SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai

DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME : ECHOCARDIOGRAPHY

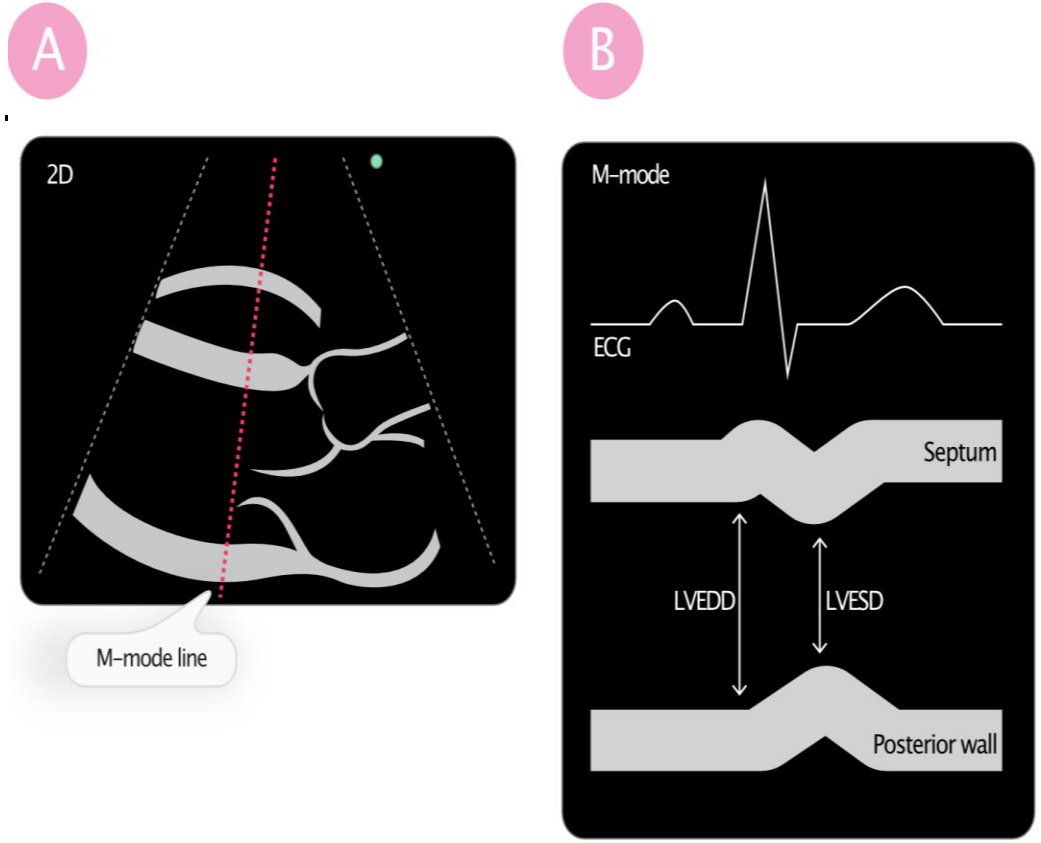
UNIT : SEGMENTAL ANALYSIS AND HEMODYNAMIC ASSESSMENT

TOPIC : ECHOCARDIOGRAPHIC ASSESSMENT OF SYSTOLIC FUNCTION

FACULTY NAME : Ms. KAVIPRIYA S

Definition

1. **Systolic function** refers to the ability of the heart—primarily the **left ventricle (LV)**—to **contract and eject blood** during systole.
2. It reflects **myocardial contractility, preload, afterload**, and coordinated wall motion, and is commonly expressed through indices such as **Ejection Fraction (EF), fractional shortening, stroke volume**, and **global longitudinal strain**.



Assessment Methodology

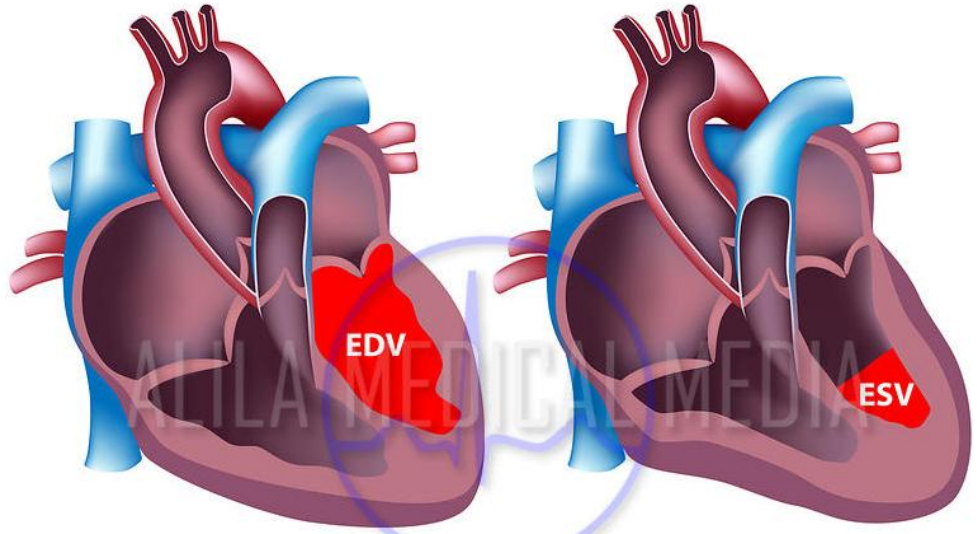
A. 2D Echocardiographic Parameters

1. Ejection Fraction (EF) – Biplane Simpson's Method (Standard)

a. Most widely used method recommended by ASE and EACVI.

b. Calculated from LV end-diastolic and end-systolic volumes from apical 4-chamber & 2-chamber views.

