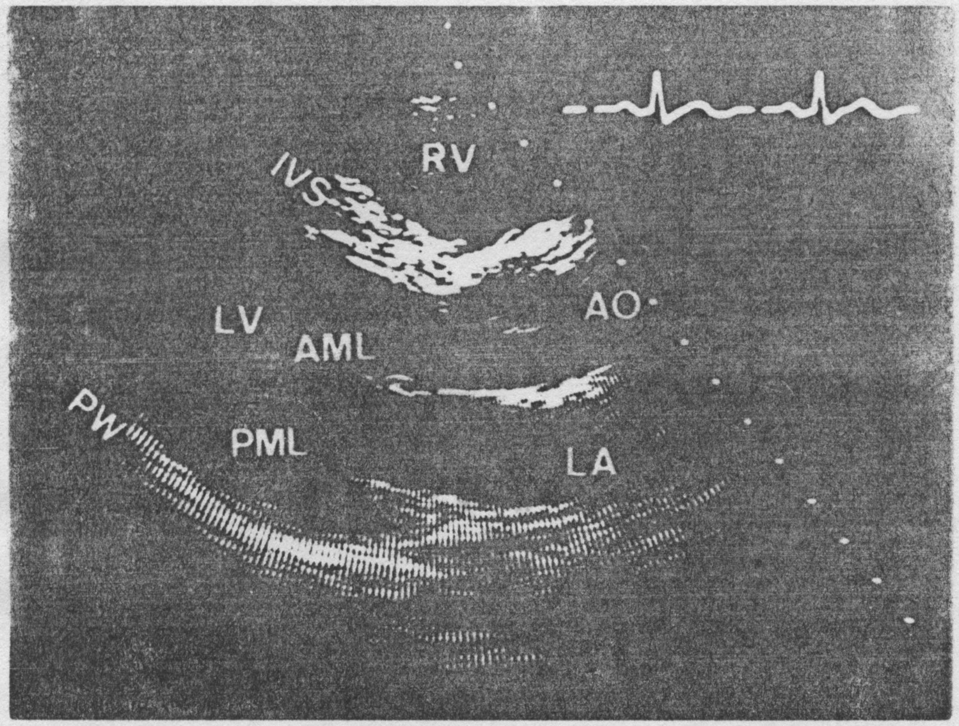
# THE ROLE OF ECHOCARDIOGRAPHY IN THE DIFFERENTIAL DIAGNOSIS OF THE LARGE HEART (CARDIOMEGALY)



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A dissertation submitted for the Degree of Master of Medicine (Division of internal Medicine)

UNIVERSITY OF ZAMBIA MARCH 1985

CONTENTS

## APPROVAL

This dissertation of WILFRED MISAWA MWANSA is approved as fulfilling part of the requirements for the degree of Master of Medicine by the University of Zambia.

Signed: ..................... Date: 11/7/87

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I WILFRED MISAWA MWANSA

SOLEMNLY SWEAR THAT THE

WORK CARRIED OUT IN

THIS DISSERTATION

HAS NEVER BEEN

PUBLISHED ELSEWHERE BEFORE

SIGNED:

ACKNOWLEDGEMENTS

I am indebted to Dr N Wadhawan (Consultant and Head of Department of Medicine, and a highly respected Senior Colleague) for his guidance throughout the last six years we have worked together and for constructive criticism while doing this work.

I wish to thank the Ultrasound team of George Msapenda, Drs Czary Tanawski and Hubert De Baetselier for helpful discussions on some of the problems of tropical cardiology. The patience and encouragement of my wife Ruth and the children during my career cannot go without notice.

I dedicate the work to our master "THE PATIENT" for whatever we do, he must always remain central.

Many thanks to Ms E M Kapenda for secretarial services.

ABSTRACT

The differential diagnosis of a large heart is a common clinical problem.. Clinicians rely primarily on routine chest X-Rays for the estimation of cardiac size. The accuracy of this technique is however very limited mainly because only the external borders of the heart are visualized. Determination of chamber size is not possible with ordinary chest X-Rays.

Reliance is entirely placed on the changes of one or two border forming walls of the chambers. For example, the estimation of the Left Ventricle is at best a very gross measurement. A radiologically large heart may be due to dilatation or hypertrophy secondary to valvular , congenital, myocardial ischemia or hypertensive heart disease. A heart may appear large because of pericardial effusion or pericardial mass or aneurysm of the left ventricle

Clinical examination with the help of a chest X-Ray complemented by a 12 lead ECG usually helps to narrow the diagnostic list, but one still remains very uncertain about the nature of the disease and which lumen or chamber is responsible for cardiomegaly.

Investigative facilities such as angiography and cardiac catheterization and pericardiocentisis are very invasive. Skills and facilities for angiography and catheter studies are not common in the third world though they are essential to establish the diagnosis in cardiac haemodynamics.

Echocardiography obviates the need for invasive investigations. It is possible to evaluate the size of chambers and functional anatomy of the heart without a single needle prick to the patient.

## A I M S

1. Assess Role of Echocardiography in the differential diagnosis of CARDIOMEGALY (the Radiologically BIG HEART).

2. Work out normal values in the local population (because Echocardiography is being introduced for the first time in Zambian clinical cardiology)

3. Assess acceptability among patients in the University Teaching Hospital.

# C H A P T E R I

## INTRODUCTION, BRIEF REVIEW OF LITERATURE AND BASIC PRINCIPLES OF ULTRASOUND UTILIZATION IN ECHOCARDIOGRAPHY

Von Kiedel in 1950 from studying the natural phenomenon of sonar used by bats and some animals to locate sound, and in location of underwater submarines and underwater bases, discovered cardiac ultrasonography. It was not until 1950 however that Edler and Hertz applied the idea to clinical medicine. By applying a transducer on the chest wall to the precordium they were able to characterise the movements of the mitral valve both in health and pathology.

This was followed by a plethora of reports that in fact echocardiography could be used to characterise not only valvular movement velocities but also different cardiac chamber sizes and evaluate ventricular function in different disease states in a non-invasive accurate and reproduceable manner. These reports provoked worldwide interest in the subject. They lead to the unprecedented growth in this technology. By 1970 using electronic advances two dimensional echocardiography was born which has since been extended to Doppler Echocardiography and now three dimensional visualization of cardiac structures.

To be able to record and interpret correctly, the physician or Echocardiographer (Technician) ought to be familiar with the basic physical principles of ultrasound used in echocardiography. This is a technique which employs ultrasound frequencies beyond the audible range of 20,000 cycles per second. Ultrasound in million cycles per second easily obeys two physical principles of reflection (turning backwards) and refraction (bending) when it meets interface between two media of differing accoustic impedance (different densities), the reflected sound (popularly known as echoes) traces the path backwards to source and the greater the accoustic mismatch between the two reflecting media, the stronger the returning signal. (For instance between air and solid or solid and liquid). Ultrasound echoes exist in two forms. They are SPECULAR when they are more angle dependent. When specular echoes hit an improper angle as the situation obtains in cardiac structures or vesse walls, the reflection is stronger.

With increasing use of cross-sectional or 2D Echocardiography as well as increasing interest in examination of the myocardium, there arose a pressing need to define the second group of Echo - termed SCATTERED ECHOES. These are Echoes which originate from relatively small objects with irregular surfaces, as a result they are reflected in multiple directions, so that only a small percentage of energy returns to the transducer but they are important to record because they help in visualizing objects parallel to the main ultrasound beam such as from the lateral or media walls of the left ventricle.

Loss of ultrasound as it transverses a medium is called attenuation which is the sum total of both absorbed and reflected sounds. Absorbed and attenuated sounds constitute a half value layer or half power distance i.e. distance covered before sound energy loses its half value.

A localised object that reflects or attenuates sound may also impede its transmission and therefore create an accoustic shadow. This is an important phenomenon in echocardiography which underlies the examinations of sense structure - (calcific deposits or prosthetic valves).

TRANSDUCERS

The utility of ultrasound in Echocardiographic diagnosis became practical with the development of PIEZOELECTRIC elements. These are substances that can change shape in an electric field. An electric current impressed through a quartz crystal changes its shape according to polarity. The crystal expands and contracts producing a series of compressions and rarefaction sending away a pulse of sound waves which when reflected as echoes hit the source and in turn produce an electrical impulse which can be recorded. Thus piezoelectric elements act both as transmitters and receivers.

Commercial transducers use ceramics such as Barium Tetanate or lead Zirconate Titanate as piezoelectric elements. Returning echoes are recorded on the oscilloscope of the echograph. Time is then converted to distance automatically.

The essential components of an echocardiographic machine therefore are:

1. TRANSDUCER which sends and receives the ultrasound.

2. THE TRANSMITTER which regulates the sensing of ultrasound by way of a timer. The timer controls frequency and duration of emitted ultrasound pulses to the transmitter and their conversion to electrical impulses which in turn go to the:

3. RECEIVER and signal amplifier where they are processed and displayed on the oscilloscope as images. (The engineering and physics involved are beyond the scope of this dissertation.

IMAGE PRESENTATION

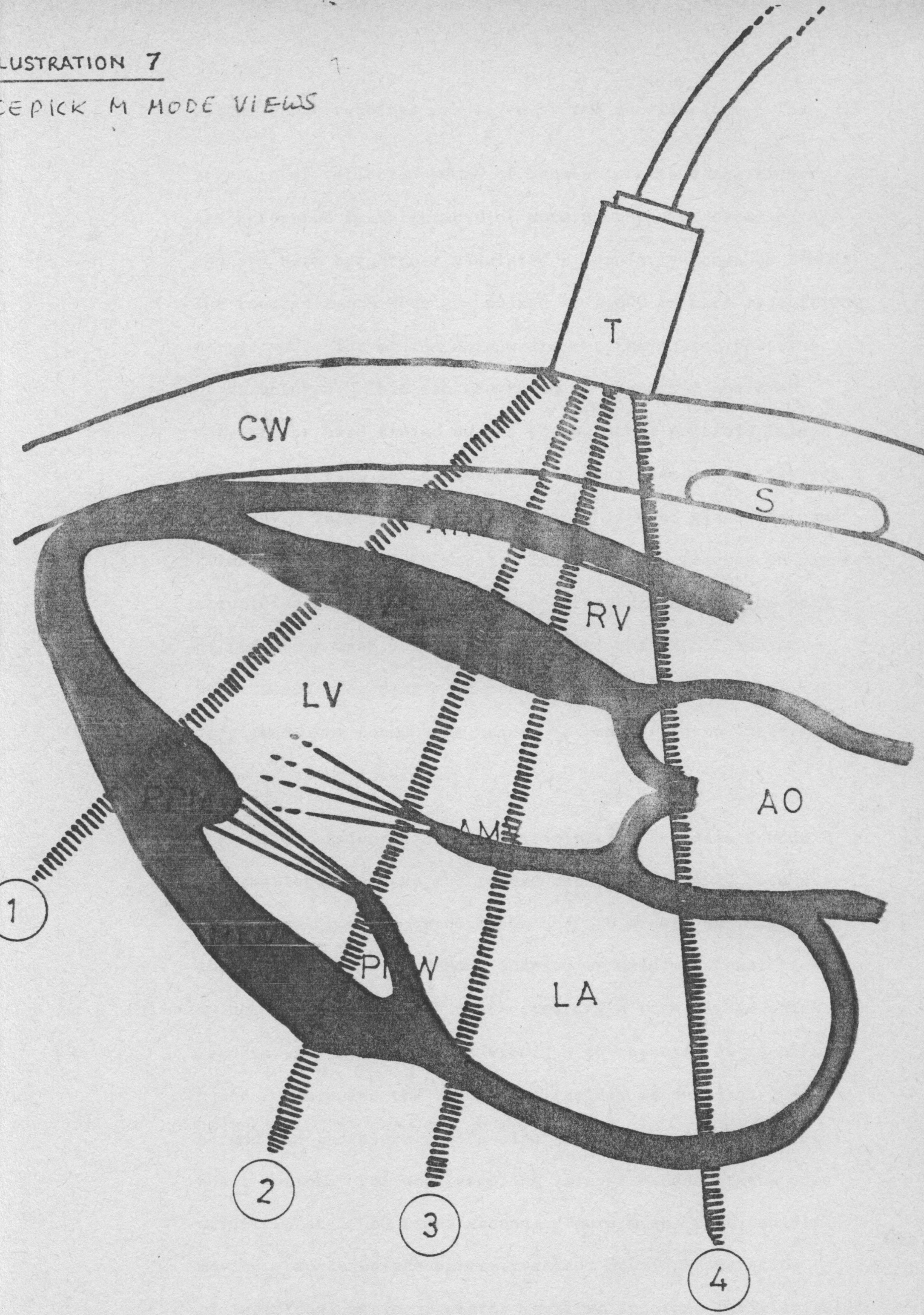
Images in Echocardiography are recorded both in M-Mode and two dimensional (real time or simply 2D). The recent advance of extension of M-Mode to 2D is an exciting development in cardiac imaging. Both M-Mode and 2D basically rely on the transmission of short pulses of high frequency ultrasound (typically in magartz) (1.5-5s MHZ).

The Echographs are calibrated electronically, converting elapsed time of both transmission and reception of each echo into measurements of distance between transducer to reflecting surfaces and back. The speed of sound transmission is assumed to be constant, so that a single set of depth readings or distance measurements are simply made relative to time.

The building block, therefore of both M-Mode and 2D is a

LUSTRATION 7

CEPICK M MODE VIEWS




M-Mode examination cross sectional view of the Heart structures through which the ultrasound beam passes as it is directed from apex to base (Feigenbaum H) clinical application of Echocardiography PCVD - 14 531.

set of depth readings displayed on the oscilloscope. The

strength of reflected sound of echoes in both modalities are presented by brightness of dots on the same oscilloscope and are both brightness modulated - popularly known as B-mode. The records for M-Mode are pulsed at 1,000 or more repetitions per second. The moving dots write out the motion patterns of structures. This can be traced on the strip chart or obtained as hard copies on the photographic polaroid films or by a freezing device left on the oscilloscope for further scrutiny. This tracking of movements is what gives the name "Time Mode or simply M-Mode". The recording focuses on discreet structures but may pick up any other structures in the path of the sound beam. It is hence called UNIDIMENSIONAL or ICEPICK and accordingly if other structures have to be icepicked, the sound beam has to be redirected to interrogate other areas of interest.

The two dimensional Echocardiography uses the same M-Mode information, but here the transducer and the sound beam are automatically moved through the body to create an image plan intergrating several M-Mode icepick or unidimensional views lying in adjacent areas hence creating a total image which results into a tomographic view. With repeated ultra high sound frequencies the frames are rapidly produced at 30-60 second and therefore give a cine film or the impression of heart motion. The high sampling rate of M-Mode of the same structure at 1,000 times/second or more means that rapidly moving structures are better tracked, but interpretation of individual motion patterns requires informed familiarization through a skilled learning process. This does not in any way imply 2D is easier. Infact is a more complicated modality to master from a technical point of view.

Basic Echocardiographic Techniques

The 3rd-5th intercostal area along the left parasternal border (LSB) constitutes an accoustic window, through which Echocardiographic examination can be done with reasonable ease. Other approaches and windows have emerged especially with the advent of two dimensional techniques such as examining the heart from the apex, the subcostal of subxiphoid area, the superasternal notch, and, if need be, from analogous places on the right side of the sternum. See illustrations 1 and 2.

The physical characteristics of the sound beam from the foregoing remain common both to M-Mode and 2D.

Axial resolution: This is the ability to distinguish two neighbouring strucutres along the path of a sound beam, and lateral resolution is the same ability but for distinguishing strucutres lying closely side by side. Both resolutions are common to both M and 2D modalities.

SECTOR SCANNERS

Sector scanners are either mechanical or phased array, but from both instruments the ultrasound beam is swept in an arc across the heart from a single point on the chest wall (CW).

