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Pediatric Heart Disease among Egyptian Children: An Overview of Relative Frequencies and Assessment of Risk Factors in Pediatric Cardiology Clinic of Ain Shams Children's Hospital

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ABSTRACT

Background: Children's heart disease is considered a public health problem, and knowing epidemiology of pediatric heart disease is important in determining cause and planning effective prevention and management.

Aim: Estimation the frequency of common cardiac lesions in the Pediatric Cardiology Clinic, in Children's Hospital, Ain Shams University. **Patients and Methods**: Retrospective study was conducted over 2 years with total number 407. Classified into a group of 360 cases with congenital heart disease (CHD), 19 cases with cardiomyopathy, 12 cases with rheumatic heart, 7 cases with arrhythmia, and 4 cases with Kawasaki disease.

Results: 71.1% had acyanotic CHD, 16.7% cyanotic CHD, and 2.9% rheumatic heart diseases. 17.1% had VSD, 13.7% had ASD, 8.7% had common AV-canal, 5% had pulmonary stenosis, 7.4% had tetralogy of Fallot, and 7.6% had VSD and ASD. Most of the children were single fetus (82.1%). The positive paternal history of CHD was commonly in patients has ASD (31.2%). Most common diagnosed heart diseases in the age of one month were VSD (12.4%), ASD (14.2%), and tetralogy of Fallot (10.1%). The most common diagnosed heart lesions during the first-year age were VSD (15.2%), common AV-canal (10.9%), pulmonary stenosis (9.4%), and (5.8%) PDA and VSD. The most common diagnosed heart lesion in preschool age patients was PS (50%).

Conclusion: CHD was diagnosed in 88.4% of which 71.1% was acyanotic CHD and 16.7% was cyanotic CHD, while the most common acquired heart diseases were cardiomyopathy 4.6%, and rheumatic heart disease 2.9%.

Keyword: Congenital Heart Disease, Egyptian, Rheumatic Heart Disease, Cardiomyopathy.

INTRODUCTION

Heart disease in children, and teenagers has been considered a major public health problem, as the children have long life ahead, thus the burden and the cost of children heart disease are substantial for families and society [1].

Heart disease in children includes congenital cardiovascular malformation, cardiomyopathies, congestive heart failure (HF), dysrhythmias, rheumatic heart diseases (RHD), coronary artery aneurysms, and myocardial infarction. As the morbimortality accompanied by these situations are significant, hence the main objectives of pediatric cardiologists and other pediatric cardiovascular researchers are to detect the cause(s) of these conditions, improve their treatment of them, and eventually prevent them [2].

Other children have disorders specifically comprising the myocardium, or the heart muscle. These cardiomyopathies are classified into primary and secondary disorders of the myocardial function [3].

Acute rheumatic fever (ARF) and RHD are significant public health concerns globally. The prevalence of ARF and RHD have been decreasing in developed nations since the early 1900s, but unfortunately they continue to be main etiologies of morbimortality among young subjects in the developing nations [4].

Dysrhythmias or disease of electric conduction in children may be congenital or acquired. The overall incidence of arrhythmia is 55.1 out of 100000 pediatric emergency department visits (less than 18 years old).

Among children with dysrhythmias, the commonest arrhythmias are sinus tachycardia (50%), supraventricular tachycardia (13%), bradycardia (6%), and atrial fibrillation (4.6%) [5]. So, this study was designed to estimate the frequency of the most common cardiac lesions in the Pediatric Cardiology Outpatient Clinic, in Children's Hospital, Ain Shams University.

PATIENTS AND METHODS

This study was a retrospective epidemiological and descriptive study. It was designed to estimate the frequency of the most common cardiac lesions in the pediatric cardiology outpatient clinic, in the Children's Hospital, Ain Shams University with especial emphasis on the common demographic features, and assessment of possible risk factors of such diseases among eliminated patients. It included 407 children attending clinic over a period of 2 years from January 2011 to December 2012. The studied groups were subclassified into a group of 360 cases with congenital heart disease, group of 19 cases with cardiomyopathy, group of 12 cases with rheumatic heart, group of 7 cases with arrhythmia, and group of 4 cases with Kawasaki disease.

