status of the patients as well as complications of the VSD and its treatments.
Settings: AL-Hawari cardiac clinic, Benghazi-Libya. University of Benghazi, Faculty of medicine.
Patients and Methods: Descriptive retrospective case series study, include 140 patients with isolated VSD, period of study from October 2010 to February 2013.
Data was collected by reviewing the medical records of patients including patient's age at last follow up time, residency, VSD Presentation, types, and size. All patients were diagnosed using transthoracic echocardiography performed by a pediatric cardiologist, VSD was classified as perimembranous, muscular, and supracrystal doubly committed further evaluation comprised a plain chest radiograph, ECG, 24-h Holter monitoring.
Outcome divided into**:** VSD still not closed at time of the study, surgically closed, closed spontaneously, closed through Trans-catheter closure, operated with Pulmonary banding, and death.

**Corresponding author: Email: mohanad.lawgali@uob.edu.ly;*

Special analysis for the causes and the outcome of surgical intervention ,the correlation between VSD types, age and outcome, as well as between size and presentation, affect of VSD on patients weight, Use of medications had been reviewed like antibiotics given for prophylaxis against infective endocarditis, diuretics and captopril (ACEI) for heart failure, Viagra (Sildenafil) for pulmonary hypertension cases , as well as digoxin .
Data was analyzed manually, patients with Down syndrome and other dysmorphic syndrome were excluded from the study.
Results: Total of 140 patients, 74 female and 66 male (1.1:1). The age ranged from 13days to 5years, 52 % perimembranous followed by Muscular 47%.
38% of patients had small VSD, were 34% Moderate size.
77/140(55%) closed, with 33% Surgically closed all of them were moderate and large size , Spontaneously closed 20%, Not closed 57/140 (41%), Died 4/140 (3%), Pulmonary banding 2 /140 (1%).
Spontaneous closure occurred in 20% of cases in the first year of life, and 96% below 7 year of age.
Spontaneously closure cases: 82% of them were small size, and 75% were muscular.
The spontaneous closure rate of muscular VSD was triple that of the Perimembranous. Most common causes of surgical intervention is heart failure 63%.
40% of surgically closed VSDs had excellent outcome, residual VSD is the most common post-operative complication with 30%.
Three quarters 6/8 (75%) of patients whose their weight below 3rd centile has large VSD.
Conclusion and Recommendation: Small VSDs were the comments size, and perimembranous VSDs were the comments type. Bronchopneumonia and Heart murmur were the most frequently presentation.
The small and muscular ventricular septal defects had better prognosis and high tendency to close spontaneously.
VSD closure surgery is safe and successful, with low mortality rate, and residual VSD is the most common post operative complication. Most of patients whose their weight below 3rd centile has large VSD.
Regular updating of the data is recommended, and increase attention to save the data electronically, Establishment of more advanced and modern equipment to help in accurate diagnosis and follow up, Trying to increase and find new pediatric cardiac clinic in areas outside Benghazi in order to facilitate the process of follow-up and treatment, Education of doctors in primary health centers about the importance of physical examination for early detection of the disease. Increase family awareness to the disease, Future studies should include large sample size and should include other centers.

Keywords: Pediatric cardiac clinic; perimembranous VSDs; infective endocarditis; antibiotics.

ABBREVIATIONS

VSD : Ventricular Septal Defect
CHD : Congenital Heart Disease
CHF : Congestive Heart Failure
Pulmonary HTN : Pulmonary Hypertension
PAB : Pulmonary Artery Banding
MR : Mitral Regurgitation
TR : Tricuspid Regurgitation
AR : Aortic Regurgitation
SVT : Supra Ventricular Tachycardia
AV : Conductionatrioventricular Conduction
ACEI : Angiotensin Converting Enzyme Inhibitors
RVH : Right Ventricular Hypertrophy
RV : Right Ventricular
LVH : Left Ventricular Hypertrophy
LV : Left Ventricular
L→R shunt : Left to Right Shunt

ECG : Electrocardiography
ECHO : Echocardiography

1. INTRODUCTION

Ventricular Septal Defect (VSD) is the most common form of CHD, accounting for up to 20-40% of patients diagnosed with CHD, Impact may range from asymptomatic to pulmonary HTN, LV volume overload and RVH [1].

Morphologically can be divided into: 4 types, according to soto and American heart Association (AHA) classification into Membranous, muscular, Complete AV septal (endocardial cushion) defects,and Supracristal [2].

Classified also according to their size into: Small, typically does not have hemodynamic impact and may close spontaneously, Moderately which create LV overload and dysfunction along with variable increase in PVR and Large LV volume overload earlier in life with progressive pulm HTN and ultimately Eisenmenger syndrome [3].

The Clinical presentation ranged from Asymptomatic patient and accidental murmur to chest infection, shortness of breath, Congestive heart failure and failure to thrive [4].

It is recommended for young infants who had intractable heart failure with increase. Pulmonary blood flow not responding to usual treatment to do early surgery within 3 months, on other hand Asymptomatic patients without increase in pulmonary flow but with LV overload they advice them for VSD Closure, but if the patients Asymptomatic with small VSD, no LV dilation conservative treatment should be follow [5].

Surgical intervention indicated in the following: Evidence of LV volume overload, bacterial endocarditis, Significant left to right shunt with pulmonary artery pressure > 2/3 systemic, Usually involves direct patch closure with cardio-pulmonary bypass with mortality rate < 2% in most centers and complications as AV heart block, Permanent AV heart block occurs in. < 1% of children undergoing VSD closure, determines the location of conduction tissue and directs the repair to avoid conduction injury.

Transient AV block is treated with temporary cardiac pacing. When AV conduction does not return (in < 1% of patients in the best centers), a permanent pacemaker is needed. Residual left-to-right shunt from incomplete VSD closure may result from insufficient intraoperative exposure or suture disruption with patch dehiscence. Significant residual shunting is most commonly observed in muscular defects (particularly multiple defects) in which trabeculations decrease visualization of the full extent of the VSD.

Death, the mortality rate associated with surgical VSD closure has decreased dramatically with improvements in perfusion, myocardial protection, and postoperative care.

The overall surgical mortality rate for patients with isolated VSD is less than 1%. Uncommon (rare complication) like pulmonary hypertension, poor cardiac output, Hemiplagia, supraventricular tachycardia (SVT), Infective endocarditis ((American Heart Association guidelines consider a repaired VSD a negligible risk lesion for bacterial endocarditis (no greater than the general population). Therefore, prophylactic antibiotics are recommended for patients for no more than 6 months after their surgical VSD repair. Percutaneous Device Closure Muscular VSDs can typically be closed percutaneously. Still no approved devices for perimembranous VSDs, although there are specific devices for this purpose [6,7].

Complications of VSDs include the following**:** Growth failure, Congestive heart failure. Pulmonary vascular disease as a consequence of left-to-right shunting, the ultimate consequence of pulmonary vascular obstructive disease is irreversible muscular hypertrophy and, ultimately, obliteration of the pulmonary vasculature and pulmonary resistance that equals or exceeds systemic resistance; this condition is known as Eisenmenger syndrome or complex*,* Severe illness with viral or bacterial pneumonia,Infective endocarditis Occurs at a rate of 2.4 cases per 1000 patients per year. Aortic regurgitation - An especially common complication in patients with subarterial VSDs, aneurysm of the ventricular septum, Paradoxical emboli, Sudden death [8].

2. LITERATURE REVIEW

VSD is the most common congenital heart disease and the advent of two-dimensional (2D) echocardiogram has aided the early diagnosis

and classification of the types and sizes of VSD, Spontaneous closure of some of small and medium-sized defects within the first 2 years of life is the expected natural history in VSD.

The likelihood of spontaneous closure is also dependent on the type of VSD, muscular types close spontaneously more readily than other types.

2.1 Historical Background

VSDs were first clinically described by Roger in 1879 ; the term maladie de Roger is still used to refer to a small asymptomatic VSD. In 1898, Eisenmenger described a patient with VSD, cyanosis, and pulmonary hypertension. This combination has been termed the Eisenmenger complex. Pulmonary vascular disease and cyanosis in combination with any other systemic-to-pulmonary connection has been called the Eisenmenger syndrome.

Heath and Edwards described the morphologic changes associated with pulmonary vascular disease in 1958, and their 6 categories of vascular change have remained the standard of comparison up to the present day [9].

2.2 Natural History of VSD

The natural history of individual defects has already been studied showed that Large VSDs are less likely to close spontaneously, Smaller defects and muscular defects tend to close spontaneously more frequently than others.