The most widely used are mechanical scanners because they are relatively inexpensive. The basic principle in mechanical scanners is achieved by mounting the transducer on a rapidly oscillating motor which rocks the ultrasonic crystal through a given arch (usually between 30-40 degrees) on the chest while the transducer performs TRANSMIT -RECEIVE cycles producing many B scan lines, but the scan orientation of the lines is determined from the position of the transducer.

The oscillating mechanical systems yield high resolution images, but are limited by their narrow field of view.

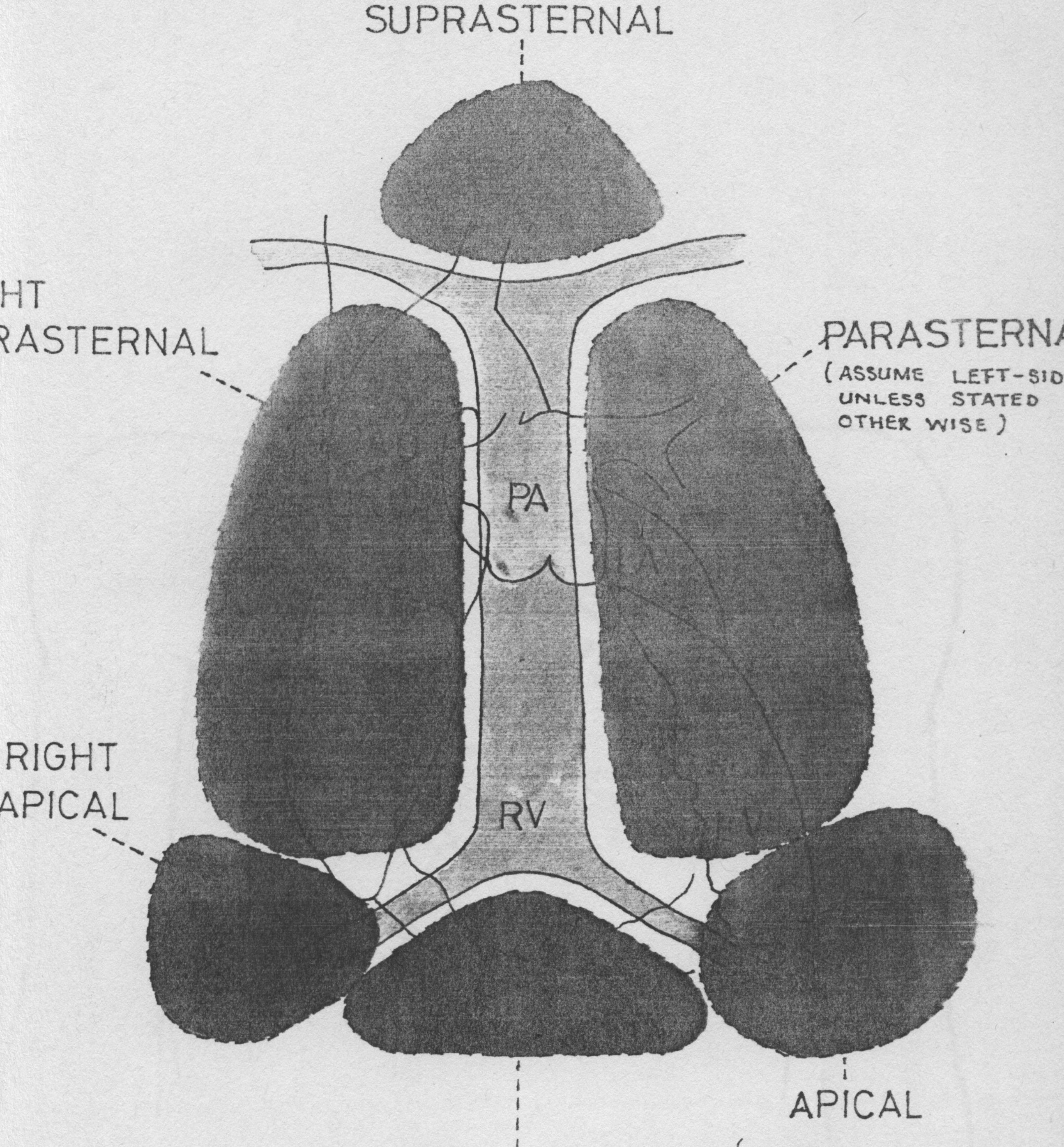
The recent generations of mechanical scanner are also rotary but have three or four transducers cut from the same pizoelectric crystal mounted equidistant on the perimeter of a wheel. The wheel rotates in a plastic housing activating each transducer in turn and sequentially processing ultrasound signals.

PHASED ARRAY SCANNERS

Phased array scanners take advantage of Huygen's principle, namely multiple small wave fronts of sound will combine to form a single sound wave whose direction is determined by component wavelets.

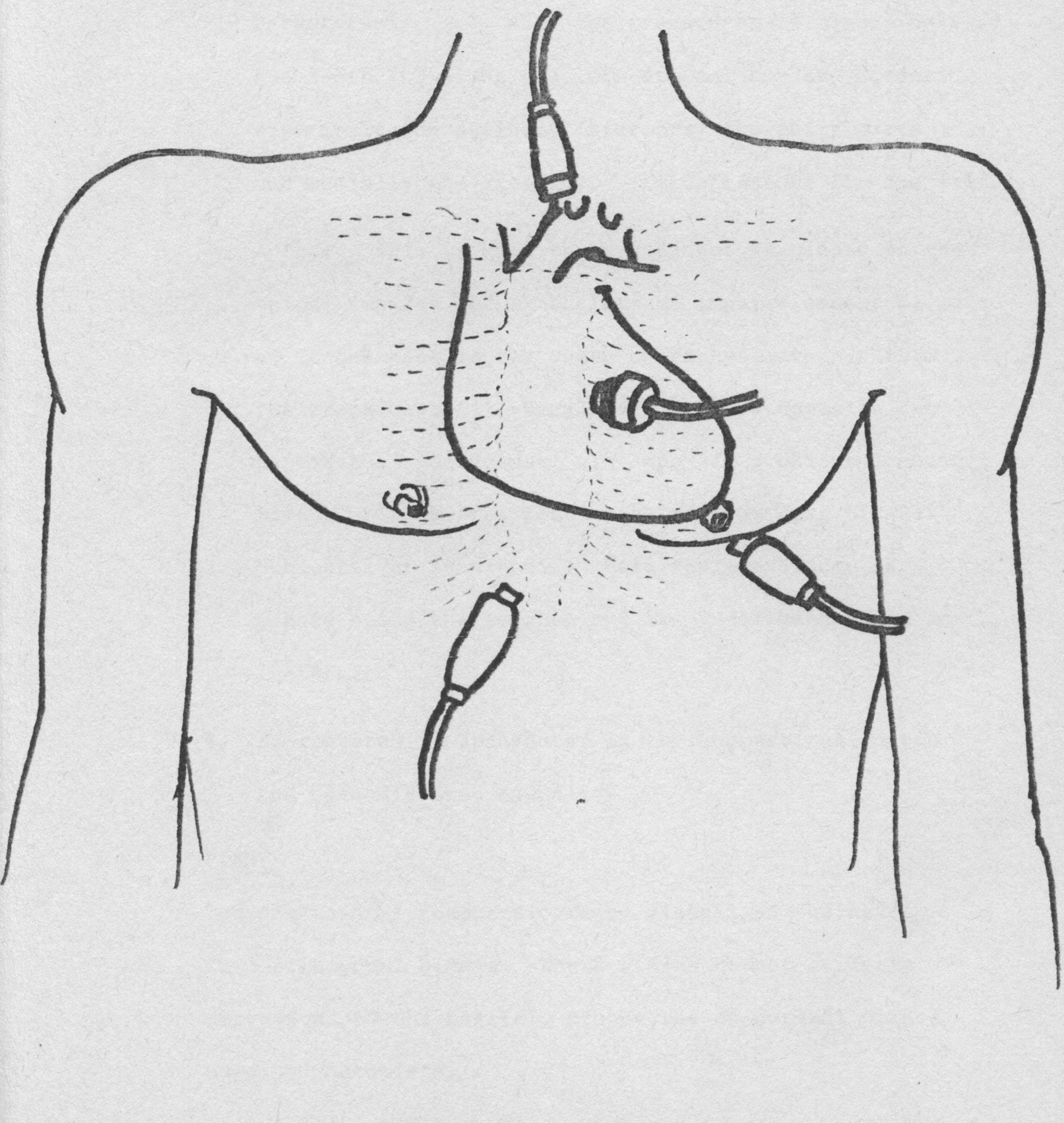
By changing time delays between activation of elements of the array, one can electronically stir the sonic beam at varying angles from the multielement transducer face. These scanners can also have a computer programme and electronic focusing gives them the advantage of high resolution rate,

LUSTRATION 1




ASE CIRCULATION 62/2

ILLUSTRATION 2



but they are complex and costly.

2D Echocardiography had introduced more transducer positions and planes which have been standardized by American Society of Echocardiography (ASE) and adopted worldwide. (Illustration 2 shows the surface markings of the transducer positions mentioned in this dissertation.)

4 Standard Transducer Locations According to ASE

1. Parasternal: i.e. when the transducer is placed between the 3-5th ICS along the left sternal border (bordering superiorly the sternum, inferiorly the apical area and medially the sternum). (Illustrations IIa and Ia).

2. Apical: This is when the transducer is placed on the apical impulse and if the'apical impulse cannot be left as is the case in the obese or emphysematous chests, the transducer will be placed directly opposite the parasternal pseudoapex. The apex is a unique accoustic window. It is free most the time from lung tissue.

3. Subcostal or subxiphoid: Here the transducer is placed below the sternum and its index mark aimed at the heart.

4. Suprasternal: Transducer in the suprasternal notch and beam directed caudally.

PLANES

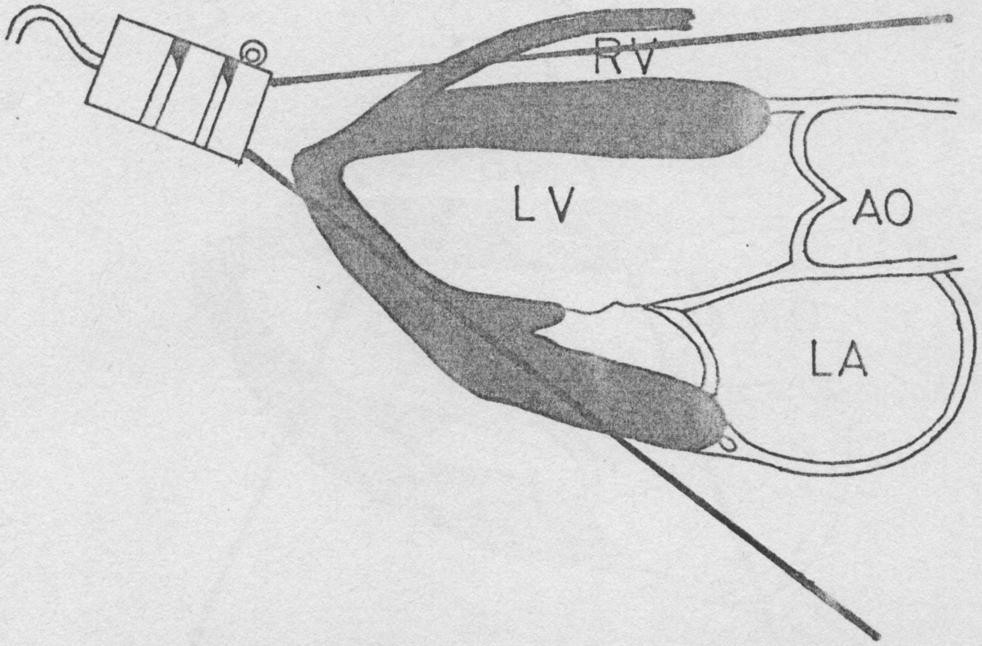
Two dimensional Echocardiography visualizes the heart in 3 orthogonal planes. These planes do not strictly correspond to the sagital, transverse or coronal planes used by Anatomists.

The plane that transects the heart perpendicular to the dorsoventral surfaces of the body but run parallel to the long axis of the heart is referred to as LONG AXIS plane and it is transected at right angles by its own short axis plane. When a plane is approximately parallel to the ventrodorsal surface it gives a 4 chamber view of the Heart.

Table IA shows different positions and planes showing different cardiac structures. It should be realised that planes are not singular views. They are a family of planes at different levels of beam slices.

ILLUSTRATION 5

A




APICAL LONG-AXIS

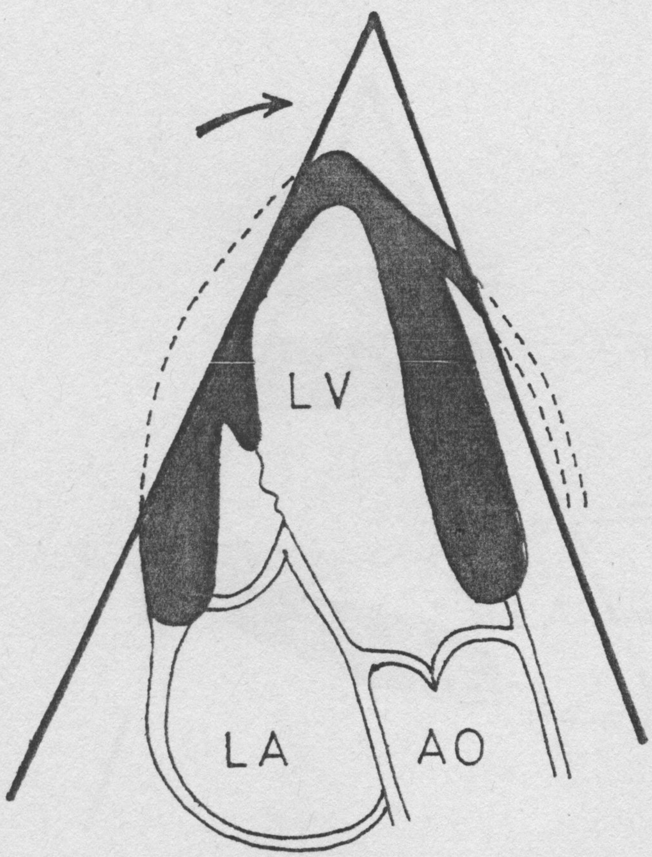
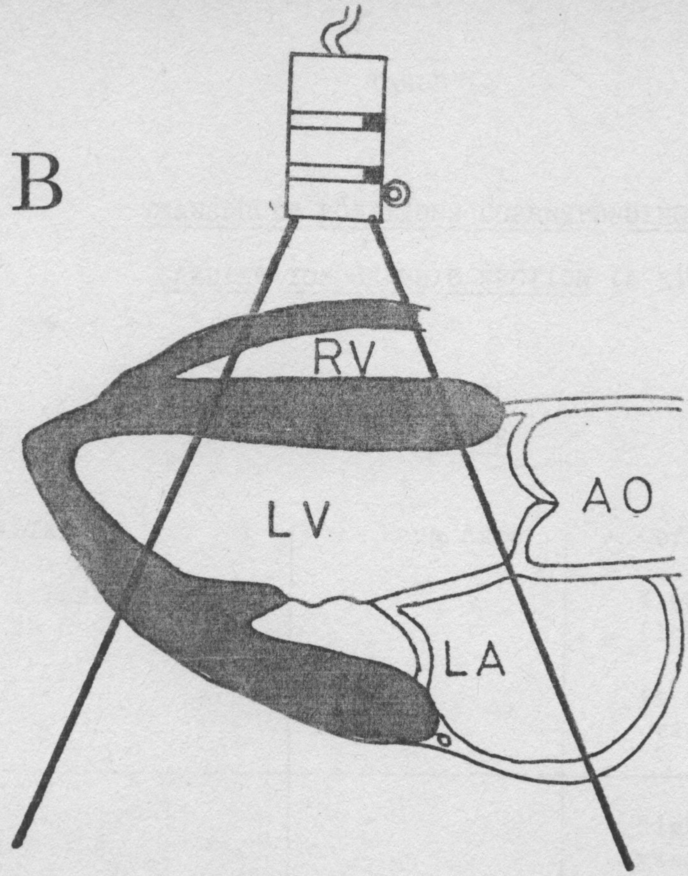