METHODS

All patients included in the study underwent full history taking including demographic data including

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name, age at diagnosis, sex, residence, father's occupation, mother's occupation, socioeconomic status, and consanguinity. Socioeconomic status is classically broken into three categories, high SES, middle SES, and low SES. Complaints of patients or their parents during diagnosis (e.g. difficulty of breathing, failure to thrive, dyspnea, and cyanosis) were documented. Antenatal maternal history included maternal age, past history of abortion, and the type of conception of the included patients (normal or assisted). Postnatal history of convulsions, respiratory distress, vomiting, cyanosis, fever, congenital anomalies, and whether there is NICU admission and if yes, the indications. Family history of consanguinity, congenital heart disease, congenital anomalies, previous abortion, sibling death, still birth, or rheumatic heart disease.

Complete general examination included weight, color (pallor or cyanosis), lethargy, congenital anomalies, vital data (blood pressure and pulse) and peripheral pulses. Chest examination included assessment of air entry, rhonchi and crepitations. Cardiac examination included assessment of deformity and visible pulsations, pulsation and thrill and heart sounds and murmurs. Abdominal examination included assessment of organomegaly. Lower limb examination was done to check for oedema.

Thorough Assessment of Common Risk Factors

Maternal risk factors included maternal diseases (maternal diabetes mellitus, hypertension, fever, rash, bronchial asthma, systemic lupus erythematosus, and maternal psychological stress), maternal infection (urinary tract infection, vaginitis, premature rupture of membrane and TORCH infection), maternal medications during this pregnancy (antihypertensive drugs, hypoglycemic drugs, bronchodilators, antiepileptic drugs or antibiotics) and maternal exposure to radiation, chemical or smoking. Risk factors related to the patient's included assessment of gestational age, presence of associated syndromes in the patients, and associated congenital anomaly.

Investigations

Imaging techniques included chest and upper abdominal X- ray, to assess the abdominal situs, cardiac size, predominant chamber enlargement and pulmonary vasculature, electrocardiogram to verify the heart rate, rhythm, regularity, axis deviation, specific chamber enlargement and bundle branch block, and transthoracic echocardiography for children below 3 years.

A traditional 2D, M-mode, color flow continuous wave (CW), and pulsed wave (PW), Doppler echocardiography examination was conducted using the segmental sequential approach. Views comprised subcostal view (short axis, four chamber and coronal), parasternal view (long axis and short axis), apical view (four chamber and five chamber) and suprasternal view (short axis and long axis). Echocardiography was conducted using the Vivid-7 machine (N-3190, Horton, Norway) and the Vivid E9 machine (GE Vingmed ultrasound, Horton, Norway).

The anatomy was defined in detail comprising the situs of the heart, atrio ventricular concordance, relation of the great vessels, interatrial interventricular septa, pulmonary and systemic venous drainage, shape and exclusion of the cardiac valves, cardiac chamber sizes and ventricular function. The study included the description of the aortic arch anatomy, the anatomy of the great vessels, the existence of PDA and aortopulmonary collaterals and the measurement of the pulmonary artery pressure. The cardiac lesions were categorized into CHD and acquired heart diseases. The former were further classified into cyanotic and acyanotic heart diseases while the later were subdivided into rheumatic heart disease, cardiomyopathies, arrhythmias, Kawasaki and others.

Ethical Consideration

The whole study design was approved by the institutional review Board, Faculty of Medicine, Ain-Shams University. Confidentiality was respected. Collected data were not and will not be used for any purpose other than the research. Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical Analysis

Data were entered and analyzed using IBM-SPSS software (IBM Corp. Released 2020. IBM, Version 27.0. Armonk, NY: IBM Corp). Data were expressed as number (%).

RESULTS

This study is a descriptive study that was conducted retrospectively on 407 cardiac patients who were newly attending the Pediatric Cardiology Clinic, the Children's Hospital, Ain Shams University during the 2 years study period.

Table **(1)** shows that 71.1% of patients had acyanotic congenital heart diseases, 16.7% had cyanotic congenital heart disease, 2.9% had rheumatic heart diseases, 1.7% had arrhythmia, 4.6% had cardiomyopathies, 0.9% had Kawasaki, and 1.2% had others. Seventy patients (17.1%) had VSD and it was the most common heart disease in children, followed by 13.7% had ASD, 8.7% had common AV-canal, 5% had

pulmonary stenosis, 7.4% had tetralogy of Fallot, and 7.6% had VSD and ASD.

