بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

Sudan University of Science and Technology

College of Graduate Studies

A Study of Left Ventricle Diastolic Dysfunction in Hypertensive Patients using Echocardiography

دراسة اختلال وظيفة انبساط البطين الأيسرللمصابين بمرض الضغط باستخدام التصوير بالموجات فوق الصوتية للقلب

A Thesis Submitted for Partial Fulfillment of Requirements of Msc. Degree in Medical Diagnostic Ultrasound

By: Taiseer Ahmed Taifour Mohamed

Supervisor: Dr. IKhlas Abdelaziz

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الآية

قال تعالى:

(وَيَسْأَلُونَكَ عَنِ الرُّوحِ قُلِ الرُّوحُ مِنْ أَمْرِ رَبِّي وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيلًا)

سورة الاسراء الاية (85)

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

First full of thanks to Allah. And a lot of thanks and great fullness to my supervisor Dr-IKhlasAbdelaziz *for his valuable and continuous help and guidance.*

I owe my most sincere gratitude to Dr. AdilAbdallah and the working team who gave me the opportunity to work with them in the department of ultrasound in Omdurman military hospital during the process of collection of data.

Abstract

The main objective of this study was to assess the diastolic dysfunction in hypertention patients. The study was conducted in Omdurman military hospital. 50 patients (28 males and 22 females) with known history of hypertention were enrolled in the study. All patients were scanned with ultrasound machine using linear high frequency transducer (7.5-10 MHz).

The results of this study showed that diastolic dysfunction was present in 45 (90 %) of the patients. Diastolic dysfunction was more common among female (95.8%) compared to male (84.6%). The prevalence of diastolic dysfunction increased with longer duration of hypertention , age and presence of Left Ventricular Hypertrophy (LVH).

The findings of this study indicate that myocardial damage in patients hypertntion with affects diastolic dysfunction before systolic function.

Doppler echocardiography is one of the most useful clinical tools for the assessment of left ventricular diastolic function.

الملخص

الهدف الأساسي من هذه الدراسة هوتقييم اختلال وظيفة ابساط البطين الأيسرلمرضى داء الضغط.

بيانات هذه الدراسة جمعت بمستشفى السلاح الطبى لعدد50 مريض لديهم تاريخ مرضي لداء الضغط. كل المرضى تم تصويرهم بجهازالموجات فوق الصوتية (MylabU/Smachine)باستخدام مسارعالى التردد (7.5-10 MHz).

نتائج الدارسة أوضحت أن اختلال وظيفة ابساط البطين الأيسروجد عند٤٥ مريضا"90 %هوأكثرشيوعا "عند النساء(8،95%) مقارنة بالرجال ٨٤،٦ % يتزايد اختلال وظيفة ابساط البطين الأيسرمع طول فترة الاصابة بداء الضغط وتضخم عضلة البطين والزيادة فى العمر كما أثبتت الدارسة أن تلف عضلة القلب فى مرضى داء يؤثرفى اختلال وظيفة الانبساط قبل الانقباض.

الموجات فو قالصوتية بالدوبلر للقلب يعد من اهم الوسائل التشخيصية لتقييم اختلال وظيفة انبساط البطين الايسر.

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List of Abbreviations

A	Peak A wave Velocity;
AM	Atrial Contraction;
ADUR	Duration of Atrial Reversal
CHD	Coronary Heart Disease
DHD	Diabetic Heart Disease
DM	Diabetes Millets
DT	Deceleration Time
DT	Deceleration Time
E	Peak E wave Velocity
EM	Early Myocardial Velocity
IVR	Isovolumic Relaxation Time
LA	Left Atrium
LVEDP	Left Ventricular End-Diastolic Pressure
LVDDF	Left Ventricular Diastolic Dysfunction
LVSF	Left Ventricular Systole Function
PW	Pulsed Wave
PVA	Peak Atrial Reversal (A Wave) Velocity;
PVD	Peak Diastolic (Dwave) Velocity
PVS	Peak Systolic (S Wave) Velocity
RCM	Restrictive Cardiomyopathy
TDI	Tissue Doppler Imaging

CHAPTER ONE

Introduction

CHAPTER ONE

Introduction

1.1- Introduction

An echocardiogram is non invasive diagnostic method that utilizes high frequency sound to assess anatomical ,functional & hemodynamic abnormalities of the cardiovascular system ,an echocardiogram is a scan which gives a detailed view of the structures of the heart, and which can show how well heart is working, the scan uses a probe that sends out sound waves, which are reflected back by the muscles and tissues in the heart. These reflected waves are picked up by the probe and translated into images on a screen (paul lesson and et al2007).

Echocardiograms can show if the heart is working as well as it should. They are particularly useful for revealing if heart has an enlarged left side or problems with the heart valves. They can also be used to investigate the causes and effects of heart murmurs and heart attacks. An echocardiogram is a painless test that takes roughly 20-25 minutes. It can be carried out in one of two ways.

The sonographer is looking for an enlarged heart muscle or heart valve problems, the probe is normally placed on the chest , Lubricating jell will be put on chest and a small probe will be moved around on the chest, moving the probe around will give different views of the heart, if the sonographer is looking for more detailed information about how heart is working, a small probe will be passed down on throat so that it lies behind the heart , this means that the sonographer will have a much clear view, patient will receive a sedative and/or local anesthetic for this procedure, but it should not require an overnight stay in hospital , the probe is going to be placed on patient chest, patient do not need to do anything beforehand (no preparation),this can be helpful to investigate 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.

The heart is subdivided by septa into right and left halves, and aconstriction 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.

The heart has four major valves . Aortic valve which carries the blood from the LV to the systemic circulation (oxygenated blood). Pulmonary valve carries the blood from the RV to the pulmonary circulation

(deoxygenated blood)Tricuspid valve guarding the orifice between the RA and RV and allow the blood to pass from the RA to the RV

(deoxygenated blood) .Mitral valve guarding the orifice between the LA and LV and allow the blood to pass from the LA to the LV(oxygenated blood).

Cardiac cycle the electrical, pressure and volume changes that occur in a functional heart between successive heart beats of the cardiac cycle when myocardium is relaxed is termed phase *diastole* phase of the cardiac cycle when the myocardium contracts is termed *systole*.

Diastole is the portion of the cardiac cycle that spans from isovolumic ventricular relaxation to thecompletion of antegrade mitral flow.

Hypertension or Arterial blood pressure is "normal" when the systolic pressure is (90-119) mmHg and the diastolic pressure is 60-79 mmHg. When the arterial pressure is ≥120/80 mmHg, a person is said to be prehypertensive or hypertensive. Mean arterial pressure is also elevated in hypertension, but it is not usually measured in people. In past years, the diastolic value was emphasized in assessing hypertension. However, elevations in systolic pressure ("systolic

hypertension") are also associated with increased incidence of coronary and cerebrovascular disease (e.g., stroke).

Hypertension is a disease that affect heart especially left ventricle so that patients have hypertension need follow-up to this important organs.

In this study we assessthe effect of hypertension in the left ventricle diastolic dysfunction using ultrasound as safety as available good diagnosisand Correlate it with age, sex ,duration time, treatment controlled and the stage of diastolic dysfunction. . In a previous study Kazuhirdiastolic function in2005 hypertensive patients with preserved left ventricular function, particularly focusing on the limitation of the transmitral flow velocity curve alone to detect diastolic dysfunction.

Comprehensive Doppler analysis was performed in 51 hypertensive patients with preserved left ventricular systolic function.The presence of diastolic dysfunction has been frequently overlooked in hypertensive patients with transmitral Doppler analysis alone, and an assessment of diastolic function with a comprehensive Doppler analysis is needed in patients at risk for diastolic dysfunction.

-Young-Hwa Kong[1], **Methods** A random selection of 1296 individuals free from known CVD, hypertension and diabetes were examined with echocardiography at baseline of the third Nord-Trøndelag Health Study, (HUNT3, 2006–2008). The primary outcomes were LV diastolic function (e′) and LV systolic function (longitudinal global strain). The primary exposures were self-report on the Hospital Anxiety and Depression Scale (HADS). Associations between outcomes and baseline exposures were available for 1034 (80%), and with previous and repeated exposures for 700 participants who also participated in HUNT2 (1995–1997). In a healthy sample, confirmed free of CVD, past and repeated depression symptoms were associated with subclinical LV dysfunction. Thus, depression symptoms might represent a modifiable risk factor for future CVD.

Therefore, this study was conducted to determine the effect of glycemic status onleft ventricular diastolic function in hypertensive patients. This study highlights the problem of left ventricular diastolic dysfunction to be taken in consideration while dealing patients withhypertensive who were free from symptoms of heart failure.

1.2 Problem Of Study

We do not have a definite data regarding the echocardiographic findings in asymptomatic Hypertention in our population. Sudanese are genetically more susceptible to compared Hypertention to other races cardiovascular complications are known to be the main cause of morbidity and death in Hypertensive patients.

1.3-Research Objectives

1.3-1 General objective

The main objective of this study will be to Assessment of left ventricle diastolic dysfunction in hypertensive patients using echocardiography

1.3-2 Specific objectives

To evaluate the left ventricular diastolic dysfunction in Hypertensive

- To study the correlation of duration of Hypertensive with the left ventricular diastolic dysfunction.
- To study the correlation between age and sex with left ventricular diastolic dysfunction .
- To study the correlation of treatment controlled of Hypertensive with left ventricular diastolic dysfunction .
- To study the correlation of the stage of diastolic dysfunction.

1.4 Importance of the study

Knowledge of Diastole is the portion of the cardiac cycle that spans from isovolumic ventricular relaxation to the completion of antegrade mitral flow to

assess left ventricle diastolic dysfunctionin hypertensive patients this study determine the relationship between age ,sex ,duration time, treatment controlled and the stage of diastolic dysfunction in Omdurman military hospital .

1.5 Overview of The Study

The research contains Five Chapters:

Chapter One: Include introduction, statement of problem, objectives, and over view.

Chapter Two: Include literature review, heart anatomy and physiology,physic and technique of ulteasound and echo , echo assessment of left ventricular diastolic dysfunction, trans-thoracic echocardiography and previous studies.

Chapter Three: Include Material and Method

Chapter Four: Include the Results of the study

Chapter Five: Include Discussion, Conclusion and Recommendation, References and appendix showing a practical work

CHAPTERTWO

Literature Review

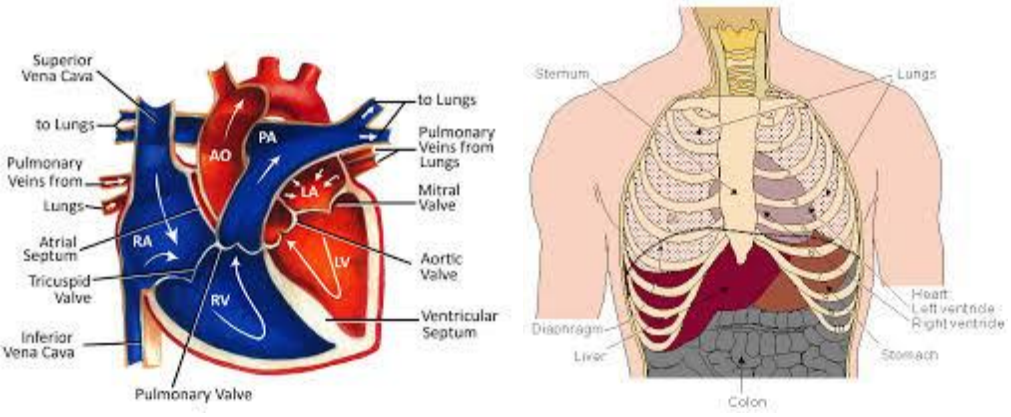
Chapter Two

Literature Review

2.1 Heart Anatomy and physiology:

2.1.2Anatomy 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 onethird of it is situated on the right and two-thirds on the left of the median plane.



Figure(2. 1) shows heart anatomy and location (Tony & Gill 2011)

The heart, in the adult, measures about 12 parts and 6 cm. InThickness. 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 aConstriction 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. The division of the heart into four cavities is indicated on

itsSurface by grooves. The atria are separated from the ventricles by thecoronary sulcus (auriculoventricular groove); this contains the trunks ofthe nutrient vessels of the heart, and is deficient in front, where it iscrossed by the root of the pulmonary artery.Theinteratrial groove,separating the two atria, is scarcely marked on the posterior surface, whileinteriorly it is hidden by the pulmonary artery and aorta.

The ventriclesare 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 theventricular portion to a notch, the incisura apices' cordis, on the acute margin of the heart just to the right of the apex.

The base (basis cordis), directed upward, backward, and to theright, is separated from the fifth, sixth, seventh, and eighth thoracicvertebra 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.

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 theleft. 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 slightlybackward, 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 islarger than the left, but its walls are somewhat thinner, measuring about 2mm; 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 bloodfrom 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 rvena 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 ofthe 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 theorifices of minute veins (venoecordis minima), which return blooddirectly from the muscular substance of the heart.

The atrioventricular opening (tricuspid orifice) is the large ovalaperture 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 theatrium.

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 altthe 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 (ventriculusdexter). The right ventricle istriangular 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 ofcommunication between the right atrium and ventricle.

