بسم الله الرحمن الرحيم

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Evaluation of morphology of mitral valve leaflets thickness in Sudanese using echocardiography

تقييم سمك وريقات الصمام التاجي عند السودانيين باستخدام موجات القلب

Thesis submitted for partial fulfillment for the requirement of M.Sc. in Medical Diagnostic Ultrasound Imaging

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بسم الله الرحمن الرحيم

قال تعالي في كتابة الكريم:

﴿وَمَا أُوتِيتُم مِّن الْعِلْمِ إِلاَّ قَلِيلاً﴾

الإسراء:85

صدق الله العظيم

DEDICATION

I dedicate this research…..

To my father and mother

To my husband who always support and encourage me

To my brothers and sisters

To my children

ACKNOWLEDGEMENT

My greatest and all thanks to Allah as he helped me to finish this research. He also gave me strength and good health while doing this work and patience to overcome the difficulties.

My thanks must go to Dr Al Safi Ahamed who helps me too much to arrange my thoughts words and data together.

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Abstract

Assessing the normal thickness of mitral valve leaflets is very important to help the surgeon during operation to assess the exact mechanical reason for valve insufficiency and any inflammation and thickening that change the morphology of mitral valve leaflets. The aim of this study was to evaluation of morphology of mitral valve leaflets thickness in Sudanese using echocardiography and correlates it with age, sex, leaflets motion, leaflets calcification and subvavular thickening, in order to account for the variation in respect to International Index.

It was carried out on one hundred, classified into fifty normal and fifty abnormal patients in Sudan-Khartoum-Khartoum Hospital. The study was conducted from July 2012 up to November 2013.The machines used in the study were high resolution real time scanner (Siemens acuson cv70) with a 3.5MHz convex transducer. The measurements of mitral valve leaflets thickness were done in millimeters and scanning was performed in left lateral decubitus position with the upper body slightly elevated.

The data was collected, classified and analysis of the results found that the female in this study with percentage 58% and the male was 42%, they have thickening leaflets mitral valve.

The study found that the mean and standard deviation of measurement for males and females was found to be

Normal anterior mitral valve leaflets thickness (2.3 ±.13), abnormal anterior mitral valve leaflets thickness (4.3 ± .35), normal posterior mitral valve leaflets thickness (2.5 ± .13), abnormal posterior mitral valve leaflets thickness (4.6 ± .30).

The study found that there was good relationship between normal and abnormal mitral valve leaflets thickness in Sudanese population. Also

the study found that correlation between anterior and posterior leaflets thickness. For leaflets thickening, leaflets motion, leaflets calcification, subvalvular thickening the study showed that there was direct correlation between them.

Regarding the results and comparing with other population it should be considered that the Sudanese findings are greater.

Regarding the results the researcher has come out with the following recommendations:

- The study recommended routine evaluation of mitral leaflets thickness in Sudanese population.
- The study recommended evaluates the same study in different component of mitral apparatus.
- The study recommended performs of several different measurement of mitral valve.
- The study recommended more research to be done with increased duration and sample volume for accurate results.
- Further study should be done for valvular disease with different method using Doppler echocardiography.

الملخص

تقيم سمك الصمام التاجي مهم جدا لمساعدة الجراح في معرفة سبب عدم كفاة الصمام اثناء العملية ،ايضا اي التهاب او زيادة سمك يغير من بنية وريقات الصمام التاجي.ومن اهداف هذه الدراسة تقيم سمك وريقات الصمام التاجي عند السودانين وربطها مع الجنس والعمر وحركة الوريقات وسمك الاجزاء التحت الصمام التاجي وذلك مع مراعاه الاختلاف واحترام الموشر الدولي.

اجريت هذه الدراسة على مئة من الاشخاص صنفوا على خمسين اصحاء وخمسين مصابين بسمك وريقات الصمام التاجي في مستشفي الشعب التخصصي بالخرطوم من يوليو2012 الى نوفمبر 2013،كانت الاجهزة المستخدمة في الدراسة هي جهاز موجات فوق الصوتية (Siemens acuson cv 70) ومسبار محدب بتردد3.5 ميغاهيرتز.

اخذت الدراسة مقاسات الوريقات بالمليمتر،واجريت مقاسات الوريقات اثناء الاستلقاء على الجانب الشمال مع امالة الجزء الاعلى من الصدر الى الخلف قليلا.

تم جمع البيانات وتصنيفها ثم تحليلها بواسطة برنامج التحليل الإحصائي وجدت ان النساء أكثر تعرض لسمك وريقات الصمام التاجي من الرجال حيث نسبة النساء 58% ونسبة الرجال 42%.

وجدت الدراسة ان المتوسط والانحراف المعياري لسمك وريقات الصمام التاجي الأمامي والخلفي كما يلي:

سمك الوريقة الأمامية الطبيعية (13.±2.3)، والغير طبيعية(35.±4.3)،وسمك الوريقة الخلفية الطبيعية (13.± 2.5)، والغير طبيعية (30.± 46)، وجد أن هنالك علاقة مباشرة بين السمك الطبيعي والغير طبيعي لوريقات الصمام التاجي ،وايضا وجد علاقة بين سمك الوريقة الامامية والخلفية للصمام.

أيضا كانت هناك علاقة مباشرة بين سمك وريقات الصمام التاجي وحركتها وسمك الأجزاء تحت الصمام التاجي .

باعتبار ما تحصلنا علية من نتائج يمكننا ان نعتبر بان نتائج سمك وريقات الصمام التاجي في السودانين تختلف من الامم الاخرى.

List of Abbreviations

RA	Right Atrium
CV	Coronary Venus
VVI	Valvula **V**enus Index
VSC	Valvula Sinus Coronary
RV	Right Ventricle
PA	Pulmonary Artery
TV	Tricuspid Valve
MV	Mitral Valve
VS	Ventricular Septum
LAW	Left Atrial Wall
MA	Mitral Annulus
MVL	Mitral Valve Leaflets
AL	Anterior Leaflet
PL	Posterior Leaflet
CT	Chordate Tendineae
CC	Commissural Chordate
SA	Sino trial
AV	Atrioventricular
CVD	Cardiovascular Disease
CM	Cardiomyopathy
CHF	Congestive Heart Failure
IHD	Ischemic Heart Disease
MR	Mitral Regurgitation

MS	Mitral Stenosis
MVP	Mitral Valve Prolapses
LTI	Leaflets Thickness Index
PLT	Posterior Leaflet Thickness
ALT	Anterior Leaflet Thickness

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CHAPTER ONE

Chapter one

1.1 Introduction

The mitral valve connects the left atrium and the left ventricle. The mitral valve opens during diastole to allow the blood flow from Left atrium to Left Ventricle during ventricular systole, the mitral valve closes and prevents backflow to Left atrium. The normal function of the mitral valve depends on its 6 components, which are the left a trial wall, annulus, leaflets, chordate tendineae, papillary muscles, and left ventricular.

In this study we assess the thickening mitral valve leaflets in Sudanese population using echocardiography and correlate it with age, sex, leaflets motion, leaflets calcification and subvalvular thickening. Assessing the normal thickness of mitral valve leaflets is very important to help the surgeon during operation to assess the exact mechanical reason for valve insufficiency and any inflammation and thickening that change the morphology of mitral valve leaflets.

We present data of the mitral valve that will be helpful to anatomists and surgeons in Sudanese population.

In a previous study the thickening mitral valve leaflets were measured by tow-dimensional and Doppler echocardiography on mitral valve prolapse, it showed the mitral prolapsed is defined as greater than 2mm superior displacement of mitral leaflets into left atrium during systole, with a leaflets thickness of at least 5 mm as revealed by transthoracic echocardiography.

In 1988 Wilkins GT done his study in46 patients (37 women,9 men ,mean age,36+9 years).Tow-dimensional and Doppler echocardiography were performed in all patients on the day before immediately after 3 months after valvuloplasty .the abnormal leaflets motion and leaflets thickening

were classified into grades mild, moderate (score0),and severe(score1). In conclusion, quantitative assessment of leaflets motion and leaflets thickening score by tow-dimensional echocardiography helpful in predicting early restenosis after mitral balloon valvuloplasty.

1.2 Problem of study

Echocardiography plays a major role in discussion-making of mitral leaflet, allowing for confirmation of diagnosis, quantization of structure and analysis of valve anatomy and measurement.

The earliest effect of disease on the mitral valve is the result of inflammation and thickening of leaflet tips that restrict the motion of tips while allowing free motion of the body of the leaflet. This result in a characteristic "doming" motion of mitral valve in diastole.

1.3 Objectives

1.3.1 General objectives

The main objective of this study will be to evaluation the morphology of mitral valve leaflet thickness in Sudanese population, because any inflammation and thickening of leaflet that change the morphology of mitral valve leaflet.

1.3.2 Specific objectives

- To increase knowledge of evaluation of morphology of mitral valve leaflet thickness in Sudanese population.
- To recognize the criteria for evaluation of morphology of mitral valve leaflet thickness in Sudanese population.
- To identify the score of morphology of mitral valve leaflet in Sudanese population thickness.