Table (1): Heart disease classification and diagnosis of the studied patients (N=407)

	N	%
Congenital heart diseases	**360**	**88.4**
Acyanotic congenital heart diseases	292	71.7
Cyanotic congenital heart diseases	68	16.7
Acquired heart diseases	**47**	**11.5**
Cardiomyopathy	19	4.6
Arrythmias	7	1.7
Rheumatic heart disease	12	2.9
Kawasaki	4	0.9
Others	5	1.2
Diagnosis		
Ventricular septal defect	70	17.2
Atrial septal defect	56	13.8
Common AV canal	35	8.6
Tetralogy of Fallot	30	7.4
VSD and ASD	31	7.6
ASD and PDA	27	6.6
Dilated cardiomyopathies	19	4.7
Pulmonary stenosis + ASD	20	5.0
Complex heart lesion	17	4.3
PDA and VSD	17	4.1
Wolf parkinsonian white syndrome	6	1.4
Pulmonary stenosis + ASD + VSD	5	1.3
Transposition of great arteries	10	2.4
Total anomaly pulmonary venous return	4	1.0
Pericardial effusion	3	0.7
Pulmonary atresia	3	0.7
Coarctation of aorta	11	2.7
Kawasaki disease	4	1.0
PDA and ASD and tricuspid stenosis	6	1.4
VSD and mitral valve prolapse	4	1.0
Hypoplastic left heart	4	1.0
Epstein anomaly	3	0.7
PS and VSD	7	1.7
Rheumatic aortic regurge + MR	3	0.7
Rheumatic mitral regurge	9	2.2
Sinus atrial block	1	0.3
Dextrocardia	2	0.5

Table **(2)** shows that accidental discovery was the most common presentation of cardiac disease (34.1%), followed by recurrent respiratory infection (30.5%). 43.1% were belonged to consanguineous parents. Most of the children affected were single fetus (82.1%), while the twin pregnancy occurred in (17.6%). While among 86.9% of the patients, pregnancies were normal conceptions, 13.1% had assisted conception, and the most common type associated with the assisted conception was the complex heart lesion (17.1%). The positive paternal history of congenital heart diseases was commonly in patients with atrial septal defects (31.2%), ventricular septal defects (25%) and Common AV-canal defects (15.6%).

Table (2): Frequency of initial presenting complaint, consanguinity, type of pregnancy among and distribution of type of the heart diseases with positive paternal history of congenital heart diseases and its frequency the studied patients (N=360)

	N	%
Initial presenting complaint		
Recurrent respiratory infection	110	30.5
Dyspnea	9	2.5
Neonatal hypoactivity and sepsis	19	5.2
Cyanotic attacks	56	15.5
Poor suckling and failure to thrive	43	11.9
Accidental discovery	123	34.1
Consanguinity		
Positive consanguinity	155	43.1
No consanguinity	205	56.9
Type of Pregnancy		
Singelton fetus	296	82.1
Twin monoamniotic	42	11.6
Twin diamniotic	22	6.1
Method of Conception		
Normal	313	86.9
Assisted	47	13.1
Atrial septal defect	4	8.5
Dilated cardiomyopathy	3	6.3
Transposition of great arteries	6	12.7
Ventricular septal defect	8	2.2
Wolf Parkinson white	3	6.3
Tricuspid valve stenosis	3	6.3
VSD+ mitral valve regurge	3	6.3
Complex heart lesion	7	17.1
Pulmonary valve stenosis	3	6.3
Patent ductus arteriosus	3	6.3
VSD+ASD	2	5.5
PS+VSD	2	5.5
Diagnosis (N=32)		
Mitral valve prolapse	1	3.1
Pulmonary stenosis	1	3.1
Atrial septal defect	10	31.2
Common AV canal	5	15.6
Total anomaly pulmonary venous return	1	3.1
Ventricular septal defect	8	25
Pulmonary stenosis	1	3.1
Patent ductus arteriosus	3	9.3
Transposition of great arteries	2	6.2

Table **(3)** shows that common AV canal defect was commonly (27.7%) associated with positive previous maternal abortion. Most of patients born full term (89.7%), (10.2%) were born preterm and about (22.7%)

of patients had neonatal problems (19.5%) of them have sepsis like picture, (47.6%) have bronchopneumonia, (3.7%) have sepsis, (6.1%) have neonatal jaundice, (23.2%) was admitted because of prematurity.

