SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr MGR Medical University, Chennai

DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME : Echocardiography

UNIT : Principles & Techniques of Echocardiography

TOPIC : Measurement of cardiac dimensions

FACULTY NAME : Kavipriya S

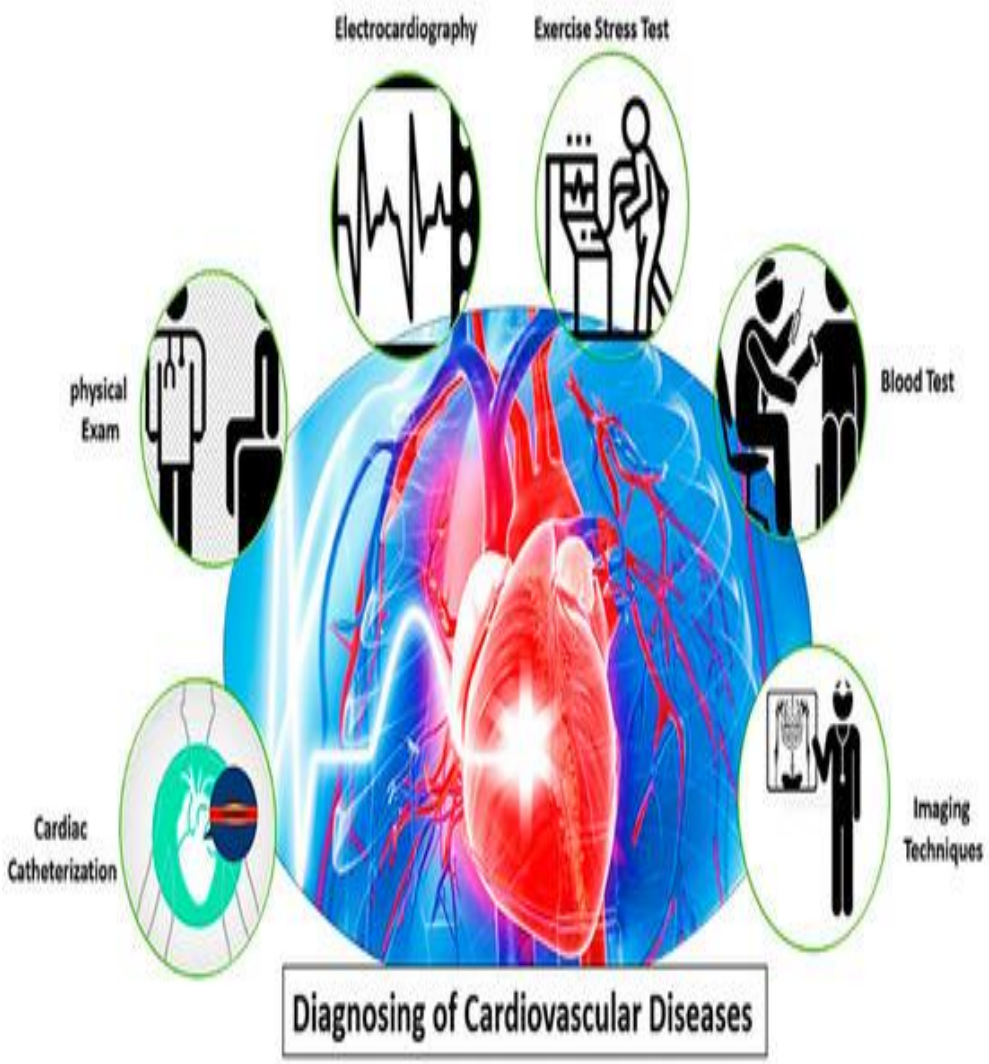
1. EMPATHIZE STAGE – Understanding the Need

Objective:

To understand why accurate measurement of cardiac dimensions is critical for diagnosis, management, and monitoring of cardiovascular diseases.

Clinical Context:

- Echocardiography allows **non-invasive assessment** of cardiac chamber sizes, wall thickness, and function.
- These measurements are essential for identifying **hypertrophy, dilation, heart failure, and valvular diseases**.