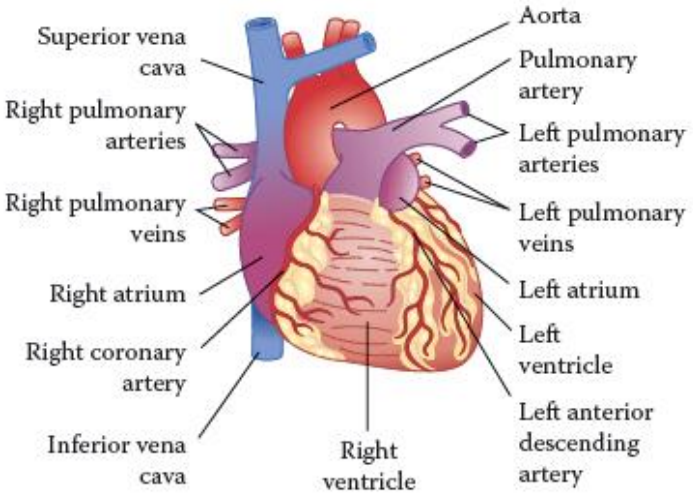
Situated at the base of the ventricle, it measures about 4 cm. in diameter and is surrounded by a fibrous ring, covered by the lining membrane of the heart; it is considerably larger than the corresponding aperture on the left side, being sufficient to admit the ends of four fingers. It is guarded by the tricuspid valve. (Lam1970)The opening of the pulmonary artery is circular in form, andsituated at the summit of the conusarteriosus, 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 (valvulatricuspidalis. consists of threesomewhat triangular cusps or segments. The largest cusp is interposed between the atrioventricular orifice and the conusarteriosus 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).

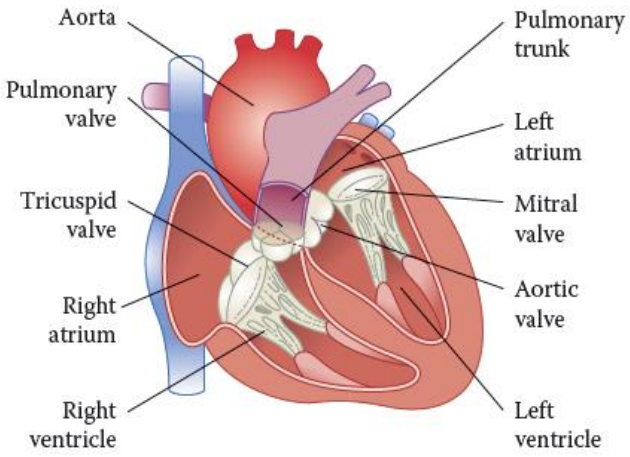
The left atrium is rathersmaller than the right, but its walls are thicker, measuring about 3 mm; it consists, like the right, of two parts, a principal cavity and an auricular.(Lam1970)The bicuspid or mitral valve (valvulabicuspidalis [metralis}is attached to the circumference of the left atrioventricular 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 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)



Figure(2. 2) The heart and major vessels (making sense)



Figure(2. 3) The heart valves and chambers (making sense)

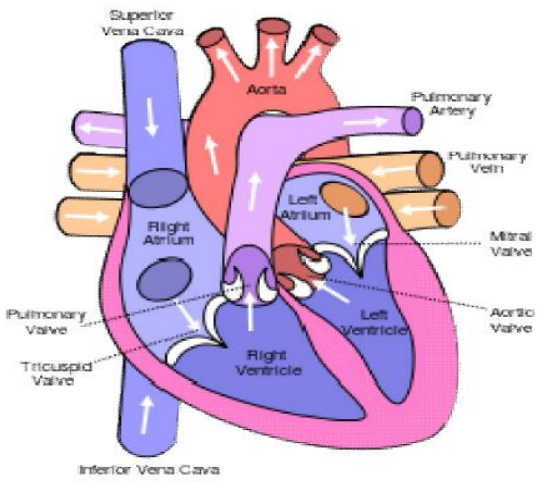
2.1.3 Histology of the Heart

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)

2.1.4 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. 4) 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 thesinoatrial (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 tocontract.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**.**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, theventricles 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 theconditions around you climate, stress, and level of physical activity and adjusts is cardiovascular system to meet those needs. (Lam1970)

2.1.5 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 ofventricle 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)

2.1.6 Pathology

1.1.6.1 Cardiovascular Disease

Category of cardiac pathology is a leading cause of death, and itincludes awide range of conditions that affect the structure or function ofthe heart. Congenital heart defects impair the action of the heart frombirth and even before birth during fetal development. The impairmentsconcern the interior heart walls, the heart valves or the vascular system ofthe heart. Coronary artery disease (CAD) results from the narrowing ofthe arteries that supply the heart muscle due to a buildup of plaque. Thecondition, atherosclerosis, can cause the heart to become starved due tolack of oxygen and other nutrients, often leading to a heart attack.(Perloff1972)

1.1.6.2 Cardiomyopathy

Diseases characterized by abnormalities in the myocardium arecardiac 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 severestenosis, thrombotic occlusion or blockage of a major coronary vessel.(Perloff1972)

1.1.6.3Congestive Heart Failure

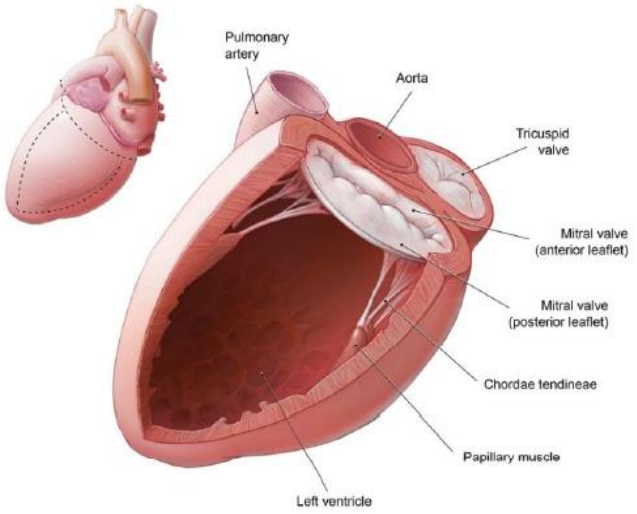
CHF describes a condition of cardiac pathology resulting when the heart pumps inefficiently, causing blood to back up into the lungs and other areas of the body. The heart cannot supply sufficient blood flow to various parts of the body. The fluid overload increases the workload on the heart. This heart 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)

1.1.6.4 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 hospitaladmissions as well as deaths. .(Perloff1972)

2.1.7 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(2. 5) components of mitral valve apparatus

(www.echobweb.com)

Left atrial Wall

The left a trial myocardium extends over the proximal portion ofthe 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

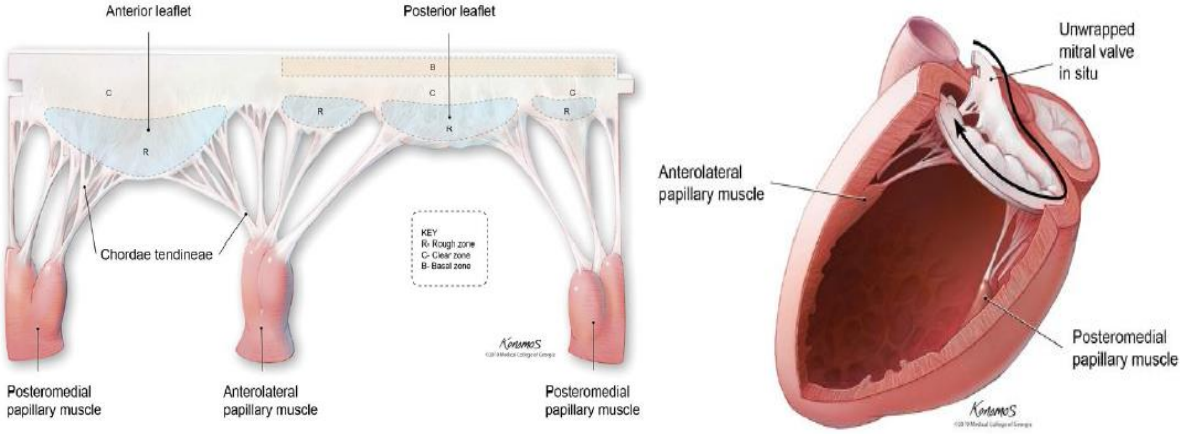
The posterior leaflet has also been known as the ventricular leaflet, mural leaflet, smaller leaflet, or the posterolateral leaflet. The posterior leaflet is the section of

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 tochoral tendineaeinsertion.The rough zone is defined in the anterior leaflet. It is distal to theridge 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(2. 6) Components of mitral valve leaflets (www.echobyweb.com)

Chordate Tendineae

The chordate tendineae are small fibrous strings that originatefrom the apical portion of the papillary muscles, or directly from theventricular 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 anterioror 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, whichdivide 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)

2.1.7.1Histology 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 adenseconnective 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)

2.1.7.2 Physiology

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

Cardiac cycle

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

2.1.7.3Pathology

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 leftventricular 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 prolapsed

Mitral valve prolapse is the most common valvular abnormality,affecting 2-6% of the population of the United States. It is the mostcommon 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)

2.1.7.4. LV diastolic dysfunction.

Doppler pattern of impaired LV relaxation, characterized by reduced early and increased late diastolic flow, is an early sign of diastolic dysfunction (DD) (grade I). More advanced grades, manifested by predominant early diastolic filling and rapid velocity deceleration (restrictive filling patterns), are associated with the most severe LV decompensation (Nishimura RA, Tajik J 1997).

The causes of diastolic dysfunction may be subdivided into a decrease in passive myocardial diastolic compliance, and an impairment in active LV relaxation. (Cosson , Kevorkian 2003).

Abnormalities in diastolic function may occur in the presence or absence of a clinical syndrome of heart failure and with normal or abnormal systolic function. Therefore, whereas diastolic dysfunction describes an abnormal mechanical property, diastolic heart failure describes a clinical syndrome (Cosson , Kevorkian 2003).

2.1.7.4.1.Causes of impaired LV diastolic function

Diastolic dysfunction is thought to reflect 'stiffness' or impaired relaxation of the LV, and so occurs in conditions where the LV becomes less compliant:

Ageing ,hypertension ,LVH ,myocardial ischaemia ,aortic stenosis and infiltrative cardiomyopathies. (Paulus et al 2007)

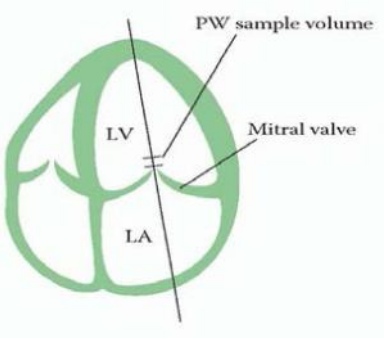
2.1.7.5. Echo assessment of LV diastolic function:

Many methods are available to characterize LV diastolic function on echo, but the most widely used are:

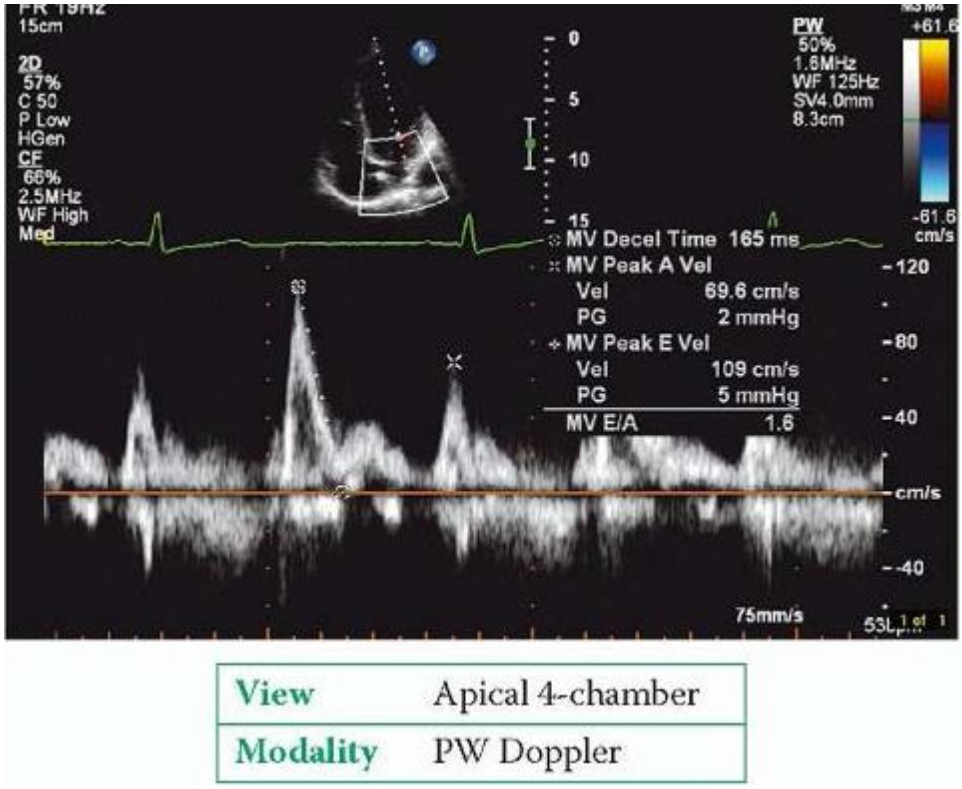
2.1.7.5.1. Inflow:

To assess LV inflow, perform PW Doppler in the apical 4-chamber view with a 1–3mm sample volume placed at the tips of the mitral valve leaflets (Fig. 2.23). Obtain a PW Doppler trace (Fig. 2.24) and measure: peak E wave velocity, peak A wave velocity, E:A ratio, E wave deceleration time (DT) and isovolumic relaxation time (IVRT). (Andrew, Houghton2002)

A sweep speed of 25 or 50 mm/s is used initially to look for respiratory variation in peak E and A wave velocities. The sweep speed is then increased to 100 mm/s before taking at least three sets of measurements with the patient's breath held at end-expiration.