1.4 Importance of the study

Knowledge of normal measurements of the component parts of the valve will help the surgeon during operation to assess the exact mechanical reason for valve insufficiency

This study determine the relationship between age, sex, leaflets thickening, leaflets motion, leaflets calcification, subvalvular thickening in Sudan-Khartoum-Khartoum Education Hospital, and will give an idea for normal and abnormal mitral valve leaflets thickness measurement.

1.5 Overview of study

This study contain five chapters, chapter one deal with the introduction ,chapter two include the theoretical back ground and the previous studies ,chapter three detailed materials and method then chapter four presents the results and chapter five presents the discussion, conclusion and recommendation.

CHAPTER TWO

Chapter Two

Literature review

2.1 Anatomy of the Heart

The heart is a hollow muscular organ of a somewhat conical form; it lies between the lungs in the middle mediastinum and is enclosed in the pericardium. It is placed obliquely in the chest behind the body of the sternum and adjoining parts of the rib cartilages, and projects farther into the left than into the right half of the thoracic cavity, so that about one-third of it is situated on the right and two-thirds on the left of the median plane.(Cheichi 1956)

The heart, in the adult, measures about 12 parts and 6 cm. in thickness. Its weight, in the male, varies from 280 to 340 grams; in the female, from 230 to 280 grams. The heart continues to increase in weight and size up to an advanced period of life; this increase is more marked in men than in women.

The heart is subdivided by septa into right and left halves, and a constriction subdivides each half of the organ into two cavities, the upper cavity being called the atrium, the lower the ventricle. The heart therefore consists of four chambers, vis., right and left atria, and right and left ventricles. (Cheichi 1956)

The division of the heart into four cavities is indicated on its surface by grooves. The atria are separated from the ventricles by the coronary sulcus (auriculoventricular groove); this contains the trunks of the nutrient vessels of the heart, and is deficient in front, where it is crossed by the root of the pulmonary artery. The interatrial groove, separating the two atria, is scarcely marked on the posterior surface, while interiorly it is hidden by the pulmonary artery and aorta. The ventricles are separated by two grooves, one of which, the anterior longitudinal

sulcus, is situated on the sternocostal surface of the heart, close to its left margin, the other posterior longitudinal sulcus, on the diaphragmatic surface near the right margin; these grooves extend from the base of the ventricular portion to a notch, the incisura apices' cordis, on the acute margin of the heart just to the right of the apex. (Lam1970)

The base (basis cordis), directed upward, backward, and to the right, is separated from the fifth, sixth, seventh, and eighth thoracic vertebra by the esophagus, aorta, and thoracic duct. It is formed mainly by the left atrium, and, to a small extent, by the back part of the right atrium. Somewhat quadrilateral in form, it is in relation above with the bifurcation of the pulmonary artery, and is bounded below by the posterior part of the coronary sulcus, containing the coronary sinus. On the right it is limited by the sulcus terminals of the right atrium, and on the left by the ligament of the left vena cava and the oblique vein of the left atrium. The four pulmonary veins, two on either side, open into the left atrium, while the superior vena cava opens into the upper, and the anterior vena cava into the lower, part of the right atrium. (Cheichi 1956)

The Apex (apex cordis).The apex is directed downward, forward, and to the left, and is overlapped by the left lung and pleura: it lies behind the fifth left intercostals space, 8 to 9 cm. from the mid-sternal line, or about 4 cm. below and 2 mm. to the medial side of the left mammary papilla. (Lam1970)

The sternocostal surface is directed forward, upward, and to the left. Its lower part is convex, formed chiefly by the right ventricle and traversed near its left margin by the anterior longitudinal sulcus. Its upper part is separated from the lower by the coronary sulcus, and is formed by the atria; it presents a deep concavity, occupied by the ascending aorta and the pulmonary artery. (Lam1970)

The diaphragmatic surface directed downward and slightly backward, is formed by the ventricles, and rests upon the central tendon and a small part of the left muscular portion of the diaphragm. It is separated from the base by the posterior part of the coronary sulcus, and is traversed obliquely by the posterior longitudinal sulcus.

The right margin of the heart is long, and is formed by the right atrium above and the right ventricle below. The trial portion is rounded and almost vertical; it is situated behind the third, fourth, and fifth right costal cartilages about 1.25 cm. from the margin of the sternum. The ventricular portion, thin and sharp, is named the acute margin; it is nearly horizontal, and extends from the sternal end of the sixth right costal cartilage to the apex of the heart. (Lam1970)

The left or obtuse margin is shorter, full, and rounded: it is formed mainly by the left ventricle, but to a slight extent, above, by the left atrium. It extends from a point in the second left intercostals space, about 2.5 mm. from the sternal margin, obliquely downward, with a convexity to the left, to the apex of the heart.

Right Atrium (atrium dextrum; right auricle). The right atrium is larger than the left, but its walls are somewhat thinner, measuring about 2 mm; its cavity is capable of containing about 57 cc. It consists of two parts: a principal cavity, or sinus venarum, situated posteriorly, and an anterior, smaller portion, the auricula.

The superior vena cava returns the blood from the upper half of the body, and opens into the upper and back part of the atrium, the direction of its orifice being downward and forward. Its opening has no valve.

The inferior vena cava, larger than the superior, returns the blood from the lower half of the body, and opens into the lowest part of the atrium, near the a trial septum, its orifice being directed upward and backward, and guarded by a rudimentary valve, the valve of the inferior

vena cava (Eustachian valve). The blood entering the atrium through the superior vena cava is directed downward and forward, *i.e.,* toward the atrioventricular orifice, while that entering through the inferior vena cava is directed upward and backward, toward the a trial septum. This is the normal direction of the two currents in fetal life. (Lam1970)

The coronary sinus opens into the atrium, between the orifice of the inferior vena cava and the atrioventricular opening. It returns blood from the substance of the heart and is protected by a semicircular valve, the valve of the coronary *sinus* (valve of Thebes us*)*

The foramina venarum minima rum (foramina Thebesii) are the orifices of minute veins (venœ cordis minima), which return blood directly from the muscular substance of the heart.

The atrioventricular opening (tricuspid orifice) is the large oval aperture of communication between the atrium and the ventricle; it will be described with the right ventricle.

The valve of the inferior vena cava (valvula vena cava inferiors [Eustachii]; Eustachian valve) is situated in front of the orifice of the inferior vena cava. It is semilunar in form, its convex margin being attached to the anterior margin of the orifice; its concave margin, which is free, ends in two cornua, of which the left is continuous with the anterior edge of the limbus fossa ovalis while the right is lost on the wall of the atrium. The valve is formed by a duplicator of the lining membrane of the atrium, containing a few muscular fibers. In the fetus this valve is of large size, and serves to direct the blood from the inferior vena cava, through the foramen oval, into the left atrium. In the adult it occasionally persists, and may assist in preventing the reflux of blood into the inferior vena cava; more commonly it is small, and may present a cribriform or filamentous appearance; sometimes it is altogether wanting. (Lam1970)

The valve of the coronary sinus (valvula sinus coronarii [Thebesii]; Thebesian valve) is a semicircular fold of the lining membrane of the atrium, at the orifice of the coronary sinus. It prevents the regurgitation of blood into the sinus during the contraction of the atrium. This valve may be double or it may be cribriform.

Right Ventricle (ventriculus Dexter). The right ventricle is triangular in form, and extends from the right atrium to near the apex of the heart. Its anterosuperior surface is rounded and convex, and forms the larger part of the sternocostal surface of the heart. It is under surface is flattened, rests upon the diaphragm, and forms a small part of the section of the cavity presents a semilunar outline.

The right atrioventricular orifice is the large oval aperture of communication between the right atrium and ventricle. Situated at the base of the ventricle, it measures about 4 cm. in diameter and is surrounded by a fibrous ring, covered by the lining membrane of the heart; it is considerably larger than the corresponding aperture on the left side, being sufficient to admit the ends of four fingers. It is guarded by the tricuspid valve. (Lam1970)

The opening of the pulmonary artery is circular in form, and situated at the summit of the conus arteriosus, close to the ventricular septum. It is placed above and to the left of the atrioventricular opening, and is guarded by the pulmonary semilunar valves. (Lam1970)

The tricuspid valve (valvula tricuspidalis. consists of three somewhat triangular cusps or segments. The largest cusp is interposed between the atrioventricular orifice and the conus arteriosus and is termed the anterior or infundibular cusp. A second, the posterior or marginal cusp, is in relation to the right margin of the ventricle, and a third,

Left Atrium (atrium sinistum; left auricle).The left atrium is rather smaller than the right, but its walls are thicker, measuring about 3 mm; it consists, like the right, of two parts, a principal cavity and an auricular. (Lam1970)

The bicuspid or mitral valve (valvula bicuspidalis [metralis} is attached to the circumference of the left atrioventricular orifice in the same way that the tricuspid valve is on the opposite side.