Define Stage – Identifying the Problem

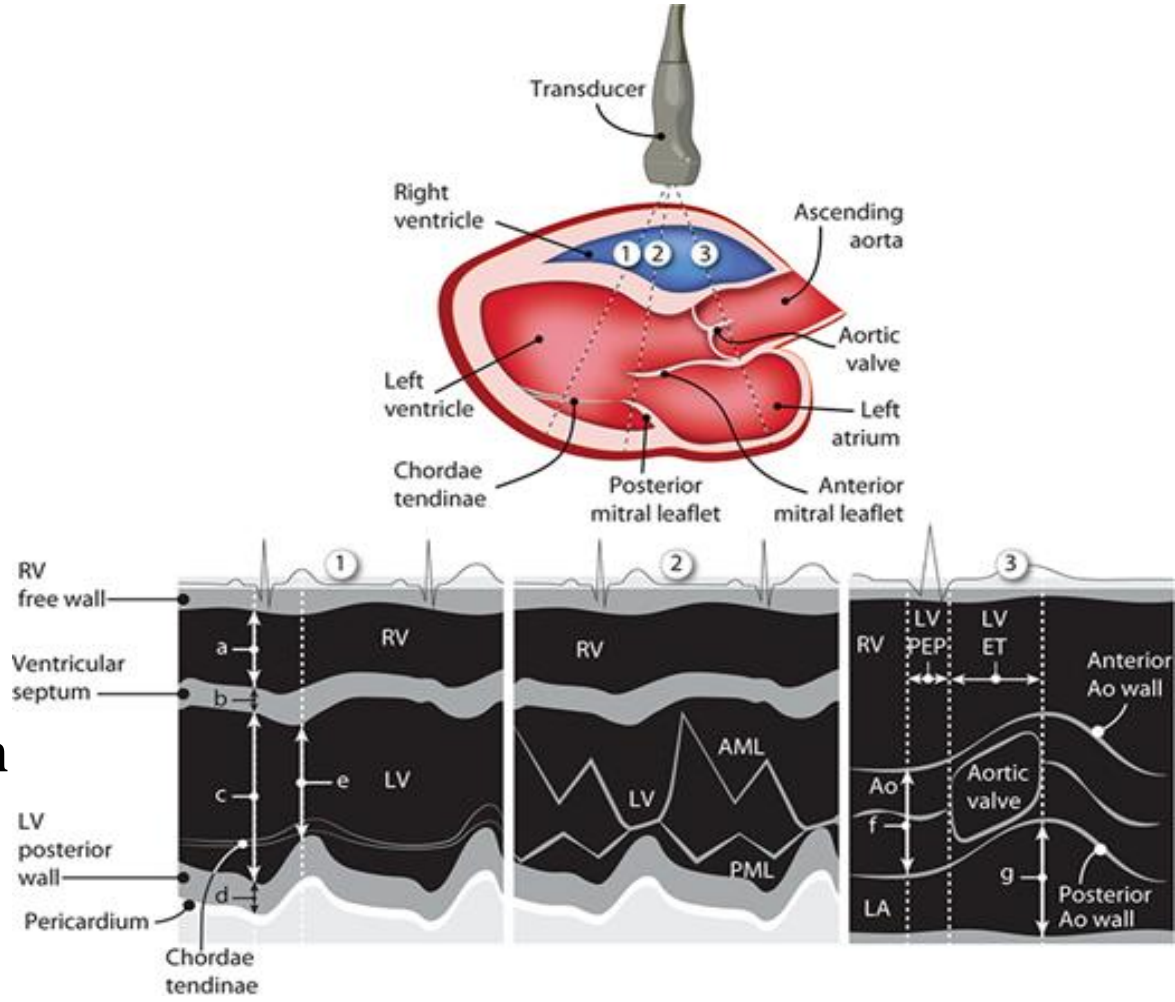
Problem Statement:

Students need to learn **how to obtain, interpret, and apply accurate cardiac measurements** using echocardiography, following standardized guidelines.

Learning Goals:

•Understand the **principles of cardiac dimension measurement**.

•Learn the **proper technique and landmarks** for each dimension.