Table (3): Distribution of gestational age and the history of neonatal problems and percentage of different types of CHD among patients with history of previous maternal abortion, (N=18, 4.9%) from the total 360 studied patients

	N	**%**
Percentage of different types of CHD among patients with history of previous maternal abortion (N=18)		
Mitral valve prolapse	1	5.5
Pulmonary hypertension	1	5.5
Common AV canal	5	27.7
Tetralogy of Fallot	2	11.1
Pericardial effusion	1	5.5
ASD and PDA	4	22.2
Complex heart lesion	1	5.5
Pulmonary stenosis and ASD and VSD	1	5.5
Transposition of great arteries	2	11.1
Gestational age		
Full term	323	89.7
Preterm	37	10.2
Neonatal problems		
No	278	77.2
Yes	**82**	**22.7**
Types of neonatal problems		
Sepsis like picture	16	19.5
Bronchopneumonia	39	47.6
Sepsis	3	3.7
Neonatal jaundice	5	6.1
Preterm	19	23.2

Table **(4)** shows that (8.6%) of patients had brothers with congenital heart disease, 0.7% had rheumatic heart diseases, and 10.7% of patients had positive CHD history in the other family members, 54.3% of patients had normal weight, 32.8% of patients had underweight, and 12.8% of patients had failure to thrive, 26% of patients had no audible murmur, and 73.9% of patients had audible murmur.

Table (4): Distribution of positive history of heart diseases in brothers and relative of the CHD and distribution of the patients weight according to Centers for Disease Control and Prevention (CDC) and patients with audible murmur studied cases (N=360)

History of brothers with heart diseases	**N**	**%**
Congenital heart diseases	31	8.6
Rheumatic heart diseases	3	0.7
No	326	90.5
History of relatives who had CHD	39	10.7
Weight of child		
Normal (50th percentile)	196	54.3
Underweight (less than the 5th percentile for age)	118	32.8
Failure to thrive (persistent weight less than the 3^{h} percentile for age)	46	12.8
Audible murmur		
Yes	266	73.9
No	94	26

Table **(5)** shows that most of the congenital heart diseases were not diagnosed in the first month (46.6%), the most common diagnosed heart diseases in the age of one month was VSD (12.4%), ASD (14.2%), tetralogy of Fallot (10.1%), common AV canal (8.5%), complex heart lesion (8.5%), and patent ductus arteriosus (7%). The most common diagnosed heart lesions during the age from first month till the age of first-year were VSD (15.2%), common AV-canal (10.9%), pulmonary stenosis (9.4%), and (5.8%) PDA and VSD. The most common diagnosed heart lesions in preschool age patients were, (50%) pulmonary stenosis, (50%), pulmonary stenosis and ASD (7.7%).

Table (5): Diagnosis of heart diseases in relation to the age of onset of its diagnosis (N=360)

	Age							
	1 month (N = 168)		**>1M – 1Y (N = 166)**		**>1Y -<5Y (N = 8)**		**5Y – 12Y (N = 18)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Diagnosis								
Mitral valve prolapse	2	1.6	5	2.9	-	-	7	38.3
Pulmonary stenosis	4	2.3	16	9.4	4	50	-	-
Left atrial isomerism	-	-	4	2.2	-	-	-	-
Pulmonary hypertension	-	-	4	2.2	-	-	-	-
Patent ductus arteriosus	14	8.3	4	2.2	-	-	-	-
Atrial septal defect	24	14.2	11	6.5	-	-	4	22.2
Transposition of great arteries	4	2.3	-	-	-	-	-	-
Ventricular septal defect	20	12.4	26	15.2	-	-	-	-
Common AV canal	14	8.5	19	10.9	-	-	-	-
Mitral stenosis	-	-	-	-	-	-	-	-
Hypoplastic left heart	-	-	2	0.7	-	-	-	-
Total anomaly pulmonary venous return	-	-	5	2.2	-	-	-	-
Pulmonary atresia	-	-	5	2.2	-	-	-	-
Tetralogy of Fallot	17	10.1	8	4.3	-	-	4	22.2
Coarctation of aorta	4	2.3	-	-	-	-	-	-
Sinus venosus	4	2.3	-	-	-	-	-	-
Dextrocardia	1	0.8	-	-	-	-	-	-
Single atrium	-	-	2	0.7	-	-	-	-
ASD and PDA	8	4.7	11	5.8	-	-	3	16.6
PDA and ASD and tricuspid stenosis	4	2.3	-	-	-	-	-	-
VSD and mitral valve prolapsed	-	-	5	2.2	-	-	-	-
Complex heart lesion	15	8.5	3	1.4	-	-	-	-
Pulmonary stenosis and ASD	12	7.0	5	2.2	4	50	-	-
TGA and VSD	4	2.3	-	-	-	-	-	-
PDA and VSD	-	-	10	5.8	-	-	-	-
VSD and ASD	7	3.9	15	8.0	-	-	-	-
PS and VSD	2	1.6	-	-	-	-	-	-
Pulmonary stenosis and ASD and VSD	5	3.1	-	-	-	-	-	-
Epstein anomaly	3	1.7	-	-	-	-	-	-
Shonn complex	-	-	3	1.4	-	-	-	-
Fenestrated intraatrial septum	-	-	3	1.4	-	-	-	-