The aortic semi lunar valves are three in number, and surround the orifice of the aorta; two are anterior (right and left) and one posterior. They are similar in structure, and in their mode of attachment, to the pulmonary semilunar valves, but are larger, thicker, and stronger; the lunula are more distinct, and the noduli or corpora Arantii thicker and more prominent. Opposite the valves the aorta presents slight dilatations, the aortic sinuses (sinuses of Valsalva), which are larger than those at the origin of the pulmonary artery. (Lam1970)

Ventricular Septum (septum ventriculorum; interventricular septum). The ventricular septum is directed obliquely backward and to the right, and is curved with the convexity toward the right ventricle: its margins correspond with the anterior and posterior longitudinal sulci aortic vestibule from the lower part of the right atrium and upper. (Lam1970)

2.1.2 Histology of the Heart

The heart consists of muscular fibers, and of fibrous rings which serve for their attachment. It is covered by the visceral layer of the serous pericardium (pericardium), and lined by the endocardium. Between these two membranes is the muscular wall or myocardium. (Lam1970)

2.1.3 Physiology

- The tricuspid valve regulates blood flow between the right atrium and right ventricle.
- The pulmonary valve controls blood flow from the right ventricle into the pulmonary arteries, which carry blood to lungs to pick up oxygen.
- The mitral valve lets oxygen-rich blood from your lungs pass from the left atrium into the left ventricle.
- The aortic valve opens the way for oxygen-rich blood to pass from the left ventricle into the aorta, your body's largest artery, where it is delivered to the rest of the body.(Perloff1972)

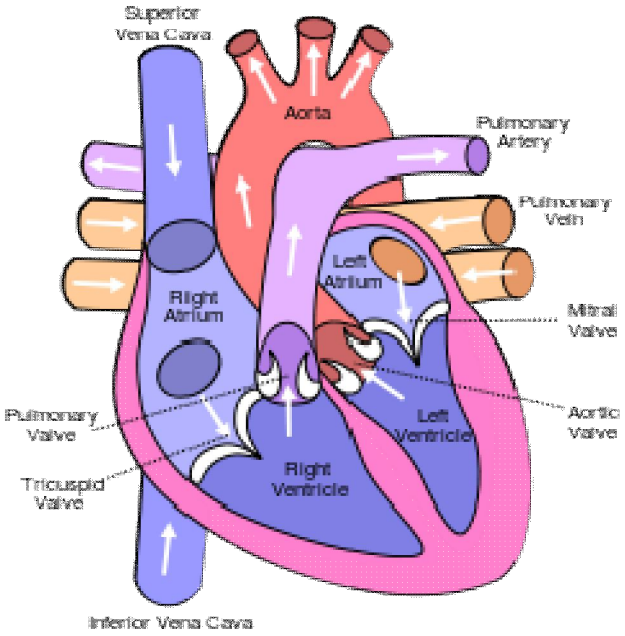


Figure 2.1 blood flows into valves of heart (www.echincontxt.com)

An electrical impulse from the heart muscle (the myocardium) cause is heart to beat (contract). This electrical signal begins in the sinoatrial (SA) node, located at the top of the right atrium. The SA node is sometimes called the heart's "natural pacemaker." When an electrical impulse is released from this natural pacemaker, it causes the atria to

contract. The signal then passes through the atrioventricular (AV) node. The AV node checks the signal and sends it through the muscle fibers of the ventricles, causing them to contract. .(Perloff1972)

The SA node sends electrical impulses at a certain rate, but heart rate may still change depending on physical demands, stress, or hormonal factors.

A heartbeat is a two-part pumping action that takes about a second. As blood collects in the upper chambers (the right and left atria), the heart's natural pacemaker (the SA node) sends out an electrical signal that causes the atria to contract. This contraction pushes blood through the tricuspid and mitral valves into the resting lower chambers (the right and left ventricles). This part of the two-part pumping phase (the longer of the two) is called diastole. . (Perloff1972)

The second part of the pumping phase begins when the ventricles are full of blood. The electrical signals from the SA node travel along a pathway of cells to the ventricles, causing them to contract. This is called systole. As the tricuspid and mitral valves shut tight to prevent a back flow of blood, the pulmonary and aortic valves are pushed open. While blood is pushed from the right ventricle into the lungs to pick up oxygen, oxygen-rich blood flows from the left ventricle to the heart and other parts of the body. . (Perloff1972)

After blood moves into the pulmonary artery and the aorta, the ventricles relax, and the pulmonary and aortic valves close. The lower pressure in the ventricles causes the tricuspid and mitral valves to open, and the cycle begins again. This series of contractions is repeated over and over again, increasing during times of exertion and decreasing while you are at rest.

The heart normally beats about 60 to 80 times a minute when you are at rest, but this can vary. As you get older, your resting heart rate rises. Also, it is usually lower in people who are physically fit.

The heart does not work alone, though. The brain tracks the conditions around you climate, stress, and level of physical activity and adjusts is cardiovascular system to meet those needs. (Lam1970)

Cardiac cycle:

At the start of diastole, the mitral valve opens widely, and blood flows swiftly from the left atrium into the left ventricle ,which expand .The aortic valve is closed .At mid-diastole ,the pressure is equalized between the atrium and ventricle .There is little or no atrioventricular blood flow ,and the mitral valve is in an intermediate position. At the end of diastole, a trial contraction again causes rapid blood flow into the ventricle, and the mitral valve is widely open. At the start of systole, contraction of ventricle causes the mitral valve closed. The aortic valve remains closed during is volumetric contraction until the pressure in the left ventricle reaches the aortic level, as the aortic valve opens, the ejection phase begins and the ventricle becomes smaller. At the end of the ejection phase, the aortic valve closed and the left ventricle reaches its smallest volume during the cardiac cycle. The mitral valve remains closed until the end of is volumetric relaxation. (Perloff1972)

2.1.4 Pathology

1. Cardiovascular Disease

Category of cardiac pathology is a leading cause of death, and it includes a wide range of conditions that affect the structure or function of the heart. Congenital heart defects impair the action of the heart from

birth and even before birth during fetal development. The impairments concern the interior heart walls, the heart valves or the vascular system of the heart. Coronary artery disease (CAD) results from the narrowing of the arteries that supply the heart muscle due to a buildup of plaque. The condition, atherosclerosis, can cause the heart to become starved due to lack of oxygen and other nutrients, often leading to a heart attack. (Perloff1972)

2. Cardiomyopathy

Diseases characterized by abnormalities in the myocardium are cardiac dysfunctions called cardiomyopathies, another type of cardiac pathology. Often these conditions appear as a weakening or a change in heart muscle structure associated with inadequate heart pumping or other related problems. A myocardial infarction (MI) is a heart attack caused by either a partially or completely blocked coronary artery. The coronary artery carries oxygenated blood to the heart muscle itself. If the flow stops or drastically slows down, the heart suffers damage, and part of the muscle may die. This type of heart attack causes many deaths from severe stenosis, thrombotic occlusion or blockage of a major coronary vessel. (Perloff1972)

3. Congestive Heart Failure

CHF describes a condition of cardiac pathology resulting when the heart pumps inefficiently, causing blood to back up into the lungs and other areas of the body. The heart cannot supply sufficient blood flow to various parts of the body. The fluid overload increases the workload on the heart. This heart failure causes shortness of breath, coughing and ankle swelling. This potentially deadly condition progressively gets worse with time, as the patient's condition deteriorates, although it is possible to survive many years with the disease. . (Perloff1972)

4. Ischemic Heart Disease

IHD or myocardial ischemia is a cardiac pathology regarded as a cardiac myopathy. This condition results from reduced blood supply to the heart muscle, and its risk increases with the age of the patient and is also associated with smoking, high cholesterol levels, diabetes and hypertension or high blood pressure. Generally, more men develop the disease than women. The first symptoms appear with chest pain or angina. In most Western countries, IHD causes the majority of hospital admissions as well as deaths. .(Perloff1972)

2.2 Anatomy of the mitral valve

The mitral apparatus is composed of the left atrial wall, annulus, leaflets, chordae tendinae, papillary muscles, and left ventricular wall. The valve is located obliquely behind the aortic valve.(Perloff1972)

Figure 1: Components of Mitral Valve Apparatus

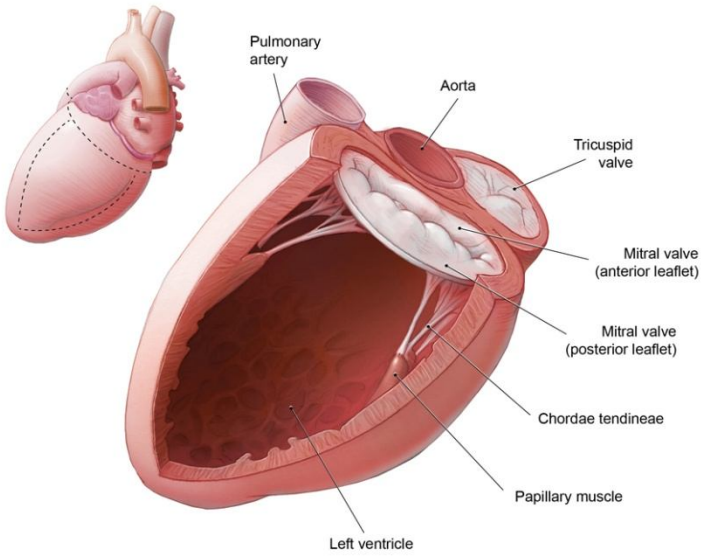


Figure 2.2 components of mitral valve apparatus (www.echobweb.com)

