

Dedication

Affectionately dedicated to my Husband& my kids

To My Parents

My Family

My Friends

My Students

To Every One

Who Helped Me To Gain Knowledge.

Acknowledgements

I am grateful to everyone who helped me in preparing this study.

I am extremely thankful to Dr. Caroline Ayad, Dr.Alsafi Ahmed,Dr.Wafa Alfaki , who

encouraged me in accepting the challenge and helped me throughout the period

of study and practical.

Appreciation must be record to

Dr.Mohammed Algamdi (King Fahad Cardiac Center - Pediatric Cardiology Unit , King

Khalid University Hospital -King Saud University-Riyadh-KSA), for his

help, advice, guidance, patience, and generosity encouragement.

TABLE OF CONTENTS

Topic	Page number
Dedication	I
Acknowledgements	II
English Abstract	III
Arabic Abstract	V
Abbreviations	VI
List of abbreviation	VII
List of figures	VIII
List of tables	X
Chapter One	
Introduction	
1.1 Introduction	2
1.2 Problem of the study	4
1.3 Objectives of the study	4
1.4 Significance of the study	5
1.5 Overview of study	5
Chapter Two	
Literature Review	
Theoretical background	6
2.1 Normal Anatomy of the Heart	7
2.2 Position Of The Heart	9
2.3 External Topography of the Heart	12
2.4 Atria	13
2.5 Atrioventricular	16
2.6 Ventricles	20
2.7 Blood Supply of the Heart	22
2.8 The Cardiovascular System Physiology	27
2.9 General principles of anatomy and pathophysiology	29
2.12 Acyanotic Congenital Cardiac Malformations	32
2.13 Ventricular Septal Defect (VSD)	35

2.14 Atrial Septal Defect (ASD)	44
2.15 Atrio-Ventricular Septal Defect (AVSD)	48
2.16 Patent Ductus Arteriosus (PDA)	57
2.17 Obstructive & Valvar & Regurgitant lesions	60
2.18 Aortic Stenosis (AS)	64
2.19 Pulmonary Stenosis (PS)	69
2.20 Coarctation of Aorta (CoA)	71
2.21 Obstructive lesions of mitral valve	75
2.22 Regurgitant lesions of mitral valve	76
2.23 Sonographic Evaluation of the Heart (Echocardiography)	79
2.24 Transthoracic Echocardiography (TTE)	81
2.25 Anatomic Sequential Segmental Approach	82
2.26 Echocardiography Technique	84
2.27 Previous studies	100
Chapter Three	
Material & Methodology	
Material & Method	103
Chapter Four	
Results	
Results & Analysis	109
Chapter Five	
Discussion, Conclusions and Recommendations	
Discussion	153
Conclusion	160
Recommendations	162
References	163
Appendix(A) Data Collection Sheet of the	172
Appendix(B) Echocardiographic Images	175

Abstract

Congenital cardiac malformations are a major health concern in newborns and children and a common cause of perinatal morbidity and mortality. The prevalence varies around the world. Congenital cardiac malformations are the cause of death in 1% of life births. Knowledge of it is the epidemiology is the basis on which researches will help to explore the causes of cardiac defects. Studies on the epidemiology of congenital heart disease in Saudi Arabia are scarce.

This a quantitative comparative and descriptive study. aims to assess the prevalence and incidence, symptoms, and gender distribution of Saudi Pediatrics Acyanotic Congenital Cardiac Malformations using Echocardiography.

Present study was a cross sectional, prospective retrospective study conducted at King Fahad Cardiac Center- Pediatric Cardiology Unit- King Khalid University Hospital A tertiary, Referral care Hospital in the region. -KSU-Riyadh –KSA, from October 2010- June 2014. The target population of the present study were, all neonates, infants and older children, of either sex, who had clinical suspicion of cardiac problem, enrolled consecutively as they attended the clinic for echocardiography to confirm their diagnosis. Demographical data, presenting symptoms, gender distribution and frequency of defects were evaluated. Data analysis was performed using SPSS (version 21, Chicago, IL).