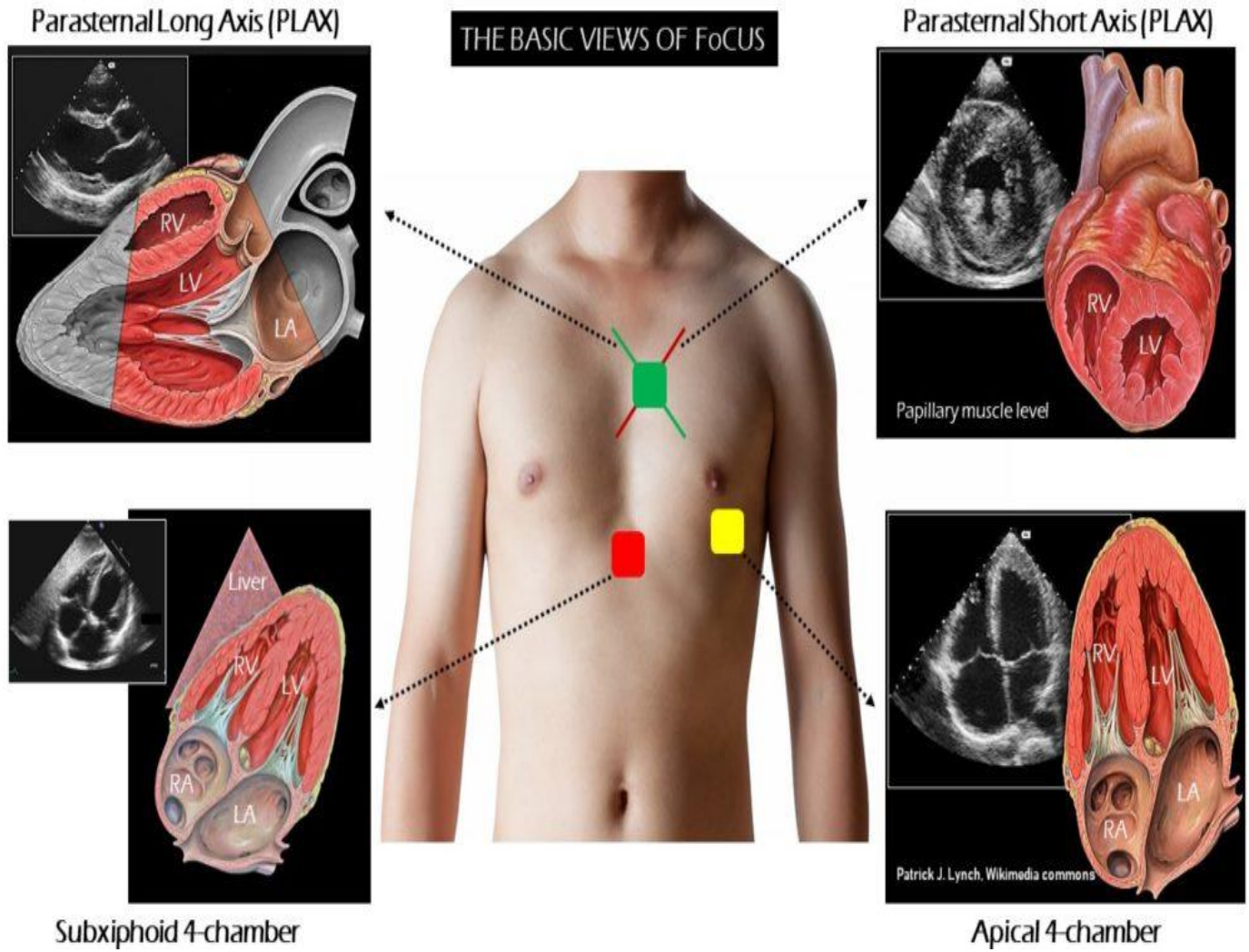


IDEATE STAGE – Conceptualizing Solutions

Core Concepts:

- **Basic Planes for Measurement**

1. **Parasternal Long-Axis (PLAX)** view: used for LV, LA, Ao root, and RVOT measurements.
2. **Apical 4-Chamber (A4C)** view: used for LV and RV volumes and function.
3. **M-mode Echocardiography:** provides precise linear measurements.



