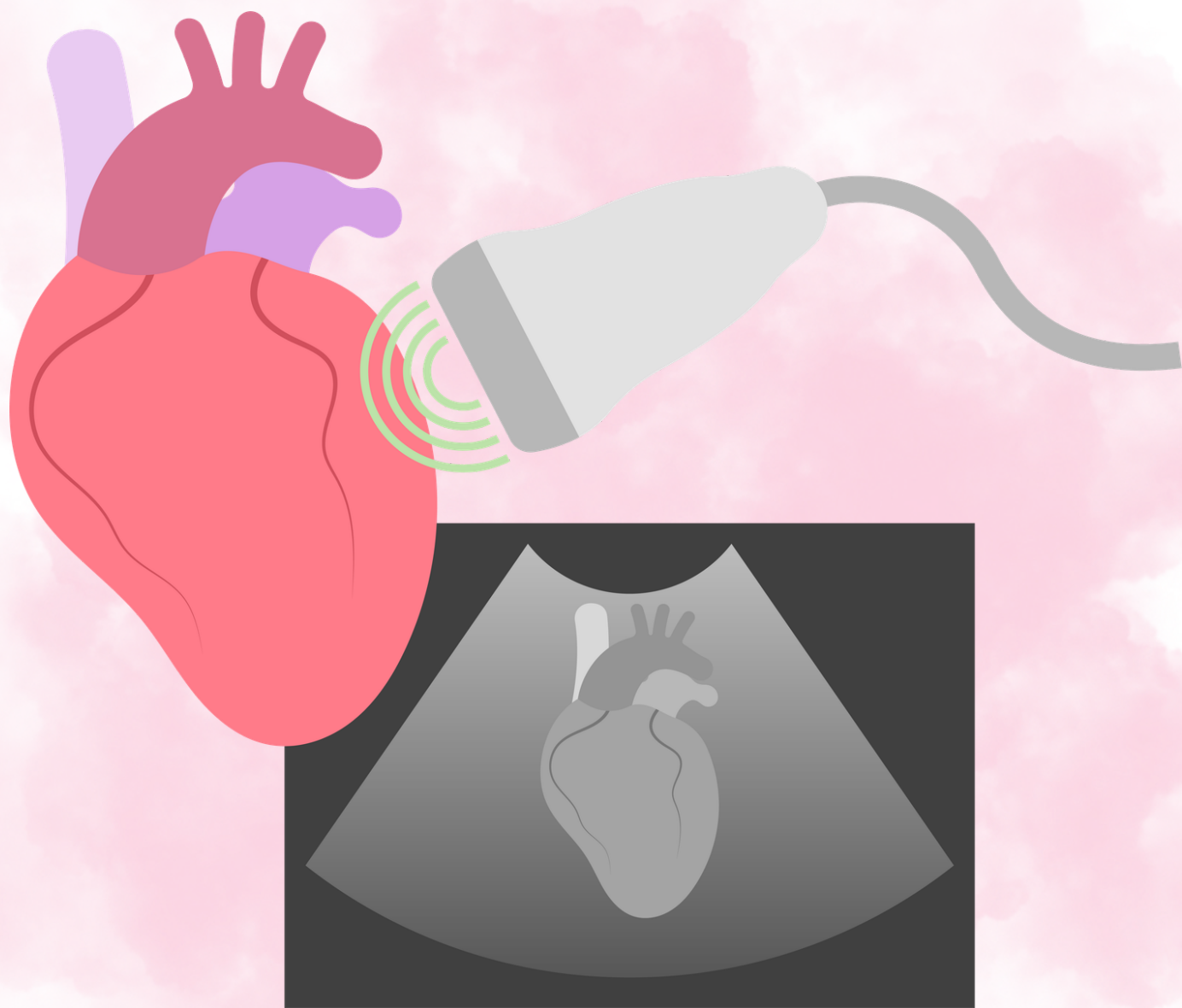


INTRODUCTION TO ECHOCARDIOGRAM

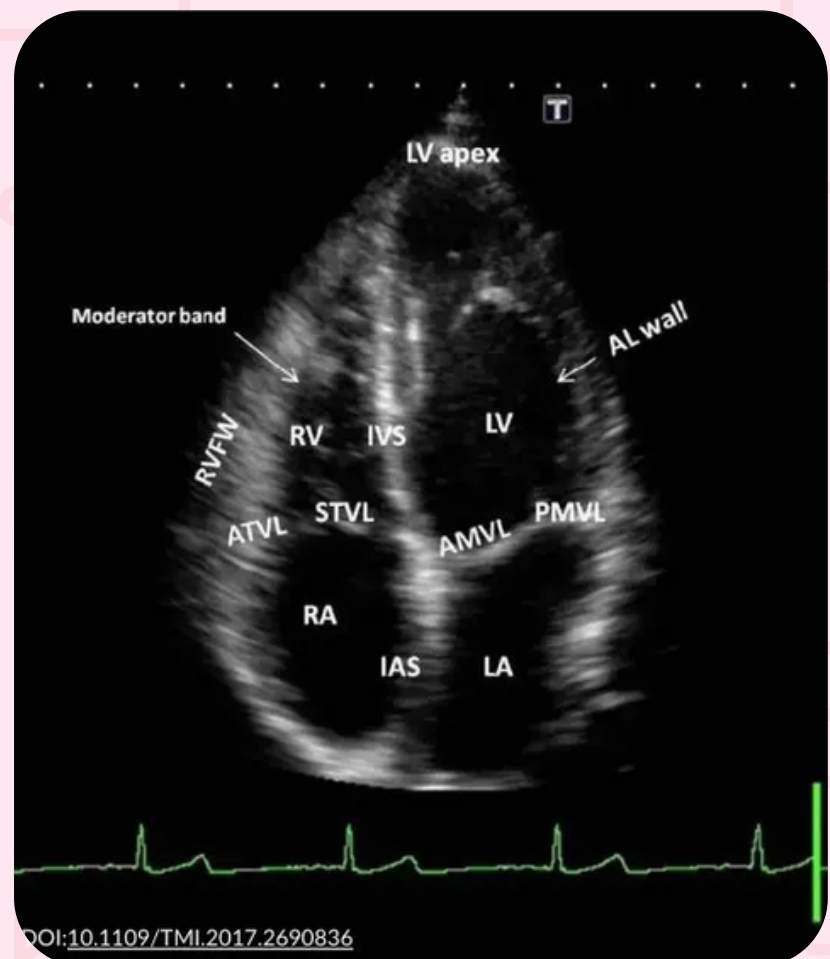


MUM
IM'S

Introduction: Echocardiography is a diagnostic procedure that uses high-frequency ultrasound waves to create detailed heart images

Transthoracic Echocardiography (TTE)

An ultrasound transducer is placed on the chest wall to capture real-time 2D heart images. It provides a comprehensive view of the heart's chambers, valves, and major vessels.



Normal result in an Apical 4 Chamber View



Non-invasive

Indications:

- Assess Left Ventricle function & ejection fraction
- Evaluate valve disease severity
- Detect structural heart disease (AF, cardiomyopathies, congenital defects)
- Identify Pericardial Effusion
- Detect intracardiac thrombus in embolism
- Investigate disease of the Aorta & Pulmonary Artery