A study done by doctor *Wilson E Sadoh in March 2010* about: Natural history of ventricular septal defects in Nigerian children at pediatric department university of Benin teaching hospital, Nigeria.

In this study Sixty-one children diagnosed with VSD were prospectively studied at between September 2006 and February 2009.

They had regular two-dimensional (2D) Doppler echocardiography evaluations for the VSD size and closure. The diagnosis was based on typical historical and physical findings, plus plain chest radiograph, an electrocardiogram beside two-dimensional (2D Doppler echocardiography, patients with an isolated VSD were finally analyzed, the age at presentation and the age at onset of illness were documented, the presenting complaints, findings on clinical examination and complications associated with the VSD were noted.

The morbidities and reasons for referral were classified into symptoms and signs of congestive cardiac failure (CCF), Chest infections, failure to thrive (FTT), Shortnesss of Breath only, incidental finding of a murmur, and delay or loss of motor milestones, and weight.

Patients with pulmonary edema and congestive cardiac failure were placed on diuretics, digoxin and captopril (angiotensin-converting enzyme inhibitor).

Patients with moderate to large VSDs were advised to have surgery especially if they were decompensated.

Those who could not afford surgery and were decompensated were placed on captopril, spironolactone and hydrochlorothiazide, and followed up in the pediatric cardiology clinic,a2D and color flow Doppler echocardiogram was done 6-monthly to assess the current size of the VSD and to confirm a suspected spontaneous VSD closure. Children with well-compensated small to Moderate VSDs were also followed up in the clinic.

At each visit they were evaluated for evidence of decomposition, clinical evidence of closure of the defect (initial increase in the loudness of the pansystolic murmur and later absence of the murmur) and for drug refill.

Summary of the study results: Most 35 – 57.4% of the patients were female, their mean age at presentation was 11.2±5.2 months, and the most common type of VSD was the perimembranous 39 – 63.9%. 28 – 45.9% of the patients had spontaneous closure he spontaneous closure rate was highest in muscular VSD 82.4% and in small defects 95.0%.

Incidental presence of a murmur, absence of heart failure and pneumonia were good clinical predictors of closure, only 3 (4.9%) patients had surgery abroad. there were 2 (3.3%) deaths from bronchopneumonia and bacterial endocarditis.

Spontaneous closure readily occurs in small-sized defects and muscular VSDs. However, most patients with moderate to large VSDs are confined to long-term medical management [10].

A 2nd study done by Girish S. Shirali and others in December 1995 about: Quantitation of echocardiographic predictors of outcome in

infants with isolated VSD, at departments of Pediatrics, Texas Children's Hospital, USA.

In this study 156 infants who had an isolated VSD studied, The study discusses Clinical and morphometric features such as ventricular septal defect (VSD) size and location may determine outcome in infants with an isolated VSD, they study done between January 1988 and December 1990.

Number of patients with membranous defect 100 and muscular 49. 46(31%) of patients had spontaneous closure, and 37 (25%) patients underwent surgical repair, the main conclusion was Muscular defects were more likely to close spontaneously than membranous defects [11].

A 3rd study done by doctor Ashok V. Mehta in August 1992 about: Ventricular septal defect in the first year of life. at Department of Pediatric Cardiology, James H. Quillen College of Medicine, East Tennessee State University, U.S.A.

Of approximately 22,000 live births in the region under study during 4 years minimum of 1year (incidence, 5.7 per 1000 live births).

Doppler color flow was performed in 93 of 124 patients, Of 124 patients, 14 were lost to follow-up, 47 had a muscular VSD and 46 had a perimembranous VSD. Only 1 patient had 2 muscular VSDs. None had a subpulmonic type of defect.

Spontaneous closure was seen in 18 patients (42%) in the muscular group, in 9 (23%) in the perimembranous group and in 10 patients (37%) in the unclassified group by the end of the first year, the overall rate of spontaneous closure was 34% by the end of the first year. Congestive heart failure developed in 2 of 46 patients with muscular VSD and in 12 of 47 patients with perimembranous VSD in the first year, 2 patients with muscular VSD as opposed to 5 with perimembranous VSD required surgery, Doppler color flow mapping is a valuable aid in the diagnosis of VSD and may be one reason for the observed increase in the incidence of VSD [12].

A 4th study done by doctor Chidambaram B in 1995 about: Natural history of isolated ventricular septal defect in the first five years of life at Tennessee and Southwest Virginia USA.

Prospective study Between December 1, 1998 and October 31, 1990, 124 infants were diagnosed clinically with isolated VSD.

VSD were classified as muscular, perimembranous, subpulmonic types by 2-dimensional echocardiogram with color flow mapping.

Cardiac catheterization and angiocardiography were performed in 14 patients when clinically indicated,patients were followed for at least five years. Results show Overall spontaneous closure of VSD was 34% at one year and 67% at five y years, 25%percent of perimembranous and 4% of muscular VSD required surgery by five years, The spontaneous closure rate of muscular VSD was twice that of the perimembranous type, Muscular VSD was consistently better than that of the perimembranous type.

Though 17% of muscular VSDs, irrespective of size, were open at 5 years of age and needed long-term follow up,22% of children with VSD need follow-up after the fifth year of life [13].

A 5th study done by doctor F van den Heuvel in 1995 about: Morphological, hemodynamic, and clinical variables as predictors for management of isolated ventricular septal defect, of Pediatric Cardiology department at, Sophia Children's Hospital, Rotterdam, Netherlands.

In which -263 patients with isolated ventricular septal defect diagnosed by echocardiography, the morphological type and hemodynamic character of the ventricular septal defect was characterized in each patient also variables were introduced to represent the need for diuretics, growth, and potential delay in growth. in 43 patients (16-3%) the ventricular septal defect was closed surgically.

220 patients (83.7%) were managed conservatively and spontaneous closure of the ventricular septal defect occurred in 65 (29-5%), there were no deaths.

Conclusions-Findings imply that early surgical closure of ventricular septal defect is indicated in patients with no restrictive ventricular septal defect and severe growth delay Other patients should be managed conservatively. In these patients the morphological type of the defect determines the probability of spontaneous closure and provides an estimate of the period over which decrease in size or closure can be expected [14].

2.3 Surgical Intervention

Children with ventricular septal defects who have congestive heart failure that is refractory to medical management and are not growing should undergo surgical closure, regardless of age or size.

Infants with large VSDs who are growing should be observed for signs that the VSD is becoming pressure restrictive and decreasing. If the VSD remains large and unrestrictive, most infants should undergo surgical closure at age 4-6 months, and although a repair later in the first year of life is acceptable, a progressive risk of pulmonary vascular disease after age 6 months is observed.

Infants with a moderate-sized, pressure-restrictive VSD should undergo repair if their growth is abnormal or if evidence is seen of progressive or persistent left-sided heart enlargement after age 6 months. After infancy, a child with a moderate-sized VSD who develops left-sided heart dilation should undergo surgical closure.

Potential complications of surgical ventricular septal defect closure include infection, postoperative bleeding requiring re exploration, valve injury (tricuspid, pulmonary, or aortic).

Pulmonary hypertension with poor cardiac output, AV heart block, residual VSD with continued left-to-right shunting, and death.

Permanent AV heart block occurs in 1% or fewer of children undergoing VSD closure. Care must be taken to correctly identify the position of the defect, since this determines the location of conduction tissue and directs the repair to avoid conduction injury. Transient AV block is treated expectantly with temporary cardiac pacing. When AV conduction does not return (in < 1% of patients in the best centers), a permanent pacemaker is needed.

Residual left-to-right shunt from incomplete VSD closure may result from insufficient intra operative exposure or suture disruption with patch dehiscence. Significant residual shunting is most commonly observed in muscular defects (particularly multiple defects) in which trabeculations decrease visualization of the full extent of the VSD.

The mortality rate associated with surgical VSD closure has decreased dramatically with improvements in perfusion, myocardial protection, and postoperative care. The overall surgical mortality rate for patients with isolated VSD is less than 1%, Risk factors for mortality include non cardiac anomalies, multiple VSDs, and major associated cardiac anomalies.

American Heart Association guidelines consider a repaired VSD a negligible risk lesion for bacterial endocarditis (no greater than the general population). Therefore, prophylactic antibiotics are recommended for patients for no more than 6 months after their surgical VSD repair.

A study done by doctor Sayadpour-*Zanjani 2008* about Residual defects after surgical repair of ventricular septal defect in children, incidence, risk factors and follow-up at department of pediatric cardiology at Shaheed Rajayee Heart Center, School of Medicine, Teheran, Iran.