Left atrial Wall

The left a trial myocardium extends over the proximal portion of the posterior leaflet. Thus, left a trial enlargement can result in mitral regurgitation by affecting the posterior leaflet. The anterior leaflet is unaffected due to its attachment to the root of the aorta.[1](Perloff1972)

Mitral Annulus

The mitral annulus is a fibrous ring that connects with the leaflets. It is not a continuous ring around the mitral orifice and appears to be more D-shaped than the circular shape of prosthetic valves,

The straight border of the annulus is posterior to the aortic valve. The aortic valve is located between the ventricular septum and the mitral valve. The annulus functions as a sphincter that contracts and reduces the surface area of the valve during systole to ensure complete closure of the leaflets. Thus, annular dilatation of mitral valve causes poor leaflet apposition, which results in mitral regurgitation (Perloff1972)

Mitral Valve Leaflets

Harkens has described the mitral valve as a continuous veil inserted around the circumference of the mitral orifice the free edges of the leaflets have several indentations. Two of these indentations, which are the anterolateral and posteromedial commissures, divide the leaflets to anterior and posterior leaflets, respectively. These commissaries can be accurately identified by the insertion of the commissural chordate tendineae to the leaflets,(Harkens1952)

Anterior leaflet

The anterior leaflet is located posterior to the aortic root and is also anchored to the aortic root, unlike the posterior leaflet. Accordingly, it is also known as the aortic, septal, greater, or anteromedial leaflet. It is large and semicircular in shape. It has a free edge with few or no indentations.

The two zones on the anterior leaflets are rough and clear zones, according to the choral tendineae insertion. The two zones are separated by a prominent ridge on the trial surface of the leaflet, which is the line of the leaflet closure. The prominent ridge is located approximately 1 cm from the free edge of the anterior leaflet.

Distal to the ridge is a rough zone that has a crescentic shape. During systole or mitral valve closure, the rough zone of the anterior leaflet will oppose to the rough zone of the posterior leaflet. The rough zone is thick and has chorale insertions on the ventricular surface. Therefore, it appears to be opaque on transillumination. Conversely, the clear zone is defined as clear on transillumination and has no choral tendineae insertion. It is located between the rough zone and annulus.(Cheichi1956)

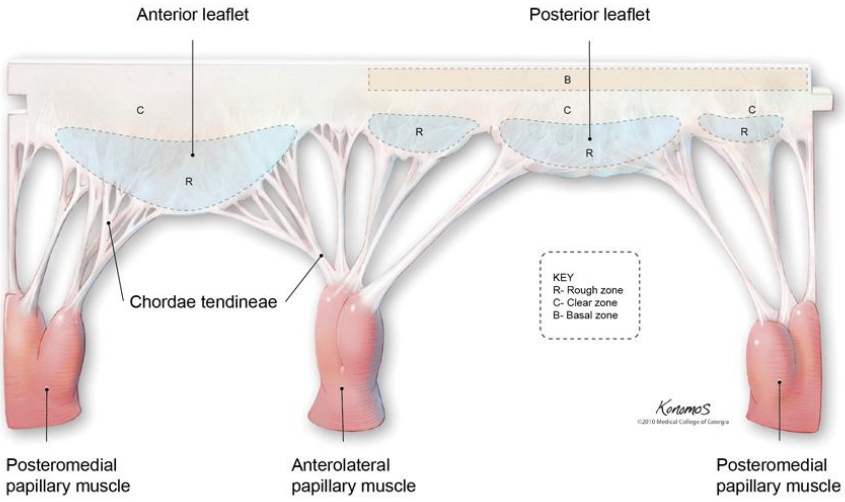
Posterior leaflet

The posterior leaflet has also been known as the ventricular leaflet, mural leaflet, smaller leaflet, or the posterolateral leaflet. The posterior leaflet is the section of the mitral valve that is located posterior to the 2 commissural areas. It has a wider attachment to the annulus than the anterior leaflet. It is divided into 3 scallops by 2 indentations or clefts. The middle scallop is the largest compared with the other 2, which are anterolateral and posteromedial commissural scallops. Three zones exist on the posterior leaflets, the rough, clear, and basal zones, according to choral tendineae insertion.

The rough zone is defined in the anterior leaflet. It is distal to the ridge of the line of the leaflet closure. It is broadest at the distal part of scallops and tapers toward the clefts or indentations between the scallops. As is true with the anterior leaflet, the clear zone of the posterior leaflet is clear on transillumination and has no chordae tendineae insertion. It is

located in the middle part of the posterior leaflet and between the rough zone and the basal zone. The basal zone is located between the clear zone and the mitral valve annulus and has the insertion of basal chordate tendineae. This zone is only seen in the posterior leaflet and is best visualized on the middle scallop. This is due to fact that most of basal chordae insert into this scallop. .(Cheichi1956)

Figure 3: Components of Mitral Valve Leaflets



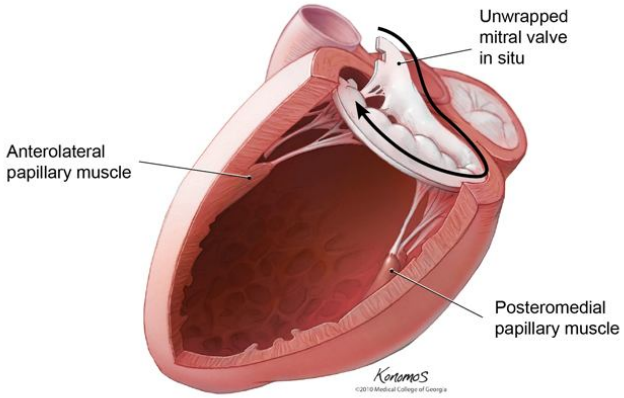


Figure 2.3 Components of mitral valve leaflets (www.echobyweb.com)

Chordate Tendineae

The chordate tendineae are small fibrous strings that originate from the apical portion of the papillary muscles, or directly from the ventricular wall, and insert into the valve leaflets or the muscle. These are called true chordate tendineae and false chordate tendineae, respectively. This article will discuss only true chordate tendineae. (Lam1970)

Commissural chordate

Commissural chordate is the chordate that insert into the interleaf let or commissural areas, which are the junction of the anterior and posterior leaflets. Two types of commissural chordate exist. Posteromedial commissural chordate insert into the posteromedial commissural area. Anterolateral commissural chordate insert into the anterolateral commissural area. Most of the main stems of the commissural chordate point toward the center of the commissural areas. .(Lam1970)

Leaflet chordate

The leaflet chordates are the chordate that insert into the anterior or posterior leaflets. Two types of the chordate tendineae are connected to the anterior leaflet. The first is rough zone chordate, which insert into the distal portion of the anterior leaflet known as the rough zone. The second is strut chordate, which are the chordate that branch before inserting into the anterior leaflet.

The posterior leaflet has 3 types of chordate tendineae. The first are the rough zone chordate, which are the same as the rough zone chordate of the anterior leaflet. Basal chordate are very unique to the posterior leaflet, and insert into the basal zone of the posterior leaflet, which is located between the clear zone and the mitral valve annulus. The posterior leaflet

does not have strut chordate like the anterior leaflet. Lastly, the cleft chordate insert into the cleft or indentation of the posterior leaflet, which divide the posterior leaflet into 3 scallops. . (Lam1970)

Papillary Muscles and Left Ventricular Wall

These structures represent the muscular components of the mitral apparatus. The papillary muscles normally arise from the apex and middle third of the left ventricular wall. The anterolateral papillary muscle is normally larger than posteromedial papillary muscle and is supplied by the left anterior descending artery or the left circumflex artery. The posteromedial papillary muscle is supplied by the right coronary artery. Extreme fusion of papillary muscle can result into mitral stenosis. On the other hand, rupture of a papillary muscle, usually the complication of acute myocardial infarction w results in acute regurgitation. (Lam1970)

2.2.1Histology of Mitral valve

The annulus fibrous. The 3 layers of the ventricular wall are the endocardium, the myocardium, and the pericardium. The endocardium consists of a simple squamous endothelium and a thin sub endothelial tissue. The myocardium consists of cardiac muscle fibers. The pericardium consists of simple squalors mesothelium and subepicardial tissue. There is a layer of dense fibrous connective tissue, called the annulus fibrosis', located between the atrium and ventricle. The mitral valve connects the left atrium (LA) and left ventricle (LV). The mitral valve leaflets are composed of an outer layer of endocardium and a dense connective tissue core.