A total of 356 children were included. The data from these patients were evaluated regarding sex distribution, age and relative frequency of different congenital heart defects. There were 149 males (43.2%) and 195 females (56.5%). The age ranged from one month to 15 years. In the present study the most common lesion was Patent Ductus Arteriosus (PDA) which present in 175(49.7%) patients, followed by atrial septal defect (ASD) was present in 162(45.6%) patients, then Ventricular septal defect (VSD) was present in 114(32%) patients. In the present study pulmonary stenosis (PS) was detected in 40(11.2%) patients, while pulmonary regurgitation in 12(3.4%) patients. There were 9(2.5%) cases of Valvar Aortic stenosis (AS) and 11(3.1%) Coarctation of aorta (CoA). Tricuspid regurgitation (TR) was present in 129(36.2%). Mitral regurgitation (MR) was present in 49(13.8%) cases. There was female predominance in the heart lesions. However, complex heart defects and mixed cardiac lesions like VSD with Right ventricular outflow tract obstruction and VSD with ASD were more common in females. Most of patients were asymptomatic 63.3 %, while heart murmur detected in 36.4 %, and 0.6% had recurrent chest infections, 12.1% patients had Symptoms that indicate the presence of congestive heart failure (CHF) e.g.(fatigue 9.8%, Tachypnea 7%).

In conclusion the incidence of acyanotic congenital cardiac malformations is high among Saudi children Careful evaluation and early diagnosis in high-risk group are highly indicated. As advanced tools of diagnosis have come up. There is a need for development of prenatal screening programs for congenital cardiac malformations in our population so as to provide better medical care and improved outcome in the region.

Key Words: Congenital heart disease, Saudi Arabia, Ventricular septal defect, Patent Ductus Arteriosus, Atrial septal defect.

ملخص الدراسة

تعتبر التشوهات الخلقية في القلب مصدر رئيسي للقلق الصحي، وسبب شائع للإعتلال والوفيات في فترة ما حول الولادة. معدل الانتشار يختلف في جميع أنحاء العالم وهي سبب في وفاة ١% من المواليد. الأبحاث والدراسات هي التي تساعد على معرفة وإستكشاف العيوب الخلقية في القلب وتوضيح مدى انتشار الحالات الويائية وأسباب حدوثها والتي تعتبر شحيحة في المملكة العربية السعودية.

تم تصميمها كدراسة وصفية كمية مقارنة، وتهدف هذه الدراسة لتقييم مدى إنتشار وحدث التشوهات الخلقية اللازراقية في القلب لدي الأطفال السعوديين بواسطة الموجات فوق الصوتية ومعرفة الأعراض المصاحبة لها، ومعدل الإصابة خلال الجنسين.

كانت هذه الدراسة المقطعية العرضية عبارة عن دراسة إستيعادية ومستقبلية تم إجراؤها بمركز الملك فهد لأمراض القلب- وحدة الأطفال- مستشفى الملك خالد الجامعي - جامعة الملك سعود- الرياض - المملكة العربية السعودية. في الفترة من أكتوبر ٢٠١٠ وحتى يونيو ٢٠١٤. الفئة المستهدفة لهذه الدراسة تشمل جميع حديثي الولادة، الرضع، والأطفال الأكبر سنا من كلا الجنسين، الذين كان يشتبه سريريا في وجود مشكلة خلقية بالقلب لديهم، وتم تسجيلهم لإجراء فحص الموجات الصوتية للقلب لتأكيد التشخيص وتحديد نوعه. وأيضا تم تقييم البيانات الديموغرافية، والأعراض المصاحبة لها، والتوزيع بين الجنسين ونسبة تكرار جميع أنواع التشوهات الخلقية اللازراقية في القلب. تم إجواء تحليل البيانات بإستخدام SPSS (الإصدار ٢١، شيكاغو II).