Figure(2. 7) Positioning of sample volume for pulsed-wave (PW) Doppler of mitral valve inflow (Andrew, Houghton2002)



Figure(2. 8) Pulsed-wave (PW) Doppler of mitral valve (MV) inflow. (Andrew, Houghton2002)

E:A ratio is simply the ratio between peak E and A wave velocities: E:Aratio= Peak E wave velocityPeak\ A wave velocity. The E wave is normally taller than the A wave, and the E:A ratio normally lies in the range 1–2. E wave deceleration time is the time period between the peak of the E wave and the end of the E wave (measured by extrapolating the E wave deceleration slope down to the baseline),

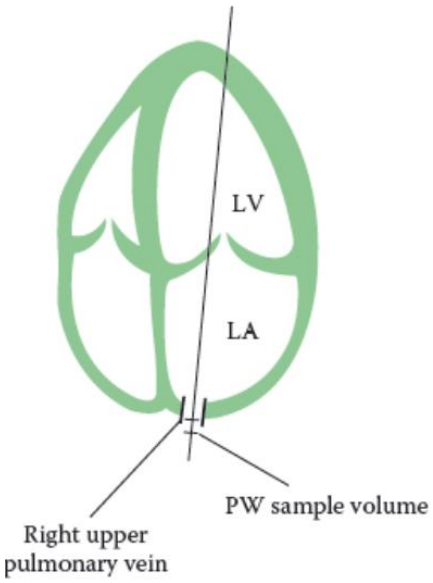
and is normally 150–200 ms. IVRT is the time period between aortic valve closure and mitral valve opening, during which LV pressure falls but there is no change in LV volume. There are various methods of measuring IVRT. The simplest is to tilt the probe, obtain a 5-chamber view and adjust the PW Doppler sample volume to lie between the mitral and aortic valves (so that both the mitral inflow and aortic outflow traces are seen on the same PW Doppler trace). Freeze the trace and measure the time period between the end of the aortic outflow trace and the start of the mitral inflow trace – this is the IVRT, and is normally 50–100 ms. (Andrew, Houghton2002)

2.1.7.5.2. Pulmonary venous flow:

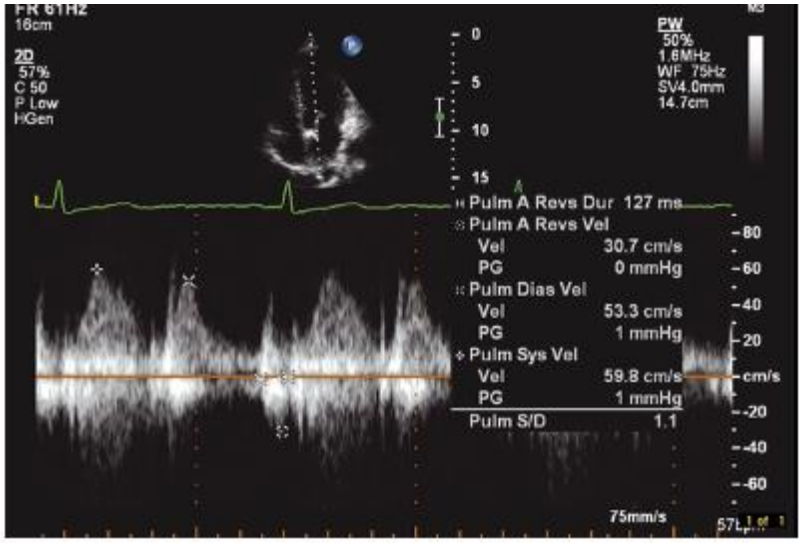
To assess pulmonary venous flow, perform PW Doppler in the apical 4-chamber view with a 2–3 mm sample volume placed 0.5 cm inside one of the pulmonary veins (the right upper pulmonary vein is usually easiest to locate, (Fig. 2.25).

Pulmonary vein flow normally consists of three components: the S wave represents forward flow into the left atrium during ventricular systole, and the smaller D wave represents forward flow during ventricular diastole. If the patient is in sinus rhythm, the S and D waves are followed by an ‘a’ wave, representing flow reversal in the pulmonary vein during atrial systole.

Obtain a PW Doppler trace (Fig. 2.26) and measure the peak systolic (S wave) velocity (PVS) and the peak diastolic (D wave) velocity (PVD) . Senior R, Ashrafian H 2005)



Figure(2. 9) Positioning of sample volume for pulsed-wave Doppler of pulmonary venous flow(Andrew, Houghton2002)



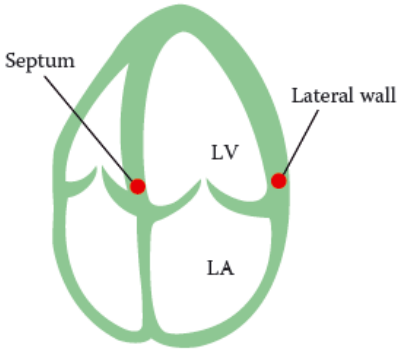
View	Apical 4-chamber
Modality	PW Doppler

Figure(2. 10) Pulsed-wave (PW) Doppler of pulmonary venous flow. (Andrew, Houghton2002)

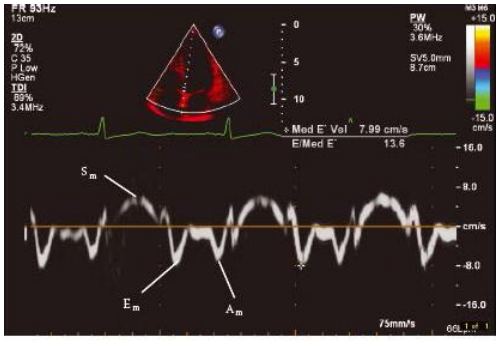
TDI of the mitral annulus:

TDI of the mitral annulus is undertaken in the apical 4-chamber view, placing the sample volume (which should be small, usually 2–3 mm) in the myocardium of the septum and then the lateral wall. The optimal location is 1 cm below the mitral annulus(Fig. 2.27).. In each location make a pulsed-wave tissue Doppler recording (Fig. 2.28). using a low gain setting and an aliasing velocity 15–20 cm/s. Set the sweep speed at 50–100 mm/s and take at least three sets of measurements with the patients breath held at end-expiration.

The mitral annular tissue Doppler recording shows an early myocardial velocity (Em or E') which corresponds to early diastolic relaxation, the myocardium moving away from the transducer. This is followed by a further movement away from the transducer, corresponding to atrial contraction (Am or A'). Normally Em> Am with a ratio between the two velocities in the range 1–2. If there is diastolic dysfunction, the Em:Am ratio reverses. The ratio between the peak LV inflow E wave velocity and Em should also be calculated; this ratio reflects LA pressure. Normal E/Em ratios are <8 at the septum and <10 at the lateral wall. .(Senior R, Ashrafian H 2005)



Figure(2. 11) Positioning of sample volume for pulsed-wave tissue Doppler imaging (TDI) of the mitral annulus(Andrew, Houghton2002)

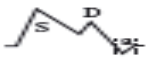
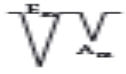
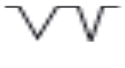
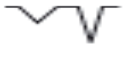


View	Apical 4-chamber
Modality	Pulsed-wave TDI

Figure(2. 12) Pulsed-wave trace of medial mitral annulus (septal wall) obtained with tissue Doppler imaging (TDI). (Andrew, Houghton2002)

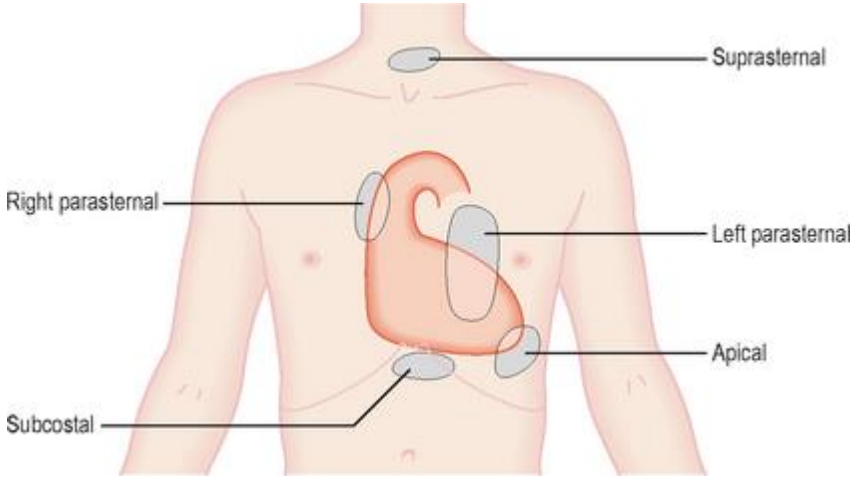
Interpretation of results:

The assessment of LV diastolic function combines each of the measures discussed above (Fig. 2.29). Using these measures, LV diastolic function can be classified as normal, mildly impaired (abnormal relaxation), moderately impaired (pseudonormal) and severely impaired (restrictive filling) .(Senior , Ashrafian 2005)

	(18)	(19)	(20)	(21)
	Normal	**Mild**	**Moderate**	**Severe**
		↓ Relaxation	↓ Relaxation ↓ Compliance ↑ LVEDP	↓ Relaxation ↓ Compliance ↑↑ LVEDP
		Abnormal Relaxation	**Pseudo-Normal**	**Restrictive Filling**
LV Inflow Doppler				
E/A ratio	1–2	<1	1–2	>2
IVRT (ms)	50–100	>100	50–100	≤50
DT (ms)	150–200	>200	150–200	<150
Pulmonary Venous Doppler				
PV_S/PV_D	$PV_S > PV_D$	$PV_S > PV_D$	$PV_S < PV_D$	$PV_S << PV_D$
PV_a (m/s)	<0.35	<0.35	≥0.35	≥0.35
$a_{dur} - A_{dur}$ (ms)	<20	<20	≥20	≥20
Mitral Annular Tissue Doppler				
E_m/A_m	1–2	<1	<1	<<1
E/E_m (septum)	<8	–	>15	–
E/E_m (lateral)	<10	–	>10	–

Figure(2. 13) Classification of left ventricular (LV) diastolic dysfunction(Andrew, Houghton2002)

Trans-thoracicEchocardiography:



Figure(2. 14) Transthoracicechowindows (Andrew, Houghton2002)

Patient preparation:

Patients attending for an echo study may feel anxious, not only about having the test itself but also about any abnormalities that it may reveal. To help reduce anxiety, describe the test to patients in clear and reassuring terms – explain to patients why they are having an echo, whether any special preparation is needed before they attend, what happens during the scan and how long it is likely to take.(Feigenbaum2010)

Reassure patients that having an echo is safe and painless. Patients can eat and drink normally before attending for a standard TTE, and they can take their medication as usual.

2.1.7.6 Standard windows and views:

There are five TTE windows (Fig. 2.30), each providing one or more views of the heart. The right parasternal window is optional and can be used when other views are suboptimal or when additional information is needed:

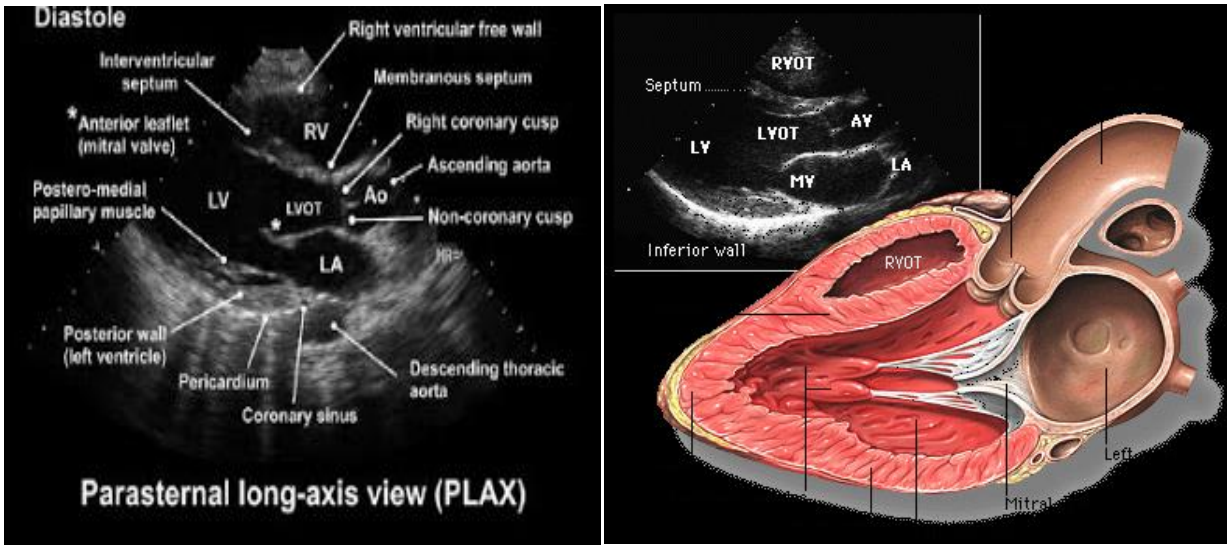
Left parasternal window:

The left parasternal window is located to the left of the sternum, usually in the third or fourth intercostal space, but in some patients you may need to adjust the

position to optimize the image by moving the probe up/down a rib space or further towards/ away from the sternum. From the left parasternal window a number of views can be obtained. .(Feigenbaum2010)

2.1.7.6.1. Parasternal long axis view:

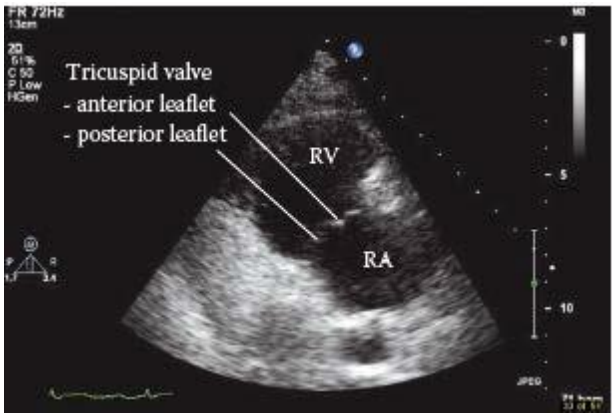
The parasternal long axis (LAX) view is shown in Fig. 2.31. To obtain the view with the probe in the left parasternal window, rotate the probe so that the probe's'reference point' (sometimes a 'dot') is pointing towards the patient's right shoulder. For an optimal view, aim to position the probe so that the view cuts through the centre of the mitral and aortic valves, without foreshortening the left ventricle (LV) or ascending aorta. .(Feigenbaum2010)



Figure(2. 15) Normal parasternal long axis view(.(Feigenbaum2010)).