ILLUSTRATION 3




PARASTERNAL LONG-AXIS

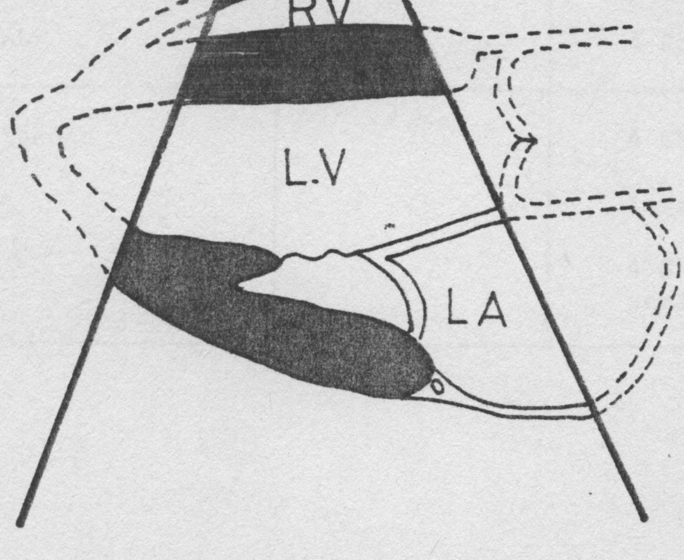


TABLE IA

TRANSDUCER POSITIONS CORRESPONDING TO

CARDIAC TOMOGRAPHIC SECTION (ASE)

| POSITION | PLANE | VIEWS OF COMMON STRUCTURES |
|---|---|---|
| PARASTERNAL<br><br>See illustrations No. 3B & 4 | Long Axis | Left Ventricle<br><br>Right ventricular in flow (RVIF)<br><br>(4 short axis group of views) |
| | | Right ventricular and left ventricular in flow<br><br>Left ventricular apex<br><br>papillary muscles<br><br>Mitral valve leaflets<br><br>Left ventricular out flow tract (LVOT)<br><br>Great vessels |
| APICAL | | 4 Chamber view |
| Subxiphoid | | 4 Chamber and Aortic valve<br><br>Inferior vena cava<br><br>4 Chamber, (good for the pericardial fluid detection) |

WALL THICKNESS

This is the most important measurement for which ultrasound is uniquely suited. Both posterior and septal wall thickness can be meausred at any time in the cardiac circle (leading edge to leading edge of the LV endocardium and pericardial epicardial echoes respectively). For septal wall thickness the leading edge of right septal echo to trailing edge of the left septal echo (ASE). Cavity and wall thickness are combined to give a thickness to cavity ratio which is a very useful parameter in pressure overload states.

Recordings and measurements with the transducer in 3-4 intercostal space, left sternal border.

The Aortic Root: is recognised as a pair of parallel lineal signal moving anteriorly upwards or posteriorly downwards (in M-Mode). The anterior wall echoes are continuous with the left side of the interventricular septum and the posterior wall with the anteriormitral valve leaflet.

Valve cusps appear as thin lines moving briskly and separating towards the periphery of the lumen in systole and coapting in diastole producing a box line configuration. (The anterior cusp is the coronary cusp, the posterior one is the non-coronary cusp).

Measurements of the root and valve separation are taken from leading edge of the anterior wall of the aorta to the leading edge of the posterior wall. Usually the posterior aortic root and the left atrium share a common border and measurements are taken at the end of diastole when both the mitral valve and the aortic valve are still closed. (See illustration No. 8).

## The left Atrium (LA)

The Left Atrium lies directly under the aortic root and is an easy structure to visualize. In the 3 standard transducer locations, (parasternal, apical and subxiphoid). The shape of the left atrium is basically spherical. It assumes even a more spherical shape when it is enlarged.

## Left Atrial Wall Motion

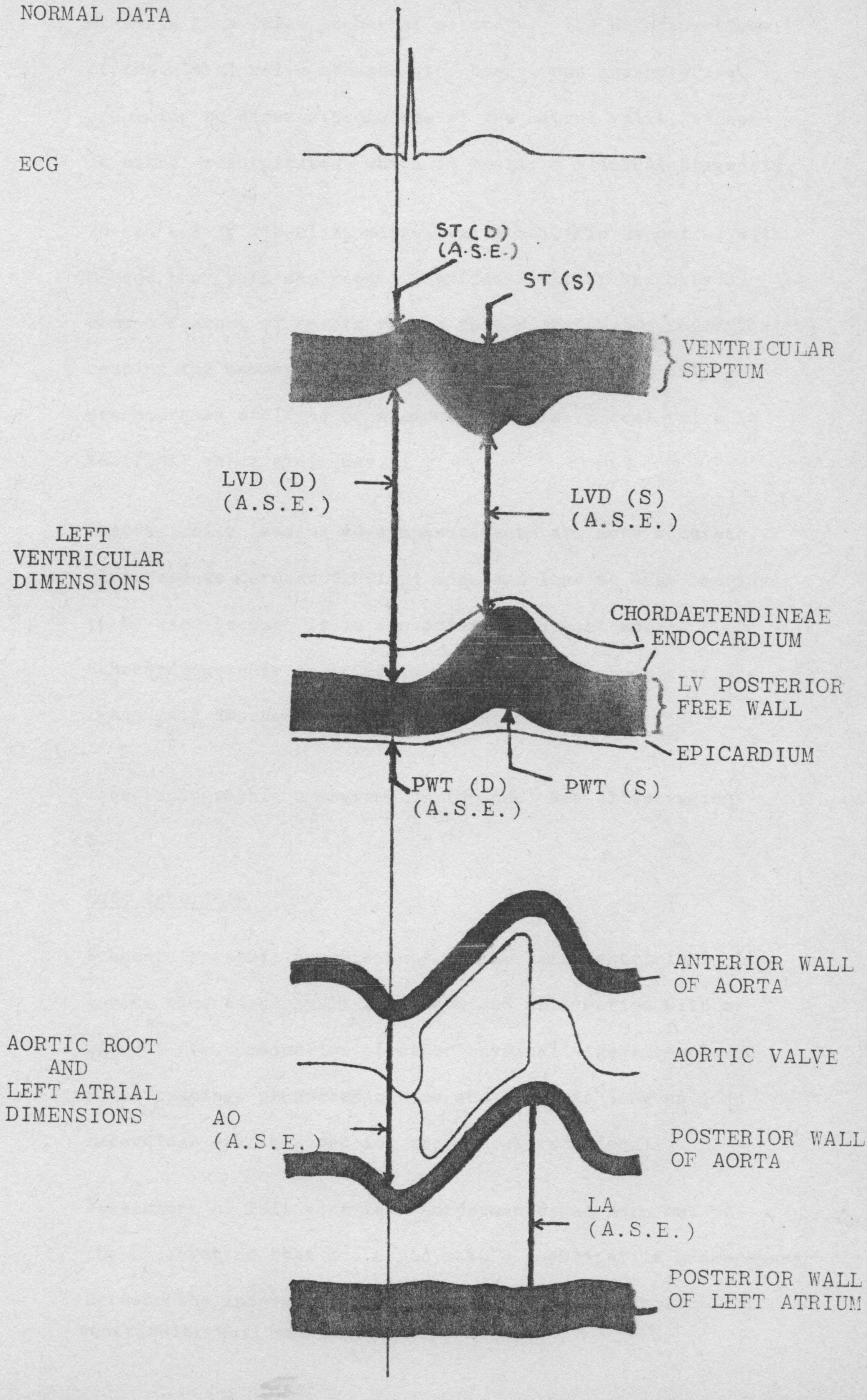
LA wall motion is very easy to distinguish from that of the left ventricle. This observation occasionally provides useful information.

## The Mitral Valve

The mitral valve is a major land mark in the Echocardiographic examination of the heart. Edler and Gustatson's observations about different mitral valve motions in normal and mitral stenosis provided the initial impetus to Echocardiographic studies.

At the beginning of diastole the anterior mitral valve leaflet and the posterior mitral valve leaflet moves backwards. At the point of maximum separation, the two leaflets begin to move towards each other bringing in partial closure late in diastole, and second full closure takes place before ventricular systole. Much of the work on mitral valve is on diastolic closure rate (DCR) which has termed the EF slope by EDLER). (2).

# METHODS OF MEASUREMENT (M-MODE)



Diastolic closure rate corelates well with the degree of stenosis in a large number of patients. The M-Mode motions of the mitral valve are easy to observe and characterise according to disease processes of the mitral valve, except in mitral regurgitation which is mostly a clinical diagnosis.

2D can easily visualize mitral valve calcific deposits, with M-Mode they both can readily indicate flutter which is a common feature of Aortic rather than Mitral valve regurgitation causing the murmur. (Austin Flint). M-Mode very ably demonstrates prolapse or hammocking of the mitral valve in the flail valve syndromes.

Theoretically leading edge measurements are more accurate, measurements between trailing edge and leading edge continue to be used because it is convenient, and most modern Echocardiographic instruments display thin Echoes that are least gain dependent in axial dimensions.

Echocardiographic measurements (M-Mode) See illustration 8.

<u>Left Ventricle</u>

Echocardiographic measurements of the Left Ventricle include cavity dimensions, wall thickness and wall motion with or without the combination of other physical signals such as pulse tracing, phonocardiograms and ECGs, as long as good recordings are obtained for easy interpretation.

Assessment of left ventricle performance was born out of the observation that one could make a quantitative measurement between the interventricular septum and the posterior left ventricular wall endocardium.

# CHAPTER 3

## MATERIAL AND METHODS

### Instrumentation

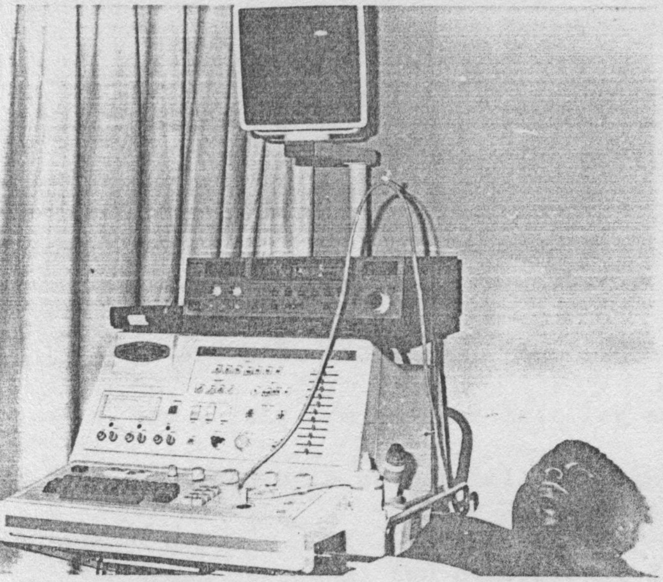
Echocardiographic evaluation of all subjects was done on the newly acquired Aloka SSD 720 located in the Diagnostic laboratory of the D block of the University Teaching Hospital. This is an $80^{o}$ angle mechanical sector scanner which has an M-Mode moving bar and B-Mode sector and can display distance at intervals of 3cm. ( 6, 9, 12, 15, 18 and 21) with independent contrasts for both M and B modes. It has 64 grey shades in B mode and 16 in M-Mode and repetition rate of 1000 seconds.

### Physiological Signals

ECG display in B mode, phonocardiogram and pulse tracing in M-Mode, Axial resolution 1.5mm and lateral resolution 3mm. The video records were done on the Sony Ordinary Video recorder. The Aloka has a 22.5 mm diagonal viewing monitor and polaroid type camera with exclusive flat face 13.5mm monitor. Unfortunately it does not have a strip chart writer yet. A standard 3.5 MHZ frequency transducer was used. (See photograph instrument panels and legends assembly figures 2a, 2b, 3a, 3b, and 3c).

### Methodology

Routine scanning began with informed consent and explanation of the procedure to the patients. A physical examination was done in all patients before echograms, together with the study of the case notes, X-rays, ECG and Hematological



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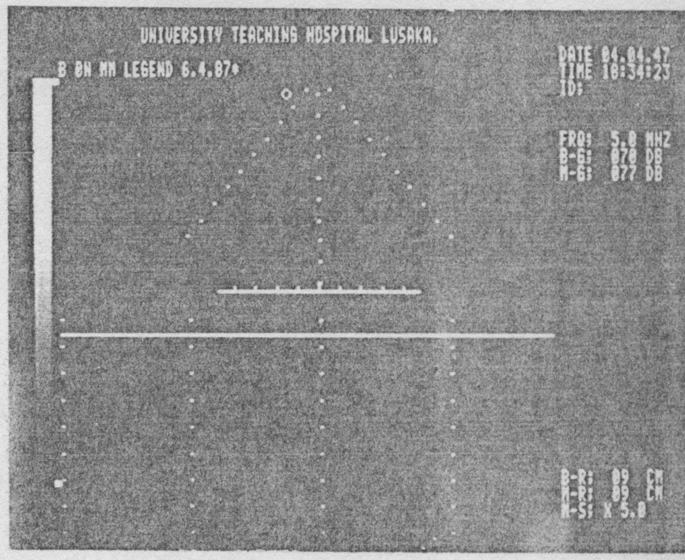
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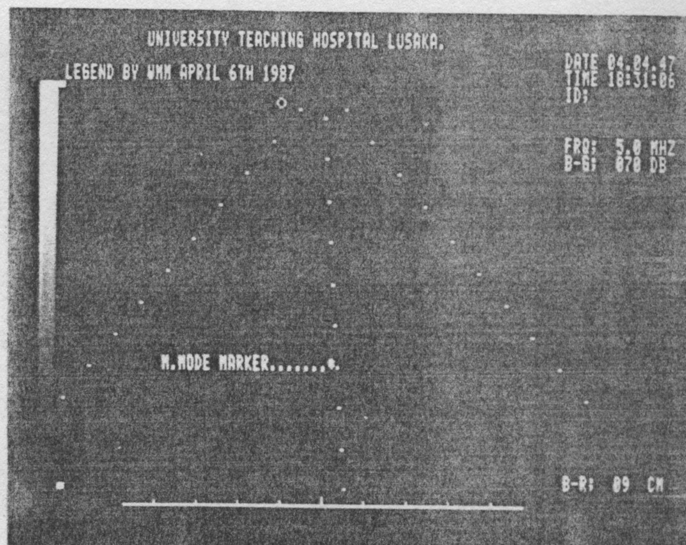
3a

2b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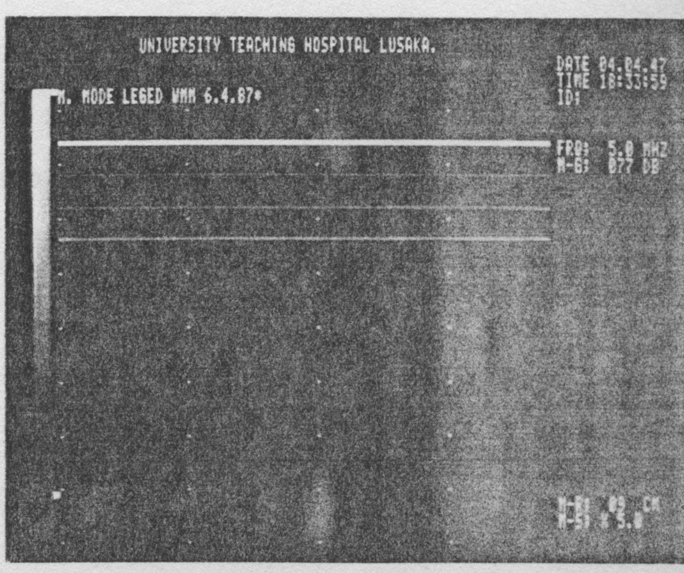
3b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3c

and biochemical data. Personal data which included the patient's name, age, diagnosis, date of examination and the investigator's initials were entered. The machine was earthed according to specifications and gain and reject settings were dimly adjusted to check the display of legends first in both M-Mode, 2D and M/D modalities. ECG leads were laid on the right arm , left arm and the left leg and an airless contact was provided by a commercially available aqua gel.