They studied the incidence of this complication, risk factors for its occurrence and short-term follow-up in 179 pediatric patients that underwent surgical closure of VSD from April 2003 until May 2004. And study residual ventricular septal defects (VSD) because it's the major complication after cardic surgery.

Data gathered retrospective Studied risk factors included age, sex, weight, height, ejection fraction, VSD size, responsible surgeon. use of patch material for closing VSD, cardiopulmonary bypass and aortic cross-clamp times, hemorrhage, documented infection, and surgical approach for defect closure.

There was notable but statistically insignificant differences in residual shunt incidence among the patients of different surgeons and with the use of different patch materials.

During the median follow-up period of 9.5 months, 35% of the residual defects were closed spontaneously.

Six patients underwent catheterization, three of which were candidates of residual VSD closure.

As residual VSD is a hemodynamic ally and psychologically important complication.

The study recommend VSD closure at lower age and the use of intraoperative epicardial or transesophageal echocardiography to minimize its occurrence [15].

A 2nd study done by doctor doctorj.wroos-hesselink in 2004 about: outcome of patients after surgical closure of VSD at young age longitudinal follow-up of 22-34 years, at department of cardiology Rotatterdam, Netherlands.

In which 176 consecutive patients underwent surgical closure of an isolated VSD between 1968 and 1980. A systematic follow-up study was performed in 1990 and again in 2001.

Among patients with surgically repaired VSDs, late results were good but late survival was poorer than in the general population.

Pulmonary hypertension and right ventricular hypertrophy were present in the 4 patients who died suddenly after operation. Pulmonary hypertension was found in 4%, and aorta insufficiency in 16%.Re-operations were necessary in 6%.Some patients 4% developed sinus node disease late after repair, requiring pacemaker implantation [16].

A 3rd study done by doctorHarald M. Gabriel, in 2002 about: Long-Term Outcome of Patients With Ventricular Septal Defect Considered Not to Require Surgical Closure During Childhood at Vienna, Austria, In this study a total of 229 consecutive patients (115 females) with a VSD considered too small to require surgery during childhood.

Physical examination, electrocardiography, and echocardiography were performed in all patients in one- to three-year intervals,Follow-up was completed in 222 patients (97%),Mean age at last visit was 30(_+) 10 years.

Spontaneous VSD closure was observed in 14 patients (6%),No patients died.

Four patients (1.8%) had an episode of endocarditis, two of them required aortic valve replacement, one additional patient (0.4%) had surgical closure for hemodynamic reasons, 94.6% of all patients studied were symptom free.

Left ventricular (LV) size by echocardiography was normal in 198 (89%) patients, borderline in 23 patients and definitely enlarged in only one patient.

None had systolic LV dysfunction, and pulmonary artery pressure was normal in all patients and 87% of patients had no arrhythmias on Holter monitoring, with the rest showing rhythm disorders.

Conclusion of the study: outcome in patients with a small VSD is good. Surgical closure does not appear to be required during childhood as long as left-to-right shunt is normal, volume overload are absent, when pulmonary pressure is not elevated [17].

A 4thstudy done by doctor in Omair Bushra Amanullah in 2013 about: Surgical Outcomes of Pediatric Patients with Ventricular Septal Defects in at Pediatric Cardiology, Aga Khan University Hospital, Pakistan.

A Retrospective Cohort Study in which 117 patients under 18 years of age with isolated VSD or VSD associated with a cyanotic congenital heart disease admitted for surgical closure of ventricular septal defect between July 1998 and June 2008.

Results: Adverse complications occurred in 35.9% (42/117) and death in 3.4% (4/117) of cases.

Larger size of ventricular septal defect were associated with an increased risk of adverse events. Infection 20% and pneumonia 10% were the commonest complications, almost one third of complications that may be avoidable and treatable.

Age under one year, weight less than ten kilograms, pulmonary hypertension, and moderate to large size ventricular septal defect are more likely to be associated with adverse events [18].

A 5th study done by Micheal fread in 1985about: VSD surgical closure before 1year, at massachusetts USA from January 1973 and July 1981, 128 patients less than 1 year of age, with failure to thrive, congestive heart failure or pulmonary artery hypertension underwent primary repair of VSD.

The hospital mortality rate was 7.8% (10 /128), and the late mortality rate was 2.3% (3 /128).Mortality was highest among younger infants with preexisting respiratory problems or hemodynamic ally significant residual lesion.

Complications included a large residual shunt in 8(6.2%), transient neurologic problems in 5 (3.9%) and persistent complete heart block in 3(2.3%).

Complete right bundle branch block developed in 74 (64%) and bi fascicular block appeared in 11 (9%).

Complete closure of the defect had been achieved in 49 (70%), and a hemodynamic ally insignificant shunt remained in 19 (27%). Patients without significant hemodynamic residual were asymptomatic and tended to accelerate in growth after surgery [19].

A 6th study done by doctor by R S Blake, about :Conduction defects, ventricular arrhythmias, and late death after surgical closure of ventricular septal defect done at the Royal Postgraduate Medical School, London.

One hundred and eighty-seven patients who had surgical closure of a ventricular septal defect between 1958 and 1975 were followed for up to 21 years.

There were 17cases with sudden deaths which eight occurred in completely fit patients while nine were already under medical care.

Here was a significant correlation between recorded ventricular arrhythmias and conduction defects, particularly progressive conduction defects.

Transient complete heart block carried a bad prognosis. The long-term treatment of survivors found to have ventricular arrhythmias must be considered.

Long-term postoperative electrocardiographic follow-up is recommended and 24 hour ambulatory monitoring and exercise testing complement the findings of the resting electrocardiogram [20].

2.3.1 Pulmonary artery banding

large or multiple ventricular septal defects causes too much blood flows to the lungs, it can damage the blood vessels in the lungs, It may not be possible to repair the defects if there are many defects or if the child is not healthy enough. In this case, pulmonary artery banding may be done to prevent too much blood from flowing to the lungs.

A study done by doctor R. G. GRAINGER, in 1996 about: Pulmonary Artery Banding for Ventricular Septal defect. at the Cardiovascular Unit, City General Hospital, and the Children's Hospital, Sheffield, UK. The series consists of 60 children under the age of 3 years, between January 1990 and September 1994.

The indications for pulmonary artery banding were primarily clinical and consisted essentially of pulmonary hyperemia with uncontrollable heart failure. The infants presented with tachycardia, tachypnea, and dyspnea.

The majority had a history of repeated respiratory infection, but most of these episodes were probably due to pulmonary congestion and oedema.

Many of the children could not suck or feed adequately, many had hepatomegaly and severe congestive failure which had failed to respond to medical treatment.

None of the children operated upon had reached average weight for age and sex, and the considerable majority were neither gaining weight nor thriving. None of the children operated upon had reached average weight for age and sex, and the considerable majority were neither gaining weight nor thriving

The results show: Of the 48 children who had their pulmonary artery banded, 29 are alive at present.

None of the children operated upon had reached average weight for age and sex.

Of the 29 children, 22 are well and without cyanosis or significant dyspnea. The majority of the children are gaining weight at the lower 10th percentile, but a few children gained weight rapidly immediately after the operation and are continuing to gain weight along the upper tenth percentile.

All of the 22 children who are of school age are attending normal schools without restrictions.

7children have been reinvestigated by cardiac catheterization duo to development of cyanosis attacks.

19 patient died out of 48 children after their pulmonary artery banding operation.

Early death (within three weeks of operation) occurred in 11 cases, the late death occurred in 8 cases.

High mortality in infants operated upon under the age of 6 weeks ,the most frequent cause of death in this group was cardiac arrest 5cases ,

either during operation or in the succeeding two or three days.

These result suggest that it would have been reasonable to defer operation in these small infants until they were older.

Four late deaths were due to undercurrent infections, one due to meningitis, another one due to measles, the remaining two infants were thought to be suffering from chest infections. In all four cases death was unexpected [21].

2.4 Trans Catheter Closure

Transcatheter closure of VSDs in various locations can be safely and effectively carried out using the Amplatzer occluders, results are encouraging Muscular defects comparable to surgery, Perimembranous VSDs can be difficult to close percutaneously.

Most procedures are performed with the patient under general anesthesia and with echocardiographic guidance. Reported complications have included aortic and tricuspid regurgitation, device embolization, complete heart block, transient left bundle-branch block (LBBB), hemolysis, small residual shunts, and perforation.

A study done by Ralf Holzer in 2002 about: Device closure of muscular ventricular septal defects using the Amplatzer muscular ventricular septal defect occlude done at, Minnesota, USA, by doctor.