Parasternal right ventricular (RV) inflow view:

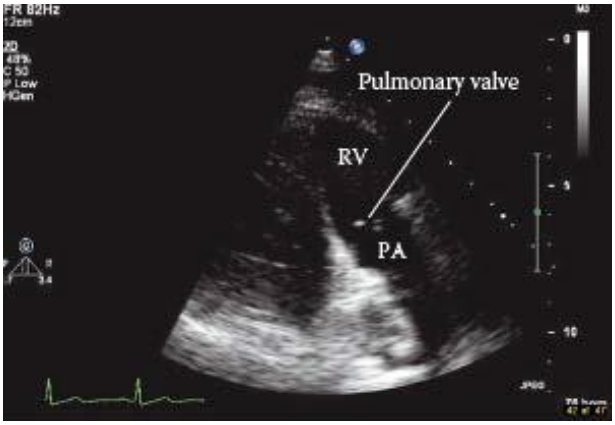
This view is obtained from the left parasternal window by tilting the probe so that it points more medially and towards the patient's right hip, bringing theright atrium (RA), tricuspid valve and RV .(Feigenbaum2010)



Figure(2. 16) Normal right ventricular inflow view(Andrew, Houghton2002).

Parasternal RV outflow view:

This view is obtained from the left parasternal window by tilting the probe so that it points more laterally and towards the patient's left shoulder, bringing the RVOT, pulmonary valve and pulmonary artery into view (Fig. 2.33). It may be possible to see the pulmonary artery bifurcation. .(Feigenbaum2010)



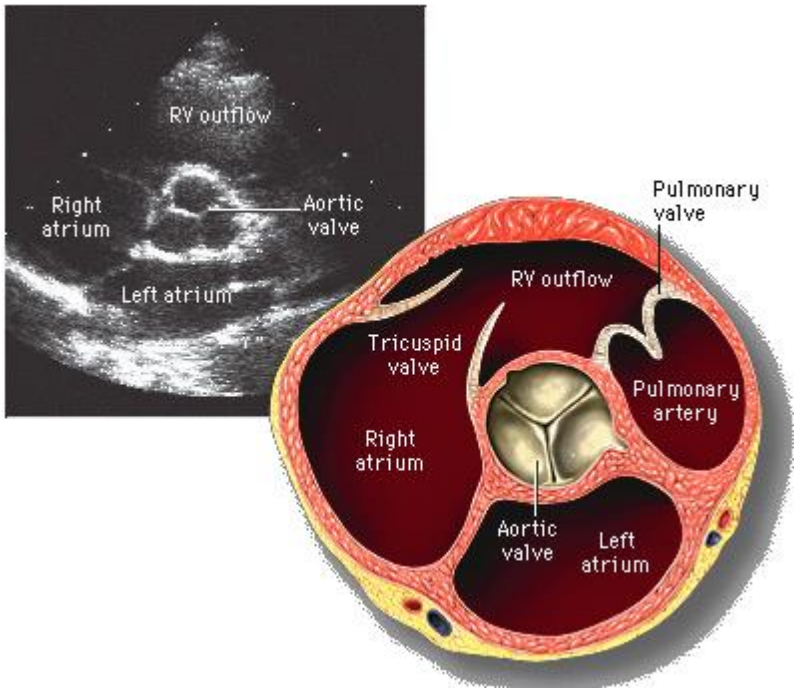
Figure(2. 17) Normal right ventricular outflow view(Andrew, Houghton2002)

2.1.7.6.2. Parasternal short axis view (base, mid-cavity, apex):

To obtain the parasternal short axis (SAX) view, keep the probe in the left parasternal window and rotate it so that the 'dot' is pointing towards the patient's left shoulder. There are actually four SAX views, obtained bysweeping the probe along the axis of the heart from the level of the aortic valve down to the apex. The standard SAX views are:

2.1.7.6.3 At the aortic valve level (Fig. 2.34):

Use 2D to assess the structure and function of the RVOT ,measure RVOT diameter at the aortic valve (AV) level (known as RVOT1) and at the pulmonary valve annulus level (known as RVOT2) ,assess the morphology of the main pulmonary artery up to its bifurcation and measure its diameter (known as PA1) ,assess the structure and mobility of the aortic valve; all three cusps should be visible ,inspect the LA and RA and interatrial septum, assess the structure and mobility of the tricuspid valve (the two leaflets seen are the septal and anterior leaflets) and toassess the structure and mobility of the pulmonary valve.(Feigenbaum2010)

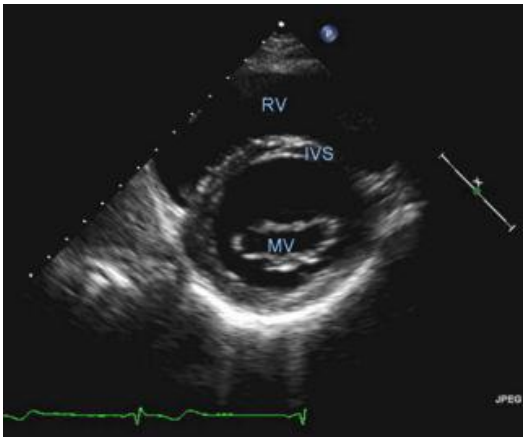


Figure(2. 18) Normal parasternal short axis view .(Feigenbaum2010)

2.1.7.6.4 At the mitral valve level (Fig. 2.35):

Use 2D to inspect the MV leaflets, mitral annulus and subvalvular apparatus. The anterior and posterior leaflets are visible as is the classical mitral valve orifice, which can be planimetered to measure orifice area **,**assess the mobility of the mitral valve leaflets **,**assess LV radial function and look for any regional

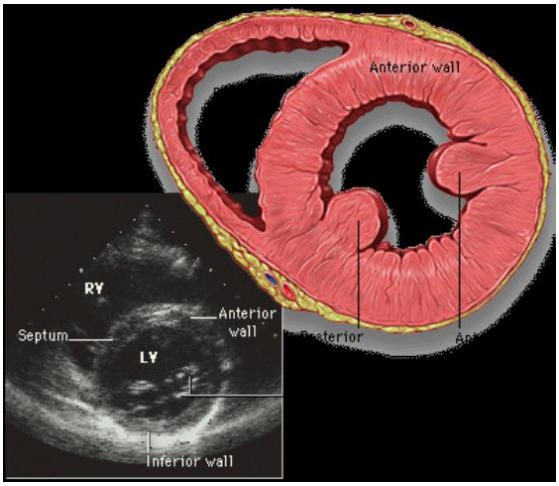
wall motion abnormalities at the basal level **and to** assess RV size and function. (eigenbaum2010)



Figure(2. 19) Normal parasternal short axis view (mitral valve level) (Andrew, Houghton2002)

2.1.7.6.5 At the papillary muscle level (Fig. 2.36):

Use 2D to assess the structure of the posteromedial and anterolateral papillary muscles ,measure LV wall thickness, assess LV radial function and look for any regional wall motion abnormalities at the mid-ventricle level and to assess RV size and function.(Feigenbaum2010)



Figure(2. 20) Normal parasternal short axis view (papillary muscle level) . (Feigenbaum 2010).

Right parasternal window :

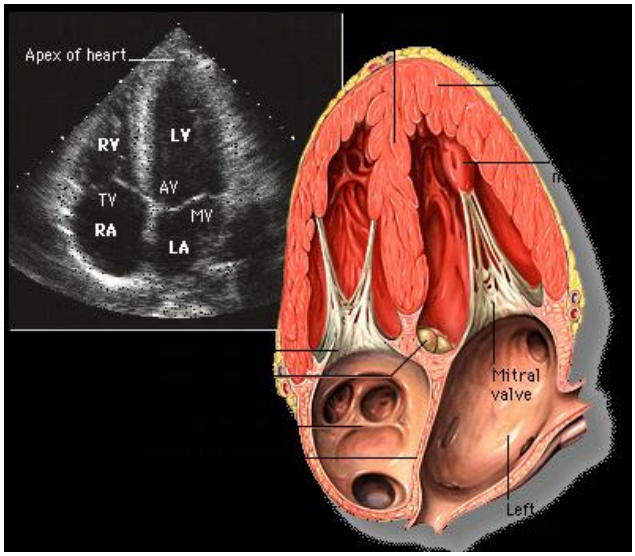
The right parasternal window is ‘optional’ but can be useful for assessing flow in the ascending aorta. With the patient lying on their right-hand side, place the probe to the right of the sternum in the third intercostal space (some adjustment may be required, as with the left parasternal window) and angle the probe downwards and pointing towards the heart. It is a challenging view, but it may be possible to visualize the ascending aorta and assess colour Doppler within it. This view is most useful for undertaking CW Doppler assessment of the aortic valve, particularly with a standalone pencil probe. .(Feigenbaum2010)

2.1.7.6.6 Apical window.

The apical window is located at the LV apex. This is normally in the mid-clavicular line and the fifth intercostal space, but may be displaced downwards and to the left if the heart is enlarged. From the apical window a number of views can be obtained. .(Feigenbaum2010)

2.1.7.6.6.1 Apical 4-chamber view:

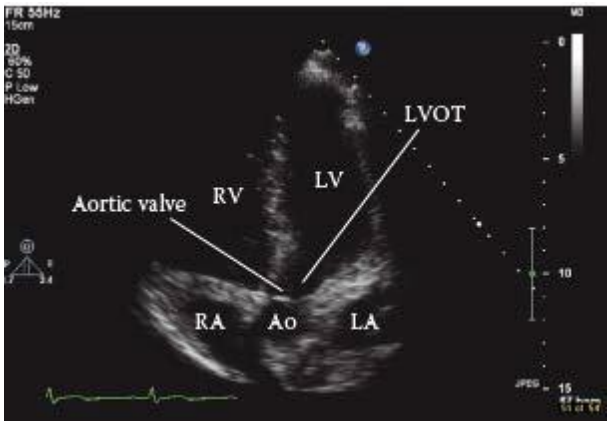
To obtain this view, place the probe in the apical position with the ‘dot’ pointing towards the patient’s left. For an optimal view, aim to position the probe exactly at the apex to avoid distortion or foreshortening of the cardiac structures. The interatrial and interventricular septa should be in line with the probe and lie vertically on the screen (Fig. 2.37). .(Feigenbaum2010)



Figure(2. 21) Normal apical 4-chamber view.(Feigenbaum2010)

2.1.7.6.6.2 Modified apical 4-chamber view:

To obtain an optimal view of the right heart, it is best to slightly adjust the standard apical 4-chamber view to centre the right heart on the screen and to ensure that there is no foreshortening. This is known as the 'modified' apical 4-chamber view.(Feigenbaum2010)

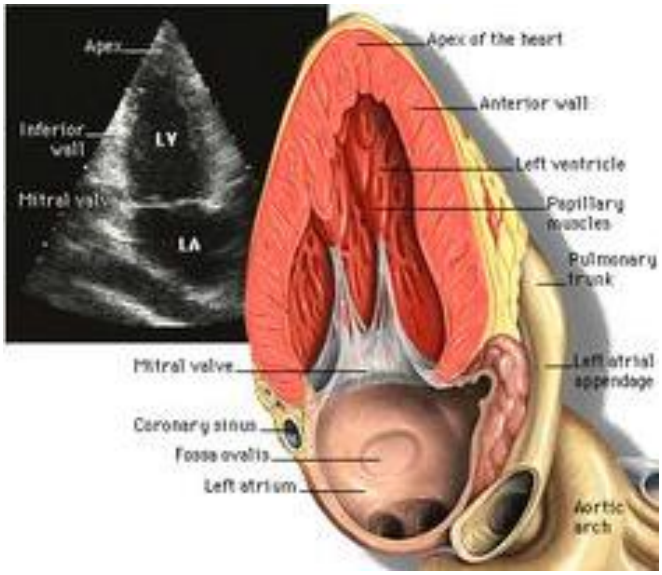


Figure(2. 22) Normal apical 5-chamber view(Andrew, Houghton2002)