Cross sectional two dimensional Echocardiography provided a dynamic display of cardiac tomograms - spartial and anatomical orientation with a 80$^{o}$ wide angle sweep sector scanning were obtained. The selected variables were measured in both M-Mode and 2D sector.

Left ventricular internal end diastolic dimension, (EDD), End systolic dimension interventricular wall thickness (SPT) left ventricular posterior free wall, left atrium and aortic root at end distole and EF slope and dimensions of the right heart where applicable were commented on.

Percentage fractional shortening and SPT, PWT ratios were the only derived indices.

In 2D examination, in addition to normally discrimination of cardiac structures, the so called granular sparkling, dysksnetic areas and intracardiac masses were looked for in detail in parasternal long axis and short axis groups apical and subcostal/subxiphoid 4 chamber approaches. (See Table 1A).

Measurements were done on frozen oscilloscopic displays and stored on polaroid films. Some material of academic interest was stored on the video films at 30-60 frames/seconds (see 2a + 2c of the instrument assembly). The video tapes were later analysed; played in slow motion backwards and forth with frame by frame analysis. Electronic calipers were of considerable aid in making measurements; unfortunately the Aloka has had no strip chart writer yet - most of the hard material is stored on polaroid or VTR (Sony 5542).

Dr Czesary Tanawski and Dr Huber De Beltseller who have been leading clinical cardiologists for at least 20 years assisted in both the selection of variable and standardizing the instrument, they were satisfied with the author's technique. They individually verified the findings in the preliminary work involving 46 healthy subjects and 19 patients (not included in this dissertation) before the investigation for the work began.

# C H A P T E R 4

## SUBJECTS

64 consecutive patients were examined over a period of six months from November 1986 to March 1987. They were divided into two groups. Group A was comprised of 16 volunteers and eight referrals for what is in this country popularly known as the ROUTINE MEDICAL CHECK UP. The subjects in Group A were totally symptom free. Their age range was between 19 - 56, mean age 30.

16 Volunteers (GROUP A)

TABLE 4A

| | Male | Female |
|---|---|---|
| UTH Board Cleaners | 2 | 1 |
| Student Burses | - | 4 |
| Civil Servants | 5 | 2 |
| Laboratory Technicians | 2 | - |
| TOTAL | N = 9 | N = 7 |
| Routine Medical Check up | | |
| Executives | 3 | - |
| Secretaries | - | 2 |
| Drivers | 3 | - |
| TOTAL | 6 | 2 |

TOTAL 15 + 9 = 24

Results

The 24 subjects had no evidence of Heart Disease and their Echocardiograms both in M-Mode and 2 dimensional were normal. Their data entered in data sheet Group A (with means, and STD deviations worked out). (See Data Table 4A)

Discussion

All the 24 subjects tolerated the examination well and there was a lot of reassurance among subjects who said for the first time they had seen their heart beat on the TV screen.

The average duration of examination was 11 minutes/subject with a range of 10 - 20 minutes (DAte Sheet Group A).

CONTROL GROUP

GROUP A

TABLE 4B

| n | EDD | ESD | LIVD | F = LIVDx100 / EDD | SEPT | PWT | SEPT / PWT | LAD | AOR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.6 | 2.2 | 2.4 | 52.2% | 0.8 | 0.9 | 0.8 | 2.6 | 2.6 |
| 24.3 | | 3.5 | 0.8 | 18.6% | 0.7 | 0.9 | 0.8 | 2.6 | 2.7 |
| 3 | 4.4 | 3.3 | 1.1 | 25% | 0.9 | 1.1 | 0.8 | 3.1 | 2.9 |
| 4 | 4.6 | 2.8 | 1.8 | 39.1% | 1.0 | 0.9 | 1.1 | 3.4 | 3.1 |
| 5 | 3.8 | 2.8 | 1.0 | 26.3% | 0.7 | 0.7 | 1.0 | 3.0 | 2.8 |
| 6 | 4.0 | 3.1 | 0.9 | 22.5% | 0.9 | 0.8 | 1.1 | 3.3 | 3.0 |
| 7 | 3.8 | 2.6 | 1.2 | 31.6% | 0.9 | 0.9 | 1.0 | 2.9 | 2.4 |
| 8 | 3.6 | 1.4 | 2.2 | 61% | 0.9 | 0.9 | 1.0 | 2.8 | 2.7 |
| 9 | 4.1 | 1.7 | 2.4 | 58.5% | 0.9 | 1.1 | 0.8 | 2.8 | 2.7 |
| 10 | 3.5 | 1.2 | 1.7 | 48.6% | 1.0 | 1.2 | 0.8 | 2.5 | 3.4 |
| 11 | 3.9 | 2.6 | 1.3 | 33% | 0.9 | 1.1 | 0.8 | 3.4 | 3.3 |
| 12 | 4.7 | 3.8 | 0.9 | 19% | 1.2 | 1.1 | 1.1 | 3.2 | 3.6 |
| 13 | 4.6 | 2.9 | 1.5 | 32% | 1.0 | 0.9 | 1.1 | 3.6 | 2.0 |
| 14 | 4.3 | 3.4 | 0.9 | 21% | 1.0 | 1.2 | 0.8 | 3.1 | 3.0 |
| 15 | 4.4 | 3.2 | 1.2 | 27% | 0.9 | 0.9 | 1.0 | 3.4 | 3.2 |
| 16 | 5.5 | 3.7 | 1.8 | 32% | 0.7 | 0.8 | 0.9 | 2.7 | 2.4 |
| 17 | 3.4 | 2.2 | 1.2 | 35.3% | 0.7 | 0.9 | 0.8 | 2.4 | 1.8 |
| 18 | 4.3 | 3.2 | 1.1 | 25% | 0.8 | 1.0 | 0.8 | 3.0 | 2.7 |
| 19 | 3.6 | 2.3 | 1.3 | 36% | 1.0 | 1.1 | 0.9 | 3.4 | 2.9 |
| 20 | 3.9 | 2.0 | 1.9 | 48.7% | 0.9 | 1.3 | 0.7 | 3.3 | 2.7 |
| 21 | 3.6 | 2.1 | 1.5 | 42% | 1.0 | 1.2 | 0.8 | 3.4 | 2.8 |
| 22 | 4.4 | 2.0 | 2.4 | 55% | 0.8 | 1.1 | 0.7 | 3.3 | 2.7 |
| 23 | 4.2 | 2.1 | 2.4 | 48% | 0.8 | 1.1 | 0.8 | 2.9 | 2.8 |

TABLE 4C

<u>NORMAL VALVES</u>

| | EDD | ESD | LIVD | FS | SEPT | PWT | SEPT/PWT | LAD | AOR |
|---|---|---|---|---|---|---|---|---|---|
| RANGE | 3.4-5.5 5.5 | 1.4-38 3.8 | 0.8- 2.4 | 18- 61.8 | 0.7- 1.2 | 0.7- 1.3 | 0.7- 1.1 | 2.4- 3.6 | 1.8- 3.6 |
| MEAN | 4.15 | 2.64 | 1.43 | 36% | 0.8 | 0.9 | 0.8 | 3.13 | 2.9 |
| STD DEV | ±0.501 | 0.773 | ±0.54 | ±12.76 | ±0.157 | ±0.21 | 1.0± 1.6 | 0.320 | ±0.40 |

GROUP B

Group B study was the patient group with the age range very much similar to group A but the subjects were not strictly matched for age. Mean age was 31. The subjects however qualified to be included in this group mainly if their chest x-ray indicated cardiomegaly since the principle aim of the study was to evaluate the ROLE Echocardiography in the diagnosis of Cardiomegaly in this local population

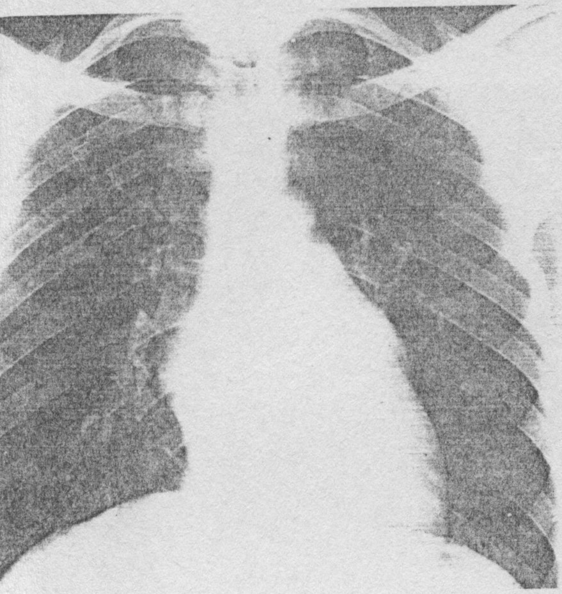
Group B patients were drawn from 5 sources but mainly from the University Teaching Hospital.

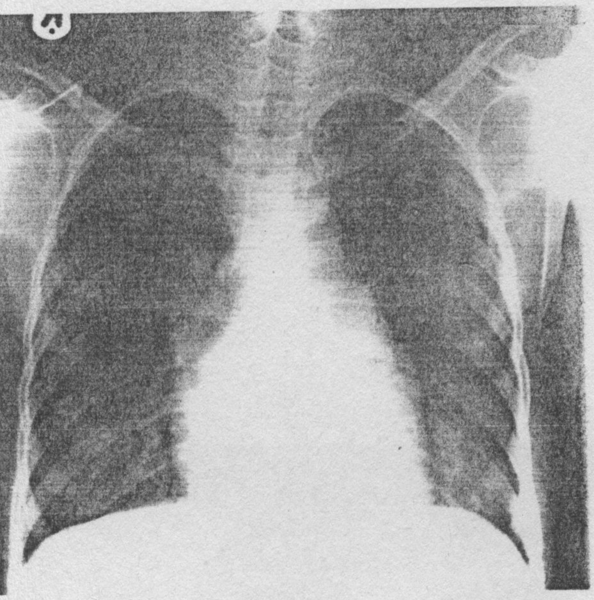
TABLE 4D

| | NO | SEX | | % |
|---|---|---|---|---|
| | | M | F | |
| HYPERTENSION CLINIC | 10 | 6 | 4 | 25 |
| CARDIAC CLINIC | 11 | 5 | 6 | 27.5 |
| WARDS (Medical) E Block | 14 | 8 | 6 | 35 |
| OBSTETRICS/GYNAECOLOGY (Referrals | 2 | - | 2 | 5 |
| BLOOD BANK | 1 | 1 | - | 2.5 |
| REFERRAL (Group practice in town) | 2 | 2 | - | 5 |
| TOTAL | 40 | 22 | 18 | 100 |

(55% Males and 45% Females)

Group B patients fell in 4 diagnostic categories with various symptoms and signs. See Table 4D.


1e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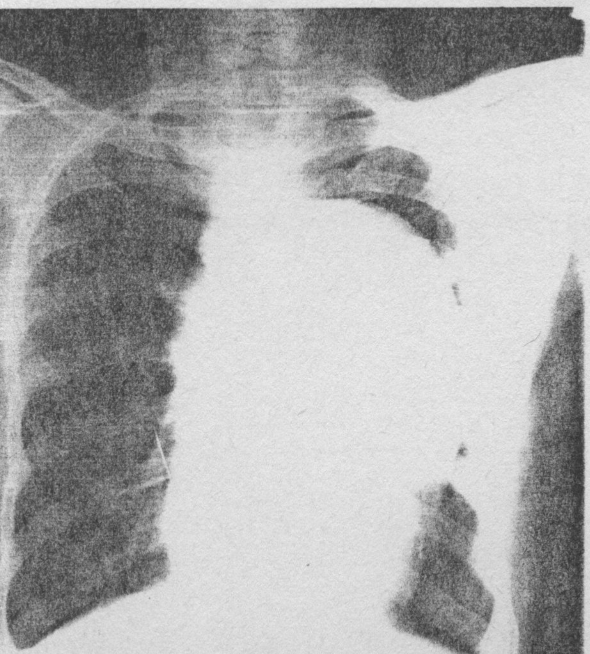

1g

RADIOLOGIST'S DESCRIPTION OF FILMS IN GROUP B SUBJECTS

UNIVERSITY TEACHING HOSPITAL FORMAT

(a) The transverse cardiac diameter is increased, but there is no evidence of cardiac decompensation (Figures 1a + 1d and 1e).

(b) Transverse diameter is increased and the silhouette is suggestive of left ventricular enlargement ( 16 ) 40% (1c).

(c) In II patients (10%) the report read: The heart is enlarged and in particular the left ATrium; in addition there is pulmonary congestion and upper lobe diversion consistent with heart failure (1d + 1e).

(d) Pericardial Effusion - There is a globular enlargement of the cardiac shadow with slightly oligemic lung fields. The appearances are suggestive of pericardial effusion (1a).

| | GROUPS | | | |
|---|---|---|---|---|
| COMMON SYMPTOMS | HYPERTENSION | CARDIOMYOPATHY | RHD | PERICARDIAL EFFUSION |
| Dyspnea | 2/10 | 9/11 | 7/15 | 6/6 |
| Palpitations | 6/10 | 3/11 | 9/15 | 2/6 |
| Dizziness | 4/10 | 6/11 | 7/15 | 2/6 |
| Chest pain other than angina pectoris | 3/7 | - | 3/15 | - |
| ?? Angina of effort | - | 2/11 | ?0/15 | - |
| Paroxysmal noctunal dyspnea | - | 9/11 | 7/15 | 4/6 |
| Swelling of feet | - | 10/11 | 7/15 | - |
| Excessive sweating | 9/10 | 10/11 | 7/15 | 6/6 |
| Headaches | 4/10 | 2/11 | 4/5 | - |
| Insomnia | 3/10 | 2/11 | 7/15 | 2/6 |
| Distension of abdomen | - | 3/11 | 5/15 | 6/6 |
| Easy fatiguability | 2/10 | 9/11 | 7/15 | 6/6 |

TABLE 4F

| | GROUPS | | | |
|---|---|---|---|---|
| SIGNS | HYPERTENSION | CARDIOMYOPATHY | RHEUMATIC HD | PERICARDIAL EFFUSION |
| Ankle Oedema | - | 10/11 | 7/15 | 4/6 |
| Cyanosis | - | 3/11 | 3/15 | - |
| Raised JVP | - | 9/11 | 7/15 | 6/6 |
| Hepatomegaly | - | 6/11 | 5/15 | 6/6 |
| Ascites | - | 6/11 | 7/15 | 6/6 |
| Pleural Fluid | - | Mild in 4/11 | 2/7 | 1/6 |
| BP 140<br>70 - 90 | 2/10 | 9/11 | 14/15 | 6/6 |
| $\frac{140}{90} - \frac{160}{110}$ | 4/10 | 2/11 | 1/15 | - |
| $\frac{171}{171}$ | 4/10 | - | - | - |
| Cardiac Rythm 2 Ectopics in a row | 2/10 | 4/11 | 3/15 | - |
| AF or Flutter | - | 4/11 | 5/12 | 1/6 |
| LVH | 4/10 | 3/11 | 4/15 | - |
| RHV | - | 1/11 | 3/15 | - |
| Biventricular Hypertriphy | - | - | 8/15 | - |

| | GROUPS | | | |
|---|---|---|---|---|
| COMMON SYMPTOMS | HYPERTENSION | CARDIOMYOPATHY | RHD | PERICARDIAL EFFUSION |
| Dyspnea | 2/10 | 9/11 | 7/15 | 6/6 |
| Palpitations | 6/10 | 3/11 | 9/15 | 2/6 |
| Dizziness | 4/10 | 6/11 | 7/15 | 2/6 |
| Chest pain other than angina pectoris | 3/7 | - | 3/15 | - |
| ?? Angina of effort | - | 2/11 | ?0/15 | - |
| Paroxysmal noctunal dyspnea | - | 9/11 | 7/15 | 4/6 |
| Swelling of feet | - | 10/11 | 7/15 | - |
| Excessive sweating | 9/10 | 10/11 | 7/15 | 6/6 |
| Headaches | 4/10 | 2/11 | 4/5 | - |
| Insomnia | 3/10 | 2/11 | 7/15 | 2/6 |
| Distension of abdomen | - | 3/11 | 5/15 | 6/6 |
| Easy fatiquability | 2/10 | 9/11 | 7/15 | 6/6 |

TABLE 4F

| | GROUPS | | | |
|---|---|---|---|---|
| SIGNS | HYPERTENSION | CARDIOMYOPATHY | RHEUMATIC HD | PERICARDIAL EFFUSION |
| Ankle Oedema | - | 10/11 | 7/15 | 4/6 |
| Cyanosis | - | 3/11 | 3/15 | - |
| Raised JVP | - | 9/11 | 7/15 | 6/6 |
| Hepatomegaly | - | 6/11 | 5/15 | 6/6 |
| Ascites | - | 6/11 | 7/15 | 6/6 |
| Pleural Fluid | - | Mild in 4/11 | 2/7 | 1/6 |
| BP 140<br>70 - 90 | 2/10 | 9/11 | 14/15 | 6/6 |
| $\frac{140}{90} - \frac{160}{110}$ | 4/10 | 2/11 | 1/15 | - |
| $\frac{171}{171}$ | 4/10 | - | - | - |
| Cardiac Rythm<br>2 Ectopics in<br>a row | ?/10 | 4/11 | 3/15 | - |
| AF or Flutter | - | 4/11 | 5/12 | 1/6 |
| LVH | 4/10 | 3/11 | 4/15 | - |
| RHV | - | 1/11 | 3/15 | - |
| Biventricular Hypertriphy | - | - | 8/15 | - |

RADIOLOGIST'S DESCRIPTION OF FILMS IN GROUP B SUBJECTS

UNIVERSITY TEACHING HOSPITAL FORMAT

(a) The transverse cardiac diameter is increased, but there is no evidence of cardiac decompensation (Figures la + ld and le).