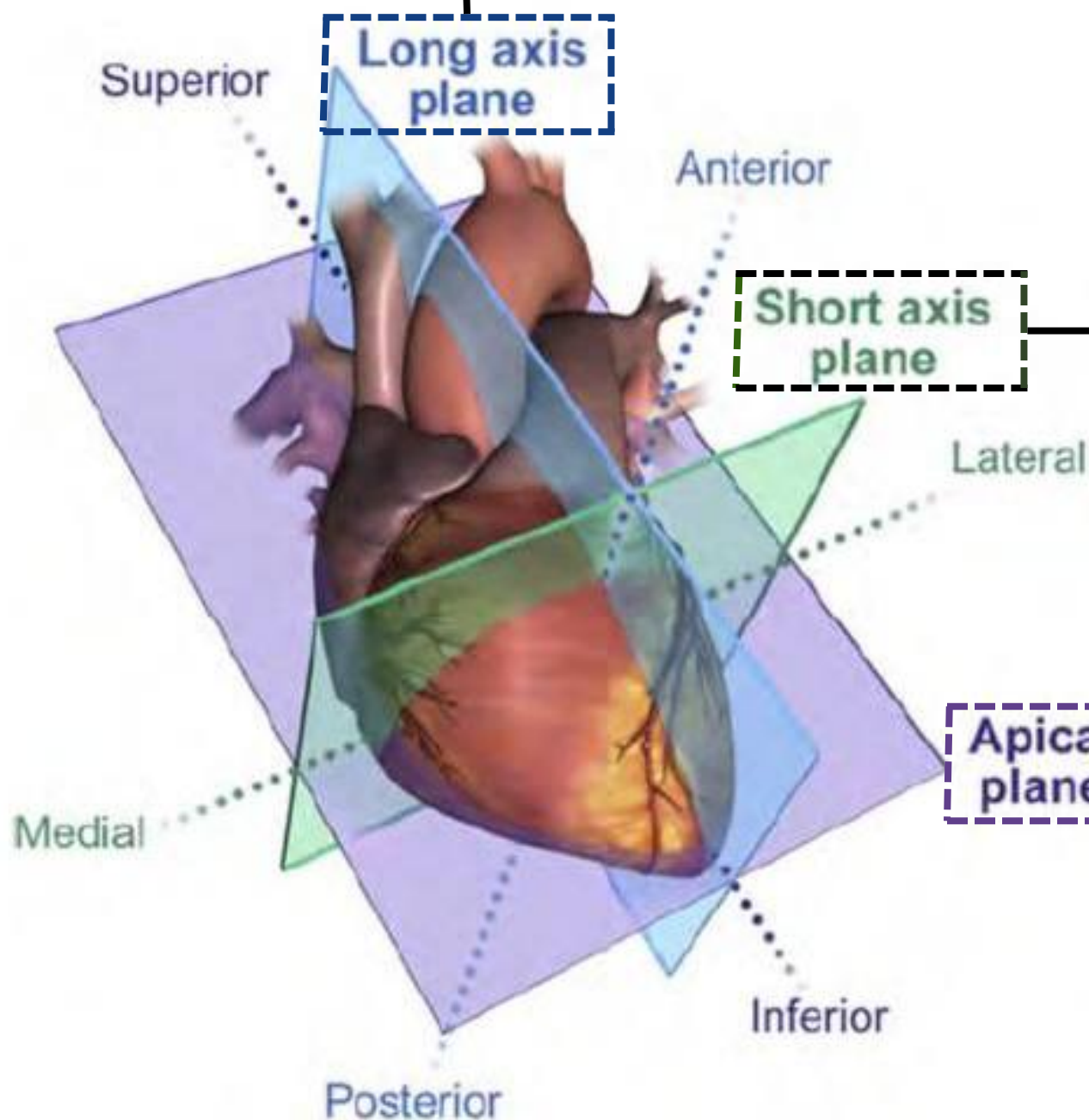


Transthoracic Echocardiography (TTE)



Scanning planes of the heart

images acquired in PLAX views



*images acquired in
PSAX views*

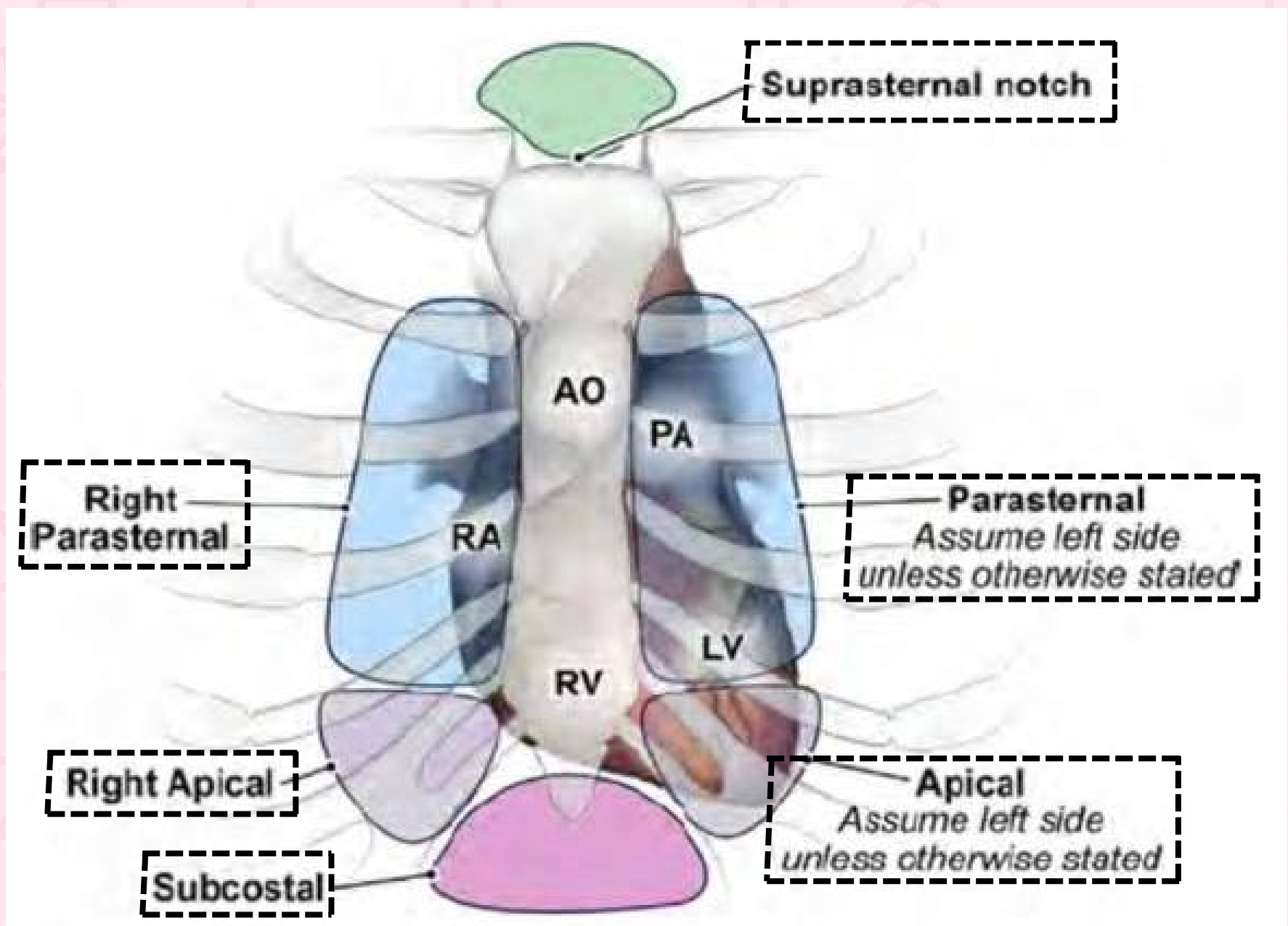
*images acquired
from the apical
window*



Transthoracic Echocardiography (TTE)



Echocardiographic windows to obtain images:



Different Views in TTE:

- Parasternal long axis view (PLAX)
- Parasternal short axis view (PSAX)
- Apical 4 chamber
- Subxiphoid (subcostal 4-chamber)
- Subcostal Inferior Vena Cava view

Parasternal Long Axis view (PLAX)

Aspect

Features

a) Patient Position

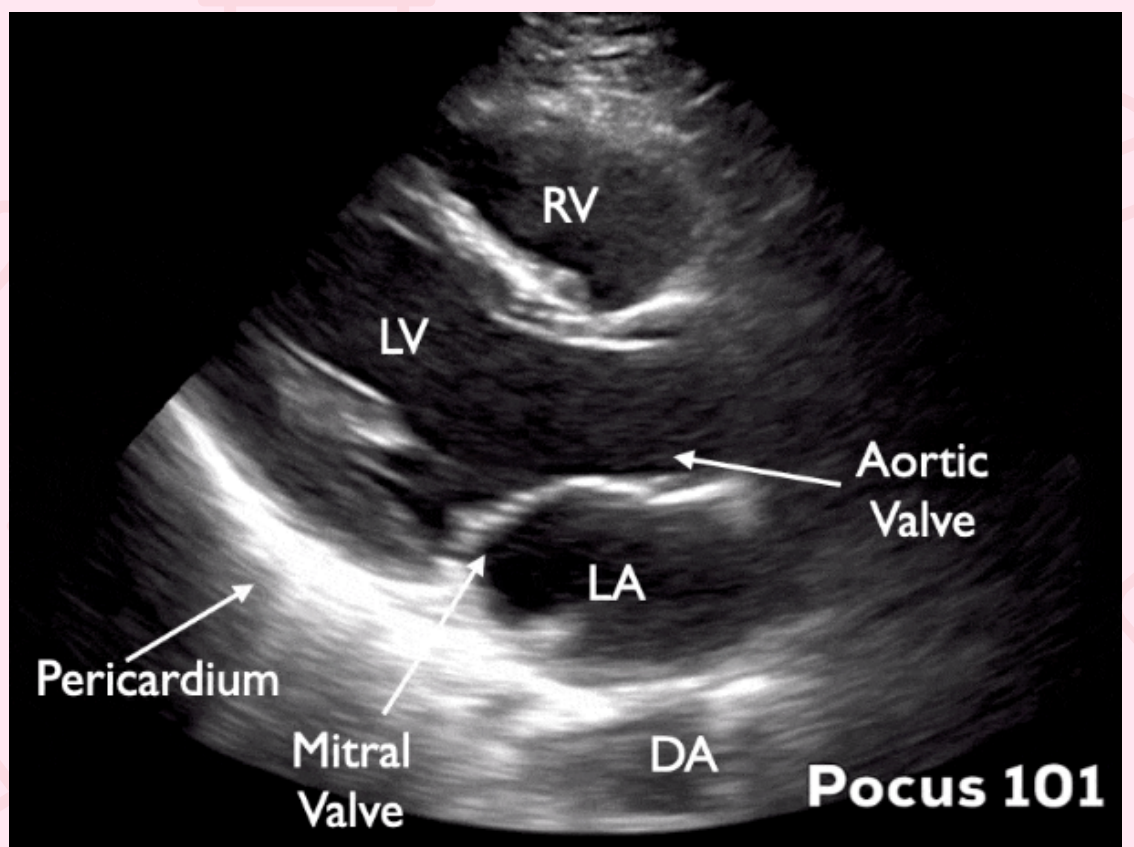
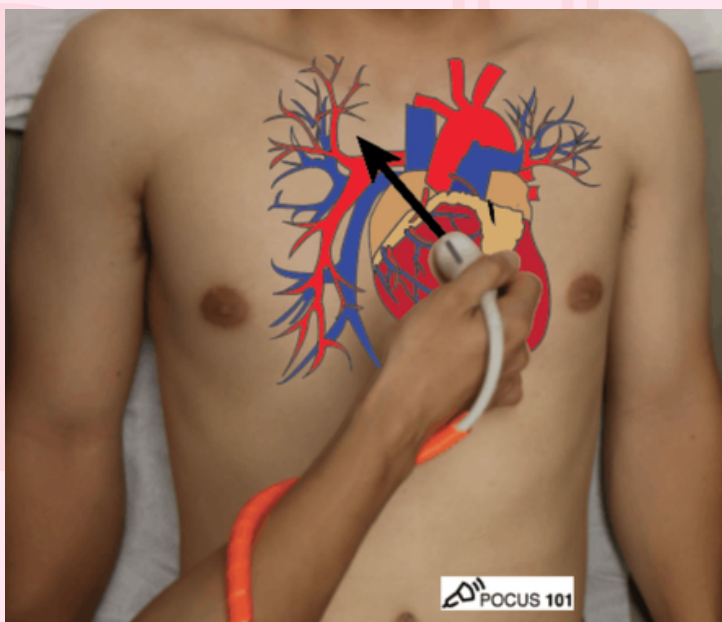
- Lying on left side, left arm raised. Raise the back of the bed or use pillows under left shoulder.