2.1.7.6.6.3. Apical 2-chamber view:

Return to the apical 4-chamber view and maintain the same window but rotate the probe about 60° anticlockwise so that the 'dot' points approximately towards the patient's left shoulder. Stop rotating the probe before the LVOTcomes into view,

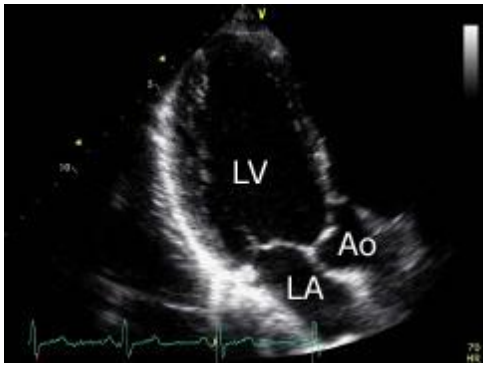
and ensure that the mitral valve is centred in the image (Fig. 2.39). .(Feigenbaum2010)



Figure(2. 23) Normal apical 2-chamber view.(Feigenbaum2010)

2.1.7.6.6.4 Apical 3-chamber (long axis) view:

From the apical 2-chamber view, maintain the same window but rotate the probe a further 60° anticlockwise so that the 'dot' now points approximately towards the patient's right shoulder. Stop rotating the probe once the LVOT comes into view, and ensure that the mitral and aortic valves are centred and not foreshortened (Fig. 2.40). This view is the apical equivalent of the parasternal LAX view. .(Feigenbaum2010)



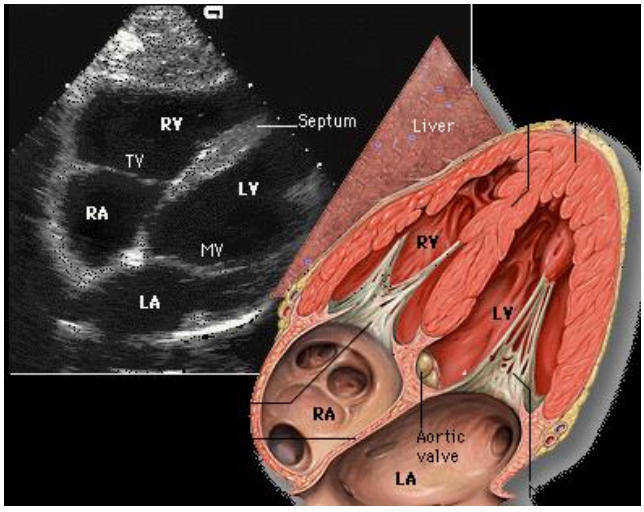
Figure(2. 24) Normal apical 3-chamber view(Andrew, Houghton2002)

2.1.7.6.7. Subcostal window:

2.1.7.6.7.1 Subcostal long axis view:

The subcostal window is obtained with the patient lying supine with their arms by their sides. It is important that the abdominal wall is relaxed, and asking the patient to lie with their knees bent can help this. Place the probe just below the xiphisternum and angle it up towards the heart, with the ‘dot’ to the patient’s left. From the subcostal window a number of views can be obtained.

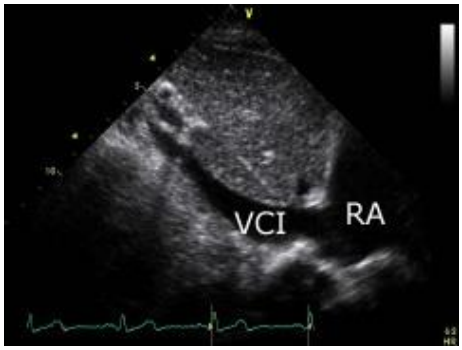
To optimize this view, ensure that the interatrial septum is perpendicular to the ultrasound beam (i.e. lies horizontally across the screen) with no foreshortening of the chambers (Fig. 2.41). .(Feigenbaum2010)



Figure(2. 25) Normal subcostal long axis view.(Feigenbaum2010)

2.1.7.6.7.2 Subcostal short axis view:

Keeping the probe in the subcostal window rotate the probe 90° to obtain a SAX view(***2.42***)



Figure(2. 26) Normal subcostal short axis(Andrew, Houghton2002)

2.1.7.6.8 Suprasternal window:

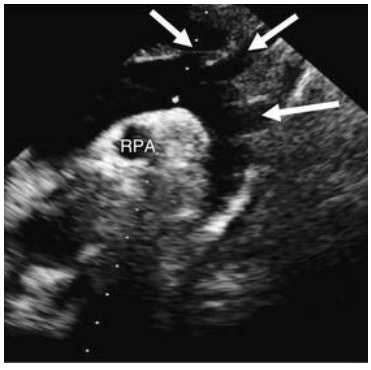
The suprasternal window is located in the suprasternal notch. Ask the patient to lie supine and to raise their chin. Place the probe in the notch and angle it downwards into the chest. Be mindful that some patients find this uncomfortable. This view shows the aortic arch in LAX (Fig. 2.43). A similar view can, if needed, be obtained from the right supraclavicular position. .(Feigenbaum2010)

2.1.7.6.8.1 Aorta view:

Use 2D to assess the appearances and dimensions of the aortic arch.

Use colour Doppler to assess flow in the aorta, looking in particular for evidence of coarctation or persistent ductusarteriosus.

Use CW Doppler to: Assess flow in the descending aorta in the presence of a coarctation (it may be better to use a non-imaging ‘pencil’ probe if alignment is difficult using an imaging probe). .(Feigenbaum2010)



Figure(2. 27) Normal suprasternal aorta view(Andrew, Houghton2002)

The transthoracic echo report:

Once you've completed the echo study, ensure that the report is written up on the same day. Structure your echo report clearly and systematically, ensuring it contains the Patient identifying and demographic information ,Detailed findings and Study summary.(Feigenbaum2010)

2.2 Previous of studies:

-A study done byJonathan,Steven in2016that there are gender differences in left ventricular (LV) systolic function, it remains unclear whether similar differences exist with regard to diastolic function. Accordingly, Doppler echocardiograms were analyzed in 515 male and 839 female, mostly treated (95%) hypertensive participants enrolled in the Hypertension Genetic Epidemiology Network (HyperGEN) study with no evidence of abnormal wall motion or significant valvular heart disease. There was no difference in age between genders, but after adjusting for age and race, men had lower body mass indexes (29.8 ± 5.2 vs 32.3 ± 7.6 kg/m^2) and heart rates (67 ± 12 vs 69 ± 11 beats/min) and higher systolic and diastolic blood pressures (BP) than women (134 ± 20 vs 130 ± 21 and 80 ± 11 vs 72 ± 11 mm Hg, all $p < 0.001$). LV mass/$height^{2.7}$ was slightly greater in women than in men (43 ± 10 vs 42 ± 9 $g/m^{2.7}$, $p < 0.05$). After adjusting for age, race, systolic BP, body mass index, heart rate, and LV hypertrophy, both mitral E-wave (70 ± 18 vs 77 ± 19) and A-wave (74 ± 15 vs 79 ± 17, both $p < 0.001$) velocities were lower in men than in women, but the mitral E/A ratio and atrial filling fraction were nearly identical in both genders. Deceleration time (221 ± 55 vs 214 ± 46 cm/s, $p = 0.018$) and isovolumic relaxation time (IVRT) were longer in men than in women (85 ± 18 vs 81 ± 17 cm/s, $p < 0.001$). Prolonged IVRT was present in more men than women (14% vs 7%, $p < 0.05$). In analyses of covariance, adjusting for age, race, systolic BP, body mass index, heart rate, and medications, male gender remained related to prolonged deceleration time and IVRT. Thus, in this population-based sample of hypertensive adults, men had evidence of slower early diastolic LV filling than women. This gender difference in diastolic function may provide insight into gender differences in congestive heart failureand other specific cardiovascular diseases.

-Jacek in 2018left ventricular diastolic dysfunction (LVDD) increases cardiovascular risk,, the aim of this study was to evaluate both the occurrence and the severity of diastolic dysfunction in a large cohort of treated hypertensives.We retrospectively analyzed records of 610 hypertensive participants of the CARE NORTH Study who consented to echocardiography and were free of overt cardiovascular disease. Mean age was 54.0 ± 13.9 years (mean $\pm$ SD), BMI $29.7 \pm 4.8\ \mathrm{kg/m^2}$. The exclusion criteria were:established heart failure, LVEF <45%, coronary revascularization, valvular defect, atrial fibrillation, or stroke. The staging of LVDD was based on comprehensive transthoracic echocardiographic measurements.high prevalence of different forms of diastolic dysfunction in treated hypertensive patients who are free of overt cardiovascular disease.

-IvarSjaastad**2010**A total of 59 patients with JDM, examined a median 16.8 years (range 2–38 years) after disease onset, were compared with 59 age-matched and sex-matched controls. Echocardiography, including early diastolic transmitral flow/early diastolic tissue velocity (E/E') as a marker for diastolic dysfunction, and 12-channel ECG were performed and analysed blinded to patient information. Disease activity and damage were assessed by clinical examination at follow-up and chart review.patients with JDM and no controls had subclinical left ventricular diastolic dysfunction; the patients with elevated E/E' also had high prevalence of pathological ECG and hypertension. High disease activity 1-year post diagnosis predicted high E/E' at follow-up. The findings suggest that subclinical heart disease is related to the systemic nature of JDM.

-Hee Kim **in 2015**Left ventricular hypertrophy and diastolic dysfunction in children and adolescents with essential hypertension tend to be underdiagnosed. A total of 38 Korean subjects aged 9–19 years without secondary causes of

hypertension were reviewed. Ambulatory blood pressure monitoring was done in the 38 subjects to diagnose hypertension and gain the information of blood pressure pattern. The subjects were divided into two groups: a group with elevated blood pressure (BP) index ($n = 29$) and a group with normal BP index ($n = 9$). Two-dimensional ultrasound with M-mode imaging and tissue Doppler imaging were performed to measure left ventricular mass index and to assess the left ventricular diastolic dysfunction.Left ventricular mass index is significantly correlated with body mass index in children and adolescents with essential hypertension, and the diastolic dysfunction could be in higher risk in subjects with left ventricular hypertrophy.

-Young-Hwa Kong[1], **Methods** A random selection of 1296 individuals free from known CVD, hypertension and diabetes were examined with echocardiography at baseline of the third Nord-Trøndelag Health Study, (HUNT3, 2006–2008). The primary outcomes were LV diastolic function (e′) and LV systolic function (longitudinal global strain). The primary exposures were self-report on the Hospital Anxiety and Depression Scale (HADS). Associations between outcomes and baseline exposures were available for 1034 (80%), and with previous and repeated exposures for 700 participants who also participated in HUNT2 (1995–1997).In a healthy sample, confirmed free of CVD, past and repeated depression symptoms were associated with subclinical LV dysfunction. Thus, depression symptoms might represent a modifiable risk factor for future CVD.

-Kazuhirdiastolic function in2005 hypertensive patients with preserved left ventricular function, particularly focusing on the limitation of the transmitral flow velocity curve alone to detect diastolic dysfunction.

Comprehensive Doppler analysis was performed in 51 hypertensive patients with preserved left ventricular systolic function.The presence of diastolic dysfunction has been frequently overlooked in hypertensive patients with transmitral Doppler

analysis alone, and an assessment of diastolic function with a comprehensive Doppler analysis is needed in patients at risk for diastolic dysfunction

CHAPTER THREE

Material and Methods

Chapter Three

Material and Methods

3.1 Materials:

The study intended to evaluation the left ventricular diastolic dysfunction in Hypertensive patient. This study was done in Omdurman military hospital. The data has been collected from September to November 2018.

3.1.1 Subjects:

Study cases were 50 patients (28 males and 22 females) with known history of Hypertensive.

3.1.2 Machine used:

All patients where scanned on Mylab40 U/S machine using sector low resolution probe (1.5-7MHZ) is essential when assessing the structures of the heart. Use 2D , PW Doppler and M mode to assess all structures of the heart with measurement.

Figure (3. 1) Mylab 40 U/S machine

3.2 Method:

Technique used:

Patients attending for an echo study may feel anxious, not only about having the test itself but also about any abnormalities that it may reveal. To help reduce anxiety, describe the test to patients in clear and reassuring terms – explain to

patients why they are having an echo, whether any special preparation is needed before they attend, what happens during the scan and how long it is likely to take.
Reassure patients that having an echo is safe and painless. Patients can eat and drink normally before attending for a standard TTE, and they can take their medication as usual.
To assess left ventricle inflow, perform PW Doppler in the apical 4-chamber view with a 1–3mm sample volume placed at the tips of the mitral valve leaflets. and M mode to assess all structures of the heart with measurement. Once you've completed the echo study, ensure that the report is written up on the same day. Structure your echo report clearly and systematically, ensuring it contains the Patient identifying and demographic information ,Detailed findings
and Study summary.

3.2.2 Data collection:

Data were collected using special designed data collection sheet to cover objective of the study.

3.2.3 Data analysis:

Data were analyzed in frequency distribution; mean and standard deviation were obtained. Crosstabulation between variables was performed. All statistical analysis was performed using SPSS version 19.