EF = (EDV – ESV) / EDV × 100%



EDV = End Diastolic Volume
ESV = End Systolic Volume

Stroke Volume (SV) = EDV - ESV

$$\text{Ejection Fraction (EF)} = \frac{\text{Stroke Volume (SV)}}{\text{EDV}} = \frac{\text{EDV - ESV}}{\text{EDV}}$$

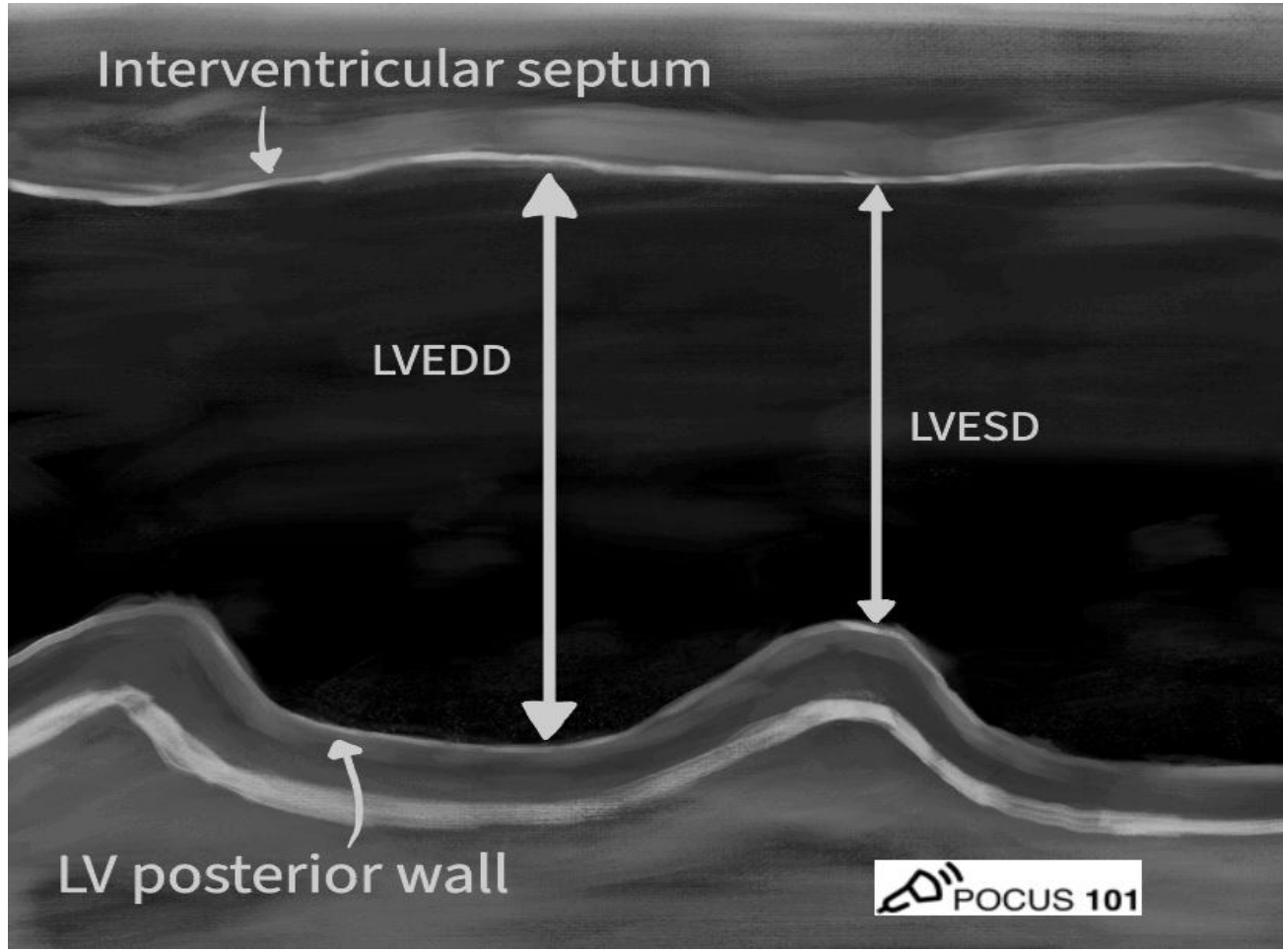
Assessment Methodology

Fractional Shortening (FS)

a. Measured in M-mode at LV mid-cavity.

b. FS = (LVEDD – LVESD) / LVEDD × 100%

c. Useful in structurally normal ventricles.