b) Probe Position

- **4th intercostal space left sternal edge** (near nipple line in males / Inframammary fold to sternum in females)

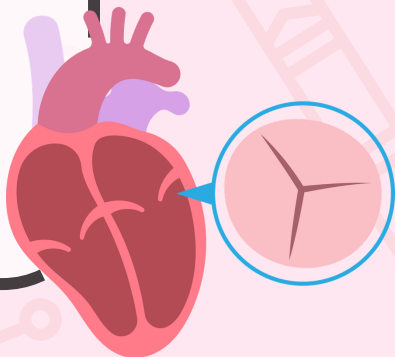
c) Probe Orientation

- Notch towards patient's right shoulder



Best for Visualising:

- Left Ventricle (LV)
- Left Atrium (LA)
- Mitral Valve (MV)
- Aortic Valve (AV)
- Ascending Aorta
- Pericardium





Apical 4 Chamber view

Aspect

Features

a) Patient Position

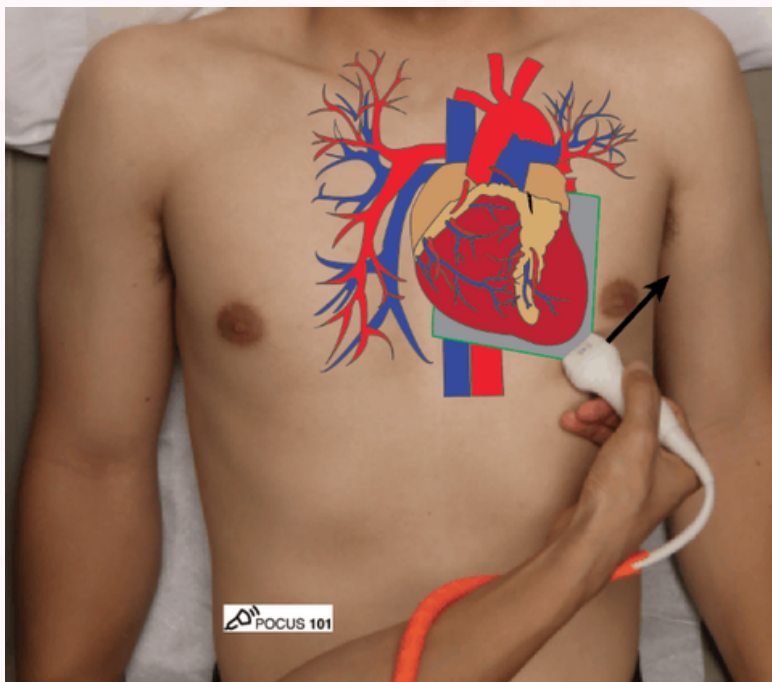
- Lying on the left side, left arm raised. Raise the back of the bed or use pillows under the left shoulder

b) Probe Position

- Over the apex beat, or V5 of ECG

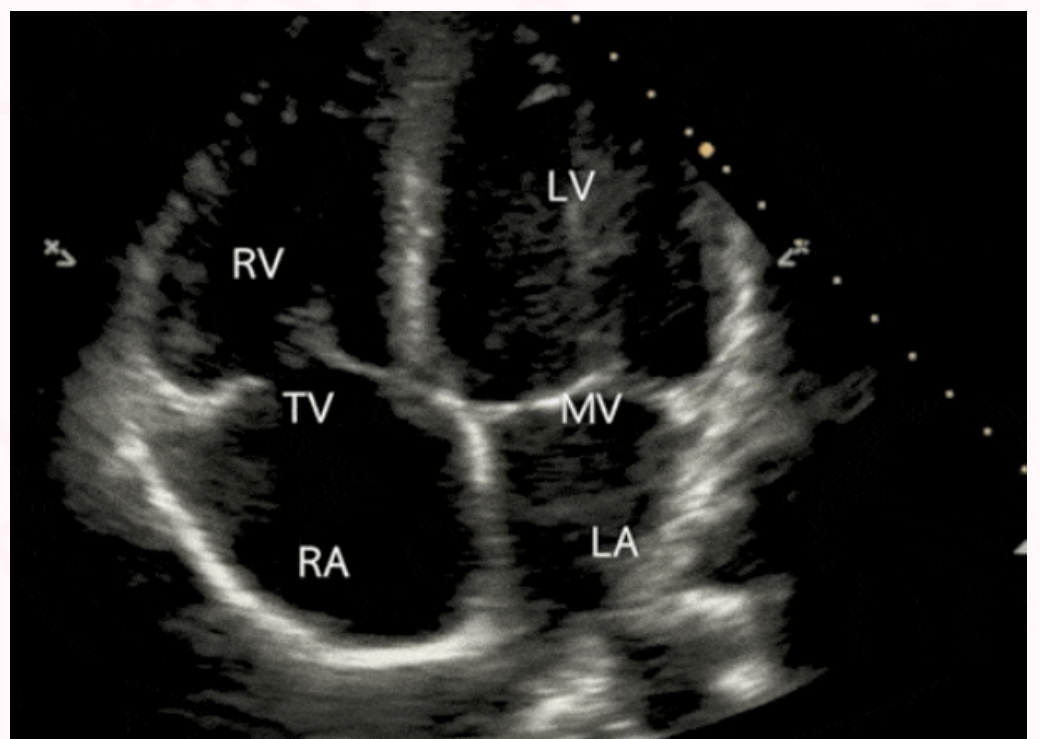
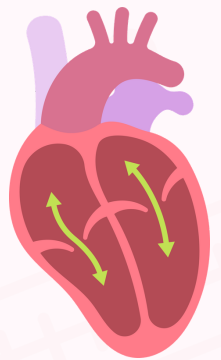
c) Probe Orientation