Table **(6)** shows that the most common heart disease occurred with hypertensive mothers were PDA (58.3%), followed by mitral valve prolapse (33.3%), and pericardial effusion (8.3%), 1.9% of CHD patients had extracardiac anomalies and 57.1% had congenital inguinal hernias.

Table (6): Percentage of the (CHD) among studied patients in relation to hypertensive mothers, (N=12, 3.3%), in relation to maternal epilepsy (n=9, 2.5%) and in relation to associated extracardiac anomalies among the CHD studied cases (N=7, 1.9%) from total number 360 of studied patients

	N	**%**
Diagnosis in relation to hypertensive mothers		
Patent ductus arteriosus	7	58.3
Mitral valve prolapse	4	33.3
Pericardial effusion	1	8.3
Diagnosis in relation to maternal epilepsy		
Common AV canal	4	44.4
VSD	3	33.3
ASD	1	11.1
VSD and ASD	1	11.1
Diagnosis in relation to associated extracardiac anomalies		
Cong inguinal hernias in child	4	57.1
Associated diaphragmatic hernia	3	42.8

Table **(7)** shows that 40.3% of Down syndrome patients had common atrioventricular canal defects, 19.2% had VSD and ASD, 8.7% had PDA and VSD, 10.5% had ASD and 100% of the DiGeorge patients had VSD.

Table (7): Percentage of type of the (CHD) in the studied patients who were syndromeatic

	Associated syndromes							
	Down (N = 57)		**Duchenne myopathy (N = 3)**		**DiGeorge syndrome (N = 1)**		**No associated syndrome (N = 302)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Diagnosis								
Mitral valve prolapsed	2	3.6	-	-	-	-	9	3.9
Atrial septal defect	6	10.5	-	-	-	-	22	9.4
Ventricular septal defect	3	5.2	-	-	1	100	33	14
Common AV canal	23	40.3	-	-	-	-	3	1.3
ASD and PDA	3	5.2	-	-	-	-	13	5.5
Complex heart lesion	2	3.6	-	-	-	-	11	4.7
PDA and VSD	5	8.7	-	-	-	-	3	1.3
VSD and ASD	11	19.2	-	-	-	-	5	2.1
Pulmonary stenosis and ASD and VSD	2	3.5	-	-	-	-	2	0.9

DISCUSSION

Congenital and acquired heart diseases in children are likely to become essential contributors to child mortality in the near future, hence it is essential to detect the actual prevalence and case burden of children heart disease so that proper changes in health policies could be suggested [6]. Therefore, the aim of the present study was to determine the frequency of the heart diseases in infants and children and to estimate the possible risk factors in our community.

This study was retrospective descriptive study and was designed to describe the most common demographic features and the frequency of the patients which were diagnosed as having a heart disease and followed up at the Pediatric Cardiology Clinic, Children's Hospital, Ain-Shams University, and the data discussed here were obtained from the patients' files in the Pediatric Cardiology Clinic.