Data were prospectively collected from 83 procedures involving 75 patients who underwent an attempt of percutaneous 93.3% of the cases. Per ventricular (surgical)

8.0% of the cases under device closure of hemodynamic ally significant muscular VSDs. The patients' median age was 1.4 years.

Results show the median size of the primary VSD was 7 mm and in 34 of 78 (43.6%) procedures, patients had multiple VSDs (range 2 to 7).

The device was implanted successfully in 72/83 (86.7%) procedures. In 17/83 (20.5%) procedures, multiple devices were implanted (range 2 to 3). Procedure-related major complications occurred in 8/75 (10.7%) patients. Device embolization occurred in two patients and cardiac perforation in one patient.

There were 2 (2.7%) procedure-related deaths. The 24-h post procedural complete closure rate was 47.2% of the patients, increasing to 69.6% at 6 months and 92.3% at 12 months.

Six patients underwent successful closure using the per ventricular surgical (beating heart) approach, with complete closure at day 1 in three patients and trivial/small residual shunts in the remainder of the patients [22].

2.5 (ACEI) Usage in VSD Patients

Angiotensin-converting enzyme (ACE) inhibitors (eg, captopril and enalapril) - These medications reduce both the systemic and pulmonary pressures (the latter to a greater degree), thereby reducing the left-to-right shunt and Diuretics (eg, furosemide) to relieve pulmonary congestion.

A study done by Mark M. Boucek about: Effects of Captopril in 1999 about the Distribution of Left Ventricular Output with VSD at Department of Pediatrics, Division of Cardiology, University of Utah School of Medicine USA.

To determine the effect of angiotensin converting enzyme inhibition on the hemodynamics with VSD, the dose response curve of captopril was measured in 12 lambs. (less than 1 month old) lambs were obtained in the first 2 wk of life and weaned to bottle feedings of a fixed amount.

The technique used to create the VSD through aplastic grommet (8 mm ID) was inserted across the ventricular septum after entry via the right atrial appendage. All surgery was performed with ketamine anesthesia.

After a 10-day recovery period, the lambs were instrumented with aortic and pulmonary artery catheters and electromagnetic flow probes, also left and right atrial pressure catheters. Animals were then allowed to recover for 1 wk after instrumentation before any data collection.

Results show: The vasoconstriction action of the renin-angiotensin system promotes the pathologic cascade of increasing left-to-right shunt through a ventricular septal defect.

The data presented in the study indicate that inhibition of converting enzyme activity with captopril favors the distribution of left ventricular output to the systemic circulation and reduces total pulmonary blood flow.The effects of captopril on systemic resistance with an ED50 of approximalety 0.5 mgLkg.

Maximum effect of captopril occurred at 2 mg/kg, and increasing the dose further to 10 mg/kg produced no greater hemodynamic effect [23].

A 2nd study done by N J Shaw, in 1988 about: Captopril in heart failure secondary to a left to right shunt at Leeds ,UK.

Captopril was used in 20 infants aged less than 1 year with heart failure secondary to defects with predominantly a left to right shunt. that was poorly controlled with digoxin and diuretics, from April 1984 to April 1987.

Total daily dose of captopril ranged from 0,88 to 2,5 mg/ in three divided doses. Improvement in the control of heart failure was seen mainly as.

An increase in the rate of weight gain from a mean of 48 g/week before treatment to 102 g/week on treatment.

Decrease in the mean respiratory rate from 68 breaths/minute to 60 breaths/minute.

Side effects were seen in four patients-two with asymptomatic mild hypotension, one with renal insufficiency which improved with a reduction in dose, and one with severe oliguria progressing to renal failure.

Significant changes in plasma electrolyte concentration did not occur except in the infant who developed acute renal failure [24].

2.6 Affect of VSD on the Growth

Significant left to right shunt and heart failure also Frequent respiratory infections, all lead to poor weight gain in VSD.

A study done by doctor Qusay A. Al- Rahim in 2006 about: Effect of Ventricular Septal Defect on the Growth Pattern of Children at Department Of Paediatrics , College Of Medicine, Baghdad University.

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

Results show: 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%), while the differences in the height of both groups was not statistically significant. There was a significant effect of moderate and large VSD on weight 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 [25].

2.7 Aims of the Study

The aims of our study are:

- To see the natural history and outcome of isolated ventricular septal defects in the VSD patients which follow Al-Hawari pediatric cardiac clinic.
- To evaluate the current status of the patients as well as complications of the VSD and its treatments.

3. PATIENTS AND METHODS

- Descriptive retrospective case series study, include 140 patients with isolated VSD.
- Period of the study from October 2010 to February 2013.
- Data was collected by reviewing the medical records of patients including patients age at last follow up time, residency, VSD Presentation, types, size.
- All patients were diagnosed using transthoracic echocardiography.
- VSD was classified as perimembranous, muscular, and supracristal doubly committed.
- Further evaluation comprised a plain chest radiograph,ECG,24-h Holter monitoring Outcome divided into**:** VSD still not closed at time of the study, surgically closed, closed spontaneously, closed through Trans-catheter closure, operated with Pulmonary banding, and death
- Special analysis for surgically closed cases in which the causes and the outcome of surgical intervention had been studied.
- The correlation between VSD types, age and outcome, as well as between size and presentation, affect of VSD on patients weight,

- Use of medications had been reviewed like antibiotics given for prophylaxis against infective endocarditis, diuretics and captopril (ACEI) for heart failure, Viagra (Sildenafil) for pulmonary hypertension cases , as well as digoxin.
- Data was analyzed manually.
- Patients with Down syndrome and other dysmorphic syndrome were excluded from the study.

3.1 Limitation

- The files in the clinic are very poor in recording.
- Limited number of staff working at statistical department make the data collection process difficult.
- Some of the patients information collected by prolonged phone calls with patients and their families, and some patients do not have phone number so their information collected from files only.

4. RESULTS

A total of 650 patients with different congenital heart disease registered in Al-Hawari cardiac clinic.

- 140 (22%) patients had isolated VSD.
- Three-quarters (74%) from Benghazi.

Fig. 1 below illustrates the residence of the patients

4.1 Demographic Figures

4.1.1 Age

- Age at last visit ranged from 20 days to 13 years with median 18 months, 52.5% less than 3years.
- Age at presentation ranged from 13days to 5years, more than half of the patients diagnosed less than 1year.

Table (1,2) below show patients age at last visit ,and presentation, (diagnosis).

4.1.2 Gender

- Females outnumber males 74/140 (53%) with M:F ratio 1:1.1.

Fig. 2 below illustrates the gender of patients included in the study

4.2 Classification of VSD

4.2.1 according to their types

There are three common types with:

- Perimembranous is the most common 73 (52 %).
- Only one Patient had supracristal doubly committed VSD. Table (3) below shows VSD types.

Table 1. Distribution of patient according to age at last visit

Age	No.	%
Up to 1y	39	28
>1y-3y	34	24.5
>3y-5y	30	21.5
>5y-7y	20	14
>7y	17	12
Total	140	100

Table 2. Distribution of patient according to age at (presentation, diagnosis)

Age	No.	%
Up to 1y	72	51
>1y-2y	44	32
>2y-3y	14	10
>3	10	7
Total	140	100

Table 3. Distribution of the patients according VSD types

Type	No.	%
Perimembranous	73	52
Muscular	66	47
Supracristal (Doubly committed)	1	1
Total	140	100

4.2.2 according to their size

According to the size of the defect, VSD is divided into:

- Small (where the size of VSD is less than one-third of the size of the aortic root) is the most common with 53 (38%) of patients.
- Moderate (where the size of VSD is one-third to two-third that of the aortic root). It represent 34% of patients
- Only 28% of the patients have large VSD (where the Size is equal to that of the aortic root). Table 4 below shows VSD size.

4.3 Presentation of Patients with VSD and its Correlation with Size, Type and Age

- Chest infections were the most frequently observed 66(47%), followed by Heart murmur which discovered accidentally during physical examination.

Table 4. Distribution of patients according to VSD size

Size	No.	%
Small	53	38
Moderate	48	34
Large	39	28
Total	140	100

- 3% of the patients came with failure to thrive
- In patients with small VSDs, the results of chest radiographs are usually normal. With medium-size VSDs, minimal cardiomegaly and a borderline increase in pulmonary vasculature may be observed. In large VSDs, the chest radiograph shows gross cardiomegaly with prominence of both ventricles, the left atrium, and the pulmonary artery. The pulmonary vascular markings are increased.