- Notch towards patient's left shoulder

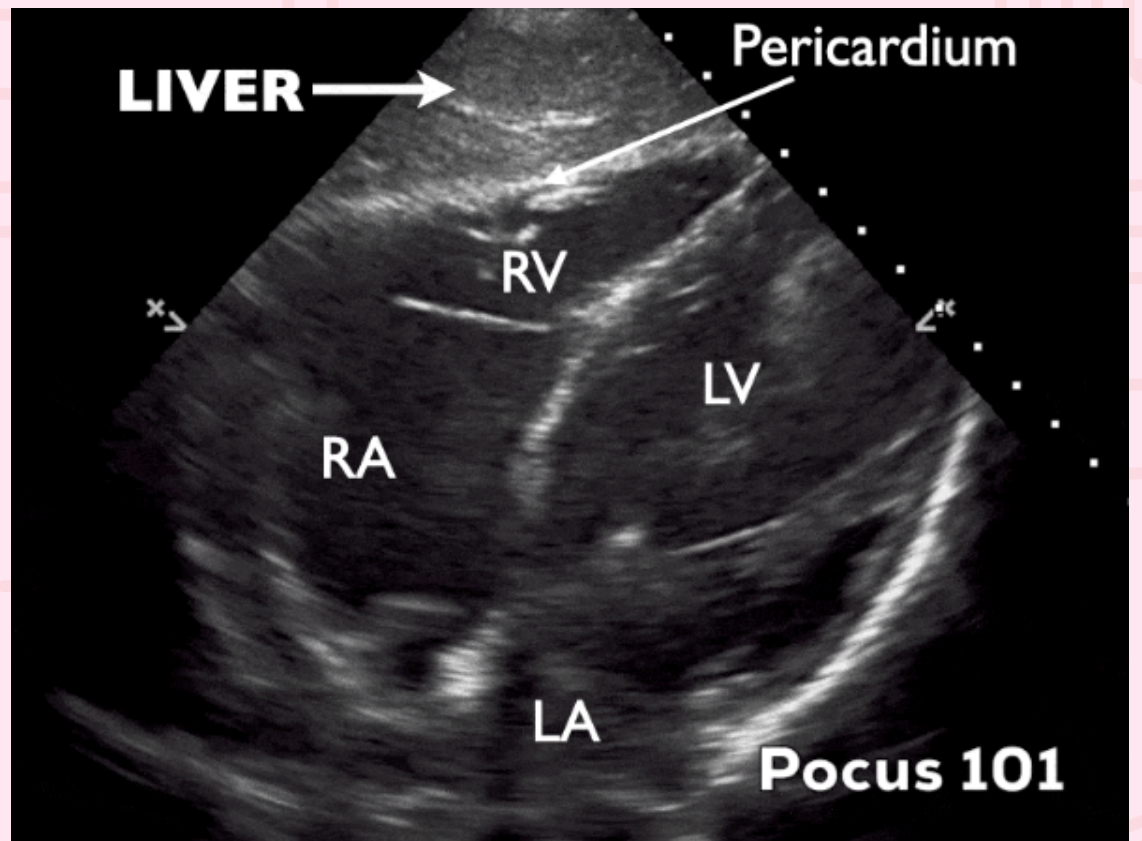
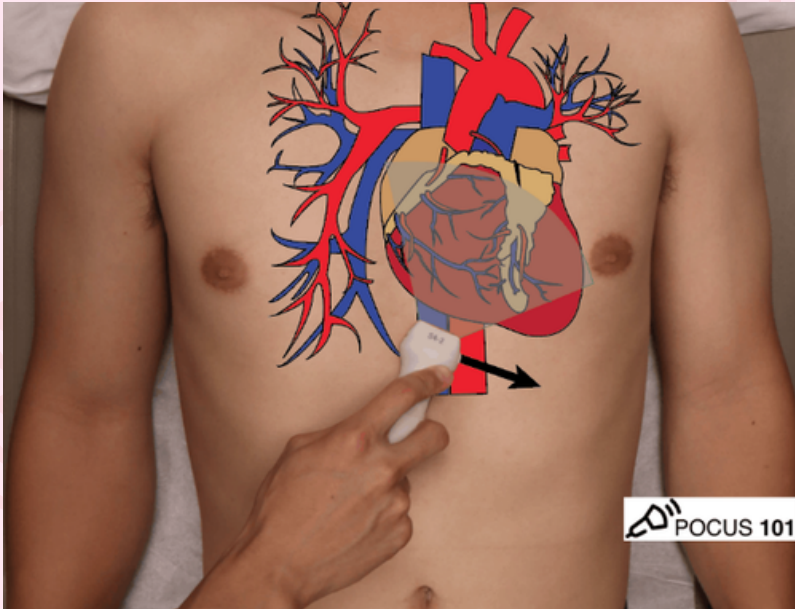


Best for visualising:

- All 4 chamber
- Mitral Valve
- Tricuspid Valve
- Interventricular Septum
- Conditions like Heart Failure and Mitral Regurgitation



Subxiphoid (Subcostal 4-chamber) view



Best for visualising:

- Right Heart
- Interatrial Septum
- **Pericardial Effusion**

Aspect

a) Patient Position

- Lying supine

b) Probe Position

- Under costal arch (beneath xiphoid process), almost flat against skin

c) Probe Orientation

- Notch towards patient's left shoulder

Subcostal Inferior Vena Cava view

Aspect

Features

a) Patient Position

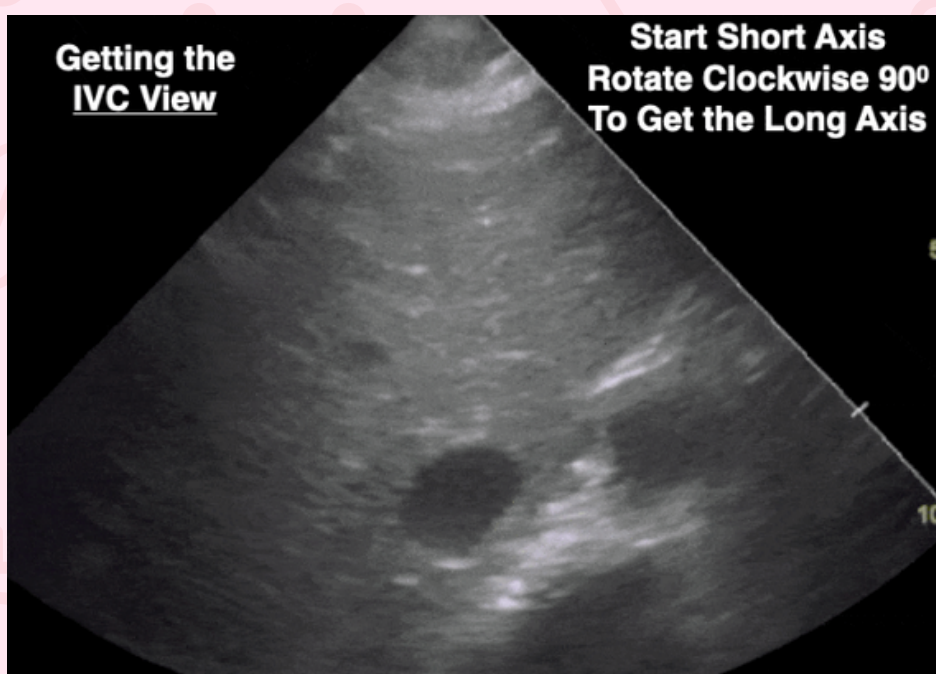
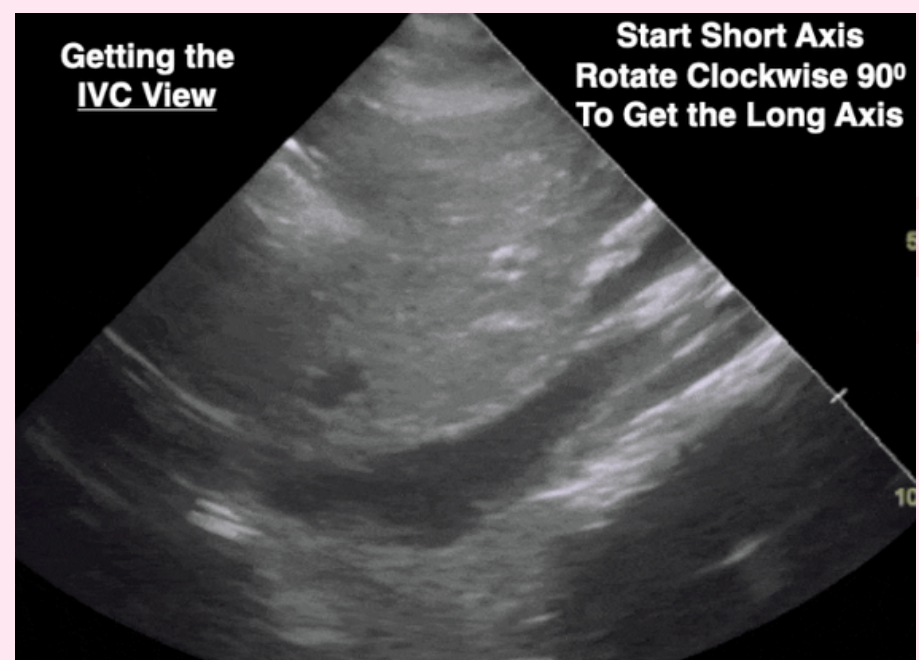
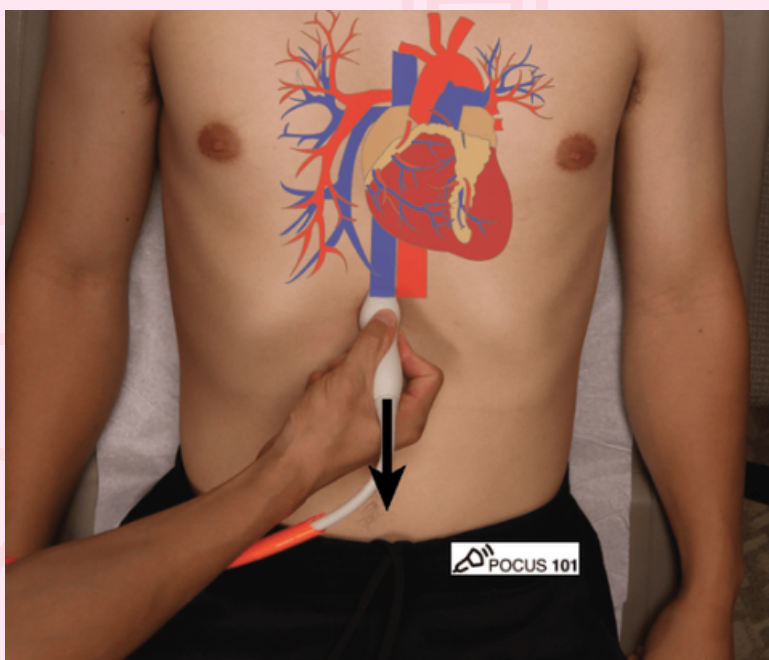
- Lying supine