تم إدراج مجموعة من ٣٥٦ طفلا مصابين بمختلف أنواع التشوهات الخلقية اللازراقية في القلب، حيث تم تقييم البيانات لهؤلاء المرضى بشأن توزيع الجنس والعمر والتكرار النسبي لجميع التشوهات. كان هنالك ١٤٩ (٤٣.٢%) من الذكور و ١٩٥ (٥٦.٥%) من الإناث تراوحت أعمارهم من ١ يوم وحتى ١٥ عاما. ووجد أن وجود القناة الشريانية السالكة (PDA) ذات أعلى تكرار حيث تم رصدها في ١٧٥ (٤٩.٧%) من المرضى، يليها عيب الحاجز الأذيني (ASD) ١٦٢ (٤٥.٦%) مريض، ثم عيب الحاجز البطيني (VSD) في ١١٤ (٣٢%) مريض، وتم رصد التضيق الرئوي في ٤٠ (١١.٢%) مريض و القلس الرئوي في ١٢ (٣.٤%) من المرضى، كانت هنالك ٩ (٢.٥%) حالات تضيق في الصمام الأورطي (AS)، و ١١ (٣.١%) حالات تضيق في الشريان الأورطي، وكان ١٢٩ (٣٦.٢%) حالات قلس الصمام الثلاثي الشرف (TR)، وأيضا كانت هنالك ٤٩ (١٣.٨%) حالات قلس الصمام التاجي (MR). ونسبة إنتشار التشوهات الخلقية اللازراقية في القلب والحالات المعقدة والمختلطة أكبر لدي الإناث. وكان معظم المرضى (٦٣.٣%) ليس لديهم أي أعراض، يليه وجود همهمة بالقلب في (٣٦.٤%) مريض، و يليه (١٢.١%) من المرضى لديهم أعراض تشير إلي وجود فشل بالقلب وهي كالتالي الشعور بالإرهاق والإعياء (٩.٨%) وتسارع في التنفس لدي ٧% من المرضى.

أظهرت نتائج هذه الدراسة أن حدوث تشوهات القلب الخلقية اللازراقية ذو إنتشار واسع بين الأطفال السعوديين. ويجب تقييم الحالات ذات نسبة الخطورة العالية بدقة أكثر. وهنالك حاجة ماسة لتطوير برامج فحص قلب الأجنة بالموجات فوق الصوتية ما قبل الولادة. على أن يؤدي إلى المساعدة على توفير الرعاية الصحية اللازمة وتحسين المخرجات.

LIST OF FREQUENTLY USED ABBREVIATIONS

Abbreviation	Full Name
AR	aortic regurgitation
AS	aortic stenosis
ASA	atrial septal aneurysm
ASD	atrial septal defect
AV	atrioventricular
BP	blood pressure
BVH	biventricular hypertrophy
CHD	congenital heart disease (or defect)
CHF	congestive heart failure
COA	coarctation of the aorta
DORV	double outlet right ventricle
ECD	endocardial cushion defect
ECG	electrocardiograph or electrocardiographic
echo	echocardiography or echocardiographic
EF	ejection fraction
IVC	inferior vena cava
LA	left atrium or left atrial
LAH	left atrial hypertrophy
LPA	left pulmonary artery
LV	left ventricle or ventricular
LVH	left ventricular hypertrophy
LVOT	left ventricular outflow tract
MPA	main pulmonary artery
MR	mitral regurgitation
MVP	mitral valve prolapse

PA	pulmonary artery or arterial
PDA	patent ductus arteriosus
PFO	patent foramen ovale
PPHN	persistent pulmonary hypertension of newborn
PR	pulmonary regurgitation
PS	pulmonary stenosis
PVR	pulmonary vascular resistance
RA	right atrium or atrial
RAH	right atrial hypertrophy
RPA	right pulmonary artery
RV	right ventricle or ventricular
RVH	right ventricular hypertrophy
RVOT	right ventricular outflow tract
S1	first heart sound
S2	second heart sound
S3	third heart sound
S4	fourth heart sound
SEM	systolic ejection murmur
SVC	superior vena cava
SVT	supraventricular tachycardia
TR	tricuspid regurgitation
VSD	ventricular septal defect
DS	Down Syndrome