Fig. 3 illustrates the presentation of the patients.

4.3.1 Correlation with the size

- 90 % of Small VSD presented with Chest infections or discover accidently with 45% for each.
- Most of the moderate VSD cases presented with Chest infections 31 (65%).
- One third of large VSD 30% presented with heart failure followed by bronchopneumonia 28%.

Table 5 shows Correlation between VSD size and VSD presentation.

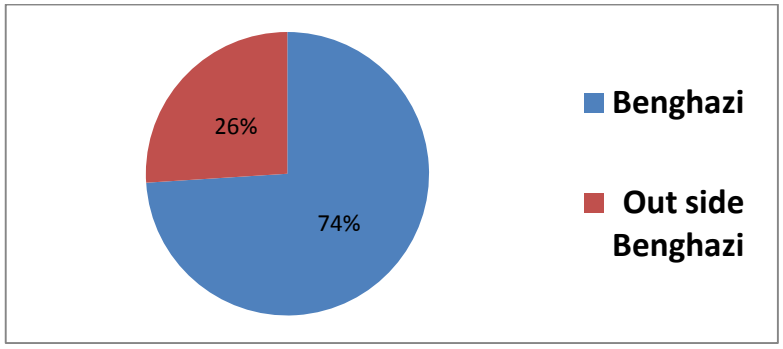

Fig. 1. Distribution of the of patients according to their residence

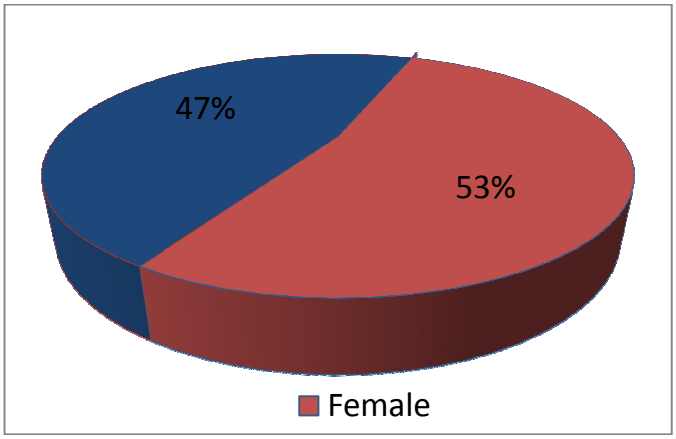

Fig. 2. Distribution of patients according to their gender

4.3.2 Correlation with types

- Most of the perimembranous VSD cases and Muscular VSD cases presented with Chest infections (58%), (37%) respectively.
- We have only one with supracristal(Doubly committed) case and presented with Heart failure.

Table 6 shows the Correlation between VSD Types and VSD presentation.

4.3.3 Its correlation to the age

- Age at time of presentation (diagnosis)
- Half of the patients below 2 years of age presented with Chest infections, as well as all cases (4) presented with Failure to thrive were below 2yearsof age.
- 15 of cases presented with heart failure, 14 of them below 2 years of age.
- Near half of patient above 2 year presented with Shortness of breath. Table 7 shows Correlation between age at diagnosis and presentation.

4.4 VSD Outcome and its Correlation to the Age, Type and Size

- 77/140 cases (55%) their VSD were closed either :
- Spontaneously 20% or surgically 33%, while 2%closed through trans catheter.
- Died 3% (4/140 cases).
- 57(41%) of our patients at last visit their VSD still not closed.

Fig. 4 illustrates Outcome of VSD patients

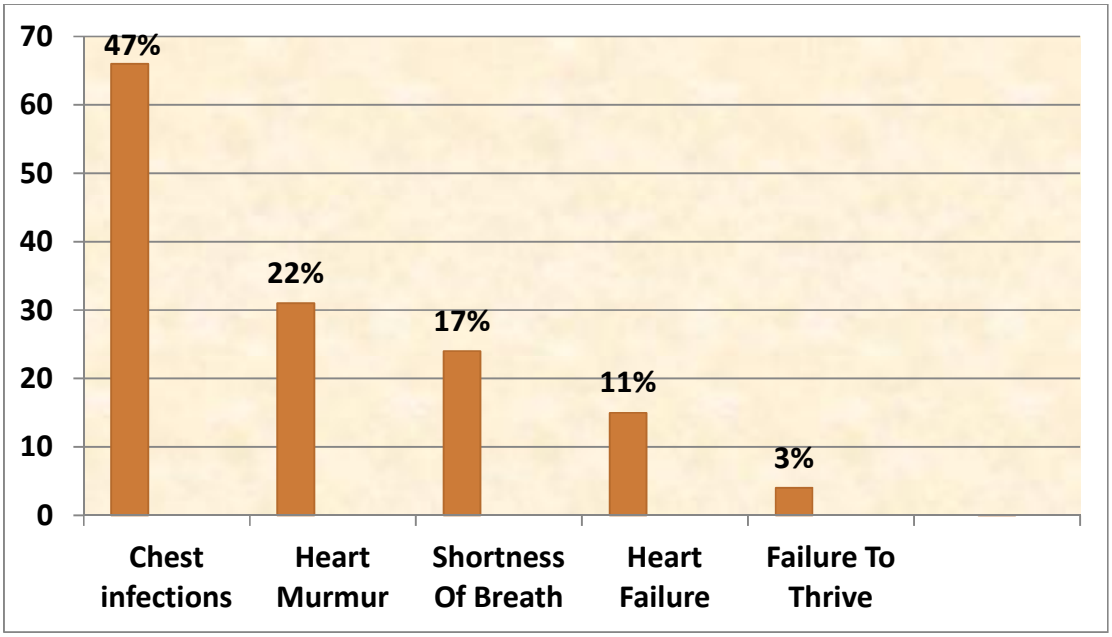

Fig. 3. Distribution of patients according to their VSD presentation

Table 5. Correlation between VSD size and presentation

Size	Presentation										Total	
	C. I		H.M		S.O.B		H.F		F.T.T			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Small	24	45	24	45	5	10	0	0	0	0	53	100
Moderate	31	65	4	8	9	19	3	6	1	2	48	100
Large	11	28	3	8	10	26	12	30	3	8	39	100

NB:C.I =Chest Infections , H.M=Heart Murmur, H.F=Heart Failure, S.O.B=Shortness Of Breath F.T.T=Failure To Thrive

Table 6. Correlation between VSD Types and presentation

Types	Presentation										Total	
	C. I		HM		SOB		HF		FTT			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Perimembra-nous	42	58	15	20	6	8	8	11	2	3	73	100
Muscular	24	37	16	24	18	27	6	9	2	3	66	100
Doubly committed	0	0	0	0	0	0	1	100	0	0	1	100

Table 7. Correlation between age at diagnosis and presentation

Age	Presentation										Total	
	C. I		H.M		S.O.B		H.F		F.T.T			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Up to 1y	42	58	13	18	7	10	8	11	2	3	72	100
>1y-2y	22	50	10	23	4	9	6	14	2	4	44	100
>2y-3y	3	21	4	29	6	43	1	7	0	0	14	100
>3	1	10	4	40	5	50	0	0	0	0	10	100

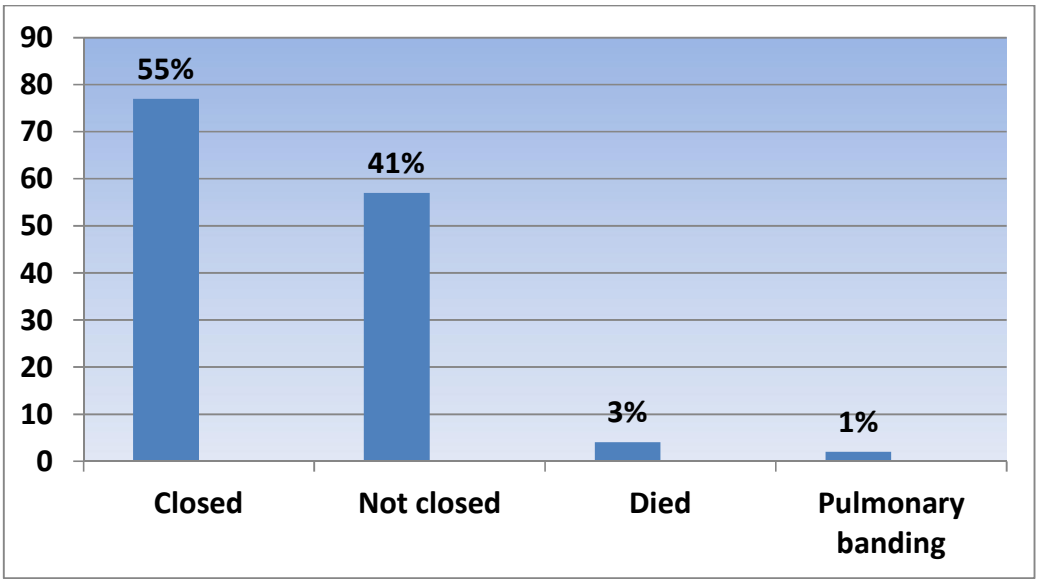

Fig. 4. Distribution to the patients according to their outcome

4.4.1 Method of VSD closure

- 77/140(55%) closed spontaneously or surgical or through transcatheter closure.
- 46/77 (60%) cases were surgically closed.
- 28 /77 (36%) cases spontaneously closed.
- 3/77 (4%) cases closed through transcatheter closure.