b) Probe Position

- Beneath xiphoid process, almost flat against skin

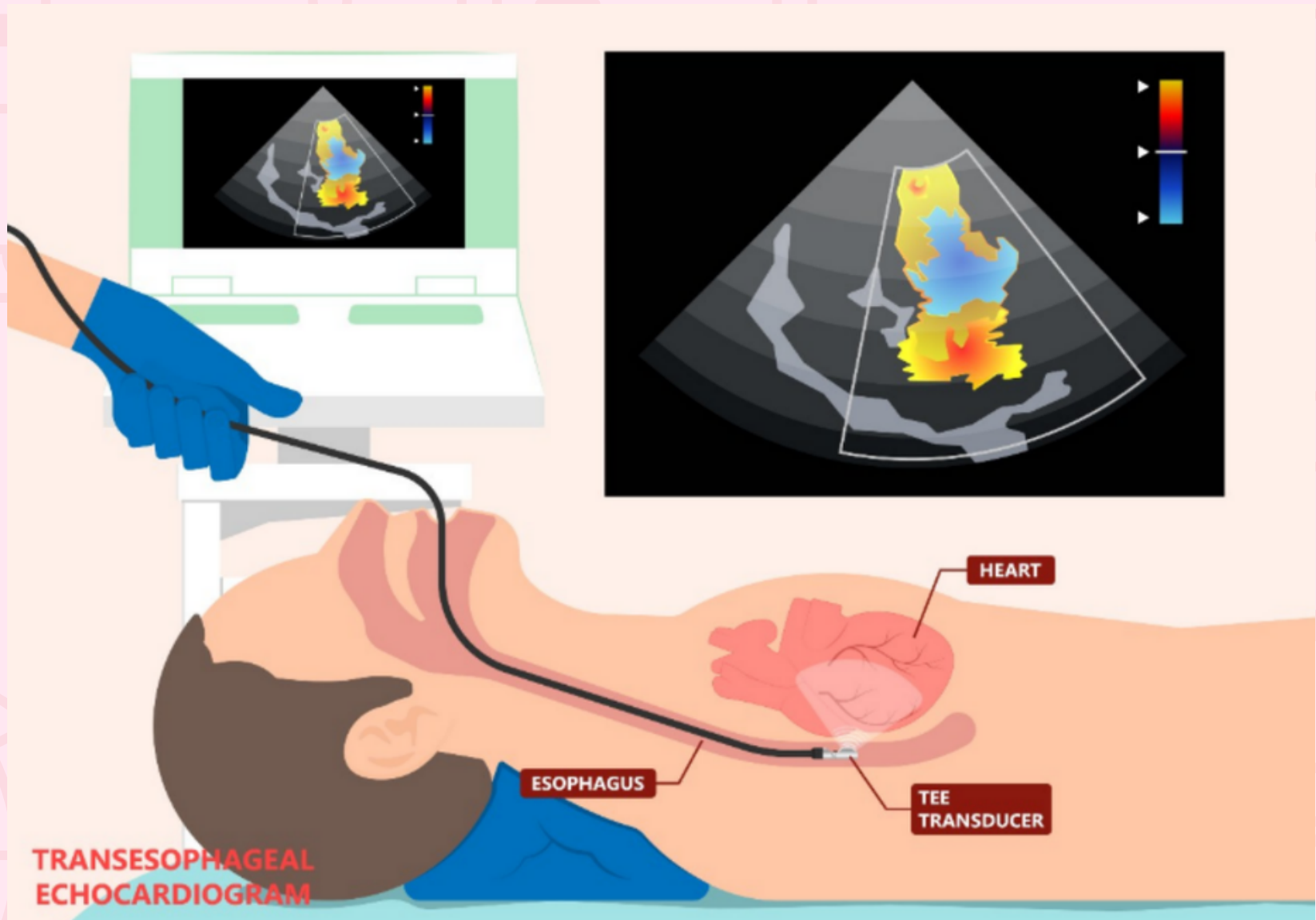
c) Probe Orientation

- Notch towards patient's left (at the 3 o'clock position), rotated counterclockwise, to visualise the IVC. Slight probe tilt towards head.



Transoesophageal Echocardiogram (TOE)

An ultrasound probe is passed into the oesophagus and upper stomach under light sedation, which enhances heart imaging due to its proximity.



Minimally invasive



Indications:

- Better visualization of **posterior cardiac structures** (Left Atrial Appendage, Pulmonary Veins, Aorta, Interatrial Septum)
- Ideal for overweight patients or those with airway obstruction
- Detects **systemic embolism & small vegetations (Endocarditis)**
- Evaluates **prosthetic valve dysfunction & native valve disease**

Normal Mitral Valve

TTE + Colour Doppler is used:

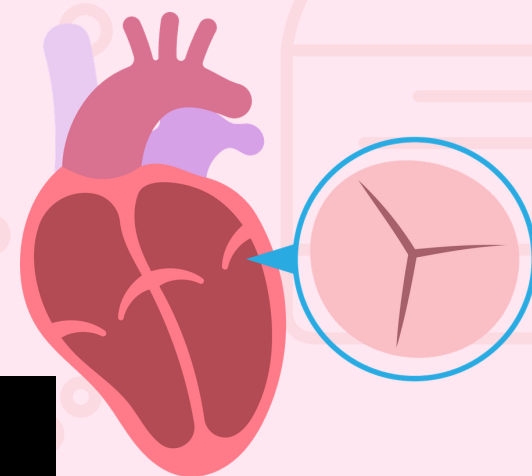
1. To evaluate the directions & velocities of blood flow
2. To assess the severity and hemodynamic consequences

Color flow imaging: Help identify turbulent flow and regurgitation



REMEMBER: BART Rule

- **Blue** Away, **Red** Toward



**Blue → Blood
moving away
from the probe**

**Red → Blood
moving toward
the probe**

Normal Mitral Valve Blood Flow
(MedicalWorks Egypt -YT)