(b) Transverse diameter is increased and the silhouette is suggestive of left ventricular enlargement ( 16 ) 40% (lc).

(c) In II patients (10%) the report read: The heart is enlarged and in particular the left ATrium; in addition there is pulmonary congestion and upper lobe diversion consistent with heart failure (ld + le).

(d) Pericardial Effusion - There is a globular enlargement of the cardiac shadow with slightly oligemic lung fields. The appearances are suggestive of pericardial effusion (la).

# C H A P T E R 5

## INDIVIDUAL GROUP EVALUATION

### Sub-Group I

### Pericardial Effusion

No of subjects 6 (1 out of 6 had proven systemic lupus Erythromatosus)

Chest Radiographs 1a + 1b

Apart from entering personal data and laying the ECG leads, the control settings (Reject and other damping modalities) were adjusted, depth was set between 9 and 15cm. Echocardiographic criteria for diagnosis of pericardial fluid was according to Harowitz (circulation 50).

1 Straightening of the posterior pericardial wall

2. A distinct and dominant echo free space between the posterior free wall and the pericardial lung interface

3. Anteriorly - a demonstration of an Echo free space between the right ventricular free wall and the chest wall meant that the accumulation was massive (it is now firmly established that small effusions are confined to dependent parts in the pericardial cavity posteriorly and anterior spread means massive accumulation)

The 5th ICS parasternal long axis plane, or apical 4 chamber view or subxiphoid positions were used. Fluid was seen in all the six subjects. Figures 4b 4c and in M-Mode 4f.

### Results

2D readily identified fluid in all six subjects. Three had massive fluid see figures 4b, 4c and because of no straining action from the pericardium, their hearts exhibited a swinging action in the pericardial sac i.e. moving anteriorly and posteriorly in systole and diastole respectively. The low voltage on the ECG in two out six subjects showed no relationship to the size of fluid. The two of the three who had massive fluid had a normal voltage, but the third subject apart from a low voltage exhibited occasional electrical alterans on the ECG tracing.

One subject who six weeks prior to Echocardiography had undergone some unsuccessful diagnostic percardiocentesis and an ATRIOGRAM to demonstrate pericardial fluid (figure 1b) presented with a massive left pleural effusion which displaced the heart to the right.

On cross sectional 2D done from right parasternal placement, he demonstrated strange features:

A mass was observed around the hilum in the posterior-lateral position to the Heart which exhibited up and down movements in unison with the cardiac cycle. It turned out to be a collapsed lung, on further scrutiny, There was some little pericardial fluid in the sac (figures 4a and 4e) as shown by the separation of the left ventricular free wall from relatively stationary pericardial Echoes.

The separation occurred in both systole and early part of diastole. Contrary to suggestions in literature (Sonia Chang) Fibrin strands with very strong echogenic characteristics were readily observed in four subjects figures 4a, 7i + 7h (Hairy appearance of the visceral pericardium floating or undulating in the pericardial fluid). (7h was a classical case of fibrinous pericarditis where a chest radiograph would give no clue).

It would be interesting to echo these patients serially and watch whether disappearance of fibrin is an index of therapeutic response or to determine how long fibrin takes to organise and calcify before causing constrictive pericarditis.

The test took close to 10-20 minutes. It was well tolerated even by the two very orthopneic patients who are scanned in a semi-recumbent position. Echo-cardiography is undoubtedly the method of choice for evaluating pericardial effusion. It can be done serially with no deleterions effects to the patient. Echo directed paericardiocentesis is one of the very sure ways of avoiding damage to the heart structures which are so often inadvertently done when the needle is blindly directed.

## DISCUSSION

Pericardial effusion in tropical clinical cardiology is a very common clinical problem (Somers and Thompson) found that 46% of effusions seen in 312 patients in Harare, were pericardial (unpublished data). Roughly the same figures are given by Abe H (Br Heart J 41, Cobbe S Br J H M 23 and Prishar, Indian Heart Journal. Adesanya G O Sanderson (Nigerian Med Journal No. 9)

In the tropics the main causative agent is Koch's but connective tissue disease, heart failure, uremia and viral infections run a close second as a group.

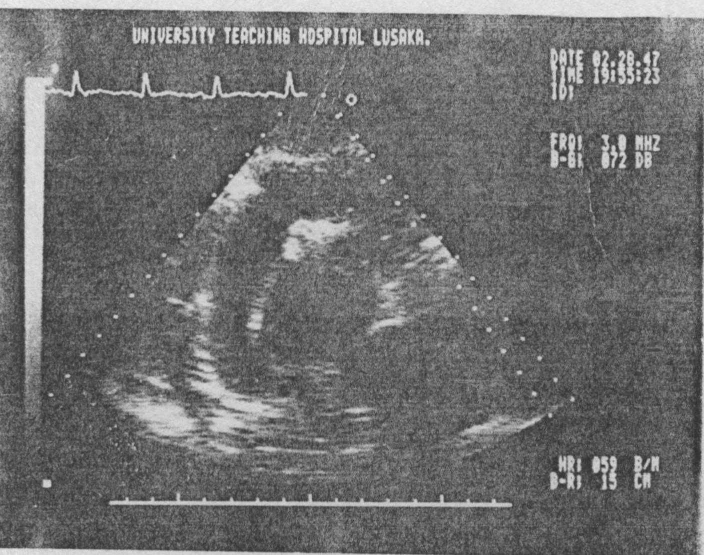
Diagnostic methods are mainly clinical with the help of X-Rays and ECGs. Low ECGs voltages has been popularly quoted as a reliable diagnostic sign in pericardial effusion, but in fact this is not altogether true - Berger M et al (Chest 7A, 174) examined 171 patients over a period of three years and found that 54% of which had moderate to large effusions but showed normal voltage on ECG. This work is collaborated by Gorbor (Chest 56, 341).

In this communication, it was found that three out of six despite the fact that they had very large amount of fluid, low voltage was not an impressive finding. The assessment of the role of echocardiography in the differential diagnosis of cardiomegaly has been done in most centres where the facilities exist. The scientific community owes to Harvey Feigenbaum (regarded by many as the father of modern echocardiography) and to the pioneer work of Abbassi who infact designed the working classification reflected in the absctract of this dissertation but with modifications by other authors (Feigenbaum H 3rd Edition (lea and Febiger).

Echocardiography has been shown apart from being a simple, accurate, innocuous bedside technique for diagnosis of pericardial fluid, to be a practical way of directing the needle for both theraupeutic and diagnostic tapping without injury to the myocardium.

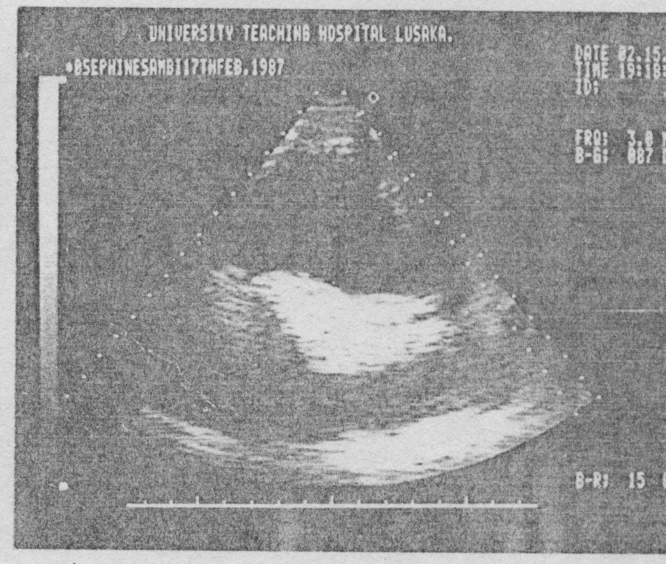
A reasonable degree of accuracy was shown in this dissertation and the author would like to recommend needle directed pericardiocentesis. ( For technique see Goldberg et alia) (AM J Cardia 31, 490), though the operator first should master the diagnostic technique.

4a



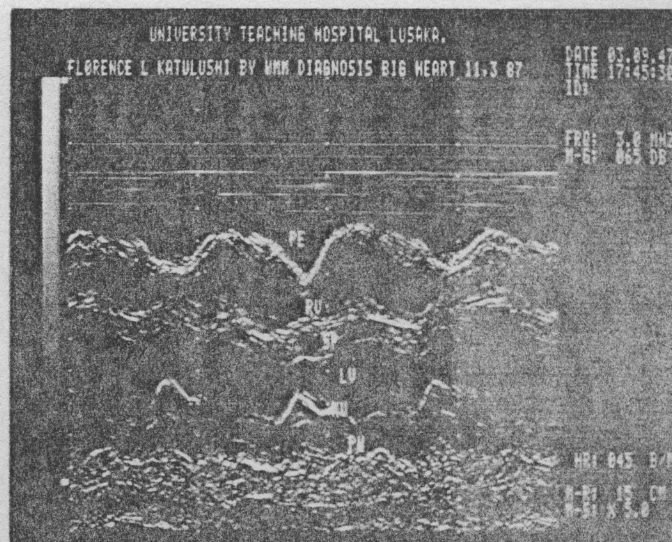

4b


4c



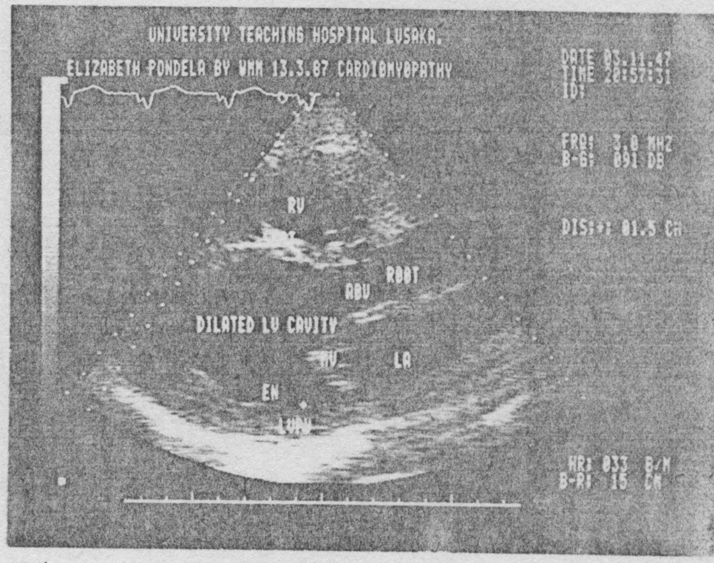

4d


4e

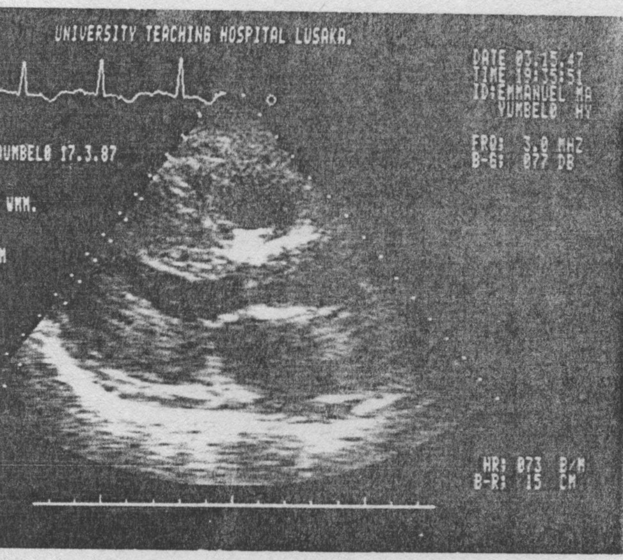


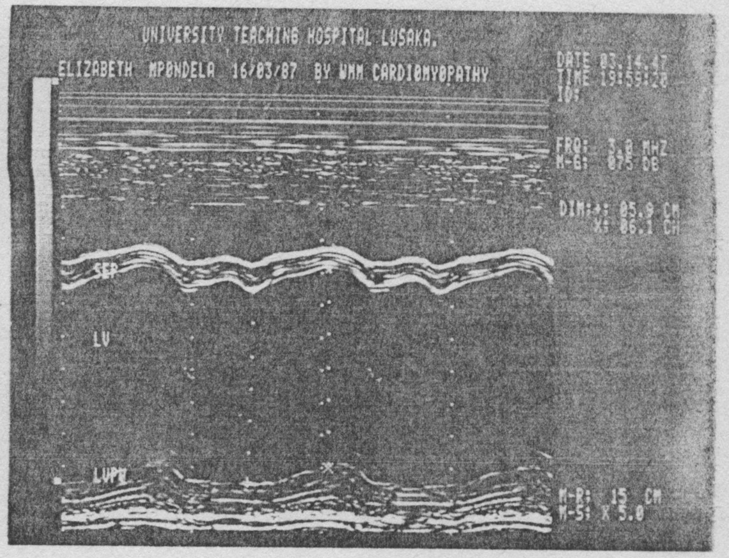

4f


UNIVERSITY TEACHING HOSPITAL LUSAKA.
MANUEL MAYUMBEYO HYPERTENSIVE HEART FAILURE 17.3.1987
BY WMM
DATE 03.15.47
TIME 19:25:15
ID:EMMANUEL MA
YUMBELO HY
FRQ: 3.0 MHZ
B-G: 077 DB
LARGE SEPTUM
SEPT
LVOT
DIS:
X: 02.3 CM
HR: 095 B/M
B-R: 15 CM


UNIVERSITY TEACHING HOSPITAL LUSAKA.
ELIZABETH PONDELA BY WMM 13.3.87 CARDIOMYOPATHY
DATE 03.11.47
TIME 20:57:31
ID:
FRQ: 3.0 MHZ
B-G: 091 DB
RV
DIS:+: 01.5 CM
ROOT
AOV
DILATED LV CAVITY
MV
LA
EN
LVPW
HR: 033 B/M
B-R: 15 CM