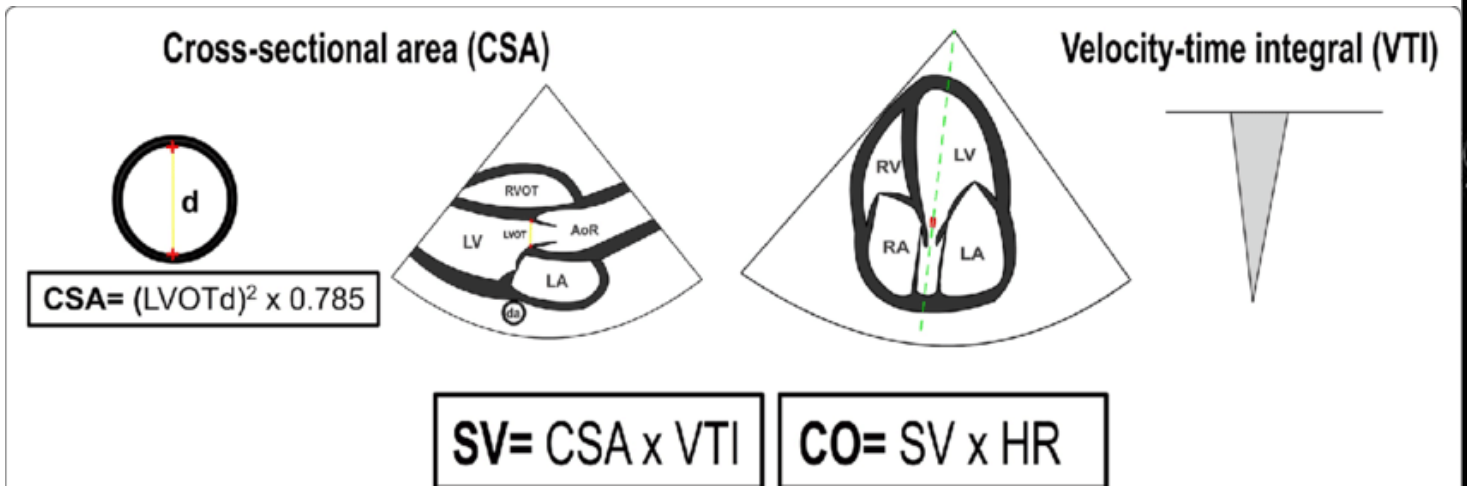
Assessment Methodology

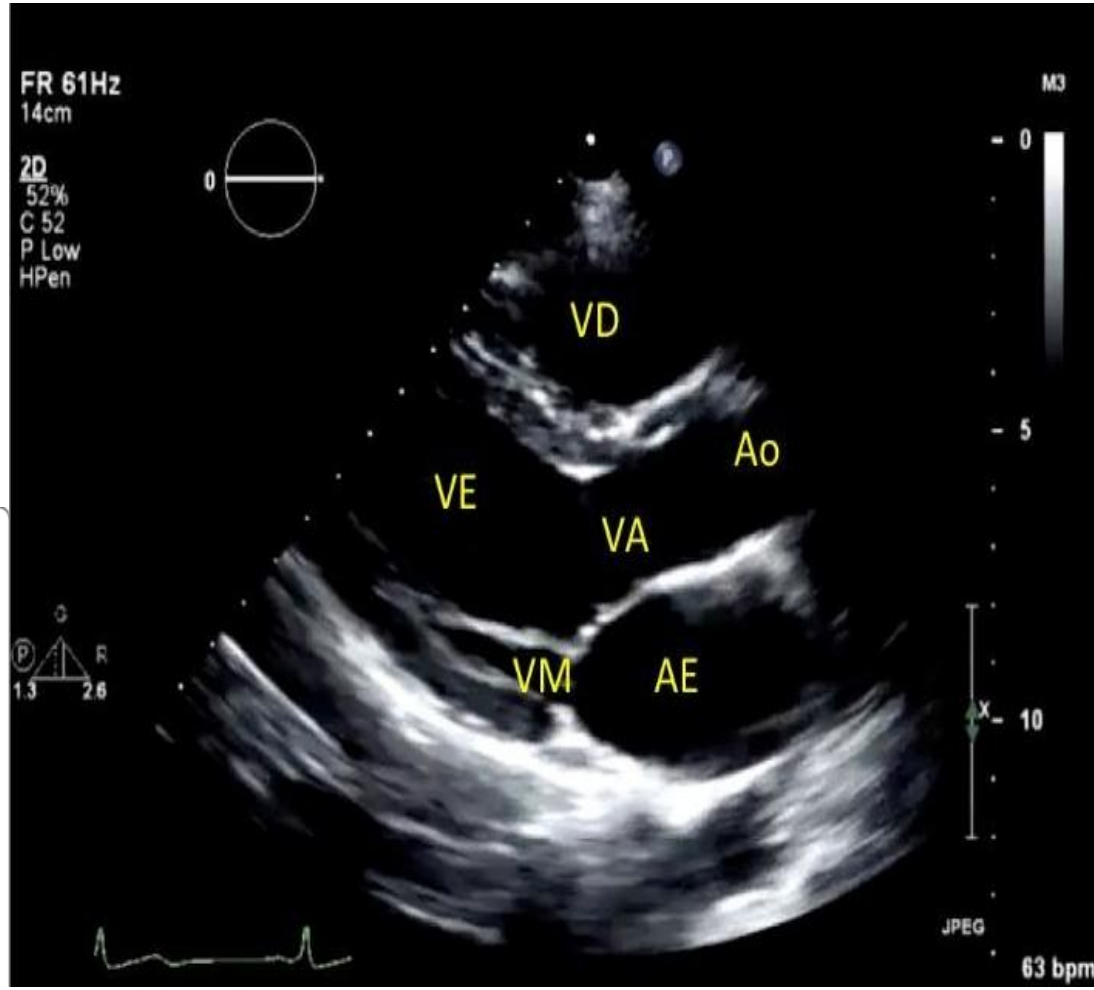
Stroke Volume (SV) & Cardiac Output (CO)

a. SV = LVOT Area × LVOT VTI

b. CO = SV × HR

c. Useful in low-EF or high-output states.