Mitral Stenosis

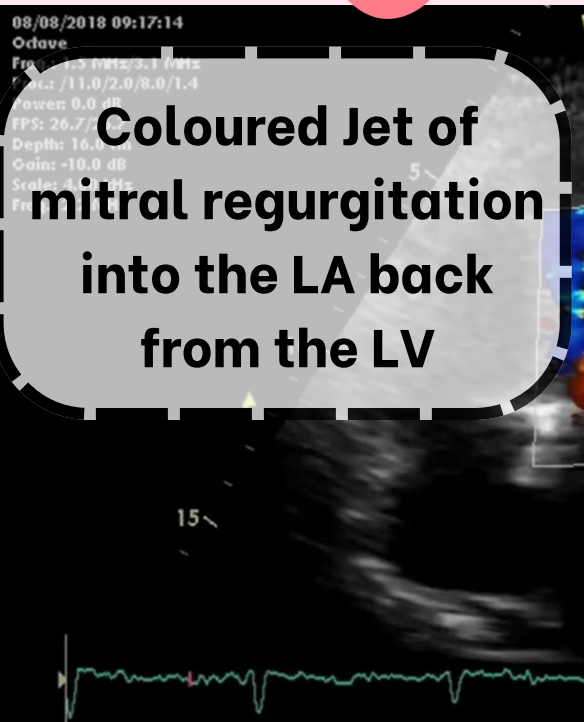
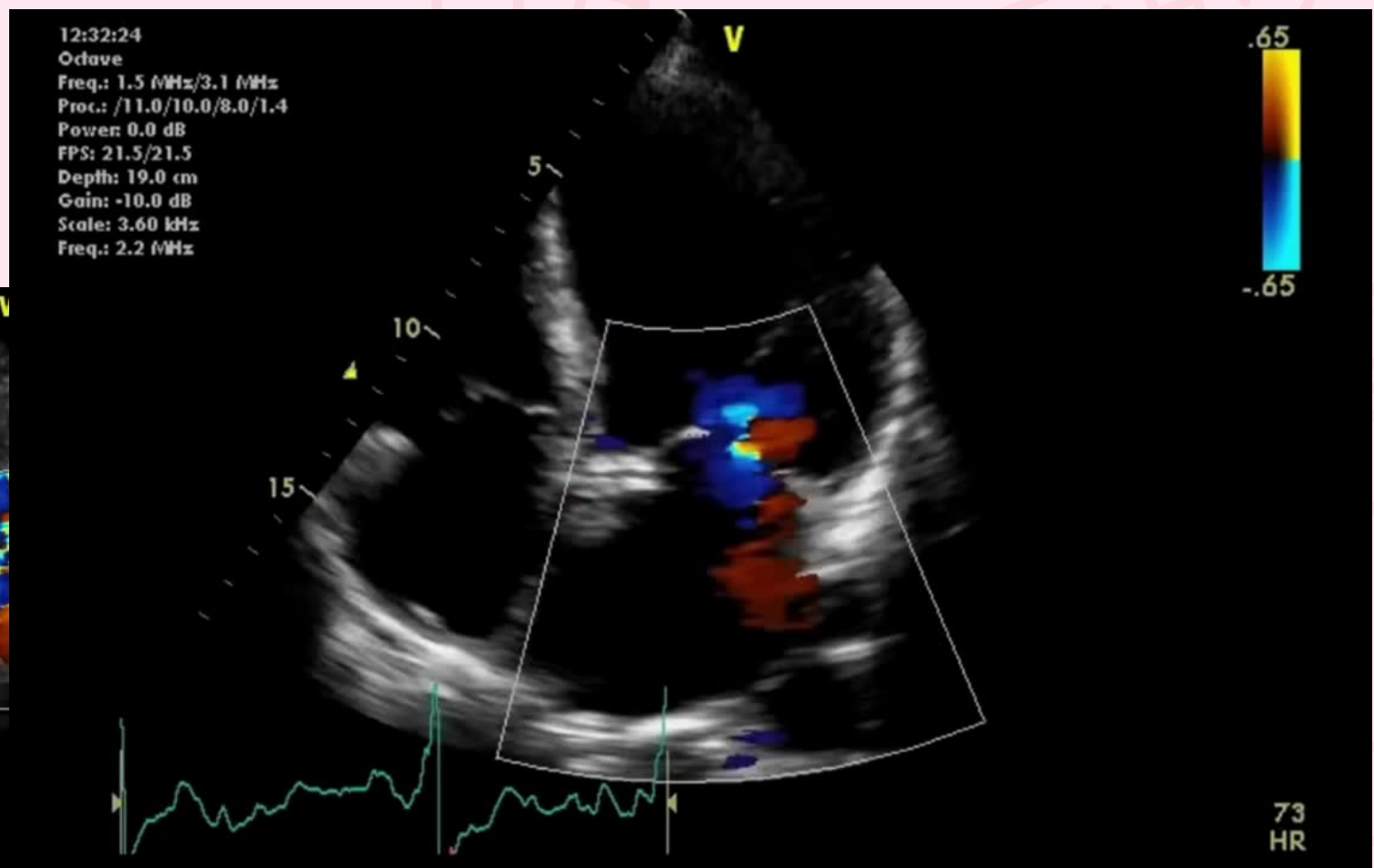
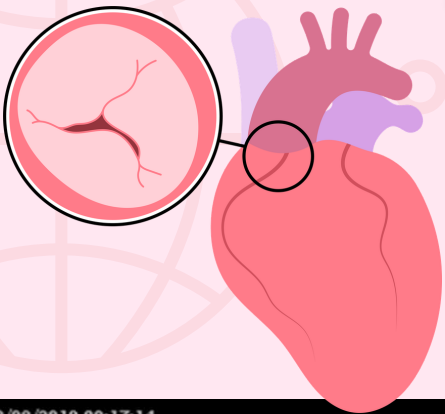


Coloured jet of mitral stenosis into the LV from LA

- Flame shape jet/ mosaic pattern
-> Turbulence blood flow
- Doming or hockey-stick shape of the anterior mitral leaflet (AMVL)
- Reduced valve area ($<1.0 \text{ cm}^2$ = severe MS)

Mitral Stenosis
(MedicalWorks Egypt - YT)

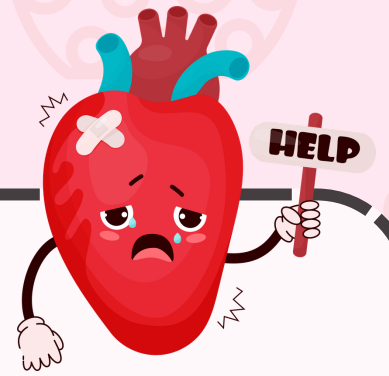
Mitral Regurgitation



Coloured Jet of
mitral regurgitation
into the LA back
from the LV

Mitral Regurgitation
(MedicalWorks Egypt - YT)

Heart Failure



1. Shows **left ventricular systolic function/ ejection fraction**

- a. **Normal: 55-69%**
- b. **Mildly reduced: 45-54%**
- c. **Moderately reduced: 30-44%**
- d. **Severely reduced: <30%**

Ejection fraction (EF) in percentage is defined as: **$EF(\%) = SV/EDV \times 100$**

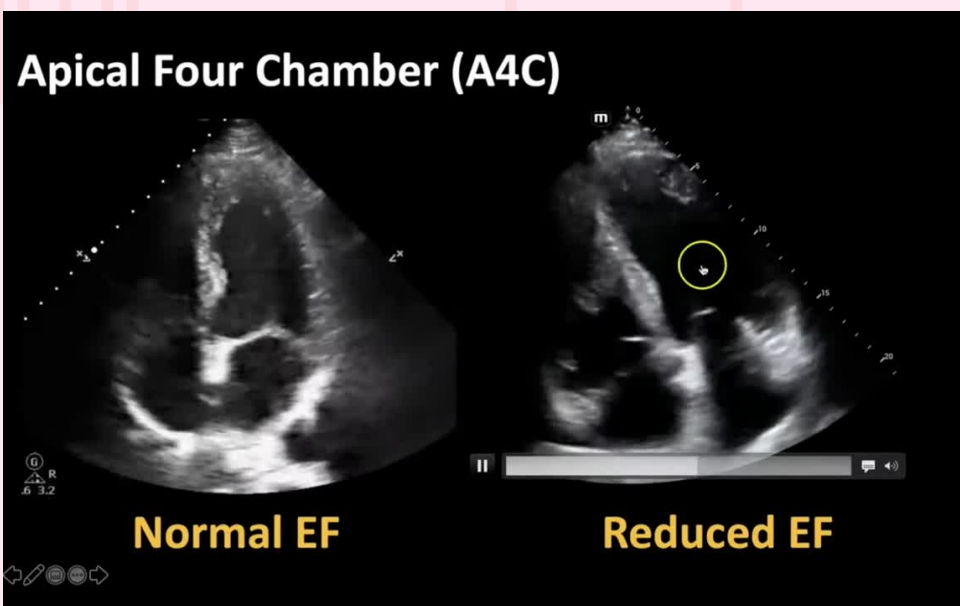
Where **SV**: Stroke Volume and **EDV**: End Diastolic Volume

2. Look for **regional wall or globular motion abnormalities** for underlying pathology

- a. **Segmental/ Regional dyskinesia -> Coronary Artery Disease**
- b. **Globular dyskinesia -> Cardiomyopathy**

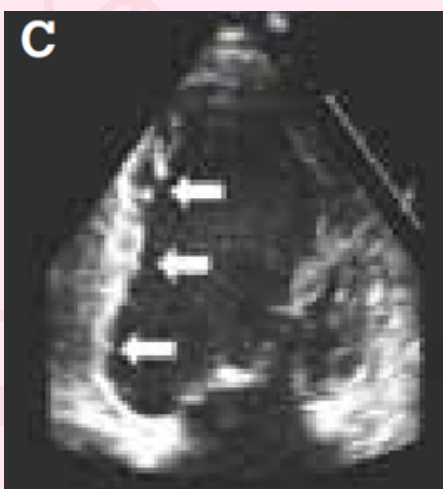
3. Look for **valve dysfunction**

- a. **Check out the previous pages!**

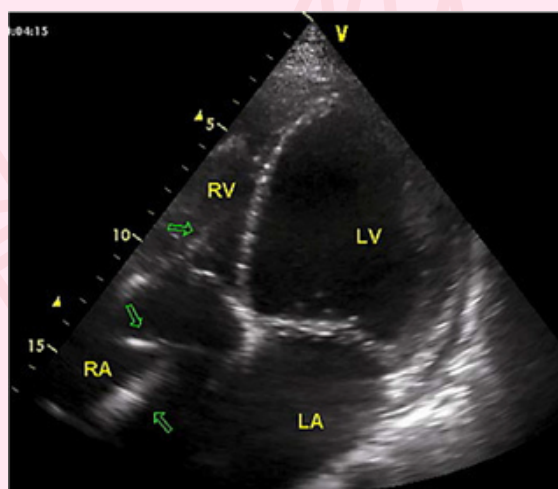


Normal Ejection Fraction vs Reduced Ejection Fraction

(Kristen Adorno, Cooper Ultrasound)



Inferior wall (arrow) is thinned & bright due to scarring from previous infarction