🧠 Key Measurements and Their Normal Values

Parameter	Method/Plane	Normal Range	Clinical Use
Left Ventricular End-Diastolic Diameter (LVEDD)	M-mode, PLAX	Men: 42–59 mm; Women: 39–53 mm	Chamber dilation, LV function
Left Ventricular End-Systolic Diameter (LVESD)	M-mode, PLAX	Men: 25–40 mm; Women: 22–35 mm	Contractility evaluation
Interventricular Septum Thickness (IVS)	M-mode, PLAX	6–10 mm	Hypertrophy detection
Posterior Wall Thickness (LVPW)	M-mode, PLAX	6–10 mm	Hypertrophy evaluation
Left Atrial Diameter (LAD)	PLAX, 2D	27–38 mm	LA enlargement, diastolic dysfunction
Aortic Root Diameter (Ao)	PLAX	20–37 mm	Aneurysm, aortic dilation
Right Ventricular Dimension (RVD)	A4C	< 41 mm (basal)	RV enlargement
Left Ventricular Mass (LVM)	Derived by formula	Males: 88–224 g; Females: 67–162 g	LVH quantification
Ejection Fraction (EF%)	Simpson's biplane, A4C + A2C	≥ 55%	LV systolic function

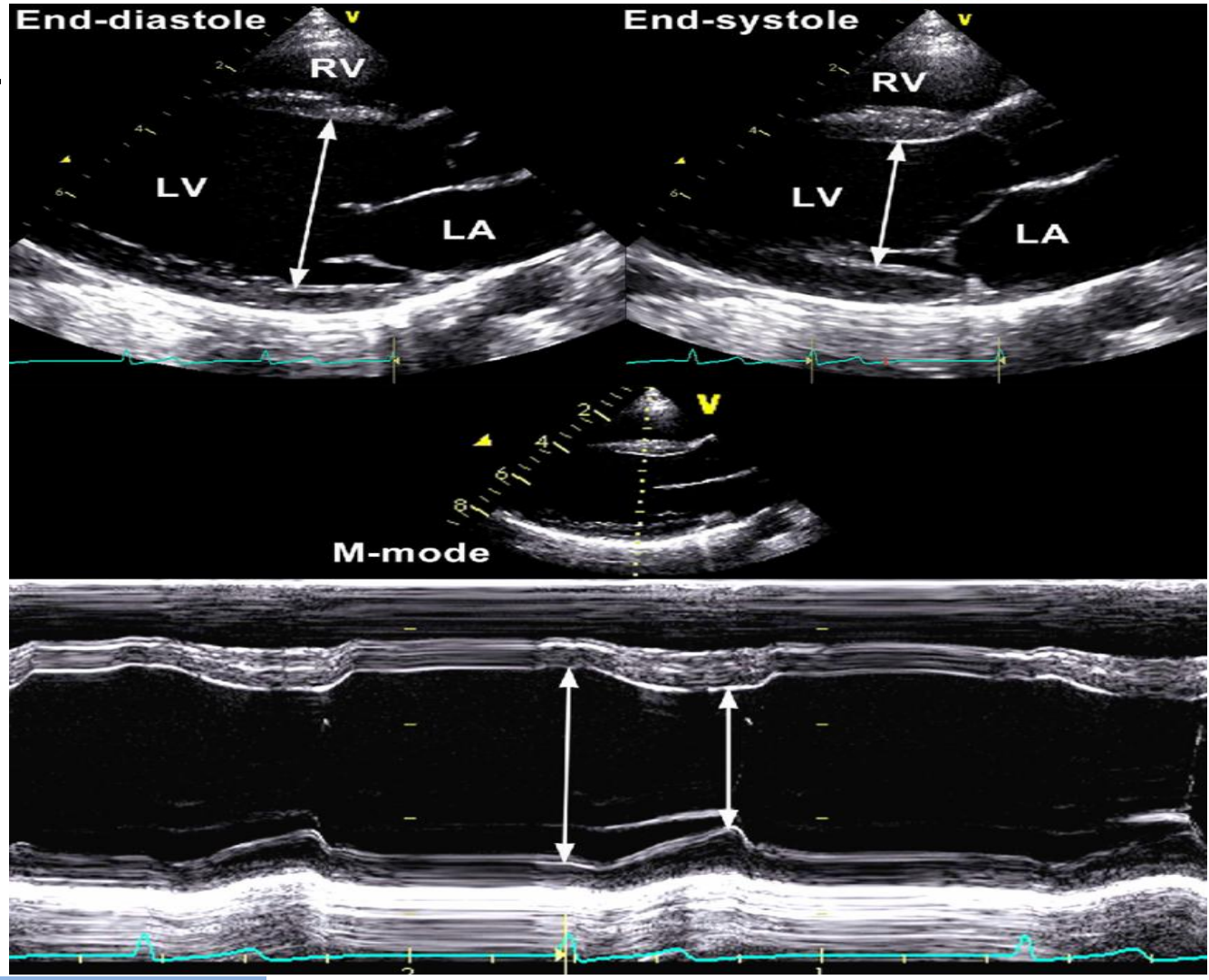
🧠 IDEATE — Measurement Techniques

1.M-Mode Echocardiography

1. Place cursor perpendicular to LV walls at **mid-ventricular level**.
2. Measure **from leading edge to leading edge** during **end-diastole and end-systole**.
3. Highly reproducible for LV dimensions.

2.2D Echocardiography

1. Used for **volumetric and area-based** measurements.
2. Biplane **Simpson's Method** for EF calculation.
3. Provides better visualization of regional wall motion.



🧠 PROTOTYPE STAGE – Application and Practice

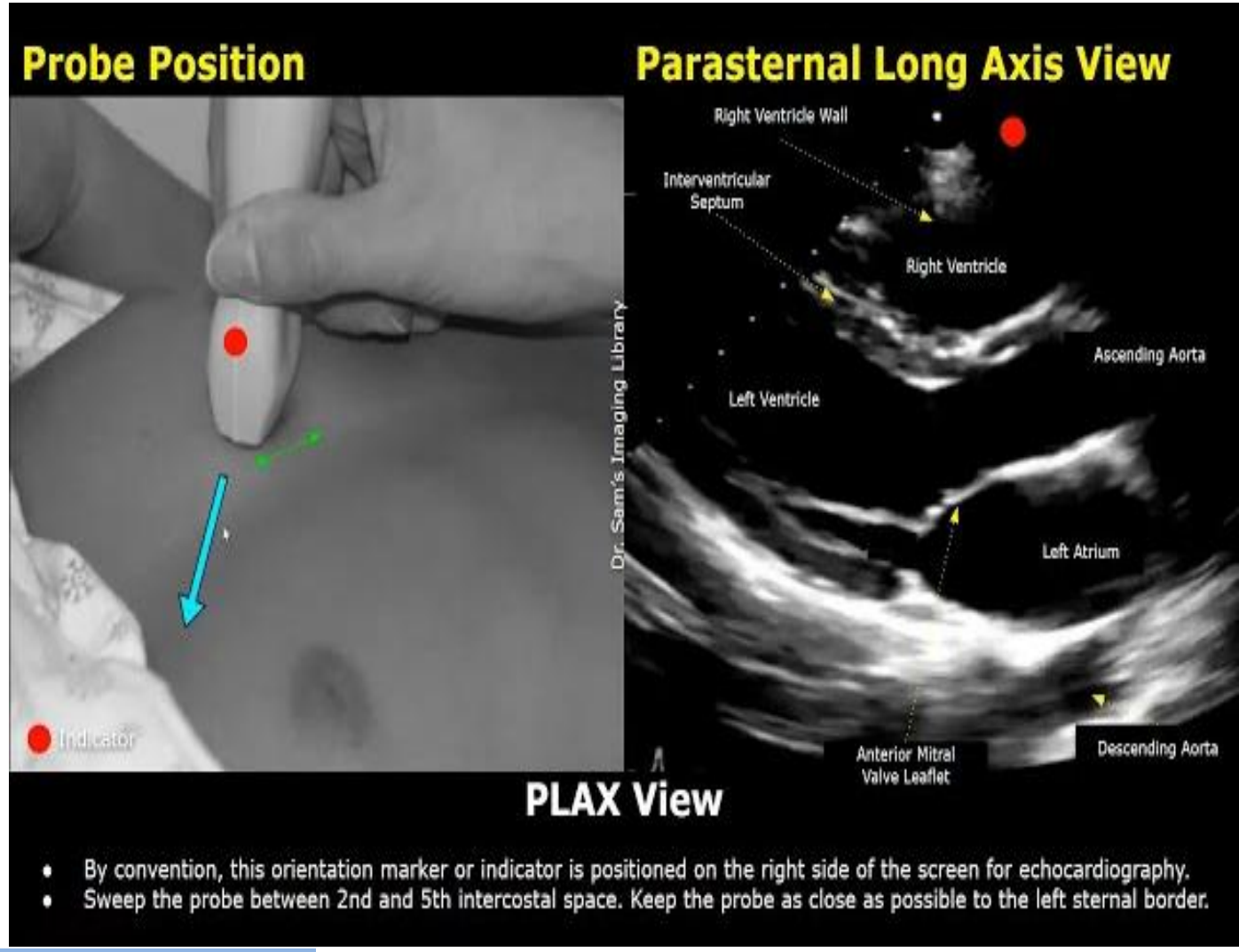
Step-by-Step Practical Approach:

1.Patient Preparation:

1. Position in **left lateral decubitus**.
2. Attach ECG leads for timing reference.

2.Probe Position:

1. Use PLAX for LV, LA, and Ao measurements.
2. Use A4C for LV volume and EF.



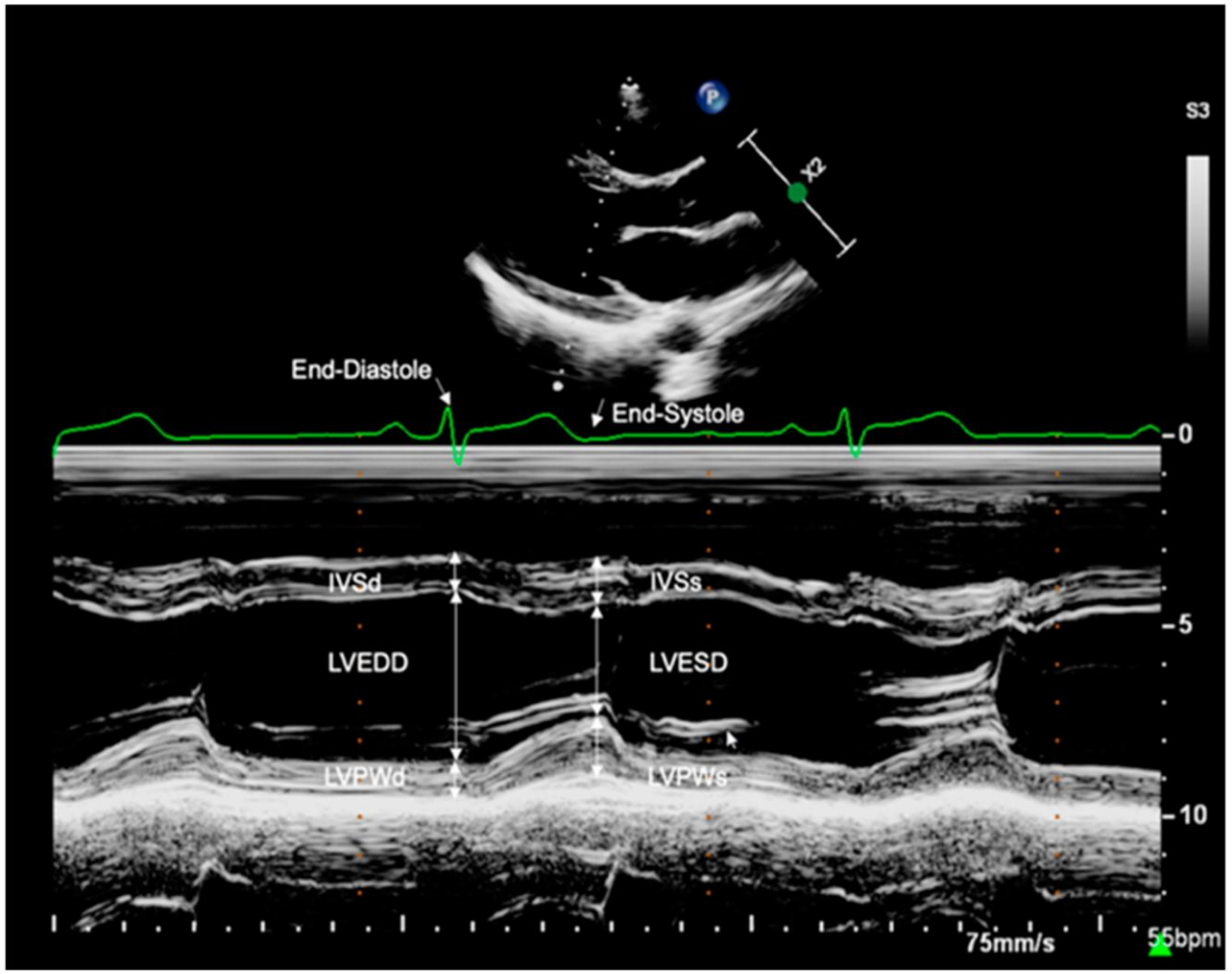
PROTOTYPE — RATE AND RHYTHM ABNORMALITIES