CHAPTER FOUR

Results

Chapter Four

Results

4.1 Results:

Table (4. 1) frequency distribution of age group

Age group	Frequency	Percent	Valid Percent	Cumulative Percent
30-45 years	12	24.0	24.0	24.0
46-60 years	20	40.0	40.0	64.0
61-75 years	18	36.0	36.0	100.0
Total	50	100.0	100.0	

Minimum = 30 ,maximum = 45, means= 55.44,st.d deviation =12.05

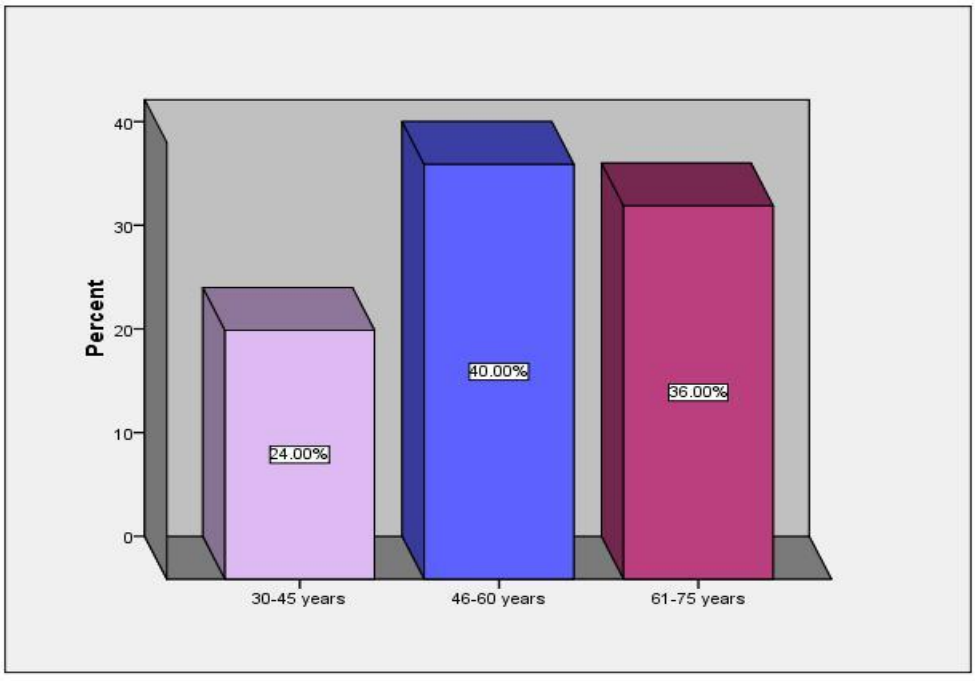


Figure (4. 1) frequency distribution of age group

Table (4. 2) frequency distribution of gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
female	22	44.0	44.0	44.0
male	28	56.0	56.0	100.0
Total	50	100.0	100.0	

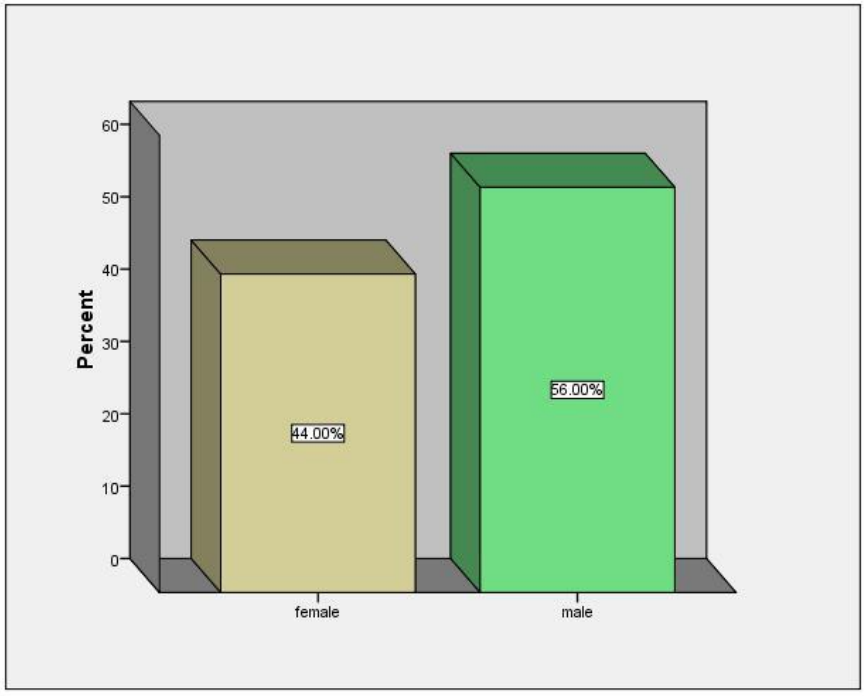


Figure (4. 2) frequency distribution of gender

Table (4. 3) frequency distribution of control

Control	Frequency	Percent	Valid Percent	Cumulative Percent
yes	38	76.0	76.0	76.0
no	12	24.0	24.0	100.0
Total	50	100.0	100.0	

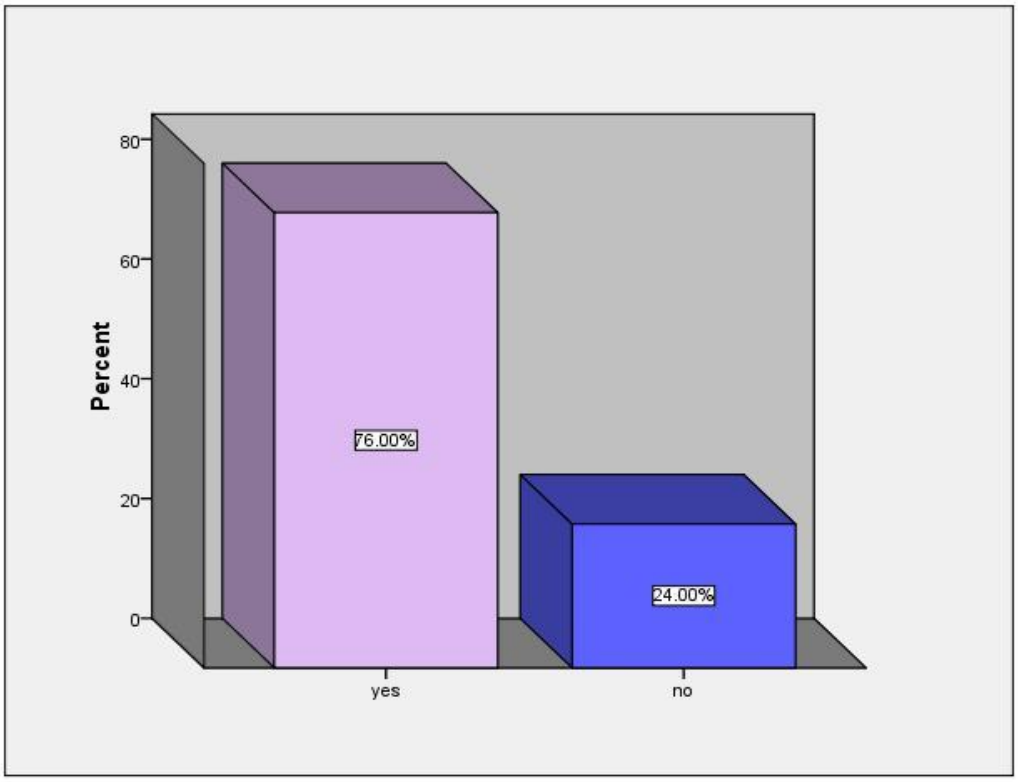


Figure (4. 3) frequency distribution of control

Table (4. 4) frequency distribution of duration

Duration \years	Frequency	Percent	Valid	Cumulative
			Percent	Percent
1	4	8.0	8.0	8.0
2	9	18.0	18.0	26.0
3	7	14.0	14.0	40.0
4	7	14.0	14.0	54.0
5	5	10.0	10.0	64.0
6	1	2.0	2.0	66.0
7	1	2.0	2.0	68.0
8	3	6.0	6.0	74.0
9	1	2.0	2.0	76.0
10	4	8.0	8.0	84.0
11	2	4.0	4.0	88.0
12	3	6.0	6.0	94.0
14	2	4.0	4.0	98.0
15	1	2.0	2.0	100.0
Total	50	100.0	100.0	

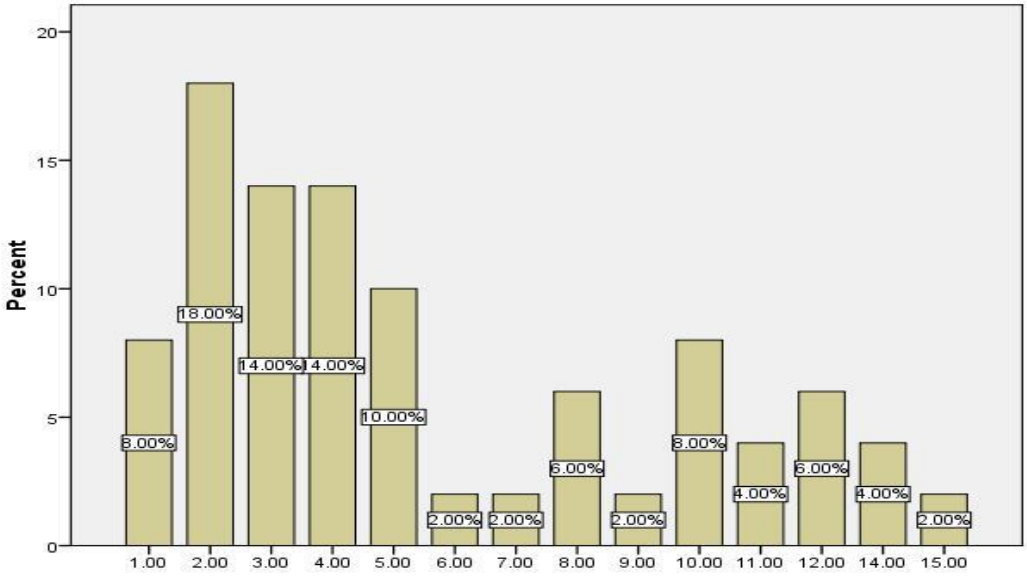


Figure (4. 4) frequency distribution of duration

Table (4. 5) frequency distribution of duration in range

Duration in range	Frequency	Percent	Valid Percent	Cumulative Percent
1-5 years	32	64.0	64.0	64.0
6-10 years	10	20.0	20.0	84.0
11-15 years	8	16.0	16.0	100.0
Total	50	100.0	100.0	

Minimum =1, maximum=15, means=5.66, std. deviation =4.00

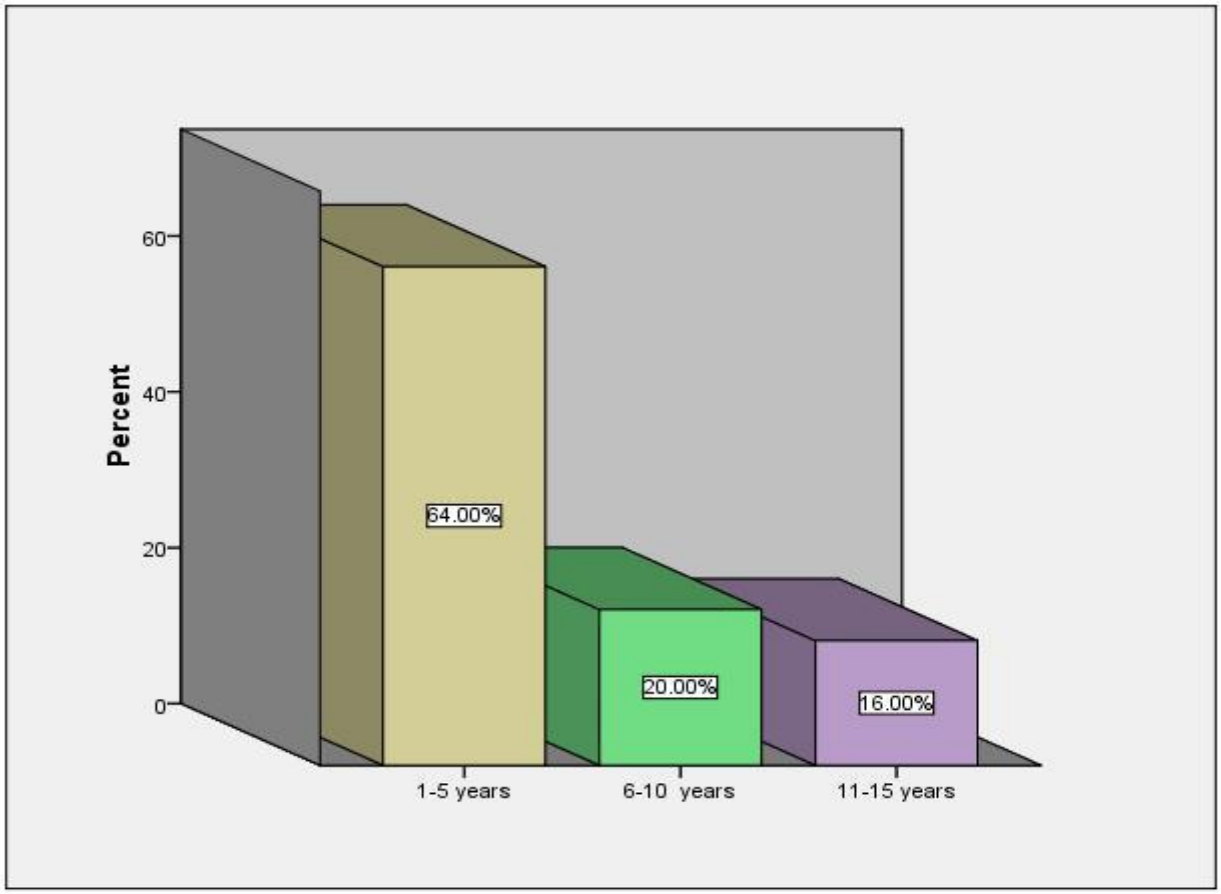


Figure (4. 5) frequency distribution of duration in range

Table (4. 6) frequency distribution of finding

Finding	Frequency	Percent	Valid Percent	Cumulative Percent
grade 1	15	30.0	30.0	30.0
grade2	21	42.0	42.0	72.0
normal	14	28.0	28.0	100.0
Total	50	100.0	100.0	