Fig. 5 illustrates method of VSD closure.

4.4.2 Correlation between outcome and patients' age

- Status of patients taken from the file at their last visit and it include the following:
- 50% of the deaths occurred below 1year of age.
- All of pulmonary banding done between 1-3 year of age.
- All of transcatheter closure cases done above 5years of age.
- Half of the spontaneously closure cases occurred below 3 year of age with20% in the first year of life, and 96% below 7 year of age.
- 63% of surgically closure done below 5 years of age.
- 86% of whom their VSD still not closed their age below 5 years. Table 8 shows the

Correlation between patients' age at last visit and outcome.

4.4.3 Correlation between size and outcome

- All pulmonary binding and died cases had large size.
- Small VSD represent the vast majority of spontaneously closed cases 82%, in contrast to large VSD which represent only 4% from spontaneously closed case
- .Large and Moderate VSDs represent 53% the largest percentage of all VSD which still not closed (30) cases.
- All surgically closed VSD were moderate and large size.
- All Trans-catheter closed cases VSD had small VSD. Table 9 shows the correlations between outcome and VSD size.

4.4.4 Correlation between outcome and types

- Perimembranous VSD represents the vast majority 65% in whom surgically closed were done as well as more than half of cases 58% in whom VSD still not closed.
- All of the (3) cases undergo transcatheter closure were muscular, as well as they represent 75% of cases who their VSD closed spontaneously.
- The spontaneous closure rate of muscular VSD was triple that of the Perimembranous type.
- All of the cases (2) undergo pulmonary banding operation were Perimembranous VSD.
- 4 died patients 2 of them 50% were muscular and 2 were Perimembranous.
- The one only doubly committed VSD case closed surgically. Table 10 shows the correlations between outcome and VSD types.

4.5 Evaluation of the Patients

- Data collected from the files of the patients at their last visit with focusing in operated case
- surgical intervention were done for 48 patients either by surgical closure 46 (96%) or by pulmonary banding for 2 patients .
- Leading cause for surgical intervention is heart failure 63%.
- 1cases complicated with post operative Hemiplegia, and another 1case with Hemi paresis.

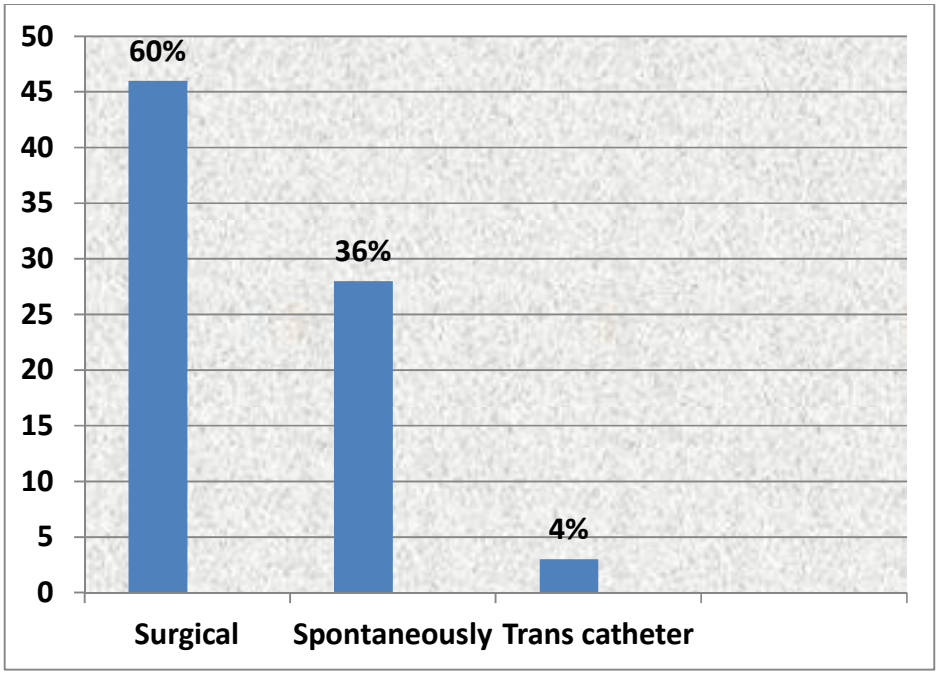

Fig. 5. Distribution of the patients according to their Method of VSD closure

Table 8. Correlation between outcome and patients' age at last visit

Age	N.C		Method of closure						P.B		Died	
	No.	%	S.C		C.S		T.C		No.	%	No.	%
			No.	%	No.	%	No.	%				
Up to 1y	22	39	9	20	6	21	0	0	0	0	2	50
>1y-3y	12	21	11	23	8	29	0	0	2	100	1	25
>3y-5y	15	26	9	20	6	21	0	0	0	0	0	0
>5y-7y	3	5	8	17	7	25	2	67	0	0	0	0
>7y	5	9	9	20	1	4	1	33	0	0	1	25
Total	57	100	46	100	28	100	3	100	2	100	4	100

NB: N.C=Not Closed, S.C=Surgical Closure, C.S= Closed Spontaneously, T.C=Trans Catheter, P.B=Pulmonary Banding

Table 9. Correlation between VSD outcome and VSD size

Size	N.C		Method of closure						P.B		Died	
	o.	%	S.C		C.S		T.C		No.	%	No.	%
			No.	%	No.	%	No.	%				
Small	27	47	0	0	23	82	3	100	0	0	0	0
Moderate	18	32	26	57	4	14	0	0	0	0	0	0
Large	12	21	20	43	1	4	0	0	2	100	4	100
Total	57	100	46	100	28	100	3	100	2	100	4	100

Table 10. Correlation between VSD outcome and VSD types

Types	N.C		Method of closure						P.B		Died	
			S.C		C.S		T.C		NO	%	No.	%
	No.	%	No.	%	No.	%	No.	%				
Perimembr-anous	33	58	30	65	7	25	0	0	2	100	2	50
Muscular	24	42	15	33	21	75	3	100	0	0	2	50
Doubly committed	0	0	1	2	0	0	0	0	0	0	0	0
Total	57	100	46	100	28	100	3	100	2	100	4	100

- Post operative echocardiogram shows that 18/46 cases (39%) of cases had Normal heart (*without residual VSD, or ventricular dilation or valve regurgitation*).
- 30% of the cases has Residual VSD as a common post operative complication.
- 1 case re operated again, and 1 case died giving a Mortality rate of 2% due to post operative pneumonia which also complicate 15% of VSD closure cases.
- Infective endocarditis did not occur in any post operative cases.
- There is clear difference in ECG changes between non operated and operated cases with.
- Left axis deviation as well as Right and Left ventricular hypertrophy were obviously more common in non operated patients with 93%,90% ,92% respectively.
- Supraventricular tachycardia and heart block is complication in operated case.

Tables 11, 13 show causes of surgical intervention as well as post operative echo finding.

Table 12 shows ECG changes (with comparison between operated and non operated cases).

Table 11. Distribution of patients according to causes of surgical intervention

Cause	No.	%
Heart failure	30	63
Pulmonary hypertension	12	25
Failure to thrive	5	10
Infective endocarditis	1	2
Total	48	100

4.6 Medication Used in VSD Patients

- All operated cases 46 received (Diuretics and ACE inhibitors) form 4-6 wks period but 2 patients continue to receive medication for 6 months.
- 35/94 from non operated cases on anti failure medication.
- Sildenafil(Vigra) used in treatment of pulmonary hypertension in 18 cases 14 of them non operated..
- Antibiotics as prophylaxis against sub acute bacterial endocarditis given to all non closed VSD cases, and in 21 of operated cases(14with residual VSD ,and 7 with valves regurgitation.
- 1 operated cases received Digoxin for supra ventricular tachycardia.