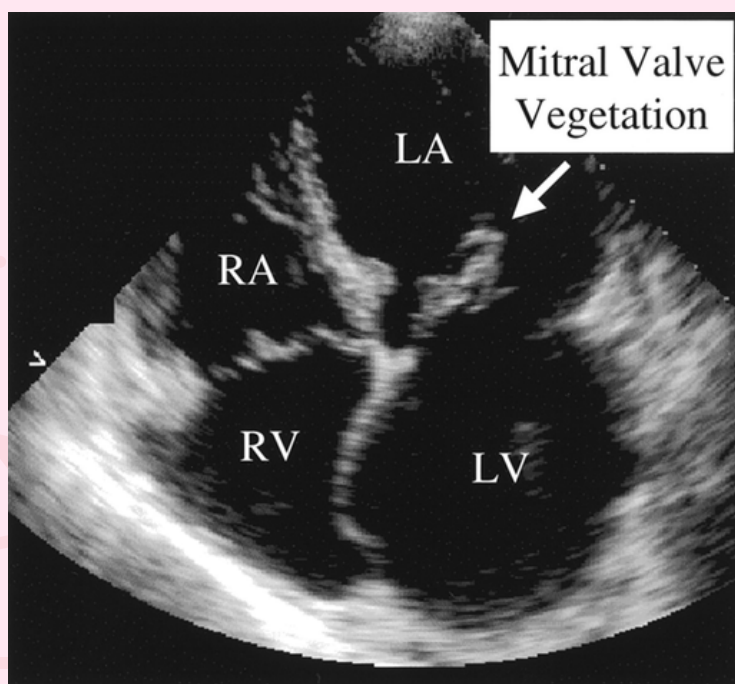
Dilated Cardiomyopathy with dilation of all 4 cardiac chambers

Infective Endocarditis (IE)

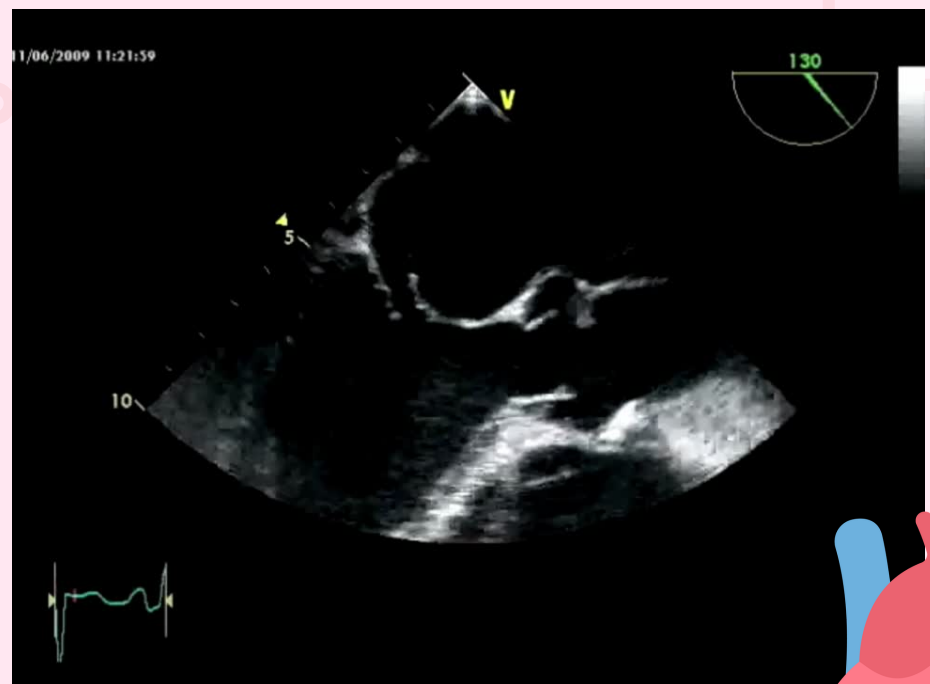


Indications of TTE:

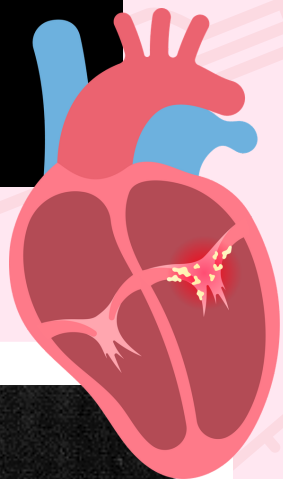
1. Assess valvular anatomy and function
2. Identify vegetation-like masses (location, size, number)
3. Evaluate valve dysfunction due to vegetation or leaflet damage
4. Determine the impact on ventricular size and function
5. Detect complications of IE (e.g., abscess, fistula)



Mitral Valve Vegetation

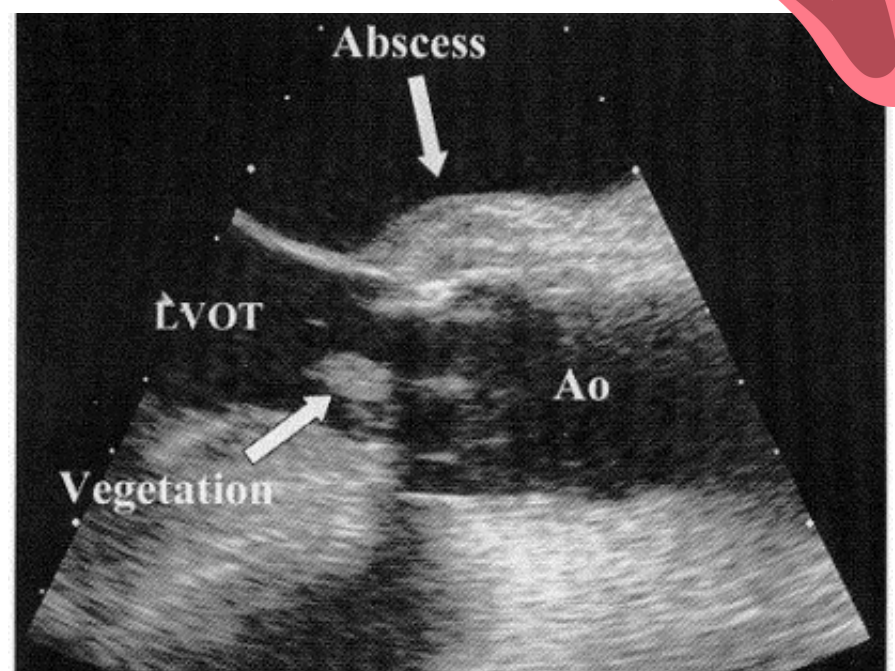


Aortic Root Vegetation



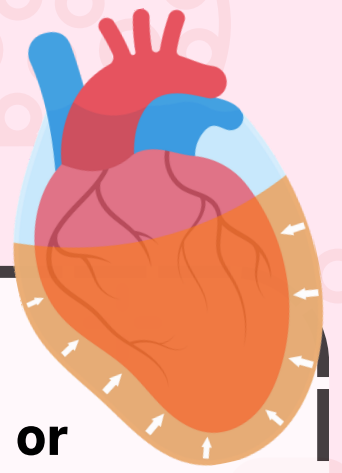
Who needs a TOE?

1. For high clinical suspicion of IE with negative/nondiagnostic TTE
2. In patients with intracardiac devices or prosthetic valves
3. Higher sensitivity in detecting complications of IE (e.g., abscess, fistula)