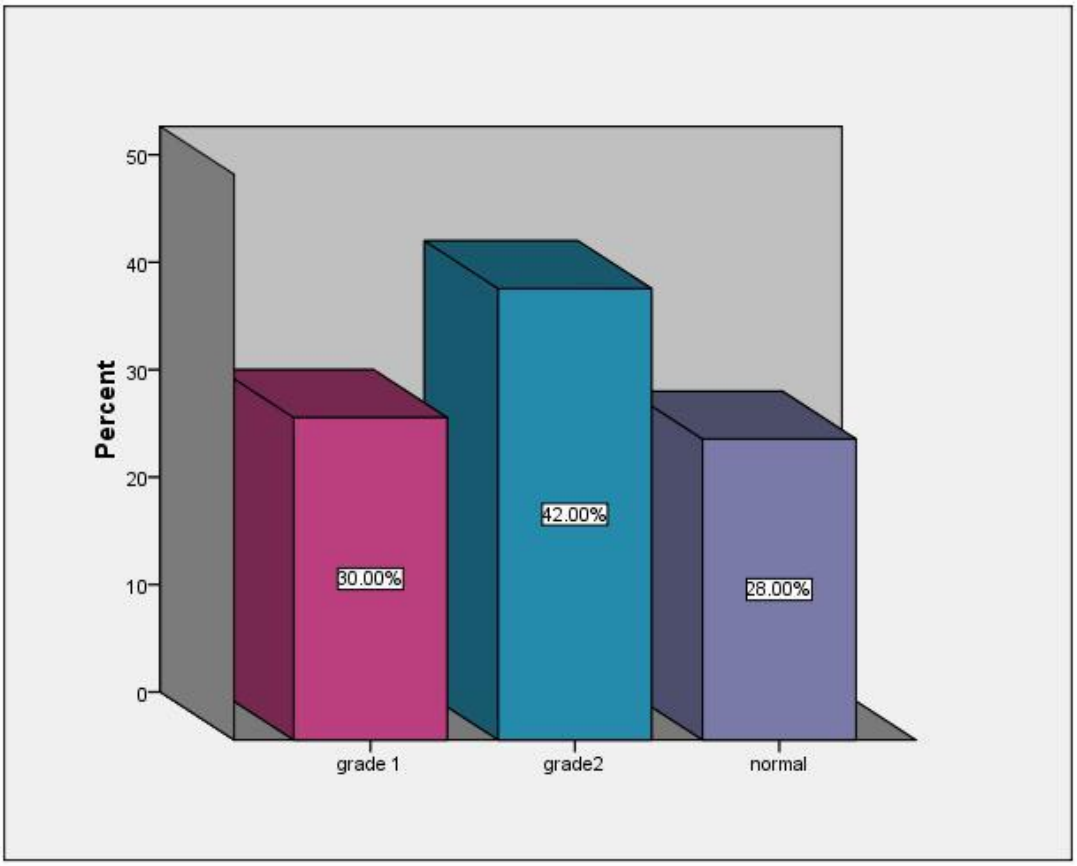


Figure (4. 6) frequency distribution of finding

Table (4. 7) cross tabulation finding and gender

Gender		finding		Total
	grade 1	grade2	normal	
female	4	13	5	22
male	11	8	9	28
Total	15	21	14	50

P value= 0.084

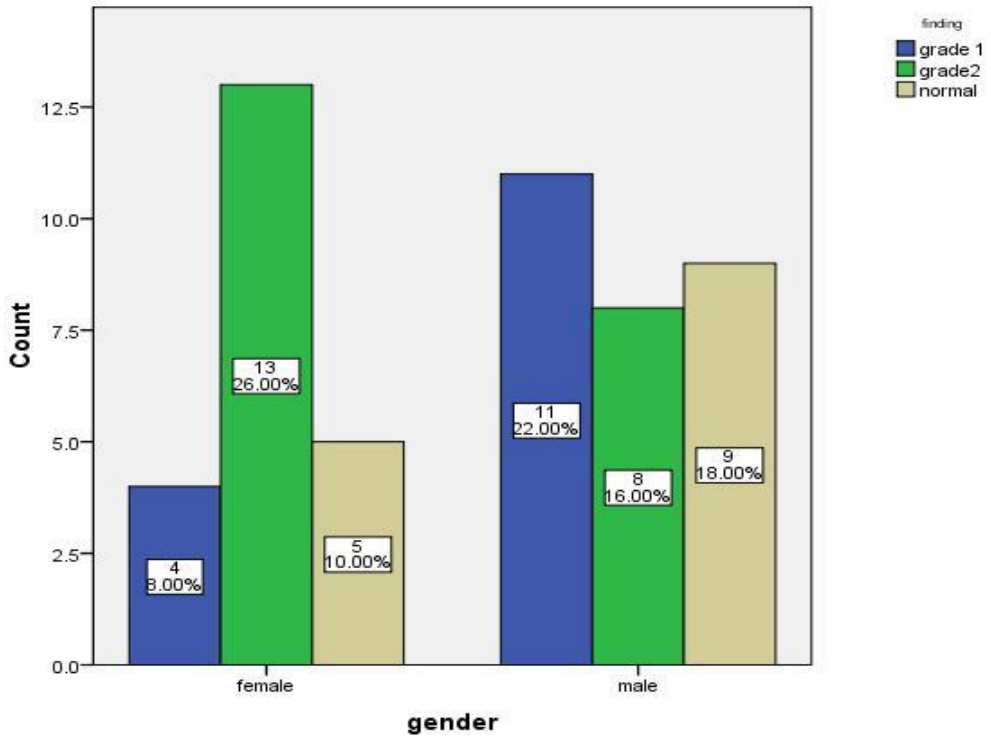


Figure (4. 7) cross tabulation finding and gender

Table (4. 8) cross tabulation finding and duration

Duration			finding		Total
	grade 1		Grade 2	normal	
1-5 years		10	10	12	32
6-10 years		4	6	0	10
11-15 years		1	5	2	8
Total		15	21	14	50

P value =0.113

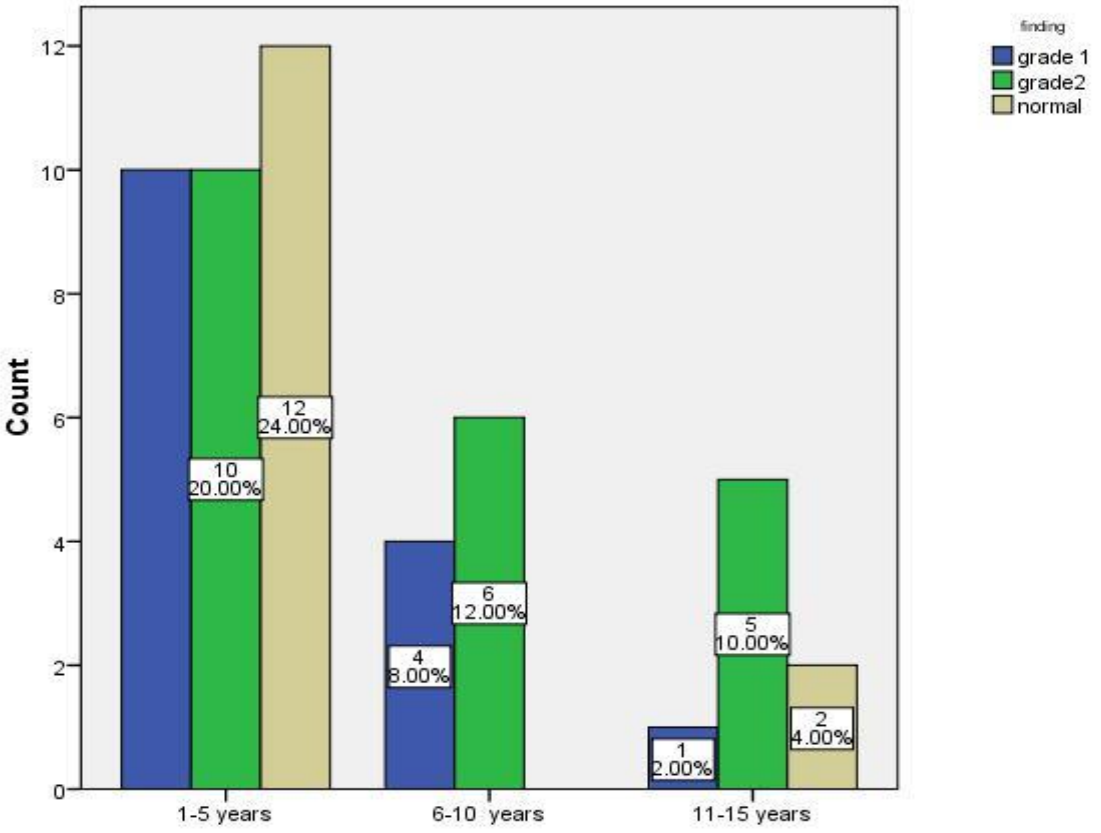


Figure (4. 8) cross tabulation finding and duration

Table (4. 9) cross tabulation finding and control

Control		finding		Total
	grade 1	Grade 2	normal	
yes	13	11	14	38
no	2	10	0	12
Total	15	21	14	50

P value = 0.003

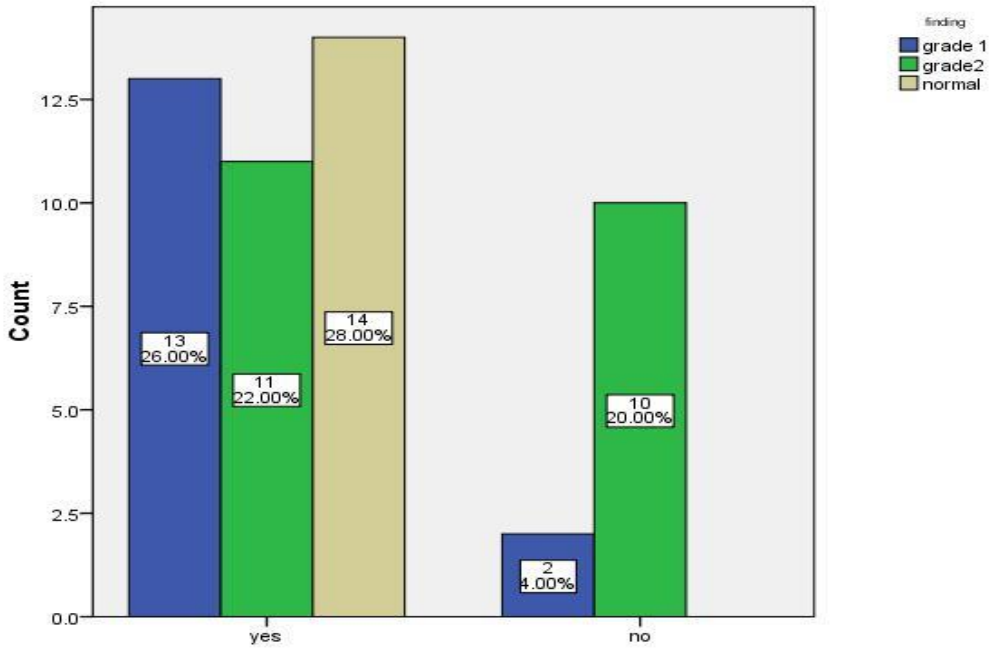


Figure (4. 9) cross tabulation finding and control

Table (4. 10) cross tabulation finding and age group

Age group			finding		Total
	grade 1		Grade 2	normal	
30-45 years		3	1	8	12
46-60 years		7	7	6	20
61-75 years		5	13	0	18
Total		15	21	14	50