Assessment Methodology

B. Doppler-Based Assessment

1. LVOT Velocity Time Integral (LVOT-VTI)

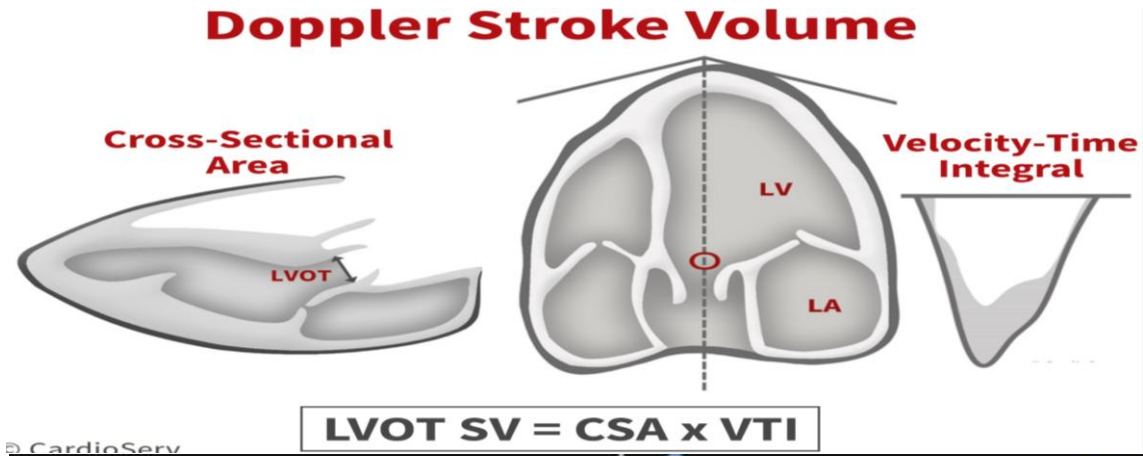
Reflects forward stroke volume.

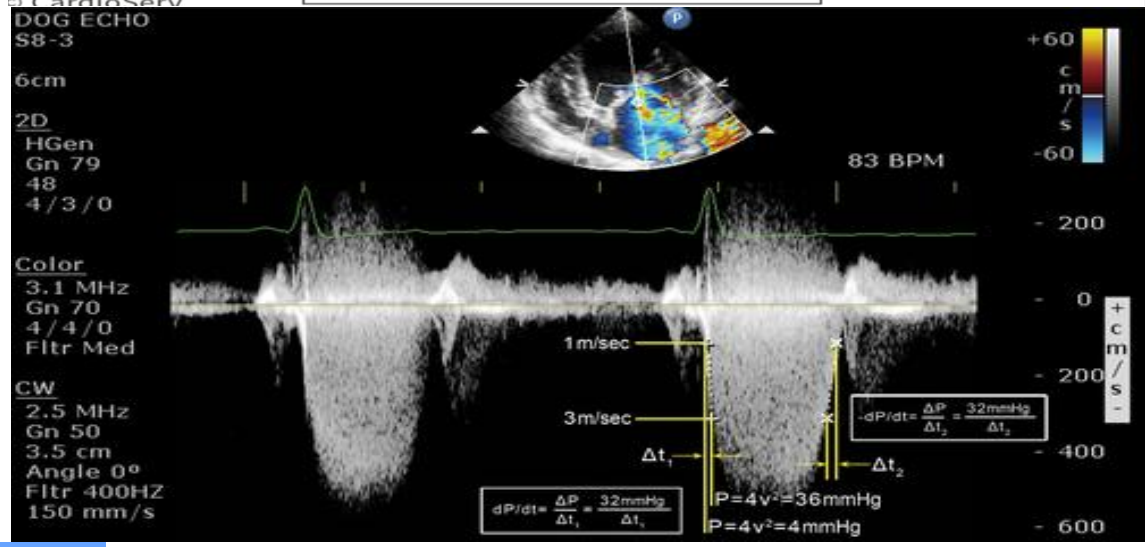
Low VTI (<18 cm) may indicate reduced systolic function.

2. dP/dt Measurement (Mitral Regurgitation Jet)

Measures the rate of LV pressure rise.

dP/dt < 1000 mmHg/s suggests impaired contractility.





Assessment Methodology

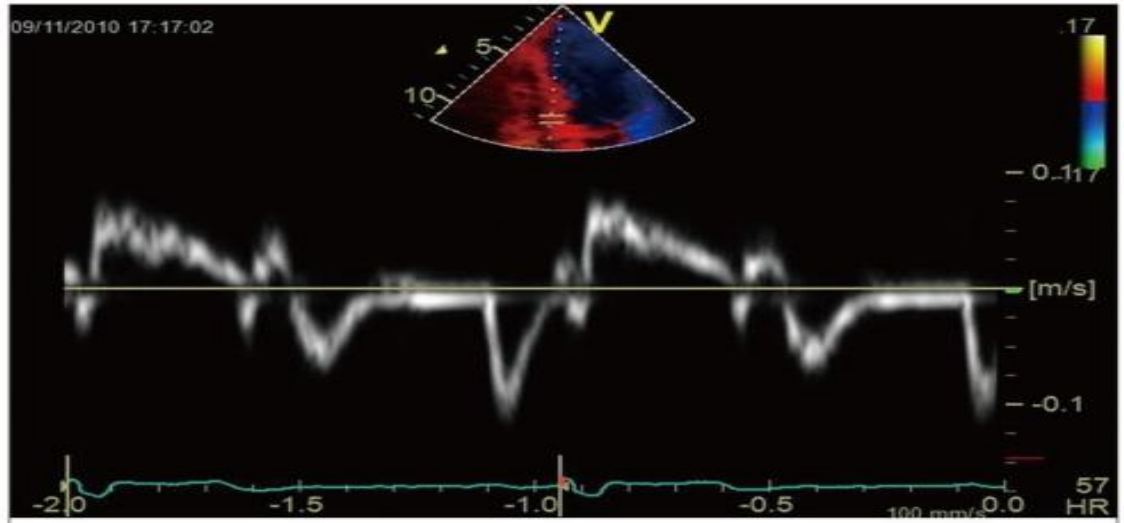
C. Tissue Doppler Imaging (TDI)