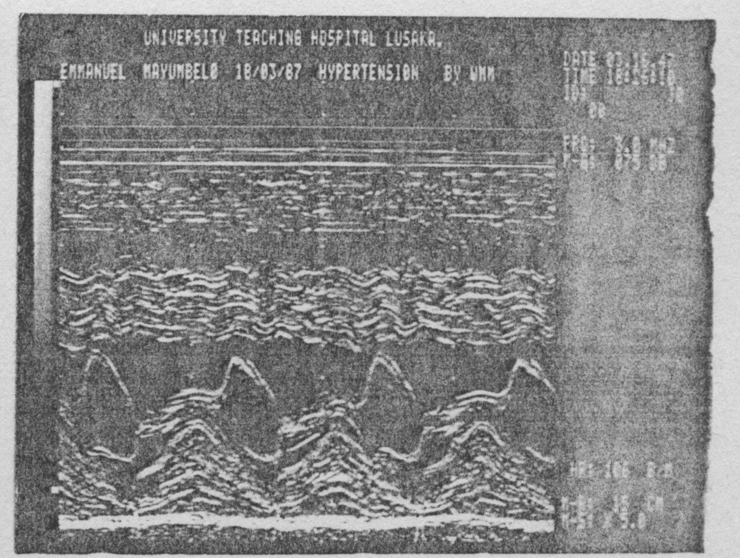
5b


UNIVERSITY TEACHING HOSPITAL LUSAKA.
DATE 03.15.47
TIME 19:35:51
ID:EMMANUEL MA
YUMBELO HY
UMBELO 17.3.87
FRQ: 3.0 MHZ
B-G: 077 DB
WMM.
HR: 073 B/M
B-R: 15 CM


UNIVERSITY TEACHING HOSPITAL LUSAKA.
ELIZABETH MPONDELA 16/03/87 BY WMM CARDIOMYOPATHY
DATE 03.14.47
TIME 19:55:28
ID:
FRQ: 3.0 MHZ
M-G: 075 DB
SEP
LV
LVPW
M-R: 15 CM
M-S: X 5.0

5d


UNIVERSITY TEACHING HOSPITAL LUSAKA.
FRQ: 3.0 MHZ


UNIVERSITY TEACHING HOSPITAL LUSAKA.
EMMANUEL MAYUMBELO 18/03/87 HYPERTENSION BY WMM

The author would also like to propose that serial screening of patients who show fibrin strands in the pericardial sac be done and instillation of steroids to prevent fibrinous pericarditis be tried as a prospective study, providing that adequate anti-tuberculous therapy is given and the human immunodeficiency virus serology wherever applicable is also determined.

## CARDIOMYOPATHY GROUP

### GROUP C II

### Congestive Cardiac Failure due to Cardiomyopathy

There is a great deal of information in world literature on various aspects of cardiomyopathy although the incidence in Africa is still unknown. Experience in West Africa and the rest of the continent south of the Sahara indicates that dilated cardiomyopathy and perhaps endomyocardial fibrosis (EMF) constitute the most common forms in Africa (Sharper et alia 1954, Okuwobi, Ojiambo and Silver-stein 1976, Teare R D 1958, Ladipo G A O 1977, Olsen and Goodwin 1968 and Oakley 1972) while examining the pattern of cardiovascular disease in Lusaka and Ndola 1976 Obineche ranked cardiomyopathy as the fourth most cardiovascular cause of morbidity and mortality in the adult population although Odesanya (others) in Zaria when they evaluated 275 referrals for various cardiac lesions using M-Mode Echocardiography put cardiomyopathy in 6th place as a cause of heart failure in Nigeria.

Most recently a review of 116 case notes from the cardiology clinic of the University Teaching Hospital indicated that 22 out of the 116 patients had been diagnosed as cardiomyopathy leading to heart failure, but was the 3rd commonest cause ( which roughly agrees with Obineche's earlier analysis). Congestive cardiac failure due to cardiomyopathy (heart muscle disease of undetermined aetiology) however has always been made as a diagnosis of exclusion rather than one of recognition by most Clinicians in the University Teaching Hospital (this opinion was formed from the list of differentials in the review of clinical notes). No clinician had a means catheter or angiographic facilities available to them to confirm their clinical impression. It is with this view that 11 patients ( seven males and four females of mean age 29. Range 22 - 58) were selected for Echocardiographic evaluation.

Sources - nine from the Medical Wards Block E and two from the Cardiology Clinic. Their symptomatology had an average duration of four years (Range 4-52 months) they all had a PA standard radiograph which indicated cardiomegaly (confirmed by IYY as the only Hospital Radiologist) as a major inclusion criterion 12 lead ECG, biochemical and hematological screening were also done.

On further questioning before echocardiography Rheumatic Heart disease, congenital heart disease, Endocrine problems were excluded and none was a regular athelete. Three men admitted to moderate Chibuku (opaque beer) drinking (the story was confirmed by spouses) they also smoked 10-20 cigarettes each as they drank their Chibuku. The three however showed no stigmata of liver cirrhosis nor alcoholic neuropathy. They all took fairly regular meals. The 11 patients were on treatment (lasix 40-80mg daily). The four in atrial fibrillation were also on digoxin 0.25mg daily (see list for signs and symptoms). Three of the females had each carried 2-3 pregnancies to term uneventfully. LHV on voltage criteria was noticed in 3, lowish voltage in 2 but there was a widespread I wave inversion in all except one female.

The standard echocardiographic procedure both for M and 2D were strictly adhered to. Technically good echograms were obtained in all except two males who were very dyspneic and restless and had very thick chest walls and therefore would not allow a satisfctory examination. After close to 35-40 minutes of examination, both Doctors C T and H de B - the leading clinical cardiologists in the diagnostic laboratory advised against their inclusion and they dropped from the study. Cross Sectural echocardiography provided the anatomical and spartial orientation and the selected variables of the left ventricular cavities (EDD, ESD) posterior free wall thickness and motion, interventricular septal thickness and motion, the mitral valve, the aortic valve, the left ventricular outflow tract (LVOT) and the left atrium were carefully examined in both M and 2D. In the parasternal left lateral position (the apical, subxiphoid/ subcoastal 4 chamber views. (See figures 5b 5d and 5e and data Table No. B1).

## RESULTS

Eight subjects (five males and two females) showed dilated LV above 5.3 with rather diminished motion of the LV free wall, but no segmental abnormalities. Subject three in data table showed a mass pressumably a clot (see figure 5e) in the left ventricular crevices. Diminished to absent septal motion was seen in four subjects but seven of them had normal septal thickness and no paradoxical motion. Fractional shortening was below normal in five subjects (see data table and statistical analysis).

The mitral valve leaflets were easily recorded but occupied rather eccentric positions in the LV dilated cavity in five subjects. The separation between the leaflets (AMVL and PMVL) looked visually diminished in those where output was low FS in two out of the seven with dilated left ventricles.

Two subjects had a thick septal wall above 1.3 i.e 1.8 and 2.2 septal; PWT ratio. The systolic septal motion was poor but the posterior free walls moved vigorously. They by definition had asymmetrical septal hypertrophy but no systolic anterior motion of the AMVL was noticed. The 2D clearly showed a constant patent left ventricular outflow tract. Their ventricular cavities were within normal limits.

CCF CARDIOMYOPATHY GROUP

TABLE 5A

| n=9 | EDD | ESD | ALIVD | FS | SEPT | PWT | SEPT/PWT | LAD | AOR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.2 | 5.8 | 1.4 | 19% | 0.9 | 1.2 | 0.700 | 4.4 | 3.1 |
| 2 | 7.0 | 4.6 | 2.4 | 34% | 0.8 | 0.9 | 0.900 | 4.1 | 3.1 |
| 3 | 5.8 | 3.2 | 2.6 | 45% | 1.0 | 1.2 | 0.8 | 3.5 | 3.3 |
| 4 | 6.0 | 2.8 | 3.2 | 53% | 1.0 | 1.1 | 0.9 | 3.2 | 2.9 |
| 5 | 5.8 | 4.6 | 1.2 | 21% | 2.7 | 1.5 | 1.8 | 2.7 | 2.6 |
| 6 | 6.7 | 5.5 | 1.2 | 18% | 1.7 | 1.8 | 0.9 | 3.3 | 3.1 |
| 7 | 5.3 | 2.9 | 2.2 | 41.5% | 1.0 | 0.9 | 1.1 | 3.7 | 3.4 |
| 8 | 6.9 | 5.8 | 1.1 | 15.9% | 1.8 | 0.8 | 2.2 | 4.2 | 3.2 |
| 9 | 7.6 | 6.3 | 1.3 | 17% | 0.8 | 0.9 | 0.9 | 4.7 | 3.4 |
| Range | 5.3-7.2 | 2.8-6.3 | 1.1-3.2 | 17-93% | 0.8-2.7 | 0.8-1.8 | 0.7-2.2 | 2.7-4.7 | 2.6-3.4 |
| Mean | 6.478 | 4.611 | 1.844 | 29% | 1.300 | 1.044 | 1.12 | 3.756 | 3.122 |
| STDEV | ±0.776 | 1.354 | ±0.768 | 13.8± | 0.642 | 0.328 | 0.48± | 0.644 | 0.254 |
| SE | ±0.25 | 0.45 | 0.25 | ±4.46 | 0.214 | 0.109 | 0.16 | 0.214 | 0.803 |

These two probably had hypertrophic cardiomyopathic features though pedigree from their families were not drawn.

(Data table was subjected to statistical analysis using the student "T" test. Confidence limits or statistical significance was not assumed if the P values were more than P=0.05. (see tables).

TABLE 5B

| VARIABLES | NORMAL GROUP | CARDIOMYOPATHY | P VALVES | SS | N |
|---|---|---|---|---|---|
| EDD | Mean $4.25\pm$<br>STD 0.501 | Mean $6.45\pm$<br>STD 0.776 | P 0.001 | – | |
| ESD | Mean $2.64\pm$<br>STD 0.773 | Mean $4.6\pm$<br>0.135 | P 0.001 | – | |
| SPT/PWT | Mean $1.0\pm$<br>STD 0.157 | Mean $1.4\pm$<br>STD o.64 | P 0.02 | | |
| LAD | Mean $3.13\pm$<br>STD 0.32 | Mean $3.8\pm$<br>STD 0.644 | P 0.001 | – | |
| FS | Mean $36\pm$<br>STD 12.8% | Mean $29\pm13.8\%$<br>STD | P 0.05 | | – |
| AOR | 2.8%<br>0.36 | 4.12<br>0.254 | P 0.05 | | – |

(SS Statistically Significant - NSS Not Statistically Significant)

## DISCUSSION

Cardiomyopathy is a worldwide problem, but the diagnosis should not be that of guess work if proper identification of the extent of the problem should be done.

Echocardiography gives more definitive information about the diagnosis than what is available at the bedside and should enhance the clinician's chances for better epidemiological surveys. The number of patients dealt with in this communication however is too small to allow a country wide conclusion but it does show that echocardiography has a very important role in the differential diagnosis of the cardiomegaly caused by congestive cardiomyopathies (Gibson et Alia).

Echocardiography readily substantiated the presence of ventricular septal hypertrophy its distribution and ventricular sizes. It was well tolerated by most patients though proper examination in this group took longer than in the foregoing groups. The author would also propose the inclusion of this modality in everyday evaluation of patients with suspected cardiomyopathy.

HYPERTENSION GROUP 5D

Assessment of changes associated with systemic hypertension has been limited to chest x-rays, EGGs, biochemical work up and mainly clinical examination, but no cardiac dimensions or functions have been obtained in this population where Hypertensive Heart disease is infact the second most common leading cause of Cardiovascular movidity and mortality.(Levitt, Obineche ZMJ 1976) 10 subjects randomly but carefully screened and selected mainly from the Hypertension Clinic 9 subjects and one from the Gynaecology Clinic (Referral) of the University Teaching Hospital were included in the study. Systolic hypertension averaged 170mm Hg (Range 135-220). Diastolic hypertension averaged 105mm Hg (Range 85-120mm Hg). The average duration of Hypertension was 14 months (Range 4-23 months) from the time of diagnosis.

Selection Criteria included:

- Cardiomegaly on the standard PA chest x-ray (Reported on according to format b) cardiothoracic ratio was not considered because it was found to give very many nonspecific false positive and false negative results.

None of the 10 subjects had a history of Angina pectoris (the chest pain indicated in symptoms column was vastly different from Angina pectoris). There was no history of previous myocardial infarction and no conduction defects on a 12 - lead EGG. All were in sinus rhythem and not in heart failure.

Patient No. 8 (see data table) prior to this evaluation had experienced an episode of Left Ventricular failure (figure 1c which cleared figure 1d) completely. The subjects were all on treatment since diagnosis but clinical notes suggested a very high default rate or non-compliance. 4 out of 10 manifested left ventricular hypertrophy on a 12 lead EGG and determined by a rather sensitive voltage and scoring, criteria of ROMHILT and Estes. Standard procedure for Echocardiography so far described in the text was followed.

Good quality Echograms in the partial left lateral decubitus and supine positions were obtained (figures 5a, 5c, 6a, 6b). Particular attention was paid to the visualization of the interventricular septum and the posterior free wall which were visualized in the plane.

Immediately below the plane of the free edges of the mitral valve leaflets in the long axis and short axis group in 2DE and undimensional views (see illustration No. 7).

<u>RESULTS</u> Table refers.

The 10 hypertension subjects who underwent Echocardiographic Evaluation had no evidence of congestive Heart failure either on clinical examination or on chest x-ray - and therefore their left ventricular End diastolic diameters and End systolic dimensions were found to fall within normal limits. (EDD = 5.0 ± 0.18 cm and ESD = 3.5 ± 0.86 cm). The aortic root diameter was 3.1 ± 0.40 cm and the left atrial dimension was 3.1 ± 0.06 both at P=0.05 which did not assume any statistical significance. However the septal; posterior wall thickness ratio for the group was 1.0 ± 0.018 at P = 0.5

( not statistically significant from the control group). Most notable was subject No 9 (Data table) whose Echocardiograms are shown in figures 5a, 5c (Long axis views). 4 chamber apical view in figure 6a and 6b shows the M-Mode description.

Earlier workers have indicated that in Hypertensive Heart disease, left ventricular function became impaired only when cardiac failure supervened. Although this is still controversial, the only index of hemodynamic function - Fractional shortening agrees with this assumption in this work. (FS was 30.0 ± 7.6% at P = 0.5 were within normal limits). Asymmetrical hypertrophy was not observed in the entire group. There was neither an IN or OUT flow obstruction observed

TABLE 5F

HYPERTENSION OR SUBROUP III

| n 1. | EDD | ESD | ALIVD | FS | SEPT | PWT | SEPT/PWT | LAD | AOR |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 4.7 | 2.4 | 2.3 | 49% | 0.8 | 1.1 | 0.723 | 3.2 | 3.9 |
| 2. | 5.4 | 4.0 | 1.4 | 26% | 0.8 | 1.4 | 0.600 | 3.6 | 3.1 |
| 3. | 4.6 | 3.6 | 1.0 | 22.0% | 1.1 | 1.5 | 0.733 | 3.1 | 3.0 |
| 4. | 5.9 | 4.1 | 1.8 | 30.5% | 0.9 | 1.3 | 0.700 | 2.9 | 2.6 |
| 5. | 4.6 | 3.2 | 1.4 | 30% | 1.0 | 1.2 | 0.833 | 3.3 | 3.1 |
| 6. | 4.7 | 2.9 | 1.8 | 38% | 0.9 | 1.4 | 0.64 | 3.5 | 2.9 |
| 7. | 7.0 | 5.4 | 1.6 | 23% | 0.8 | 1.6 | 0.5 | 4.1 | 3.9 |
| 8. | 5.2 | 3.7 | 1.5 | 29% | 1.2 | 1.3 | 0.9 | 3.5 | 3.0 |
| 9. | 3.8 | 2.8 | 1.0 | 26% | 2.2 | 1.9 | 1.2 | 2.7 | |
| 10. | 4.7 | 3.1 | 1.5 | 32% | 1.4 | 1.0 | 1.4 | 3.4 | 2.9 |

RESULTS

| | EDD | ESD | ALIVD | FS | SEPT | PWT | SEPT/PWT | LAD | AOR |
|---|---|---|---|---|---|---|---|---|---|
| RANGE | 3.8-7.0 | 2.4-5.4 | 1-2.3 | 30.6% | 0.8-2.2 | 1-1-9 | 0.5-1.4 | 2.9-4.1 | 2.6-3.9 |
| MEAN | 5.060 | 3.520 | 1.630 | 30.6 | 1.11 | 1.370 | 1.0 | 3.350 | 3.110 |
| STD DEV | 0.88 | 0.86 | 0.36 | +7.56 | 0.45 | 0.26 | 0.04 | 0.36 | 0.45 |
| STD ERROR | | | | | | | | | |

DATA

TABLE 5G

Statistical analysis with an unpaired student t-double trail test.