P value =0.001

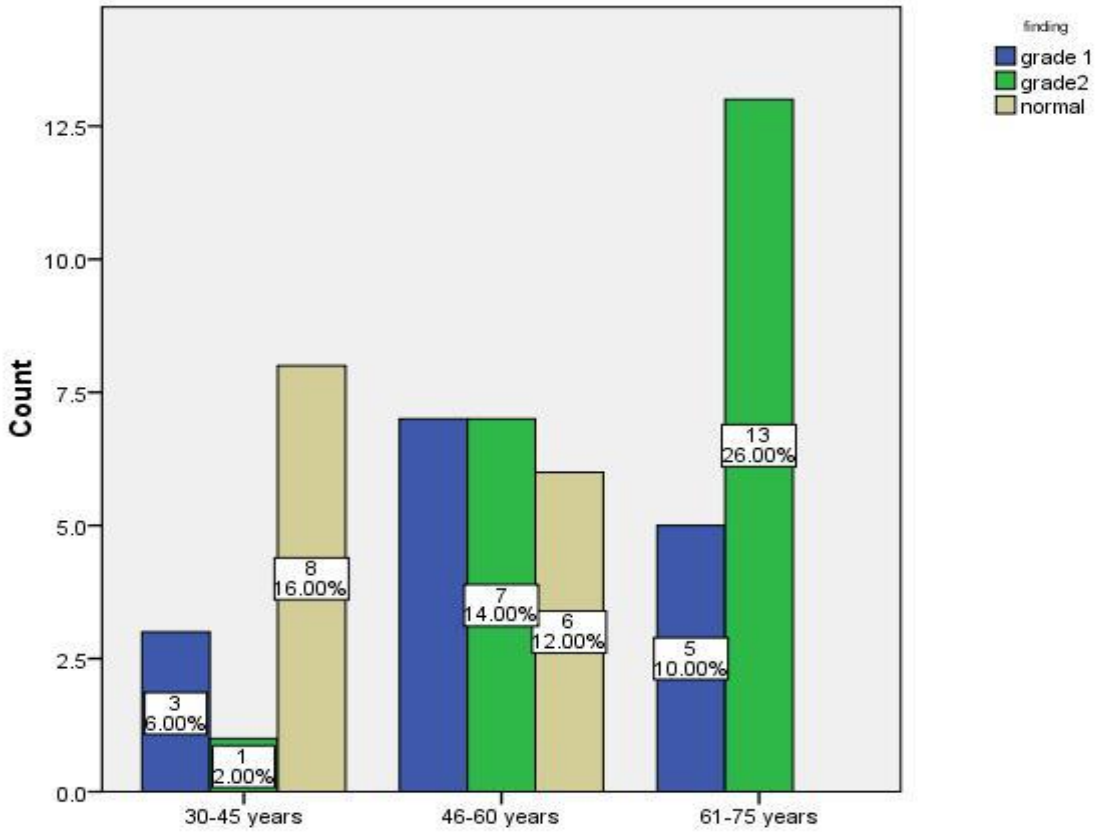


Figure (4. 10) cross tabulation finding and age group

Chapter Five

Discussion, Conclusion and Recommendation

Chapter five

Discussion, Conclusion and Recommendation

5.1 Discussion

This is prospective study was done to evaluate the left ventricle diastolic dysfunction in hypertensive patients using echocardiography.this study determine the relationship between age, sex,duration time, treatment controlled and the stage of diastolic dysfunction .

The study group consisted of fifty (50) patients, aged between 30-75 years old with mean age 55±12.05 years old. The study population was divided into three age groups, 12 patients from 30-45 years old (24%), 20 patients aged between 46-60 years old (40%).and the last group aged between 61-75 years old consist of 18 patients (36%) as described in table (4.1).

The study population consist of 28 males (56%), and 22 females (44%) as described in Table (4.2).

The study noted that 38 patents control their hypertention (76%), while 12 patients (24%) were not using drugs (Table 4.3).

Duration of hypertension was studied , the maximum duration noted was 2 years (18%), while the minimum duration noted was 6 years, 7 years, 9 years and 15 years ,all of them with the same number of patients (2%) as shown in table (4.4)

The minimum hypertention duration was 1 year while the maximum was 15years, with mean duration of 5.6±4 years .The duration of hypertention was divided into three groups, 32 patients were suffer from hypertention from 1-5 years (64%), 10 patients suffer of hypertention for 6-10 years (20%), 8 patients were suffer for 11-15 years (16%) as shown in table (4.5).

Table (4.6) show the frequency distribution of finding, it was found that 14 patients were normal (28%), while 15 patients (30%), 21 patients (42%) were with grade 1 and grade 2 diastolic dysfunction respectively.

The study correlate between gender and findings, it was found that there is no significant different between them (p value= 0.084).11 males were with grade 1, 8 were with grade 2, while 9 patients were normal. 4 females were with grade 1, 13 females with grade 2,while 5 females were normal (Table 4.7).

The study also correlate between findings and duration, it was found that there is no significant different between them (p value=0.113). 12 patients wree normal, 10 patients were with grade 1, while 10 were with grade 2 , these patients had hypertention for 1-5 years. 10 patients were hypertensive for 6-10 years, 4 of them were with grade 1 while 6 were with grade 2 diastolic dysfunction.8 patients were hypertensive for 11-15 years, 2 of them were normal, 1 was with grade 1 while 5 were with grade 2 diastolic dysfunction (Table 4.8).

The study correlate between age group and findings, it was found that patients from 30-45 years were 12 patients , 8 of them were normal , 3 with grade 1, while patient was with grade 2 diastolic dysfunction. Patients who aged from 46-60 years , 6 of them were normal, 7 with grade 1, while 7 were with grade 2 diastolic dysfunction. Patients who were aged between 61-75 years were 18 patients , 5 of them were with grade 1, while 13 were with grade 2 diastolic dysfunction as shown in table (4.9). the study also found that there is significant different between age group and findings (p value=0.01).

5.2 Conclusion;

The prevalence of left ventricular diastolic dysfunction in patients with hyper tention without significant coronary artery disease is much higher than previously suspected as evidenced by the results of this study and also of similar other studies. LV diastolic dysfunction correlated with duration ofhyper tention s, age, and LVH. Echocardiography with measurements of diastolic functional parameters appears to be a sensitive noninvasive method for evaluating the manifestation and course of earlyhyper tention cardiomyopathy. Early diagnosis and institution of treatment for LVDD inhyper tention patients will reduce the morbidity and improve the outcomes by preventing future development of heart failure.

5.3 Recommendation;

The echocardiography is very effective and accurate, it must be used as the first tool.

Improve health through healthy food choices and physical activity.

Making lifestyle changes and taking prescribed medicines can help to prevent or control many risk factors 0f DHD.

Prevent and treat the chronic complications of hyper tention. Modify nutrient intake and lifestyle as appropriate for the prevention and treatment of obesity, dyslipidemia, cardiovascular disease, daibatic, and nephropathy.

follow the treatment plan and the doctors advises may help to avoid or delay serious problems, such as a heart attack or heart failure

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Appendices

Appendix (A) Data sheet

No	Age	Sex	Duration	Controlled treatment	Stage of diastolic dysfuntion

Appendix (B) **Ultrasound images:**

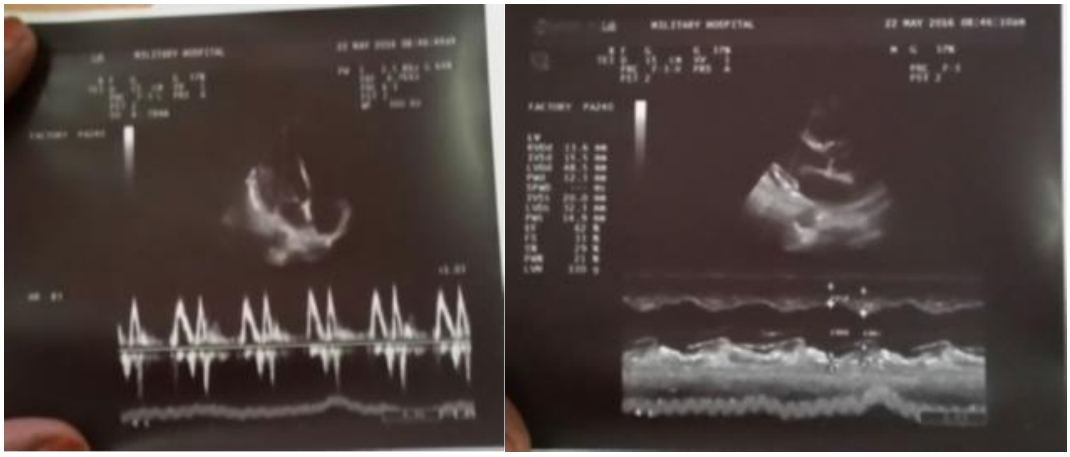

Image 1: female 58, LVDD, LVH

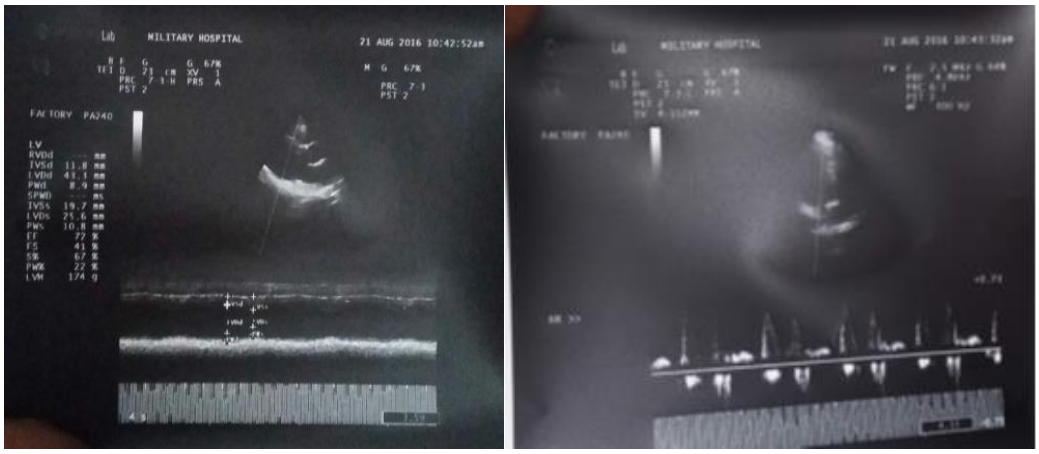

image 2; male 58 **LVDD**

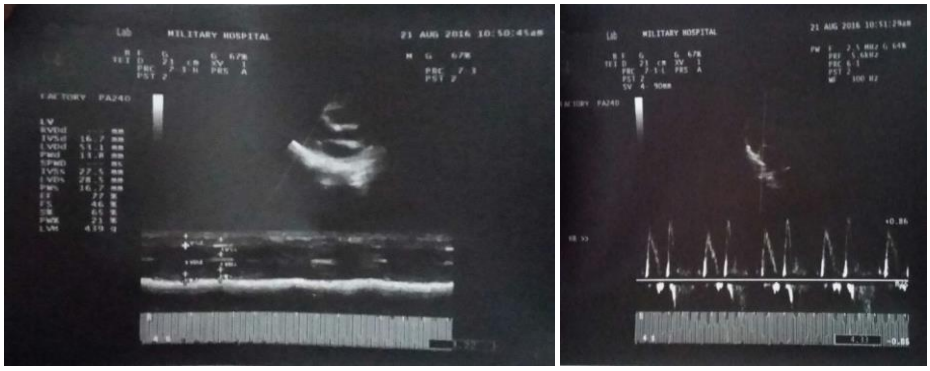

Image3: male 65, LVDD, LVH

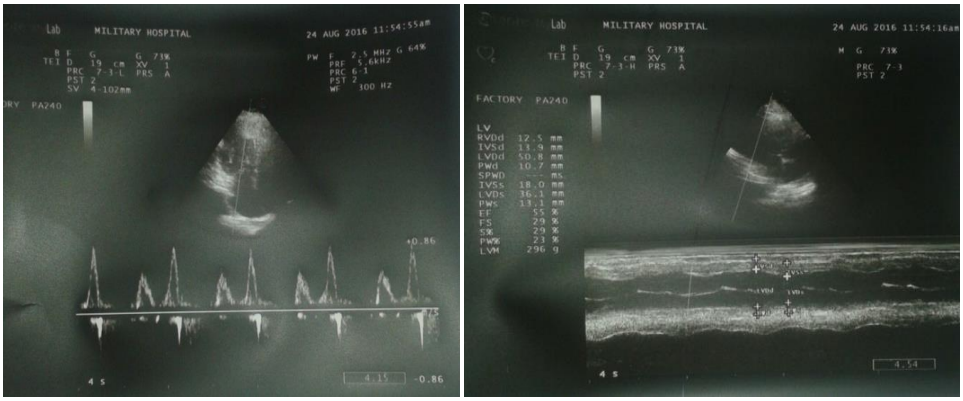

Image4: female 65, LVDD, LVH

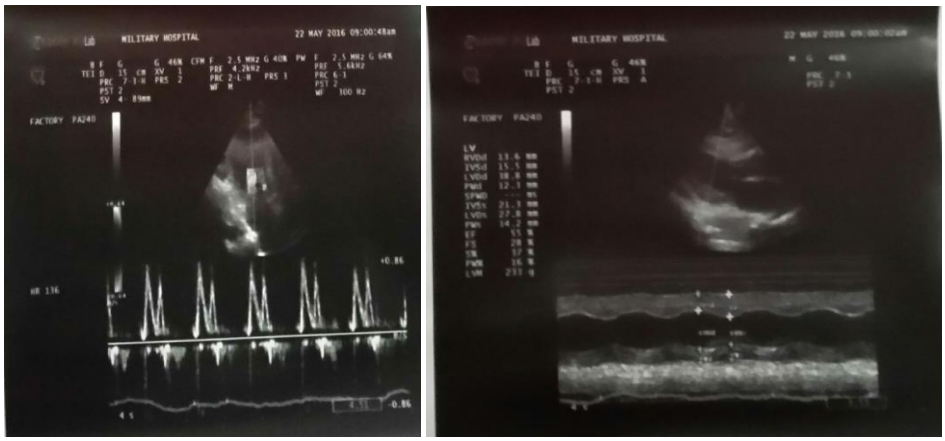

Image5:female 85, LVDD, LVH