Vessels and Nerves. The **arteries** supplying the heart are the right and left coronary from the aorta; the **veins** end in the right atrium.

The send in the thoracic and right lymphatic ducts. (Hosy2002)

2.2.2 Physiology

The mitral valve lets oxygen-rich blood from your lungs pass from the left atrium into the left ventricle.

Cardiac cycle

At the start of diastole, the mitral valve opens widely, and `

2.2.3Pathology

1. Mitral regurgitation

Mitral regurgitation is characterized by the reversal of blood flow from the left ventricle (LV) to the left atrium (LA). The presentation of mitral regurgitation varies and largely depends on etiology, severity, and onset.

2. Mitral stenosis

Mitral stenosis is characterized by a narrowing of the left ventricular inflow tract at the level of the mitral valve due to a structural abnormality of the mitral valve apparatus. The most common cause is rheumatic heart disease

3. Mitral valve prolapse

Mitral valve prolapse is the most common valvular abnormality, affecting 2-6% of the population of the United States. It is the most common cause of isolated mitral regurgitation in the United States. Classic mitral valve prolapsed is defined as greater than 2 mm superior displacement of the mitral leaflets into the left atrium during systole, with a leaflet thickness of at least 5 mm as revealed by transthoracic echocardiography (parasternal long-axis view).(Hosy2002)

2.3 Previous studies

(Wilkins GT,1988) done his study in46 patients (37 women,9 men ,mean age,36+9 years).Tow-dimensional and Doppler echocardiography were performed in all patients on the day before immediately after 3 months after valvuloplasty .the abnormal leaflets motion and leaflets thickening were classified into grades mild, moderate (score0),and severe(score1). In conculsion, guantitative assessment of leaflets motion and leaflets thickening score by tow-dimensional echocardiography helpful in predicting early restenosis after mitral balloon valvuloplasty.

(Du plessis and Paul marchand, 1964) made research about annular circumference, length of free edge of valve, maximum length of leaflet anterior and posterior and by 2D echocardiography method in 50 cadaveric hearts. In the results they found that annular circumference is maximum in range 8.248cm, length of free edge of valve ring 7.362cm, maximum length of leaflet anterior1.92cm and posterior1.104cm. They present data of the dimension of mitral valve, which may be of interest to anatomists and surgeons. Knowledge of normal measurements of the component parts of the valve will help the surgeon during operation to assess the exact mechanical reason for valve insufficiency.

(Hosy2002)done study on mitral valve prolapsed, it showed the mitral valve prolapsed is defined as greater than 2mm superior displacement of mitral leaflets into left atrium during systole, with transtharoacic echocardiography (parasternal long axis-view)

CHAPTER THREE

Chapter three

Methodology

3.1 Type of the study

This is prospective study deals with the normal and abnormal of thickening mitral valve leaflets and correlates it with age, sex, leaflet motion, leaflets calcification and subvalvular thickening.

3.2 Population of the study

Sudanese in Sudan-Khartoum-Khartoum Hospital from (From July 2012 up to November 2013).

To make the acoustic windows as large as possible, the patient is placed in left lateral decubitus position with the upper body slightly elevated.

3.3 Study sample

The study group consisted of hundred (100) patients, (50) normal and (50) abnormal was taken as case study.

3.4 Inclusion criteria

Normal and abnormal thickening leaflets of mitral valve, leaflets motion, leaflets calcification and subvalvular thickening.

3.5 Material

The sonographic examination performed with a high resolution real time scanner (Siemevs acuson cv70) with a 3.5 MHz convex transducer.

3.6 Method

- By measurement the tip, mid and base of the anterior and posterior leaflets of the mitral valve in the parasternal long-axis view or parasternal short-axis view.
- Leaflet thickness index was then expressed as average by sum the thickness of the anterior and posterior leaflets.

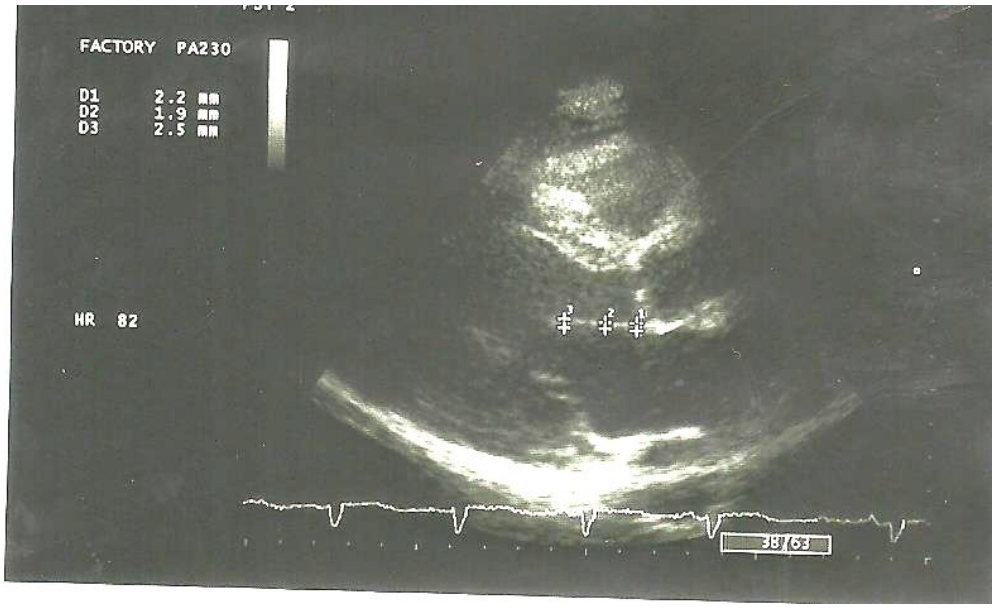


Figure 3-1 Parasternal long axial view of anterior leaflet.

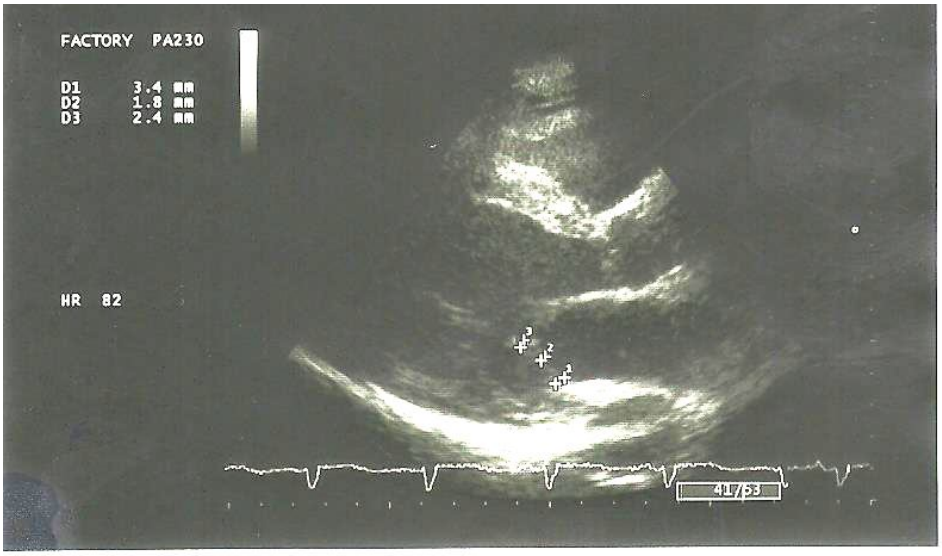


Figure 3-2 Parasternal long axial view of posterior leaflet.

3.7 Duration of the study

From July 2012 up to November 2013.

3.8 Tools of data collection

The data will be collected by data collecting sheets and ultra sound images.

3.9 Data analysis

Statistical analyses using SPSS. The data was presented as figures, tables and graphs.

3.10 Ethical considerations

In this study all patients will give oral consent prior to the examinations; Ethical approval will obtained from the ethics committees of medical center.

3.11 Data storage

The data was stored on;

Personal computer.

Patients' data collection sheet.

CHAPTER FOUR

Chapter four

4.1 Results

The following tables and graphs show summary of results including distribution of age, sex, leaflets thickening, leaflets motion, leaflets calcification, subvalnular thickening.

Table 4.1: shows the frequency of normal male and female.

Sex	Frequency	Percent
Male	23	46.0
Female	27	54.0
Total	50	100.0

Table 4.2: shows the frequency of abnormal male and female.

Sex	Frequency	Percent	Valid Percent	Cumulative Percent
Male	21	42.0	42.0	42.0
Female	29	58.0	58.0	100.0
Total	50	100.0	100.0	

Table 4.3: shows the data of Occupation status of normal Patients

work	Frequency	Percent
Student	14	28.0
Housewife	18	36.0
worker	18	36.0
Total	50	100.0

Table 4.4: shows the data of Occupation status of abnormal Patients.