ECHOCARDIOGRAPHIC INDICES IN HYPERTENSION

| VARIABLES | NORMAL CONTROL GROUP | HYPERTENSION GROUP | P Valve | SS | NS |
|---|---|---|---|---|---|
| MEAN EDD ± STD DEV | 4.15 + 0.11 | 5.0 + 0.18 | P=0.5 | | NS |
| MEAN ESD ± STD DEV | 2.64 + 0.20 | 3.5 + 0.86 | P=0.02 | | NS |
| FS ± STD | 36 +12.8% | 30 + 7.6% | P=0.05 | | NS |
| LAD ± STD | 3.1 + 0.0.06 | 3.4 + 0.36 | P=0.05 | | NS |
| AOR ± STD | 3.0 + 0.07 | 3.1 + 0.014 | P=0.5 | | NS |
| SPT/PWT ± SD | 1.0 + 0.157 | 1.0 + 0.014 | P=0.001 | SS | |

DISCUSSION

Cardiomegaly of the standard Radiograph permitted Echocardiographic Evaluation of the 10 patients in the study coupled with the fact that Hypertension is the most leading cause of cardiovascular mortality and morbidity in Zambian (or the black race in general Obineche (2D). Complications become manifest at a rather early age and significantly contribute to the mortality and morbidity. In a clinical study of 87 Zambians (Hypertensive) subjects Levitt et al (27) estimated that 56% of them had evidence of hypertensive Heart disease changes as judged on both x-rays and ECGs at diagnosis. This work was collaborated by observations of Abrahams and Alele (28) in West Africa who in fact analysed 100 patients and found 67 of them to have some cardiac complications.

These findings of the two groups of workers though peculiar to the blacks are however at variance with the work of Friedberg (29) who observed that in Ethnic groups where coronary atherosclerosis is a rarity (typically in the blacks) it is the cerebral rather than the cardiac manifestations that frequently lead to fatalities in hypertension. However what actually leads to predominantly cardiac changes in the black hypertensives has not been fully defined. The question is whether early detection using echocardiography as a reliable and non-invasive method would help motivate more supervised therapy or drug compliance by patients.

A.O Falase and Odia (23) using Echocardiographically determined posterior wall and septal thickness and septal: posterior wall ratios in a series of 648 Nigerians over a period of 5 years observed that ECG and x-ray changes reflected only late and advanced complicatio and earlier changes were noticed on Echo examination making a good case for employing this modality in the Evaluation of all newly diagnosed hypertensives. The observations in this work agree with the two authors, although the patient number is small. The author would like to propose that the modality be exploited to the full to allow proper documentation of hypertension in Zambia. There is a lot to learn about the pathophysiology of Zambia's number one cardiac killer - hypertension; and Echocardiography offers us a sharper diagnostic tool in the field of clinical cardiology.

RHEUMATIC HEART DISEASE C III GROUP

Fifteen patients (11 females and 4 males) average age 30.4 (Range 18 to 55) were included in this study group. The criteria was Radiological cardiomegaly on the PA standard film. History and clinical findings and EGG were also contributed to the diagnosis. All except two had some hospital admission in the University Teaching Hospital or elsewhere in the country. Average duration of their symptomatology was between 15-40 months, had received for a mean 16±2 months. All the 15 had been followed up in the cardiac clinic at the University Teaching Hospital and were on prophylactic treatment. Close to 85% were on digoxin and or a diuretic, none of them was on anti-coagulation therapy.

The routine procedure for entry to Echocardiographic evaluation described in the text was strictly adhered to. Orientation of the mitral valve orifice was established first with the help of cross sectional 2D using parasternal long axis and a group of short axis views which ensured optimal transducer placement for subsequent scanning.

Appropriate gain settings were carefully adjusted Delineation of the septal and posterior wall Echoes were done for measurements of the EDD and ESD as averages of 3-4 consecutive cardiac cycle. The left ventricular longitudinal view was considered adequate when both mitral leaflets were visualized and the continuity of AMVL with posterior aortic root and IVS with anterior aortic root were preserved. Short axis views involved multiple tomographic 2D sections of the papillary muscles at the apex. (See short axis group illustration table on page )

The apical 4 chamber views were considered adequate when the atrioventricular valves and chambers were visualized. Both Dr CT and H de B as experienced cardiologists analysed these cross section views and verified the findings. The anterior mitral valve leaflets analysed like in the control group. i.e (The tip, body and the base of leaflets). The mitral orifices could be confidently assessed both as they opened in longitudinal parasternal long axis views and the short axis close up views with difference reject and gain setting accordingly adjusted. (See illustrations 4 and figures 7a - 7e with 7a as the M-Mode views).

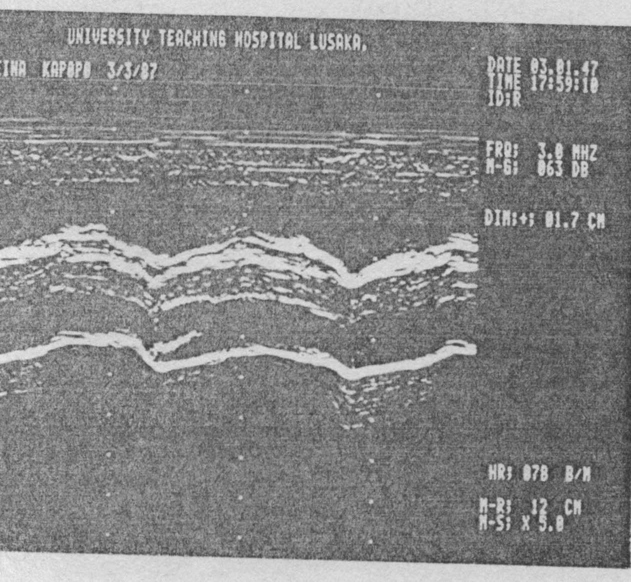
Records of still frames of the mitral valve apparatus for both 2D and M-Mode were done on polaroid films. Some material was left on the VTR, later reviewed in real time slow motion, frame to frame backwards and forth, measurements of other structures the aortic root and Left Atrium were also done.

## RESULTS

Left ventricular dimensions were normal in 9 cases in group I pure mitral stenosis, group 2 MS with some mild clinically determined mitral regurgitation (MS + MR) and one from group 3 with a perivalvular leak due to a prosthesis (Carpentier Edwards). Grossly dilated left atrium in 2 subjects with tight stenosis and in the other 2 with combined lesions.

No associated tricuspid stenosis was seen in any of the 15 patients emphasizing its rarity. The mean EDD was 5.2 ± 1.2 cm, at P=o.001 mean fractional shortening 29% ± 14% P=0.05 (not assummed to attain statistical significance) and they were within normal limits. Left atrial dimension - mean 4.1 ± 0 64 P=0.001 (5 skewed towards the MS predominant group) Aortic root and aortic valves basically normal except for one patient who had severe aortic incompetence and mitral regurgitation and stenosis.

Some rather exaggerated left ventricular free wall motion was observed in 5 patients with mitral regurgitation, angiography however here would have been the method of choice to determined the degree of regurgitation, and it was not available for the present study.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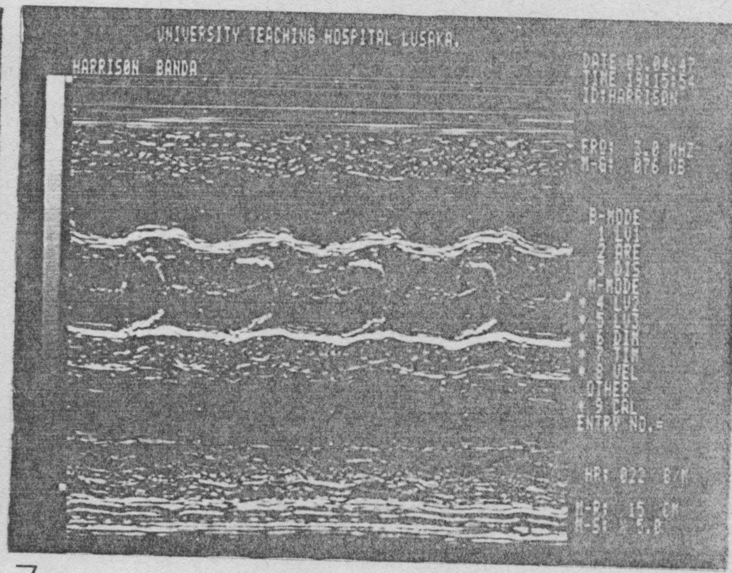
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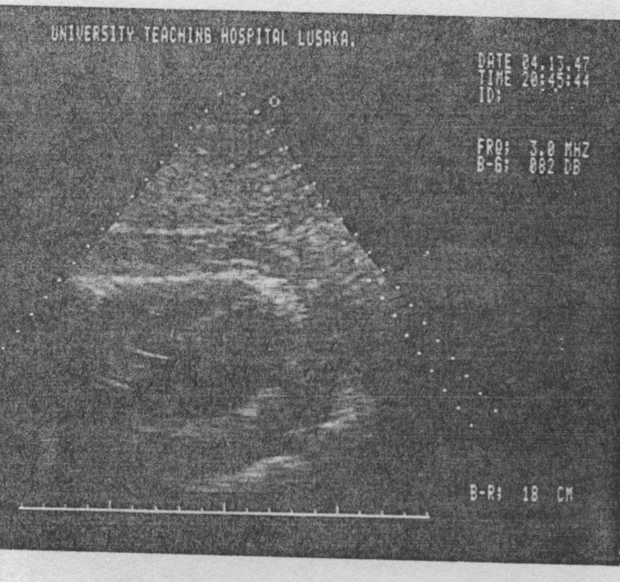
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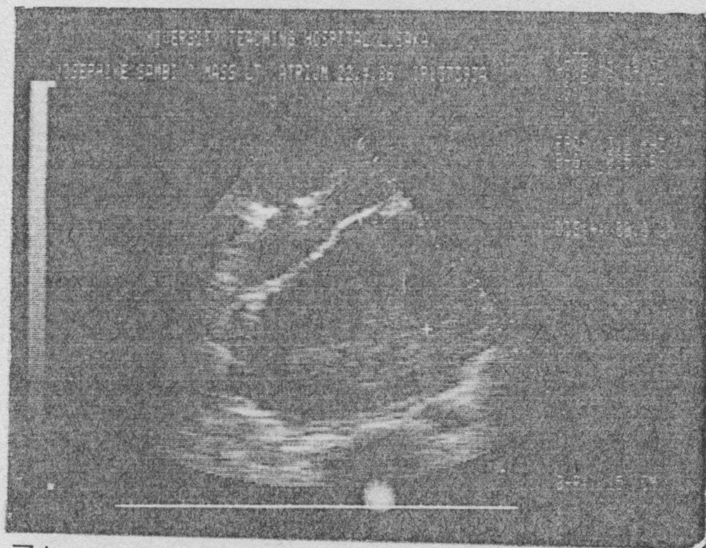
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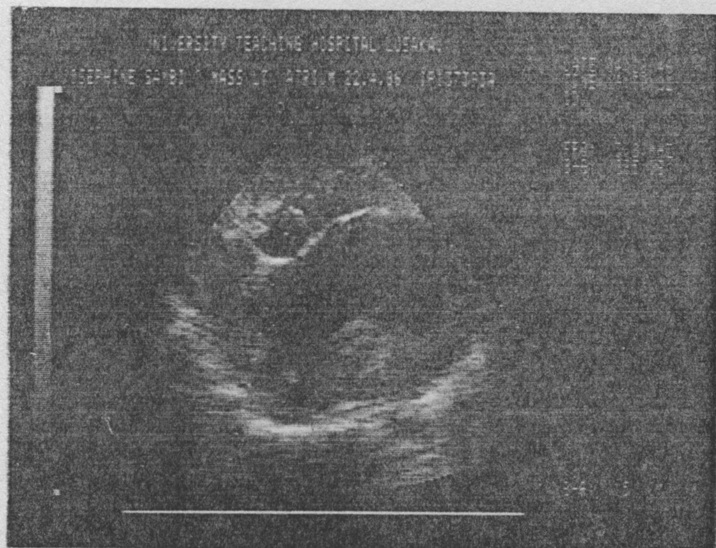
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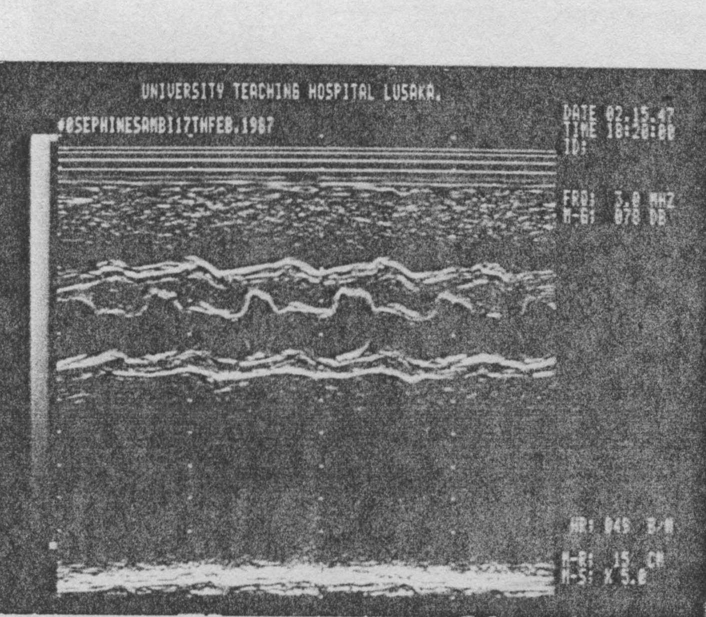
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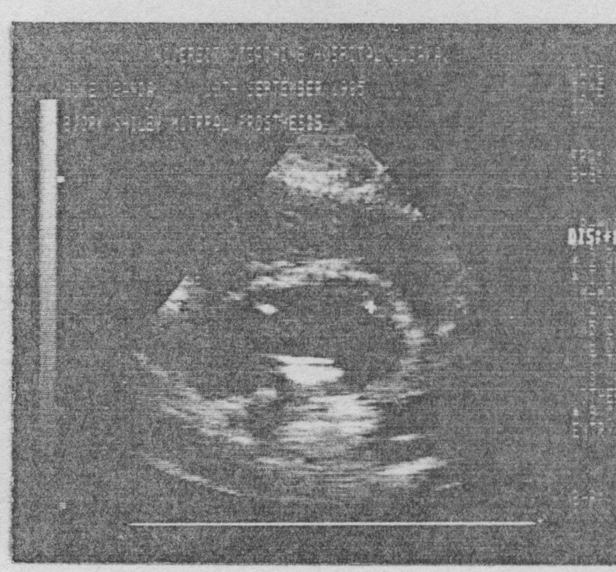