LIST OF FIGURES

Figure	Title	PP
Figure 2-1	Mediastinum	8
Figure 2-2	A Normal Heart Superimposed On The Frontal Chest Radiograph	10
Figure2-3	Arrangement Of The Cardiac Silhouette As Seen In Frontal Projection	11
Figure 2-4	Structures Of The Heart	15
Figure 2-5	The Positions Of The Valves	18
Figure 2-6	Anatomic Features Of Atria, Atrioventricular Valves, And Ventricles	19
Figure 2-7	Dissection Of The Short Axis Of The Heart, Shown From Its Atrial Aspect	23
Figure 2-8	The Aortic Sinuses	24
Figure 2-9	Coronary Veins	26
Figure 2-10	A Cyanotic Congenital Cardiac Malformations	32
Figure 2-12	Ventricular Septal Defect	35
Figure 2-13	Identify The Number, Size, And Exact Location Of The Defect	37
Figure 2-14	Echocardiographic Profile In Ventricular Septal Defect	39
Figure 2-15	VSD Jet Visualized By Colour Flow Mapping	40
Figure 2-16	Moderate Sized Ventricular Septal Defect In Peri-Membranous Location	42
Figure 2-17	LV – RA Shunt In Perimembranous VSD	43
Figure 2-18	Common Anatomic Types Of Atrial Septal Defects (ASDs)	46
Figure 2-19	Subcostal Paracoronal Sections Showing A Superior Sinus Venosus Defect	47
Figure 2-20	AVSD Summary	49
Figure 2-21	Embryologic Development Of The Atrioventricular Canal Region	51
Figure 2-22	Atrioventricular Septum In The Normal Heart (Four-Chamber View)	54
Figure 2-23	Transitional AVSD.	55

Figure 2-24	Elongate LVOT Has Been Described As A Goose Neck	56
Figure 2-25	Complete AVSD: Apical Four-Chamber Images In Systole	56
Figure 2-26	Patent Ductus Arteriosus	57
Figure 2-27	A Large Vertically Oriented Patent Ductus Ateriosus.	58
Figure 2-28	Secondary Changes Are Seen In Aortic Valve And Pulmonary Valve Stenosis	61
Figure 2-29	Supravalvular Aortic Stenosis	63
Figure 2-30	Representation Of Isolated Coarctation Of The Aorta (CoA).	72
Figure 2-31	Aortic Arch, 2D.	74
Figure 2-32	The Heart As A Segmented Structure	83
Figure 2-33	Long-Axis Planes That Cut Through Two Chambers Of The Heart	85
Figure 2-34	The Location Of The Echocardiographic Windows	86
Figure 2-35	Probe Position	86
Figure 2-36	Parasternal Long-Axis View (PLAX)	87
Figure 2-37	Parasternal Long-Axis Transducer Position	88
Figure 2-38	Image Of Right Parasternal Short-Axis View	89
Figure 2-39	Parasternal Short-Axis Views	90
Figure 2-40	Apical 4-Chamber View (AP4CH)	91
Figure 2-41	Apical 4-Chamber View (AP4CH)	92
Figure 2-42	Two-Dimensional Echo Views At Apical Position	93
Figure 2-43	Subxiphoid View Probe Position	94
Figure 2-44	Serial Images Of Subxiphoid Long-Axis Sweep;	95
Figure 2-45	Serial Images Of Apical Four Chamber Sweep	97
Figure 2-46	Image Of Suprasternal Notch Aortic Arch View.	98
Figure 2-47	Serial images of suprasternal notch short axis sweep	99
Figure 3-1	Philips IE33x Matrix Echocardiography System	105
Figure 4-1	Patient Gender	111
Figure 4-2	Patients Body Types	112
Figure 4-3	Patients Symptoms	113