Work	Frequency	Percent	Valid Percent	Cumulative Percent
Student	10	20.0	20.0	20.0
Housewife	16	32.0	32.0	52.0
Worker	24	48.0	48.0	100.0
Total	50	100.0	100.0	

Table 4.5 presented the date of male and female including mean and standard deviation for leaflets thickness.

Group Statistics				
Conclusion		N	Mean	Std. Deviation
anterior	Normal	50	2.3240	.13637
	Abnormal	50	4.3400	.35167
posterior	Normal	50	2.5020	.15971
	Abnormal	50	4.5480	.30186

Table 4.6 shows the relationship between anterior and posterior leaflets thickness

Independent Samples Test			
		t-test for Equality of Means	
		T	Sig. (2-tailed)
Anterior	Equal variances assumed	-37.794	.000
Posterior	Equal variances assumed	-42.364	.000

Table 4.7 presented the date of male and female including mean and standard division for anterior leaflet thickness.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Male Anterior Thickness	44	3.3000	1.06115	.15997
Female Anterior Thickness	56	3.3571	1.04514	.13966

Table 4.8 presented the date of male and female including mean and standard division for posterior leaflet thickness.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Male Posterior Thickness	44	3.4682	1.04765	.15794
Female Posterior Thickness	56	3.5696	1.06957	.14293

Table 4.9 shows the relationship between anterior leaflet thickening and age.

Correlations

		anterior	Age
Anterior	Pearson Correlation	1	.308**
	Sig. (2-tailed)		.002
	N	100	100
Age	Pearson Correlation	.308**	1
	Sig. (2-tailed)	.002	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.10 shows the relationship between posterior leaflet thickening and age.

Correlations

		Age	Posterior
Age	Pearson Correlation	1	.326**
	Sig. (2-tailed)		.001
	N	100	100
Posterior	Pearson Correlation	.326**	1
	Sig. (2-tailed)	.001	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.11 shows frequency of normal and abnormal leaflets motion.

Leaflets Motion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	50	50.0	50.0	50.0
	Abnormal	50	50.0	50.0	100.0
	Total	100	100.0	100.0	

Table 4.12 shows frequency of normal and abnormal leaflets calcification.

Leaflets Calcification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	50	50.0	50.0	50.0
	Abnormal	50	50.0	50.0	100.0
	Total	100	100.0	100.0	

Table 4.13 shows frequency of normal and abnormal subvalvular thickening.

Subvalvular Thickening

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	50	50.0	50.0	50.0
	Abnormal	50	50.0	50.0	100.0
	Total	100	100.0	100.0	

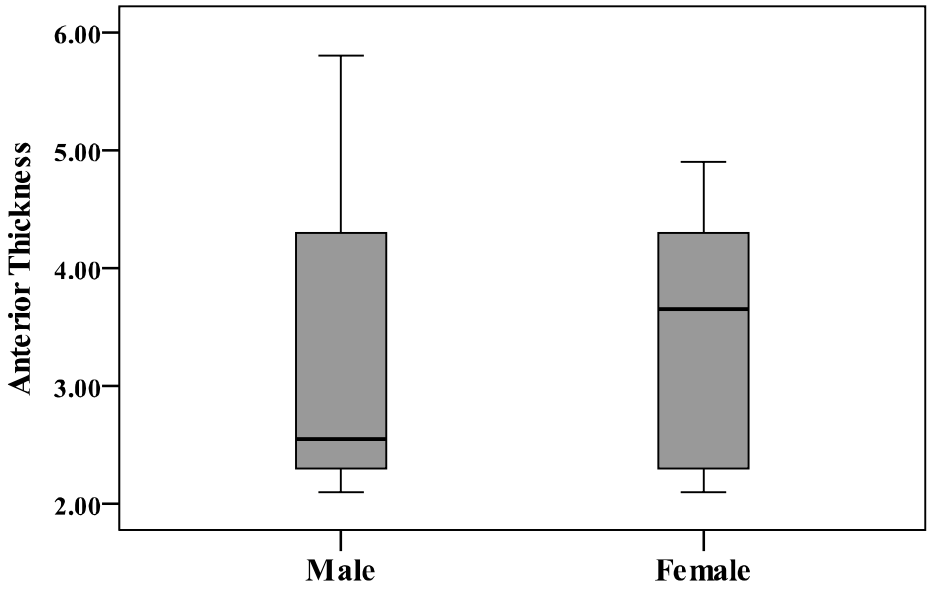


Figure 4.1 showes anterior thickness of male and female.

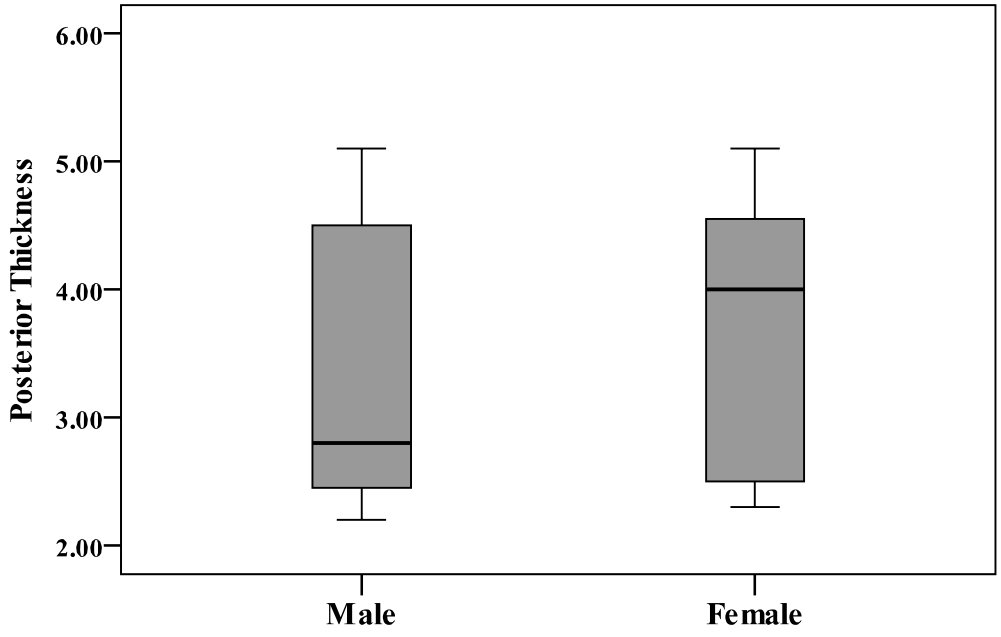


Figure 4.2 showes posterior thickness of male and female.

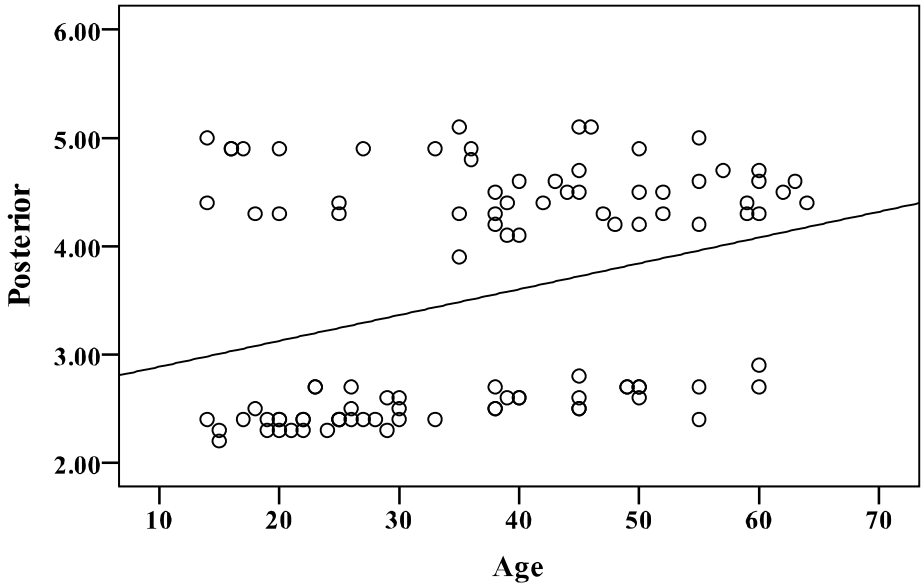


Figure 4.3 shows the relation between posterior male and female thickness and age.