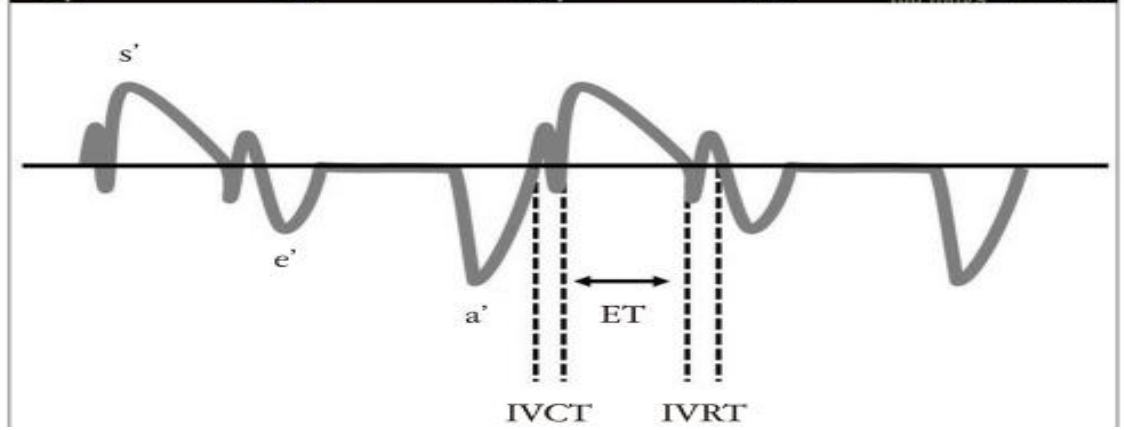
1. S′ (Systolic Annular Velocity)

a. Measured at mitral annulus (septal & lateral).

b. Normal S′ > 7.5 – 8 cm/s

c. Reduced S′ indicates impaired longitudinal systolic function.





Assessment Methodology

D. Speckle Tracking Echocardiography (Strain Imaging)

Global Longitudinal Strain (GLS)

Reflects myocardial fiber shortening.

Normal GLS = **–18% to –22%**

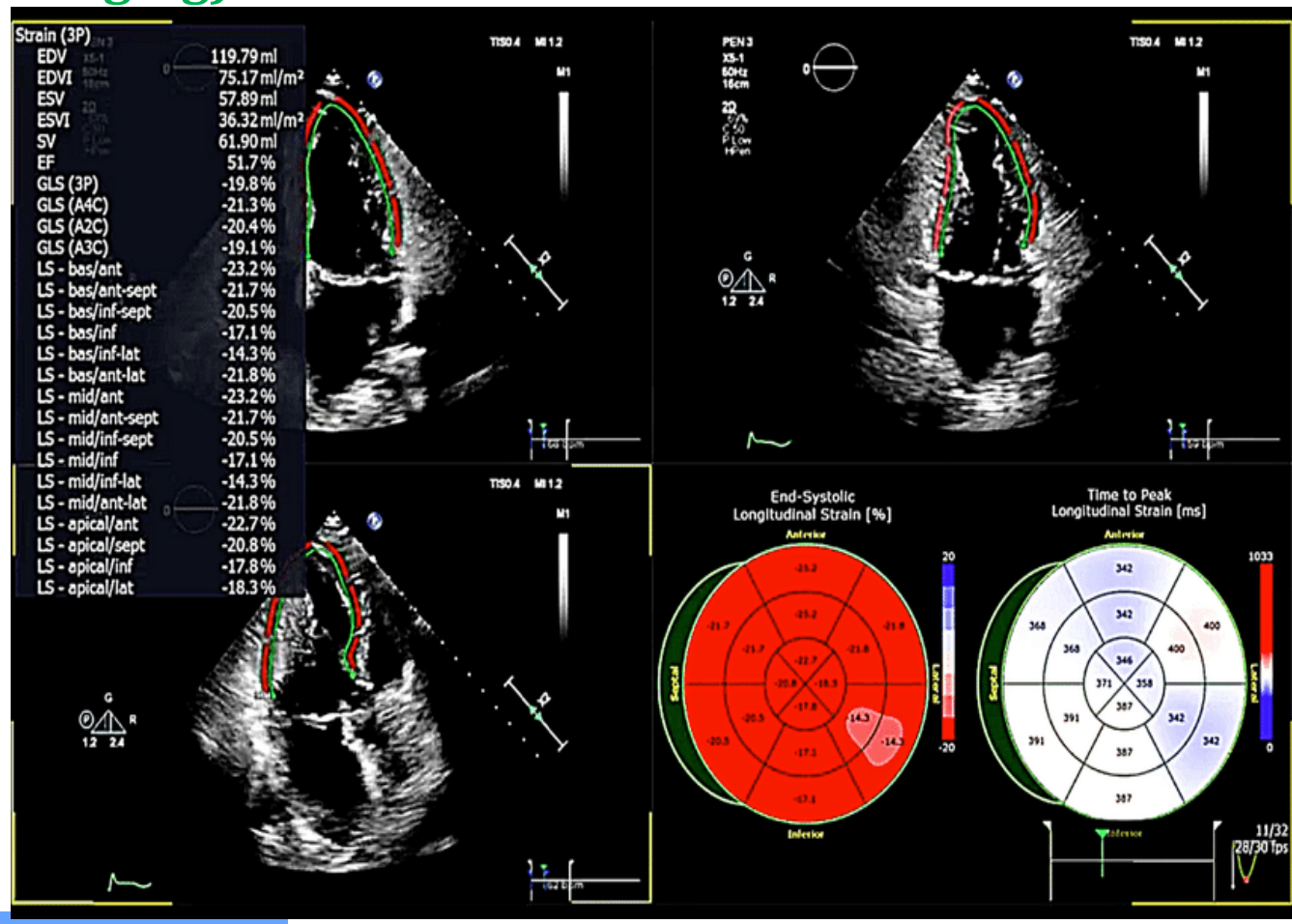
Early marker for:

a. Chemotherapy cardiotoxicity

b. Hypertensive heart disease

c. Diabetic cardiomyopathy

d. Early ischemia



Clinical Significance

A. Diagnosis of Cardiac Diseases

Identifies **systolic heart failure (HFrEF)**

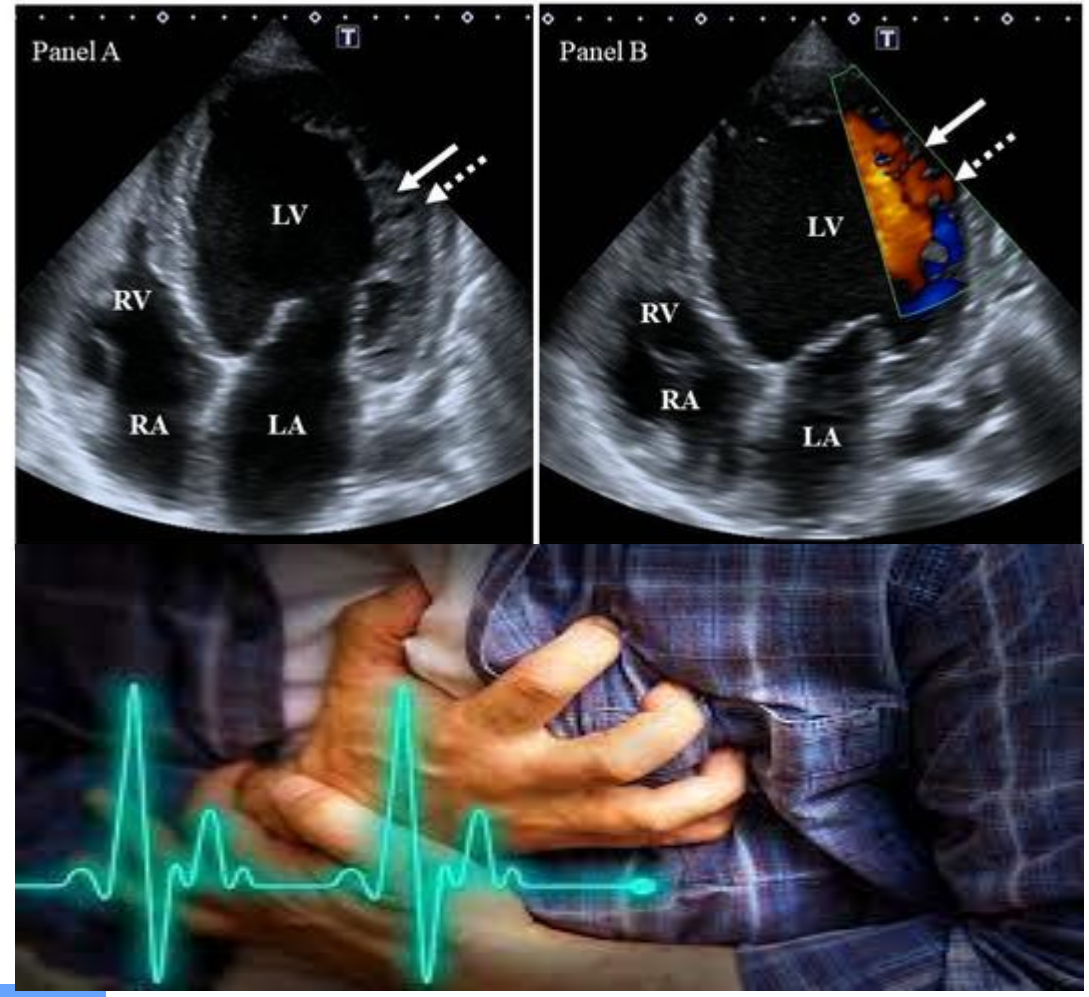
Detects early myocardial dysfunction in:

- CAD / MI
- Cardiomyopathies
- Valvular heart diseases

B. Prognostic Significance

EF < 35% identifies high risk for:

- Ventricular arrhythmias
- Sudden cardiac death
- Need for ICD therapy



Clinical Significance

C. Treatment Guidance

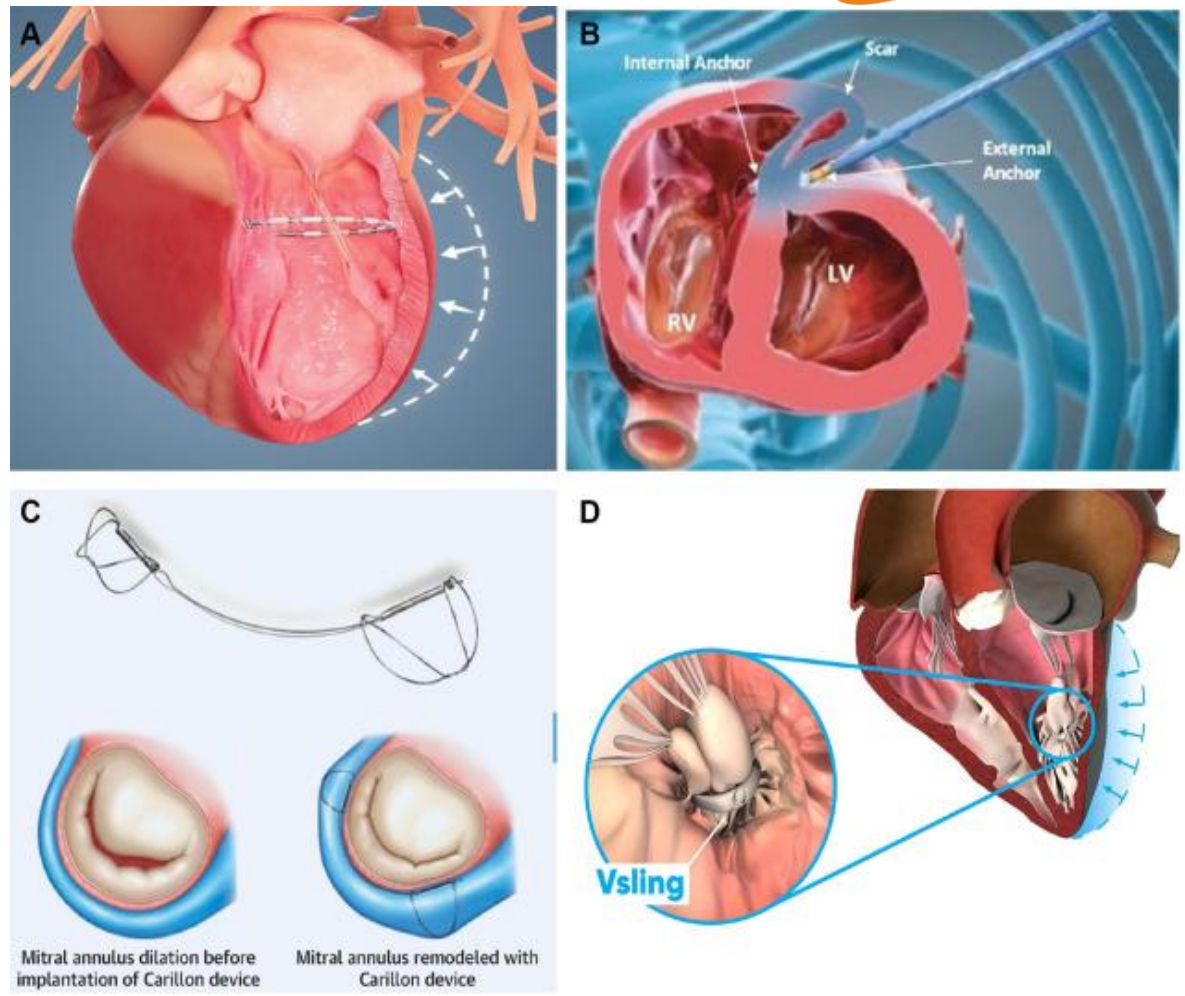
Determines suitability for:

- Heart failure medications (ACEI, ARNI, beta-blockers)
- Device therapy (CRT, ICD)
- Revascularization decisions
- Valve interventions (TAVI, MitraClip)