4.7 Patient's Weight

- Weight was taken from the file for each patient at last visit.
- More than one- third of the patients (35%) below 25th centile, with 6% of them Below 3rd centile.
- Only 1% of the patient above above 97th centile.

Table 12. Distribution of patients according to ECG changes

ECG Changes	Op		Non Op		Total	
	No.	%	No.	%	No.	%
LAD.	2	7	25	93	27	100
RAD.	0	0	3	100	3	100
R. V. H	1	10	9	90	10	100
L .V.H	1	8	12	92	13	100
BI.V. H	0	0	6	100	6	100
Pul. HTN	2	40	3	60	5	100
S.V.T	1	100	0	0	1	100
H.B	1	100	0	0	1	100

NB: LAD= Left axis deviation, RAD= Right axis deviation, R.V.H= Right ventricular hypertrophy, L.V.H= Left ventricular hypertrophy. B I. V. H = Biventricular hypertrophy. Pul HTN= pulmonary hypertension, supra ventricular tachycardia= S.V.T, OP=operative, Non OP= Non operative, H.B=Heart Block

Table 13. Postoperative echocardiogram finding

.

Echo finding	No.	%
Normal	18	39
R . VSD.	14	30
L.V.D	9	20
P.E	5	11
Mild (MR) (TR)	5	11
Mild (AR)	2	4
Pul. HTN	2	4

NB: R.VSD=Residual VSD, L.V.D= Left Ventricular Dilation, P.E= pericardial effusion, MR=Mitral Regurgitation, TR= Tricuspid Regurgitation, AR=Aortic Regurgitation, Pul.HTN= pulmonary Hypertension

Table 14. Distribution of patients according to their used medication

Medication	Indication	State	
		Non OP	Op
Diuretics &ACEI	HF	35	46
*Viagra	Pul. HTN.	14	4
Antibiotics	prophylaxis for SBE	57	21
Digoxin	S.V.T	0	1

*NB : Non OP= Non Operative, OP= Operative , ACEI= Angiotensin-converting enzyme inhibitors, PUL HTN= Pulmonary hypertension, SBE= subacute bacterial endocarditis, S.V.T= supraventricular tachycardia, *Viagra=Sildenafil*

Table 15. Distribution of the patient's weight at their last visit

Centile	No.	%
<3rd	8	6
>3rd - 25th	41	29
>25th -50th.	34	24
>50th -75th.	33	24
>75th -97th.	23	16
>97th.	1	1
Total	140	100

Table 16. Correlation between weight of the patients and size

Size	<3rd		3rd - 25		25- 50th		50 -75th		75 -97th		>97th	
	N0.	%	N0.	%	N0.	%	N0.	%	N0.	%	N0.	%
Small	0	0	9	22	16	47	14	42	13	57	1	100
Moderate	2	25	16	39	8	24	15	45	7	30	0	0
Large	6	75	16	39	10	29	4	13	3	13	0	0
Total	8	100	41	100	34	100	33	100	23	100	1	100

- Three quarters 75% of patients with weight below 3rd centile has large VSD.
- 87% of the patients whose weight more than 50th centile had small and moderate VSD.
- The only one patient whose weight above 97th centile has small VSD.

Tables 15, 16 show the weight of the patients and its correlation to VSD size

5. DISCUSSION

VSD is the most common congenital heart disease(CHD) represents about 20% of all (CHD) , and also the most common CHD causing heart failure in childhood [1,2].

Patients with ventricular septal defect have a history, presentation and physical examination that typically reflects the size of the ventricular septal defect. Most infants with a ventricular septal defect are symptomatic in the neonatal period regardless of the size of the defect as their pulmonary vascular resistance is still relatively high, and the volume of shunting is relatively low. Most will feed and thrive in the first weeks of life. However, as the pulmonary vascular resistance continues to fall through the first month of life, the volume of left to right shunting progressively increases and signs and symptoms will become apparent [2,3].

In study done at Iraq, the age of presentation of VSD patients ranged from (14 days to 14 years), while In the Nigerian study, The mean age of presentation in the cardiac clinic was 11.2±5.2 months (range from 2 - 24) months [25,10].

The age of our patients lie in between the two previous studies ranged from 13days to 5years with median 18 months.

There is no significant difference in gender between VSD patients, VSDs are slightly more common in female patients with Male to Female ratio 1:1.3 in Nigerian study , in the Iraqi study the male to female ratio was 1.1 to 1 [10, 25].

Which is going with our finding In our study also there is no significant difference with male to female ratio was 1:1.1.

VSD classified according to (soto) classification into Perimembranous which form 70-80% of all VSD cases, Muscular 5-20%, Inlet/ AV canal type 5-8%, Supracristal) (conalseptal, infundibular, subpulmonic, subarterial, subarterial doubly committed, outlet) which range from 5-7% [2].

Most studies support these results, in USA, Nigeria and UK, they found that the perimembranous type represent 65-70% of cases; others were the muscular type 25-30% and the subarterial type 5-10% [11,10,26].

In comparison to our study still the perimembranous is the most common type of VSD with 52%, Muscular is the second type with increasing in its ratio to 47%, with around 1% Supracristal (doubly committed) type.

The previous study showed that, most of the VSDs 26 – 43% were moderate-sized, while 33% were small and 25% were large VSDs [11,10,26].

In contrast to our finding and to Iraqi study which is similar to our study results were small VSD is the most common type with 32-38%, followed by moderate size with 34% and large size 28-34% [25].

The presentation of VSD patients showed more than half of the patients 33 – 54%.

Presented with symptoms of chest infections, and about a third 33% complained of shortness of breath and easy fatigue, 16% were referred because of the incidental finding of a murmur only, Almost quarter of them 27 % had failure to thrive [10].

Going with the results in the above study chest infection was the most common presentation of our patients, almost half of the patients 47%, followed by heart murmur and shortness of breath, while in contrast to the pervious study failure to thrive is not common in our patient with less than 3%.

A Study done in, USA, showed that VSD Presentation vary according to the size in which ,Small VSDs patients typically have mild or no symptoms these patients are most often brought to the cardiologist's attention because a murmur is detected during routine examination. Feeding or weight gain usually is not affected, moderate VSDs patients may have shortness of breath, excessive sweating and fatigue especially during feeding, also Frequent respiratory infections may occur secondary to the pulmonary congestion ,Large VSDs Symptoms and signs are similar to, but more severe than, those observed with moderate defects, heart failure and poor weight gain and frequent respiratory infections are common [27].

Similar to our study which showed, accidental murmur as well as chest infections is the main presentation of Small VSD 45% for each ,most of the moderate VSD cases presented with chest infections 65%, also most of the patient with large VSD presented with sign of heart failure 30% and chest infections 26%,only 2% of moderate VSD and 8% of large VSD present with Failure to thrive.

The natural history of ventricular septal defects (VSDs) showed that, the overall clinical outcome of muscular VSD was consistently better than that of the perimembranous type also small defect tend to close more than moderate and large defects.

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 results in complete recovery.

There are studies, supports the previous results about natural history of VSD, Jordanian study done to evaluate the natural and modified history of isolated ventricular septal defects they conclude that, muscular ventricular septal defects have better prognosis and infants with moderate and large ventricular septal defects usually need medical and/or surgical treatment, 59% of muscular defects closed spontaneously, 8% were closed surgically and 33.0% remained open.

On the other hand 24% of membranous defects closed spontaneously, surgical closure of the defect were needed in 35% infants, and 41% membranous ventricular septal defects remained open.

Regardless of type 64. % of moderate and large size defects needed medical and/or surgical treatment [10, 27,11].

Another study showed the spontaneous closure rate was highest in muscular VSD 82% and in 95% of small defects, Only 5% patients had surgery, there were 3% deaths from chest infection and bacterial endocarditis.

The mean age at spontaneous closure range from (6 - 24) months, 29% closed within the first year of life, and 20 (71%) closed in the second year of life [10].

In the American study the overall clinical outcome of muscular VSD was consistently better than that of the perimembranous type, the spontaneous closure rate of muscular type was twice that of the perimembranous type ,Overall spontaneous closure of VSD was 34% at one year and 67% at five years. Twenty-five percent of perimembranous and 4% of muscular VSDs required surgery by five years [11].