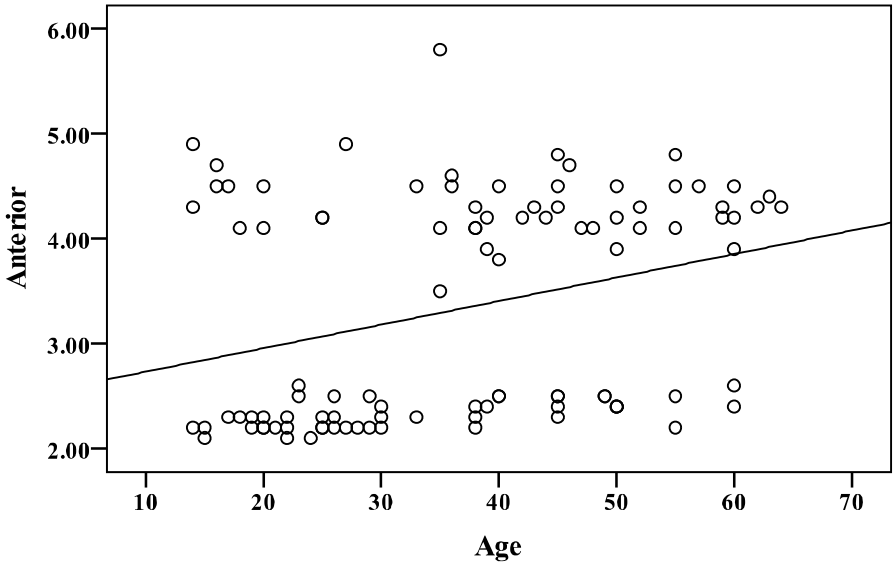


Figure 4.4shows the relation between anterior male and female thickness and age.

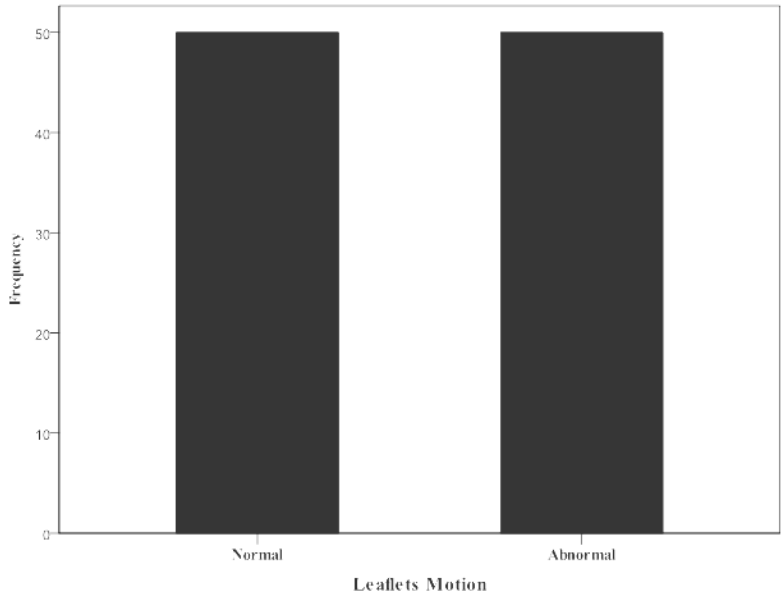


Figure 4.5 shows frequency normal and abnormal leaflets motion.

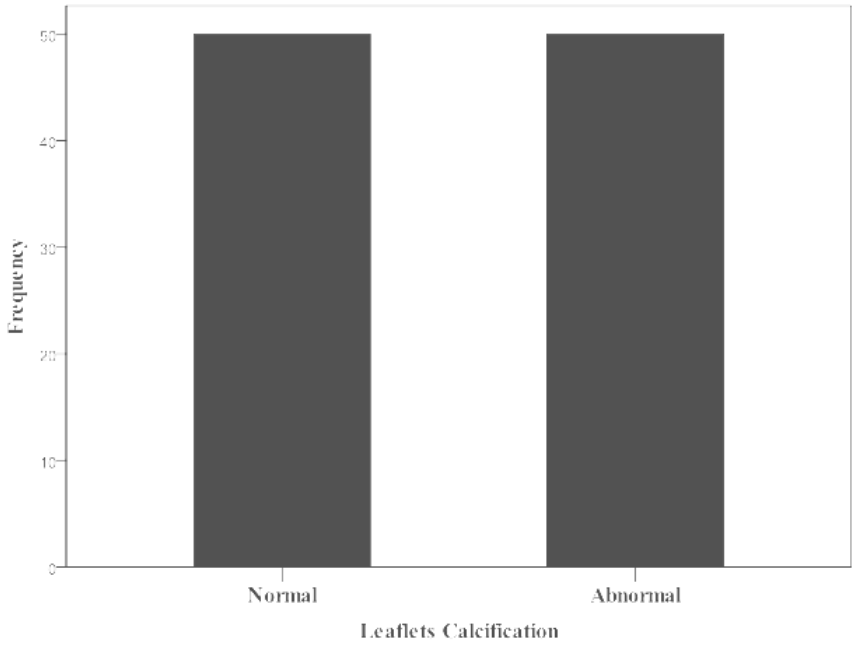


Figure 4.6 shows frequency of normal and abnormal leaflets calcification.

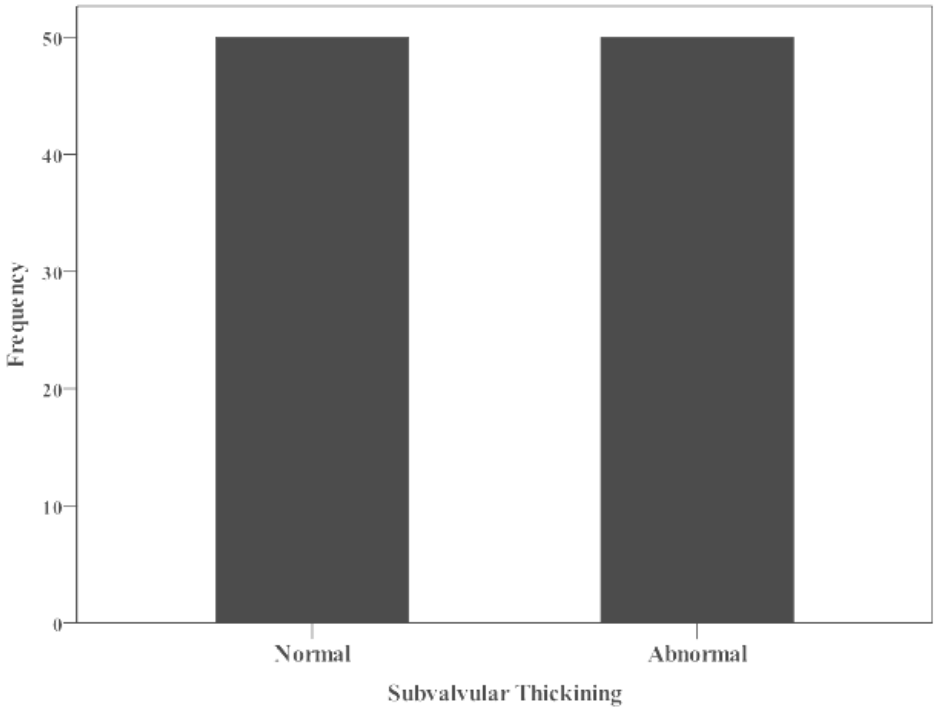


Figure 4.7 shows frequency of normal and abnormal subvalvular thickening.

CHAPTER FIVE

Chapter Five

5.1 Discussion

The researsher selected the patient age range was 14 to 67 years old to study the normal and abnormal mitral valve leaflets thickness.In tables 4.1and 4.2 were presented the data for frequncy of normal and abnormal male and female, which include 46% of male and 54% of female.

In table 4.3 and 4.4 were presented the data for frequency of student, housewife and worker, the study found that the percentage of worker48%, housewife 32% and student 20% that they have leaflets thickening.

In table 4.5 presented the date of male and female including mean and standard deviation for leaflets thickness, the study found that the mean and the standard deviation for normal anterior ((2.3 ±.13), abnormal anterior (4.3±.35), normal posterior(2.5±.13), and abnormal posterior

(4.6 ±.30).When we correlate between the normal and abnormal mitral valve leaflets thickness sample the study found that correlation is significant at the .000 level 2-tailed. Also the study found that correlation is significant at the .000 level 2-tailed between anterior and posterior leaflets thickening in table 4.6.

In table 4.7 presented the date of male and female including mean and standard division for anterior leaflet thickness, the study found that the mean and standard division of male(3.3±1.06),female(3.36±1.04),in table 4.8 the study found that mean and standard division of posterior leaflet thickness of male(3.46±1.04),female(3.56±1.06), the study found that no relationship between them.

But the relation between anterior, posterior male and female thickness and age were done in tablea and figures,the researcher found that the correlation is significant at the .002 level 2-tailed.

The frequency and mean of leaflets motion, leaflets calcification, subvalvular thickening data were presented in tables and figures, for male and female, which shows good correlation with leaflets thickness.

This is similar to**W**ilkins GT study which shown good correlation between leaflets motion and leaflets thickening. Also Dr Hsoy showed the mitral valve prolapsed is defined as greater than 2mm, with a leaflet thickness of at least 5 mm as revealed by transthoracic echocardiography (parasternal long-axis view).

5.2 Conclusion

Evalution changes in the thickness of mitral valve leaflets necessitate knowtng the normal range of dimensions for these organs in healthy persons .