In this present study the total number of children who attended the all-specialized outpatient clinics of the Children's Hospital, Ain-Shams University in the 2 years-the period of the study- were 20056 patients, of which the total number of the heart diseases patients attended the cardiology outpatient clinic were 407 patients representing 20.3 per1000 attendants. Moreover, in this present study the number of CHD cases among the children attended the Pediatric Cardiology Outpatient clinics was 360 patients, represent 17.9 per 1000 attendants.

Kotby *et al.* [7] conducted a study that included 1732 children who attended the outpatient clinic from 1981 till 1995. Rheumatic heart disease was diagnosed in 50.5% of their cases while 49.5% had congenital heart defects and cardiomyopathy. CHD percentage among the cardiac cases is higher in the present study as compared by their study. This observation may be explained by the difference in the age of patients studied between the 2 studies.

As regarding the CHD classifications in this present study. 360 out of 407 (88.4%) were found to have CHD, and [47 (11.5%)] had acquired heart diseases. The CHD patients were subdivided into [292 (71.1%)] with acyanotic CHD, and [68 (16.7%)] with cyanotic CHD. Similar findings were reported by a previous studies done in Egypt [8]. **Kapoor and Gupta** [9] recorded that acyanotic heart diseases were present in (79%) of children, and (21%) had cyanotic heart diseases.

In this present study the most common cyanotic CHD was tetralogy of Fallot (TOF) [30 cases (7.4%)], followed by complex heart lesion [17 (4.3%)], total anomaly pulmonary venous return [4 (1%)], transposition of great arteries (TAG) [10 (2.4%)]. Similarly, **Arafa *et al.*** [10] study found that the most common cyanotic CHD was TOF [8%], followed by TGA in [4.1%], tricuspid atresia [2.5%] and pulmonary atresia [1.9%].

In this present study, the most common acyanotic CHD was VSD [70 (17.1%)], followed by ASD [56 (13.7%)], common AV canal [35 (8.7%)], VSD +ASD [31 (7.6%%)], PDA + ASD [27 (6.6%)], and pulmonary stenosis +ASD [20 (5%)].

That was similar to what **Kapoor and Gupta** [9] recorded as their results revealed that the most common acyanotic CHD was VSD (21.3%), ASD (18.9%), PDA (14.6%). **Arafa *et al.*** [10] reported also that the commonest acyanotic CHD was the VSD (30.6%) followed by VSD and PDA (11.7%), VSD+PS (5.5%),

ASD (16%), PS (9.2%), endocardial Cushing defect (8.3%), PDA (5.7%), and AS in (3.8%).

Regarding presenting symptoms, accidental discovery was the most common among patients with CHD [123 cases (34.1%)], followed by repeated respiratory infections [110 (30.5%)], poor suckling and failure to thrive [43 (11.9%)], dyspnea [9(2.5%)], neonatal hypoactivity and sepsis [19 (5.2%)]. The high figure for accidental discovery in the present study reflects negligence in routine examination and follow up of the infants as well as medical incompetence in early detection of the CHD in newborn.

El-Kholy [11] study, reported that six of the 192 admitted neonate's patients presented with central cyanosis. This difference may be due to the fact that, this present study was done on different age group in which some cyanotic heart diseases were beyond the neonatal period like tetralogy of Fallot, while the other study was done only in the neonatal age.

Audible murmur is often accompanied by CHD, and detection of a murmur depends upon the examiner's skill. In the present study audible murmur was present in 266 patients (73.9%). **Beebe *et al.*** [12] reported that cardiac murmurs were heard in (57 %) of infants with CHD.

Ainsworth *et al.* [13] studied the prevalence and clinical significance of murmurs detected on 7204 newborn babies undergoing routine examination by senior house officers. All those with murmurs underwent echocardiographic assessment, and all infants presenting later in infancy were also recognized. It was displayed that if a murmur is heard there is a (54%) chance of there being an underlying cardiac malformation.

Arafa *et al.* [10] reported that (11.5%) of cases were with failure to thrive. They attributed this to feeding difficulties and malnutrition observed in patients with CHD with HF and pulmonary hypertension. **Asghar** [14] reported that most of their patients (82%) with CHD were underweight. This difference may be due to better follow up in the outpatient clinic of Ain Shams University Hospital as well as good medical management.