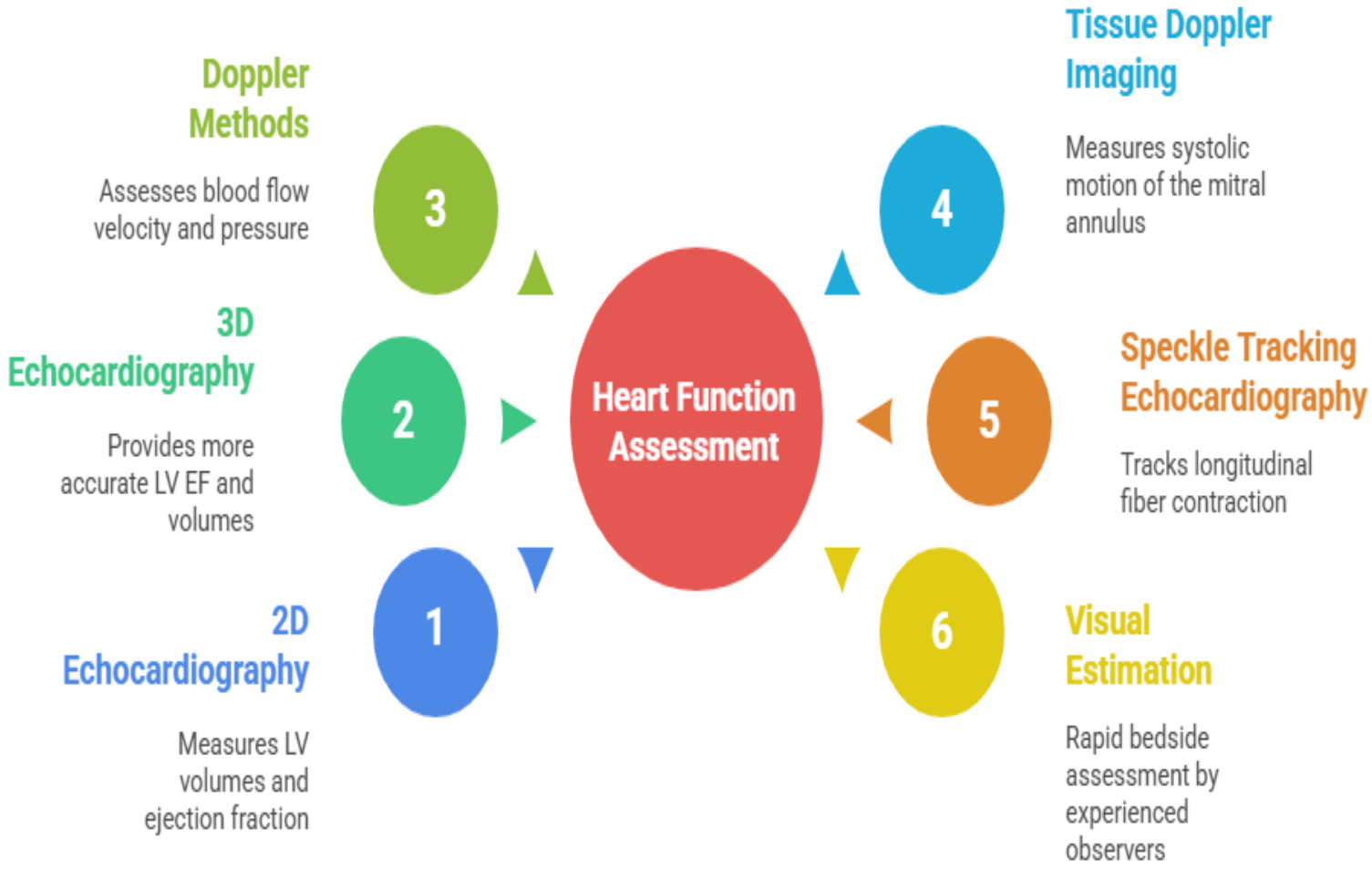
D. Monitoring of Therapy

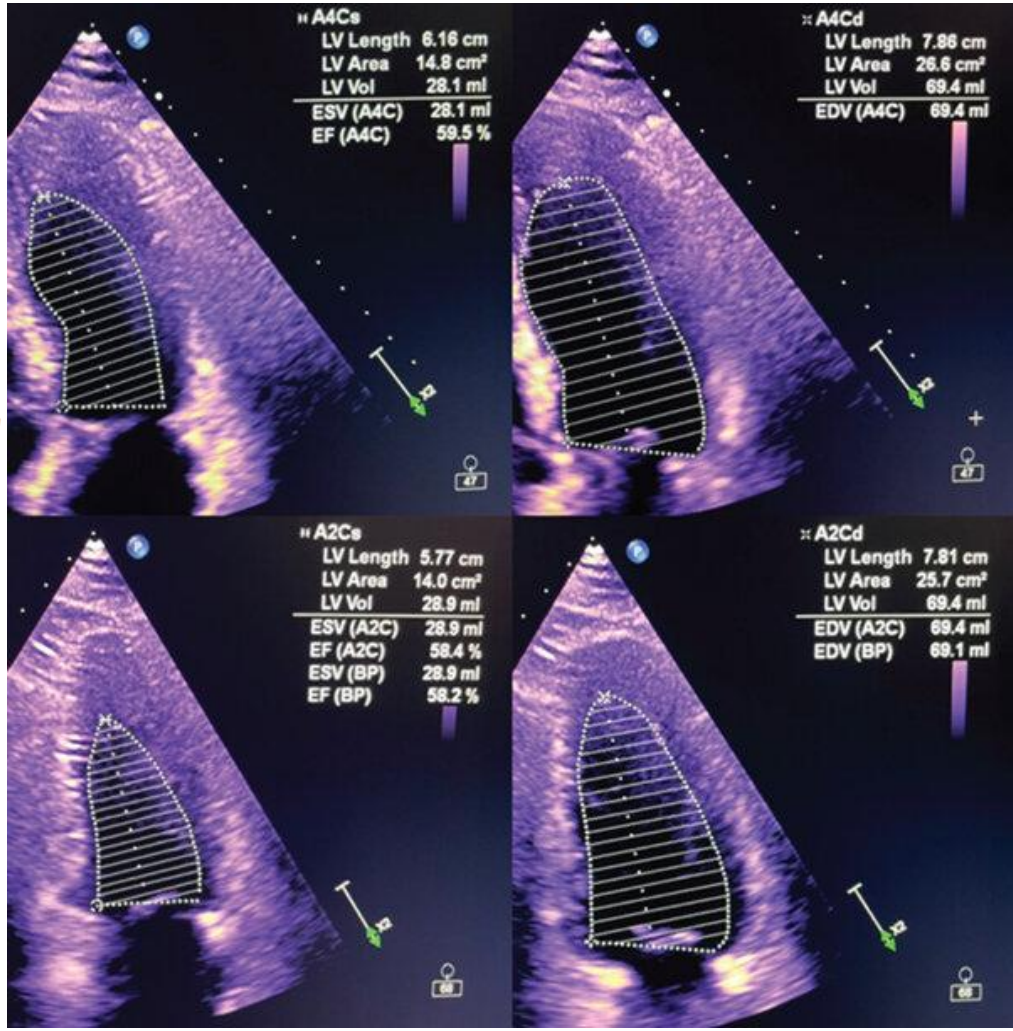
Tracks improvement/worsening of LV function with:

- Heart failure management
- Chemotherapy
- Post-operative cardiac surgery
- After acute MI



SUMMARY


Doppler Methods
Assesses blood flow velocity and pressure
3
3D Echocardiography
Provides more accurate LV EF and volumes
2
2D Echocardiography
Measures LV volumes and ejection fraction
1
Heart Function Assessment
4
Tissue Doppler Imaging
Measures systolic motion of the mitral annulus
5
Speckle Tracking Echocardiography
Tracks longitudinal fiber contraction
6
Visual Estimation
Rapid bedside assessment by experienced observers


A4Cs
LV Length 6.16 cm
LV Area 14.8 cm²
LV Vol 28.1 ml
ESV (A4C) 28.1 ml
EF (A4C) 59.5 %
A4Cd
LV Length 7.86 cm
LV Area 26.6 cm²
LV Vol 69.4 ml
EDV (A4C) 69.4 ml
A2Cs
LV Length 5.77 cm
LV Area 14.0 cm²
LV Vol 28.9 ml
ESV (A2C) 28.9 ml
EF (A2C) 58.4 %
ESV (BP) 28.9 ml
EF (BP) 58.2 %
A2Cd
LV Length 7.81 cm
LV Area 25.7 cm²
LV Vol 69.4 ml
EDV (A2C) 69.4 ml
EDV (BP) 69.1 ml

References

1. **American Society of Echocardiography (ASE) Guidelines**

   – Lang RM et al., *Recommendations for Cardiac Chamber Quantification*, JASE.

2. **European Association of Cardiovascular Imaging (EACVI) Guidelines**

3. Otto CM – *Textbook of Clinical Echocardiography*, 6th Edition.

4. Feigenbaum – *Echocardiography*, 8th Edition.

5. Armstrong & Ryan – *Feigenbaum's Echocardiography*, Wolters Kluwer.

6. Marwick TH – *Myocardial Strain and Strain Rate Imaging*, JACC Review.