The main finding of the study was;

1-The mean and standard deviation for leaflets thickness, the study found that the mean and the standard deviation for normal anterior (2.3±.13), abnormal anterior (4. 3±.35), normal posterior (2.5±.13), and abnormal posterior (4.6±.30).When we correlate between the normal and abnormal mitral valve leaflets thickness sample the study found that direct correlation between normal and abnormal mitral valve leaflets thickness. Also the study found that correlation between anterior and posterior leaflets thickening.

2-There was good correlation between anterior, posterior male and female thickness and age.

3-There was good correlation between leaflets motion, leaflets calcification, subvalvular thickening with leaflets thickness.

4-when compared between the present study and other studies ,our findings showed that it were similar to **W**ilkins GT and Dr Hsoy.

5.3 Recommendations

Regarding the results the researcher has come out with the following recommendations:

- The study recommended routine evaluation of mitral leaflets thickness in Sudanese population.
- The study recommended evaluates the same study in different component of mitral apparatus.
- The study recommended performs of several different measurement of mitral valve.
- The study recommended more research to be done with increased duration and sample volume for accurate results.
- Further study should be done for valvular disease with different method using Doppler echocardiography.

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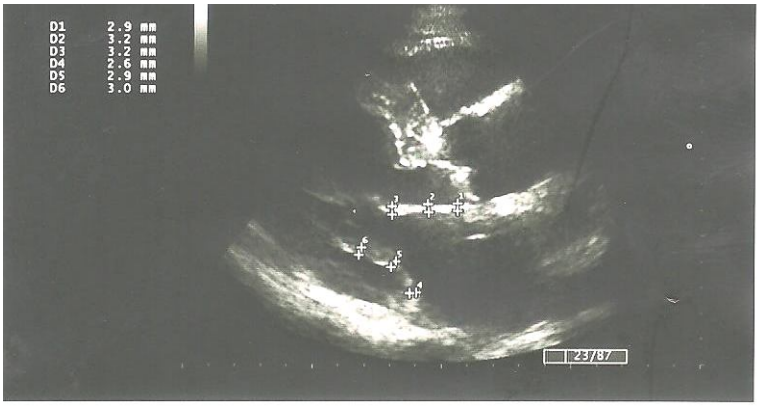
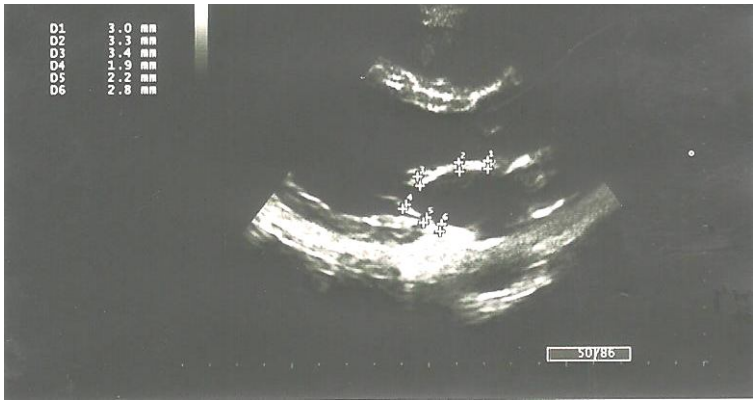
Appendix

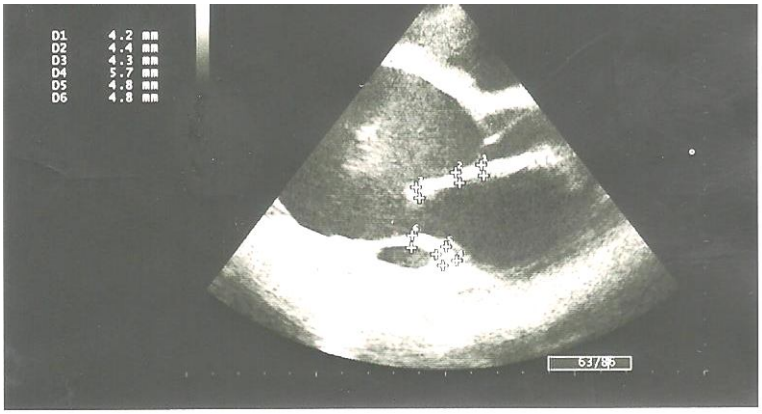
Sonogram of normal mitral valve of leaflet thickness for 45 years old female.



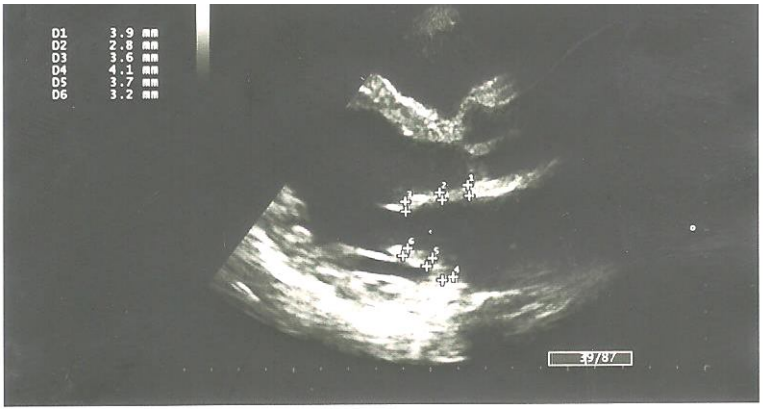
Sonogram of normal mitral valve of leaflet thickness for 60 years old male.



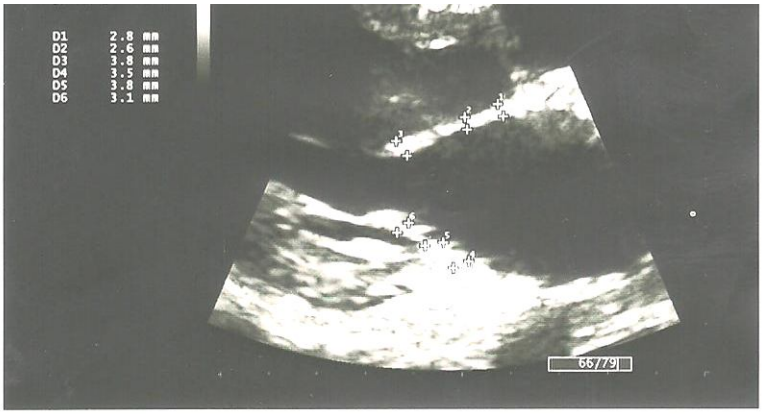
Sonogram of normal mitral valve of leaflet thickness for 33 years old female.



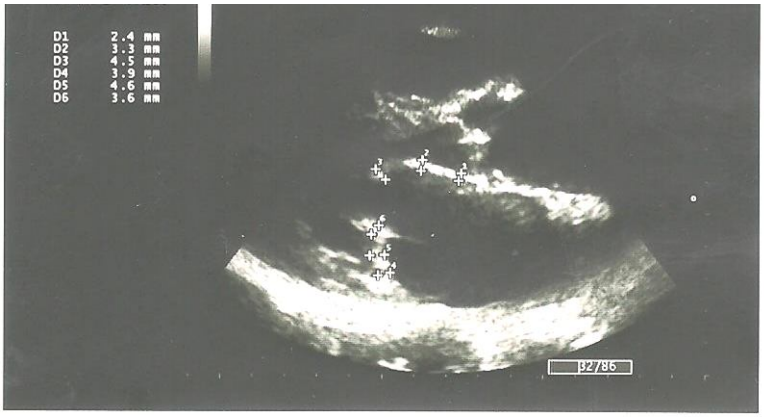
Sonogram of abnormal mitral valve of leaflet thickness for 60 years old male.



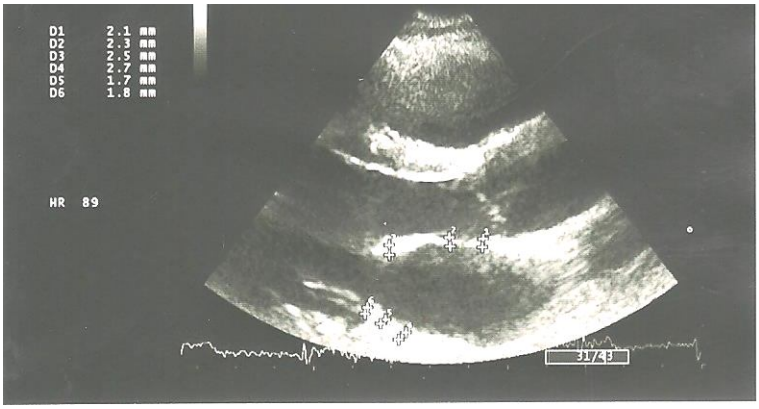
Sonogram of abnormal mitral valve of leaflet thickness for 25 years old female.



Sonogram of abnormal mitral valve of leaflet thickness for 55 years old female.



Sonogram of abnormal mitral valve of leaflet thickness for 30 years old male.



Sonogram of abnormal mitral valve of leaflet thickness for 14 years old female.