Figure 4-4	Patient's Symptoms Indicates Congestive Heart Failure (CHF)	114
Figure 4-5	Right Atrium (RA) Size	115
Figure 4-6	left atrium (LA) size	116
Figure 4-7	Atrial Septum	117
Figure 4-8	atrial septal defect(ASD) size	118
Figure 4-9	atrial septal defect(ASD) Types	119
Figure 4-10	tricuspid valve (TV)	121
Figure 4-11	tricuspid valve Regurgitation (TR)	122
Figure 4-12	Mitral valve (MV)	123
Figure 4-13	Mitral valve Regurgitation (MR)	125
Figure 4-14	Right ventricle (RV) cavity size	126
Figure 4-15	Increased RV cavity size	127
Figure 4-16	Right ventricular outflow tract (RVOT) obstruction	128
Figure 4-17	Right ventricular systolic pressure (RVSP)	129
Figure 4-18	Left Ventricle (LV) cavity size	130
Figure 4-19	Left Ventricle (LV) cavity size	131
Figure 4-20	Increased LV cavity size	132
Figure 4-21	Interventricular septum(IVS)	133
Figure 4-22	Ventricular Septal Defect (VSD) size	134
Figure 4-23	ventricular septal defect (VSD) Types	135
Figure 4-24	ventricular septal defect (VSD) shunt jet direction	136
Figure 4-25	ventricular septal defect (VSD) pressure gradient	137
Figure 4-26	Pulmonary valve	138
Figure 4-27	Pulmonary Stenosis (PS) types	139
Figure 4-28	Pulmonary Stenosis (PS) Degree	140
Figure 4-29	Pulmonary valve regurgitation	141
Figure 4-30	Aortic valve	142
Figure 4-31	Abnormal Aortic valve	143
Figure 4-32	Aortic valve Regurgitation	144
Figure 4-33	Sub-Aortic stenosis/membrane	146
Figure 4-34	Aortic Arch in the present study	147
Figure 4-35	Pulmonary Artery Branches	148
Figure 4-36	Patent Ductus Arteriosus (PDA)	149
Figure 4-37	Patent Ductus Arteriosus (PDA) blood flow direction	150
Figure 4-38	Pericardial Effusion	151

Appendix B

Figure	Title	Page
Figure 5-1	parasternal long-axis view shows Normal left atrium (LA), left ventricle (LV) and aorta (AO).	175
Figure 5-2	Suprasternal notch aortic arch view show normal Aortic Arch	176
Figure 5-3	Small Muscular VSD	177
Figure 5-4	Small Secundum ASD	178
Figure 5-5	Color Doppler showing ASD secundum type	178
Figure 5-6	Apical four-chamber view demonstrating a complete AVSD	179
Figure 5-7	Large Patent Ductus Arteriosus (PDA) in 2D echocardiogram , And Clour flow (CF) doppelr confirmation	180
Figure 5-8	Left ventricle out flow obstruction (LVOT) 2D echocardiogram , Confirmation by CF doppler Aortic Stenosis(AS)	181
Figure 5-9	Pulmonary stenosis(PS)	182
Figure 5-10	COARCTATION OF AORTA (COA) in 2D echocardiogram	183
Figure 5-11	COARCTATION OF AORTA (COA) Color Flow (CF) Doppler mode confirmation	184

LIST OF TABLES

Table	Title	Page
Table 2.1	Comparison of right-sided and left-sided anatomy	29
Table 2.2	Mechanism of Decreased Systemic O2 Delivery	30
Table 4-1	Right atrium size regarding to ASD patients	121
Table 4-2	Mitral valve (MV)	125
Table 4-3	Interventricular septum (IVS)	133
Table 4-4	Aortic Stenosis(AS)	144