Our results confirm and support the previous studies we found that the small and muscular ventricular septal defects have better prognosis and high tendency to close spontaneously. The spontaneous closure rate of muscular VSD was triple that of the perimembranous type, while 23% of muscular type need surgical closure ,and 36% still not closed.On the other hand we also found 9% of membranous defects closed spontaneously, surgical closure of the defect were needed in 40% infants, and 45% membranous ventricular septal defects still not closed.

Also, we find that the vast majority 82% of spontaneously closed cases were Small VSD, In contrast to large VSDs which were the least type (4%) of all VSD closed spontaneously, no small VSD closed surgically and Moderate VSDs were the commonest type of VSDs surgically closed cases with (57%).

Spontaneous closure occurred in 20% of cases in the first year of life, and 96%of cases below 7 year of age.

3% of our patients died in the study which identical to the deaths ratio in Nigerian study, all of them were large size VSD.

The outcome of VSD cases in our study divided into: Closed 55%, surgically closed 33%, Spontaneously closed 20%, transcatheter closure 2%, Not closed 41%, died 3%,Pulmonary banding 1%.

Dr. Munesh Tomar pediatric cardiologist from(New delhi India) Summarizes the indication for Surgical intervention in VSD patients in following : Moderate to large VSD with uncontrolled CHF, recurrent lower respiratory tract infections or growth failure (early infancy), Small perimembranous or doubly committed VSD's with associated aortic insufficiency require early repair to prevent progression of aortic insufficiency, history of Infective endocarditis [28].

A study done in Texas, USA about Current expectations for surgical repair of isolated ventricular septal defects showed the indication for surgery in VSDs patients in which congestive heart failure in the top of the surgery indication with 30%, followed by poor weight gain 28%, pulmonary hypertension form 20% of the reasons, other cause like VSDs associated with valve insufficiency and endocarditis together make up 22% of the causes of surgical intervention [29].

In Our study we found similar results heart failure was the main cause in 63% of surgical intervention, followed by pulmonary hypertension 25%, and infective endocarditis 1%.

The outcome surgical closure had been studied in many places around the world like the pervious study which done in Texas, USA in which 215 patients underwent isolated VSD repair they conclude that: Surgical closure of isolated VSD is a safe, effective therapy, Risk of death, complete heart block, and reoperation is minimal. As new technologies for VSD closure evolve, Incidence of significant postoperative complications was extremely low. No patient underwent reoperation for a residual VSD. None had complete heart block.

One operative mortality 0.5% and 2 late deaths 1% occurred. In the immediate postoperative period 6 patients 3% required reoperation, No patients were discharged on anti arrhythmic agents, only mild new-onset tricuspid valve regurgitation, no aortic valve injuries occurred [29].

Another study done in Pakistan about Surgical Outcomes of VSD, The study showed that Adverse complications occurred in 36% (42/117) and death in 3% (4/117),

Infection 20% and pneumonia 10% were the commonest complications under one year age , weight less than ten kilograms, pulmonary artery hypertension ,and moderate to large size ventricular septal defect are more likely to be associated with adverse outcomes after surgical repair of ventricular septal defect [18].

In developing countries Infection and pneumonia comprise almost one third of the total complications, compared to higher arrhythmic events in developed countries. Adverse outcome include Ventricular dysfunction 9%, Pericardial effusion 5% Pleural effusion required chest tube 7%, Pneumonia 10%, Lung collapse 4% Infections 20%, Seizures 6%, arrhythmia (Transient rhythm abnormality 13%,Transient heart block 2%, Permanent pace maker 1%, 2% need another VSD closure surgery [18,17].

In comparison to the mentioned studies , in our study 46 cases underwent VSD surgical closure and our results intersect with previous studies at certain points as VSD closure surgery is safe

operation and the mortality rate 2%, 1 patient die), and Infective endocarditis did not occur in any cases.

Around 40% of patients had normal heart with excellent outcome without residual VSD, or ventricular dilation or valve regurgitation, residual VSD is the most common complication with 14/46 (30%), followed by chronic complication like left ventricular dilation which affect 9/46 (20%) of VSDs surgically closed cases , mild valve (mitral, Aortic, tricuspid) regurgitation affect 7/49 (15%), evidence of Pulmonary hypertension observed in 2/46 cases (4%). Arrhythmia and conductive defect t like complete heart block affect 4/46(4%) cases, and 1/46 case 2% re operated again, 2/46 (4%) complicated with post operative neurological deficit (Hemiplegia, Hemiparesis).

Acute postoperative complication like post operative pneumonia occurred in 15% of operated cases (7/46), and it's the cause of death of the only expired case, Post operative pericardial effusions occurred in 11% of VSD closure cases.

Another two procedure used in VSD treatment ,first one is pulmonary binding which is palliative procedure, another one is transcatheter closure of VSD.

Pulmonary artery banding is reserved for patients with unique circumstances, a small infant with multiple trabecular muscular VSDs may have a better result from definitive surgery after he or she has grown. In addition, some VSDs disappear with time and growth, certain surgeons have advocated pulmonary artery banding for low birth-weight infants, others have recommended the same approach as that used for term newborns In study done at Denver USA in which 24 children with isolated ventricular septal defect (VSD) underwent pulmonary artery banding(PAB) . Survival after PAB was 96% with isolated VSD, Mean age at banding was 13months, The mortality for pulmonary artery banding of VSD was 8.3% [30].

A multicenter study of European Registry in which 430 patients demonstrated successful Transcatheter device occlusion of VSDs in 410 (95%) of cases. Complete heart block occurred in 16 patients (4%), aortic regurgitation in 14 patients (2 required surgery), and tricuspid regurgitation in 27 patients (none required surgery) [31].

The authors recommended careful monitoring of rhythm and AV conduction, especially with perimembranous VSDs.

In our study there is little experience regarding use of both transcatheter occlusion device or pulmonary artery banding ,only 3/140 (2%) of all VSDs patient undergo transcatheter closure, the VSDs were small size and muscular VSD, all of transcatheter closure cases done above age of 5 year, there is no complication as conduction defect or valve regurgitation.

Also in our study, Only 2/140 cases undergo pulmonary banding operation both of them were large, in contrast to the study done in Denver, USA both cases were perimembranous VSD, all of pulmonary banding cases (2 cases) occurred at age 1-3 year.

Another important effect of Ventricular Septal defect on the patients growth, which is vary according to the size, a study conducted in Iraq discussed the relationship between VSD and growth. This is a prospective study of 50 patients with isolated VSD. In patients with VSD the weight of 20 patients 40% were below 3rd centile ,the percentage of patients who are below 3rd Centile for weight were 45% for moderate VSD, 40%for large VSD, while it was 15% for small VSD.

All the cases Above 50^{th} centile were small , no moderate or small cases above50^{th} centile, This study reveals that the effect of VSD on the growth parameters depended on the size of the VSD, weight is greatly affected by the moderate size VSD than large VSD and less affected by small VSD [25].

Our study results differ from the previous Iraqi result, we found that: 6% of patients Below 3^{rd} centile ,more than third of the patients 35% below 25^{th} centile. Near half of the patients 48% comes between 25^{th} centile and 75^{th} centile, .1% of the patient above above 97^{th} centile.

Three quarters 6/8 (75%)(of patients with weight below 3^{rd} centile has large VSD, 25% has moderate VSD, no small VSD patients their weight below 3^{rd} centile. The only one patient whose weight above 97^{th} centile has small VSD, there is no large or moderate their weight above 97^{th} centile, 87% patients whose their centile chart between 50^{th} -75^{th} centile and between 75^{th} -97^{th} centile have small and moderate VSD,

weight is greatly affected by the large size VSD than moderate VSD and less affected by small VSD.

6. CONCLUSION

- Small VSDS are the comments size, perimembranous VSDs are the comments type.
- Chest infections and Heart murmur were the most frequently observed VSD presentation.
- The small and muscular ventricular septal defects have better prognosis and high tendency to close spontaneously.
- The spontaneous closure rate of muscular VSD was triple that of the perimembranous type.
- Most common causes of surgical intervention is heart failure.
- VSD closure surgery is safe and successful operation with low mortality rate, and residual VSD is the most common complication.
- Most of patients with weight below 3rd centile has large VSD.

7. RECOMMENDATION

- Regular updating of the data is recommended, and increase attention to save the data electronically.
- Establishment of more advanced and modern equipment to help in accurate diagnosis and follow up.
- Trying to increase and find new pediatric cardiac clinic in areas outside Benghazi in order to facilitate the process of follow-up and treatment.
- Education of doctors in primary health centers about the importance of physical examination for early detection of the disease .
- Increase family awareness to the disease.
- Future studies should include large sample size and should include other centers.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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