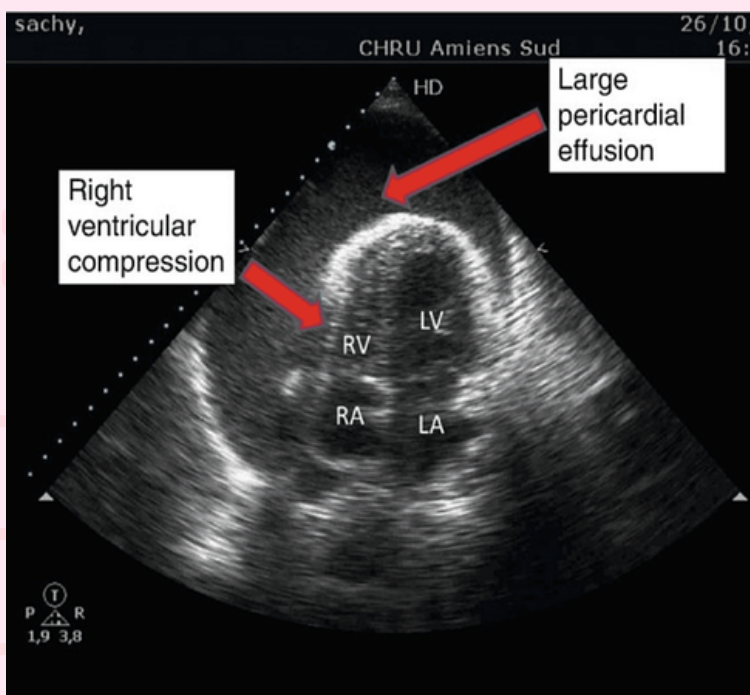
Aortic Root Abscess

Pericardial Effusion

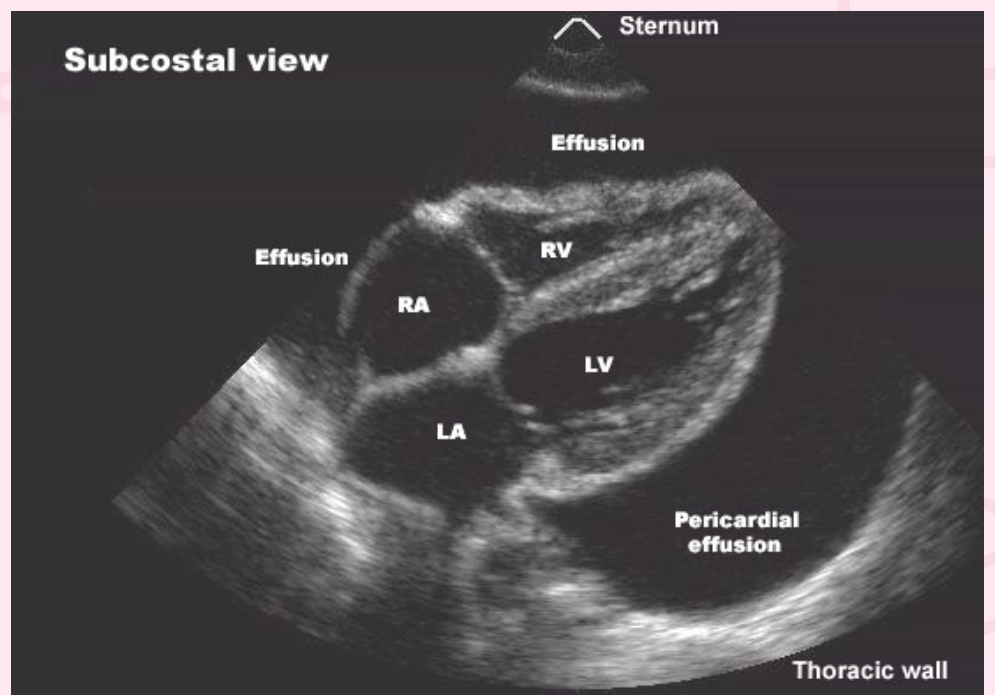


Role of TTE:

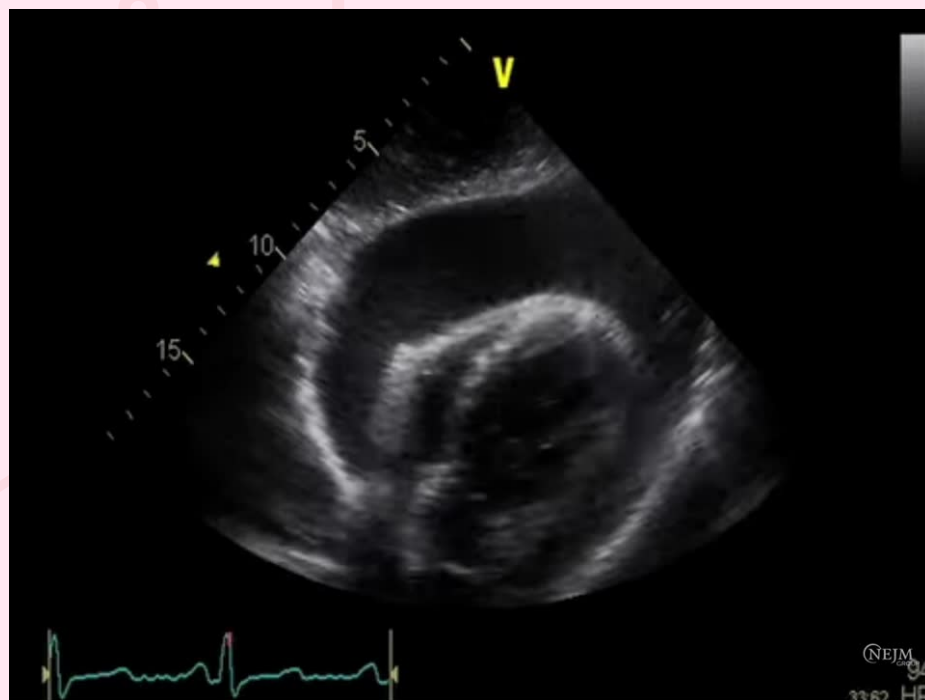
- For suspected pericardial disease (effusion, constriction, or effusive-constrictive pericarditis)
- For suspected pericardial bleeding (trauma, perforation, post-op)
- For monitoring Pericardial Effusion or diagnosing early Constrictive Pericarditis



Large Pericardial Effusion + RV compression (Apical 4-chamber view)



Large Pericardial Effusion (Subcostal view)



Echocardiography with a Significant Pericardial Effusion (NEJM group - YT)





How does an Echo Report look like

Name: Patient name		DOB: 10/12/1950	Date: 08/10/2010
M-mode measurements		2-D measurements	
LV diastolic diam:	6.7 cm (N<5.7)	LVEF:	35% (N>50)
LV systolic diam:	5.2 cm	LVEF method:	Biplane Simpson's
Septum:	1.1 cm (N<1.1)	LA area:	26 cm ² (N≤20)
Posterior wall:	1.0 cm (N<1.1)	LAVI:	40 mL/m ² (N<29)
Fractional shortening:	22% (N>26)	RA area:	23 cm ² (N<18)
Left atrium:	4.8 cm (N<4.0)		
Aortic root:	3.2 cm (N<3.6)		
Doppler measurements			
	Doppler velocity(m/sec)		Valve gradients (mmHg)
	Peak	Normal	Peak Mean
Aortic:	1.0	(1.0-1.7)	
Pulmonary:	0.7	(0.6-0.9)	
Tricuspid:		(0.3-0.7)	
Mitral:	E = 0.9 A = 0.3	(0.6-1.3)	
Mitral decel time:	140 msec		
MV area:	cm ²	RV pressure:	33 mmHg + RA
AR half time:	msec	RVSP:	43 mmHg (N<36)
AoV area:	cm ²	E/E' septal:	16
Indication: ? heart failure			
ECG: Sinus rhythm			
Left ventricle: Mildly dilated left ventricle with moderate systolic dysfunction. The pattern is segmental with thinning and akinesis of all apical segments. No mural thrombus evident. The estimated LVEF = 35 ± 5%. Restrictive diastolic filling and an E/E' of 16 indicate elevated filling pressures			
Right ventricle: Normal right ventricular size and function			
Left atrium: Mildly dilated left atrium			
Right atrium: Mildly dilated right atrium. The inferior vena cava is not dilated			
Aortic valve: Normal trileaflet aortic valve which opens widely. No aortic regurgitation			
Mitral valve: The mitral valve leaflets are normal, however posterior leaflet closure is restricted by LV dilation. There is moderate mitral regurgitation which is directed posteriorly			
Pulmonary valve: Normal pulmonary valve with trivial regurgitation			
Tricuspid valve: Normal tricuspid leaflets with trivial regurgitation			
There is mild pulmonary hypertension with an estimated RV systolic pressure of 43 mmHg			
Conclusion			
1. Mildly dilated LV with moderate segmental systolic dysfunction. The presence of apical infarction is suggestive of underlying coronary disease			
2. Mild biatrial enlargement with features of elevated LA pressure			
3. Moderate functional MR due to LV enlargement			
4. Mild pulmonary hypertension			

Ejection fraction

**Regional/
Globular wall
abnormalities**

**Valvular
dysfunction**

Conclusion

N = normal value, LV = left ventricular, LVEF = left ventricular ejection fraction, LA = left atrium, LAVI = left atrial volume index, RA = right atrium, MV = mitral valve, RV = right ventricular, RVSP = right ventricular systolic pressure, AR = aortic regurgitation, AoV = aortic valve.

References

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2. **UpToDate - Transthoracic Echocardiography**
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4. **<https://www.pocus101.com/cardiac-ultrasound-echocardiography-made-easy-step-by-step-guide/>**
5. **<https://radiopaedia.org/articles/transthoracic-echocardiography>**
6. **<https://www.asecho.org/guideline/guidelines-for-performing-a-comprehensive-transthoracic-echocardiographic-examination-in-adults/>**
7. **<https://www.onlinejase.com/article/S0894-7317%2818%2930318-3/fulltext>**
8. **UpToDate - Heart Failure: Echocardiography**
9. **RACGP - Transthoracic Echocardiography Findings**
10. **RACGP - Echocardiography in Heart Failure**
11. **UpToDate - Role of Echocardiography in Infective Endocarditis**
12. **Transesophageal Echocardiography (TEE) in the Evaluation of Infective Endocarditis- Science Direct**
13. **UpToDate - Echocardiography evaluation of the pericardium**
14. **YouTube (Cardiac Ultrasound: Basic Pathology) by Cooper Ultrasound**
15. **YouTube (Echocardiographic assessment of the mitral valve by MedicalWorks Egypt)**
16. **YouTube (Big Aortic Vegetation/ Infective Endocarditis Echocardiography Cardiac Ultrasound) by ECHOCARDIOGRAPHY**
17. **YouTube (Echocardiography with a Significant Pericardial Effusion) by NEJM group**
18. **<https://www.escardio.org/Journals/E-Journal-of-Cardiology-Practice/Volume-16/Understanding-the-role-of-echocardiography-in-the-assessment-of-mitral-valve-disease>**
19. **UpToDate - Clinical manifestations and evaluation of adults with suspected left-sided native valve endocarditis**