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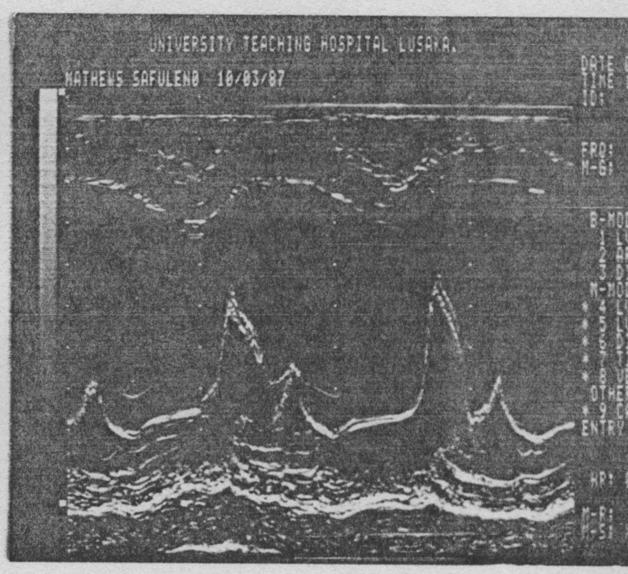
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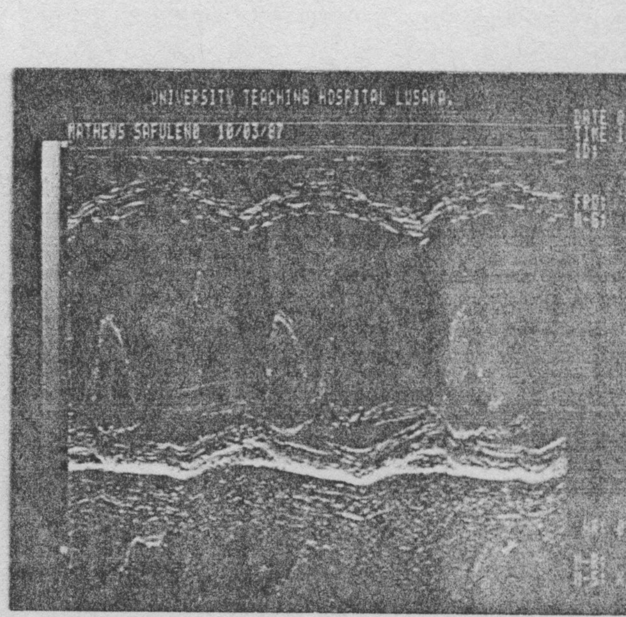
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MATHEWS SAFULENO 10/03/87

TABLE 5C

RHEUMATIC HEART DISEASE

| DIOGNOSIS GROUP | NO. OF PTS | SEX | RYTHM | X-RAY TYPE | ECHOGRAM TYPE | OBSERVATIONS |
|---|---|---|---|---|---|---|
| Pure MS (Clinically) | 2 | F | AF | Fig le & IF | Figs 7a+ 7d + 7b | Restricted motion of the leaflet tips with domin of the whole apparatus Marked reduction of the E.F. slope observed, reduced Mitral valve orific Markedly increased L.A size, more spherical in shape, a huge trhombus easily identified in figures hhi and 7i in 2D but M-Mode showed this as a conglumerate of Echoes |
| MS + MR (MR Mild) | 4 | 2M 2F | IN SR | le & | 7c + 7e | 2D readily demonstrated calcific deposits in the mitral annulus extending from the left ventricular wall. No prolapse was seen in both M and 2D. Plain radiographs completely missed the visualization. |
| MS + Mr | 1 | F | STILL | Le + IF | 7h, 7i & | Grossly dilated left atrium with a conglumerate of Echoes (Huge thrombus) |
| MS + MR | 1 | M | SR | le+lf | 7f | Mild AI with MS+MR calcificed anterior wall of the root and the valve, but little pressure over load on the LV (mild dilation) VDRL negative and no MV fluttering seen |

| n | EDD | ESD | LIVD | FS | SPT | PWT | SPT/PWT | LAD | AOR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 2.5 | 0.8 | 24% | 0.7 | 0.8 | 0.88 | 3.6 | 2.6 |
| 2 | 4.2 | 3.0 | 1.2 | 28.5% | 0.8 | 1.0 | 0.80 | 3.8 | 2.9 |
| 3 | 5.3 | 3.4 | 2.9 | 40% | 0.9 | 1.1 | 0.82 | 4.7 | 3.1 |
| 4 | 4.8 | 3.0 | 1.8 | 38% | 1.1 | 1.0 | 1.1 | 5.2 | 3.6 |
| 5 | 7.2 | 5.1 | 2.1 | 21% | 0.8 | 0.9 | 0.9 | 5.1 | 2.9 |
| 6 | 6.9 | 5.4 | 1.5 | 22% | 0.7 | 0.8 | 0.88 | 4.5 | 3.2 |
| 7 | 6.3 | 4.4 | 1.9 | 30% | 0.9 | 1.0 | 0.9 | 4.0 | 3.5 |
| 8 | 5.7 | 4.1 | 1.6 | 28% | 1.0 | 1.3 | 0.77 | 4.3 | 3.1 |
| 9 | 3.9 | 1.2 | 2.7 | 31% | 0.7 | 0.8 | 0.88 | 3.8 | 2.6 |
| 10 | 5.4 | 3.0 | 2.4 | 44% | 0.7 | 0.9 | 0.78 | | |
| 11 | 6.8 | 4.4 | 2.4 | 32% | 1.3 | 1.3 | 1.0 | 4.8 | 3.2 |
| 12 | 5.9 | 3.9 | 2.0 | 34% | 0.9 | 1.2 | 0.75 | 4.1 | 3.6 |
| 13 | 4.6 | 2.6 | 2.0 | 48% | 0.8 | 1.3 | 0.62 | 3.9 | 3.1 |
| 14 | 4.0 | 2.6 | 1.6 | 40% | 0.9 | 1.1 | 0.82 | 3.8 | 2.9 |
| 15 | 4.7 | 3.3 | 1.4 | 30% | 0.8 | 1.0 | 0.80 | 2.3 | 3.0 |
| Range | 3.3- | 2.4- | 0.8- | 24- | 0.7-1.3 | 0.8- | 0.62- | 3.2- | 2.6- |
| | 7.2 | 5.4 | 2.9 | 48% | | 1.3 | 1.1 | 5.4 | 3.6 |
| MEAN | 5.2 | 3.55 | 1.8 | 33% | 0.800 | 1.033 | 0.85 | 4.00 | 3.100 |
| STD DEV | +1.2 | 0.954 | ±0.55 | ±6.4 | ±0.124 | ±0.18 | 0.126 | ±0.61 | ±0.31 |

STATISTICAL ANALYSIS USING THE "T" TEST (DIMENSIONAL MEASUREMENTS)

TABLE 5E

| VARIABLE | | NORMAL GROUP | RHD GROUP | P VALVES SS | P VALVES NS |
|---|---|---|---|---|---|
| n | | 22 | n=15 | | |
| EDD | MEAN +STD | 4.15 + 0.501 | 6.45 + 0.78<br>P 0.001 | - | |
| ESD | MEAN +STD | 2.64 + 0.773 | 4.6 + 0.78<br>P 0.001 | | |
| MEAN FS + STD | | 36 + 12.8% | 29 + 13.4%<br>P = 0.5 | | |
| SPT MEAN + STD | | 1 + 0.157 | 0.8 + 0.48<br>P = 0.5 | | - |
| LAD MEAN STD | | 3.13 + 0.32 | 4.1 + 0.64<br>P 0.001 | — | |
| AOR MEAN + | | 2.8 + 0.36 | 3.12 + 0.254<br>P = 0.5 | | - |

(SS= Statistical significant)
(NS= Not statistical significant)

## DISCUSSION

Echocardiography both M-Mode and 2 dimensional has played a crucial role in the differential diagnosis of cardiomegaly in this communication.

The principal advantage of spatial orientation inherent in 2 dimensional imaging provided the unique opportunity for the first time in Zambian clinical cardiology to study the shapes of intracardiac structures (valves), chamber sizes and be able to comment on some of their hemodynamic activities.

The excellent ability of M-Mode Echocardiography to do rapid sampling of individual valve and structural motions provided answers also in various forms of heart diseases in this hospital which seemingly is the pattern country wide.

In the Zambian setting (particularly the University Teaching Hospital) it was possible to distinguish various heart diseases which on chest radiographs closely simulate each other and produce the syndrome of cardiomegaly (large Heart), which could be due to cardiomyopathy, pericardial effusion, rheumatic valvular heart disease (mitral stenosis pure or in combination with either mitral or aortic regurgitation. The triscuspid rheumatic involvement was not observed in the group investigated. The observation by many workers that mitral valve stenosis in isolation occurs rather rarely than in combination was also confirmed with the help of Echocardiography in this communication and the author totally agrees with Schrie and Shamroth and Maurice Banard's observations at the Milpark Hospital - unpublished data) and wi the work of Jaiyesimi F and Antia (Tropical Geog Med 1981 33, PG D'arbela - RHD - the problem of cardiological practice in Africa in Akinkugbe O.O. Ciba Geigy). Intra -cardiac masses (left atrial clot or thrombus in the left ventricular crevices and calcific deposits were readily detectable without the danger of vadiation to the patient caused during fluoroscopy or the invasiveness of catheterisation in establishing these diagnoses. Constrictive pericarditis would be vividy distinguishable. Early effects of Hyptertension on the posterior wall thickness could be picked up before the onset of congestive Heart failure which would alert the physician and patient alike to a more motivated therapy programme and more strict control of hypertension.

In conclusion therefore the introduction of Echocardiography in the Univeristy Teaching Hospital is already seen to play a great role in clinical cardiology. Differential diagnosis of a cardiomegaly was just one of the facets. It was found to be a very acceptable method of investigating the patients without harm, noninvasive safe and definitely ideal in the Zambian setting where no angio-cardiographic facilities exist. A few normal values about cardiac chamber sizes were worked out in the local population.

Echocardiography is not here however to supplant other existing investigative facilities. It should be regarded as complementary. Its major limitations are that:

1. No 100% answers are obtainable especially in the restless uncooperative tachycardic, and tachypheic patient.

2. In patients with a depressed or deformed sternum due to any cause.

3. In some obese and thick chests.

Echocardiography should not be regarded as a technical service. It demands some working knowledge from clinicians seeking information from it. This would only be appreciated if the clinicians underwent some basic tutored learning as the situation obtains in basic radiology and electrocardiography.

The author would like to propose that basic Echocardiography be intergrated in the final year of Medical School training and during the relevant rotational schemes in internal medicine. This way the health delivery authorities would be persuaded to extend the facility to some of the centres where our medical graduates serve their probation. Perhaps this way we will avoid lopsided cardiovascula disease statistics in the local population. Besides routine Echocardiographic evaluation of cardiac sufferers would enable us draw up a more accurate list for referral to cardiac surgeous.

# C H A P T E R 6

## APPENDIX A

## REFERENCES


1. Abbasi: As Chest 62 1972

   Abbasi: As Chest 63 1973

   Abbasi: As New England Journal of Medicine 289

   Abbasi and Alia: Circulation 46 8977 1972

2. Abrahams O.G. and Alele C O :

   West African Med J (9) 1983

3. Akinkugbe O O 1976 :

   Cardiovascular disease in Africa
   (All Africa Cardiovascular Symposium (Basle)
   (Ciba Giegy)

4. American Society of Echocardiography Circulation
   62 = 212 1980

5. Chang Sonia - Echocardiography:
   Techniques recording patterns and recognition
   1981 Philadelphia (Lea and Ferbiger)

6. Cooperberg P L and Alia:

   Estimation of Cardiac Chamber size by Routine Chest
   Radiography and Echocardiography Radiology 119 93 1976

7. Dahl and Obineche E N:

   Pattern of Cardiovascular disease in Lusaka,
   Ndola and Kitwe EAMJ Volume 53 No 8 435 1976

8. Edler L Et Alia:

   Ultrasound cardiography
   Acta Medic Scand(Suppl) 370 68

9. Edler L and Gustatson:

Ultrasound cardiogram in mitral stenosis
Acta Med Scand 159 85 1957

10. Falase A O and Odia:

Evaluation of ECG criteria for diagnosis of left ventricular

Hypertrophy in adult Nigerian Abstract (2nd Pan African Congress of Cardiology - Cairo 1986)

11. Gibson D G:

Estimation of left ventricular size by Echocardiography
British Heart Journal 35 128 1973

12. Goodwin J F, Oakley C M, Olsen E G J

Symposium on Cardiomyopathy
Postgrad Med Journal No. 48 1972

13. Harowitz M Et Alia:

Sensitivity and specificity of Echocardiographic diagnosis of Pericardia Effusion

Circulation 50: 239 1974

14. Hertz C H and Landstrom K:

A fast ultrasonic scanning System for Heart investigations.

3rd International Congress on Medical Physics. Gottenberg - Sweden

15. King L:

Cardiac Ultrasonography

Cross section imaging of the Heart

Circulation 47 112 1974

16. Krishna Somers Et Al:

The wider view - Cardiology: Africa versus Australia (The Medical Journal of Australia January 17 1976)

17. Feigenbaum H:

Echocardiography
3rd Edition 1981 (Lea and Ferbiger) Philadelphia

18. Feigenbaum H, Popp R L, Chip J E Et Alia:

Left ventricular wall thickness measured
by ultrasound

ARCH. Intern Med 121: 391 -395 1968

19. Feigenbaum H, Waldhausen J A and Hyde L P:

Ultrasound diagnosis of pericardial effusion

J A M A 191: 107, 1965

20. Friedberg C K :

Disease of the Heart
3rd Edition W B Saunders Co. (Philadelphia and
London)

21. Ladipo G O A

Patterns of Heart Disease in adults of Nigerian

Savanna. Africa Med Science 1977 (6) - 185

22. Levitt D, Obineche E N and Foster D:

E A M 51 869

Hypertension in Zambian Africans

23. Maron B J Et Al.

Hypertrophic cardiomyopathy
Recent observations regarding the specificity of
three Hallmarks of the disease.

A symmetrical septal Hypertrophy septal disorganisation
and systole anterior motion of teh anterior mitral
valve leaflet - A M Cardiol 45 141 1980

24. Martin R P Et Al.

Intrapericardial abnormalities in patients with pericardial effusion: Findings by two dimensional Echocardiography: Circ. 61 568 - 1982

25. Meltzer R S and other:

Diagnosis of left ventricular Hypertrophy by two dimensional echocardiography
Br Heart J 42: 261 1979.

26. Okuwobi B O:

Tropical cardiology No (4) 15 129

Okuwobi B O: Et alia

Hemodynamic and Angiographic features of Nigerian Cardiomyopathy - Myocardiopathy in Africa
Volume I

27. Olsen E J G:

Pathology of cardiomyopathy
P G M J 48 732

28. Statistics at Square One: Swinscow P V - BMA 1980

29. Somers K: and P D'Arbela:

Proceedings of 3rd Asian Pacific Congress on Cardiology 162 1964

30. Sharper A G, Hutt and Fejkar

31. Teare:

A symmetrical hypertrophy of the Heart in young adults Br Heart Journal No. 20

32. Vaughan J P:

Cardiovascular disease seen in Tanzania Hospitals.

E A M J Vol. 54 No. 7 1977

## APPENDIX B

| | |
|---|---|
| AMVL | Anterior mitral valve leaflet |
| AO | Aorta |
| AOR | Aortic Root |
| ARV | Anterior Right Ventricular Wall |
| ASE | American Society of Echocardiographers (Circulation 62/2) |
| CW | Chest Wall |
| EDD | End Diastolic Dimension |
| ESD | End Systolic dimension |
| FS | Fractional Shortening = $\frac{EDD - ESD \times 100\%}{EDD}$ |
| IVS | Interventricular Septum |
| LA | Left Atrium |
| LV | Left Ventricle |
| LVPFW | Left Ventricular Posterior Free Wall |
| RV | Right Ventricle |
| RHD | Rheumatic Heart Disease |
| PLV | Posterior Left Ventricular Wall |
| PPM | Posterior Papillary Muscles |
| PMVL | Posterior Mitral Valve Leaflet |
| PWT | Posterior Wall Thickness |
| SPT | Septum |
| T | Transducer |