Regarding the CHD in monochorionic/diamniotic twin gestations, the association between congenital anomalies and multiple gestations has been recorded. In this present study, the reported diamniotic gestation among the studied CHD cases was [42 (11.6%)], and [22 (6.1%)] for the monochorionic twin gestation.

Manning [15] and **Bahtiyar *et al.*** [16] reported that monochorionic/diamniotic (MC/DA) twins seem to be accompanied by an increased risk of CHD. This observation is of important clinical implication as the number of twin gestations appears to be steadily rising (partly because of the increased use of assisted reproductive technologies).

During normal heart development, VEGF is specifically upregulated in the atrioventricular field of the heart soon following the onset of endocardial cushion formation. Placental anomalies (such as vascular anastomosis) that are detected in MC/DA twin gestations causing TTTS may also be a manifestation of abnormal angiogenic factor regulation. In fact, greater levels of VEGF have been recorded in twin pregnancies compared to singleton pregnancies [16].

Regarding types of the CHD among mothers with previous abortion, in this present study the history of abortion was in 18 cases (4.9%), and the most common associated CHD type was the common AV canal defect (27.7%), followed by ASD+PDA (22.2%), tetralogy of Fallot (11.1%), and complex heart lesion (5.5%). **Arafa *et al.*** [10] found that the history of maternal abortion was positive in 12.5% of CHD.

The higher incidence of PDA found in the present study compared to what was detected by **Tanner *et al.*** [17] might be explained by the difference in the population studied. Moreover, our hospital is a tertiary center where critically ill children are being referred.

Regarding the type of neonatal problems that needed NICU admission among the CHD studied cases, there were 82 cases (22.7%) who needed NICU admission. Out of them, (19.5%) were admitted due to sepsis like picture but after investigation and echocardiography sepsis was excluded and the final diagnosis was left sided obstruction. Other causes of admission were bronchopneumonia (47.6%), confirmed sepsis (3.7%), jaundice (6.1%), and prematurity (23.1%).

El-Kholy [11] study on 192 neonates diagnosed with CHD admitted in the NICU of Ain Shams University Hospital, reported comparable percentages of causes of admission [Neonatal respiratory distress (8.2%), sepsis (7.2%), cyanosis (8.2%), hemorrhagic disease of newborn (1.8%), convulsions (3.6%), jaundice (52.7%) and surgical indications (13.6%)]. **Duffels *et al.*** [18] recorded pulmonary hypertension in (4.2%) among 5970 patients with CHD. VSD was the commonest underlying defect (42%).

The cardiomyopathy cases number in this present study was 19 [0.94:1000 among the total number of cases attending the outpatients' clinics and 4.6% from the total number 407 cardiac cases]. All cases were dilated cardiomyopathies.

Elmasry *et al.* [19] reviewed the files of 1876 cardiac case. There were 124 cardiomyopathic patients (6.6%) of which 108 cases (87.1%) with dilated cardiomyopathy, (9.7%) with hypertrophic cardiomyopathy, and (1.6%) with restrictive cardiomyopathy. The present study was slightly

different from **Nugent *et al.*** [20] study, they recorded an annual incidence of 1.24 per 100, 000 children. Dilated cardiomyopathy made up (58.6 %) of cases, hypertrophic cardiomyopathy (25.5 %), restrictive cardiomyopathy (2.5 %), and left ventricular noncompaction (9.2 %) of cases. The difference between the two results may be due to under-reporting, and the present results represent the number of patients who were referred to Ain Shams Hospital Outpatient Clinic and not a screening of the populations for that period.

CONCLUSION

The total number of patients studied was 407, and the CHD was detected in 88.4% (360/407) of which 71.1% (292/407) was acyanotic CHD and 16.7% (68/407) was cyanotic CHD, while the most common acquired heart diseases were cardiomyopathy 4.6% (19/407), and rheumatic heart disease 2.9% (12/407). Furthermore, 46.6% of the CHD cases (168/360) were diagnosed during the neonatal period, and 53.3% were diagnosed after the neonatal period because there was no routine echocardiography applied to neonates. Moreover, (22.7%) of the patients had neonatal problems that required NICU admission; of which (19.5%) had sepsis like picture as the provisional diagnosis but after echocardiography the diagnosis was duct dependent left sided obstruction CHD. The presence of a heart murmur was only in 73.9%, and so the absence of murmur doesn't exclude CHD.

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