3.Measurement Protocol:

1. Identify **end-diastole (largest LV dimension)** and **end-systole (smallest LV dimension)**.
2. Use **frozen images** and **calipers** to mark measurement points.
3. Follow **ASE guidelines** for consistency.

4.Documentation:

1. Record all measurements with units.
2. Calculate **LV mass**, **EF**, and **relative wall thickness (RWT)**.



Summary

View Used	Parameters Measured	Technique	Clinical Interpretation
PLAX	LVEDD, LVESD, IVS, LVPW, LA, Ao root	M-mode / 2D	LV size, wall thickness
PSAX	LV wall motion	2D	Regional wall motion defects
A4C	LV & RV volumes, EF	Simpson's biplane	Global systolic function
Subcostal	RV and IVC	2D	Volume status, RA pressure

Formulas and Calculations

Ejection Fraction (EF%)

- $EF = \frac{(LVEDV - LVESV)}{LVEDV} \times 100$

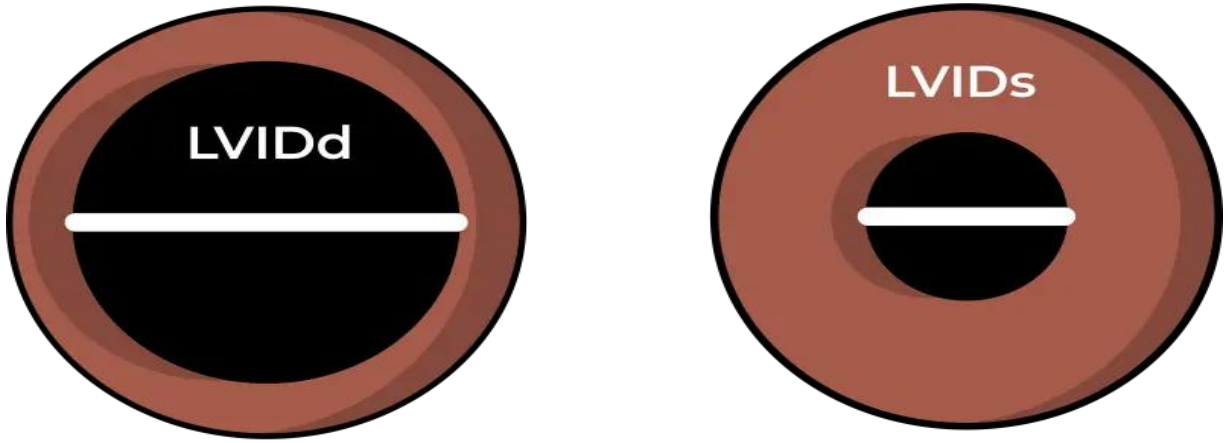
LV Mass (ASE formula)

- $LV\ Mass = 0.8 \times \left[1.04\left((LVEDD + IVS + LVPW)^3 - LVEDD^3\right)\right] + 0.6$

Relative Wall Thickness (RWT)

- $RWT = \frac{2 \times LVPW}{LVEDD}$

LVEF by Teicholz



Diastole Systole

$V_d = [7/(2.4 + LVID_d)] \times LVID_d^3$

$V_s = [7/(2.4 + LVID_s)] \times LVID_s^3$

$LVEF = (V_d - V_s) / V_d$

📚 References

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- Otto CM. *Textbook of Clinical Echocardiography*, 6th Edition, Elsevier.
- Lang RM et al., *ASE and EACVI Recommendations for Cardiac Chamber Quantification*, JASE 2023.
- Braunwald's *Heart Disease*, 12th Edition.