# Bedside Echocardiography

Justin Davis, MD, MPH, RDMS
Subchief for Emergency Ultrasound
Kaiser Oakland Medical Center, Oakland CA

# Intro Case

56 y/o male, h/o Afib, nl EF, Referred from cardiology for cardioversion in ED

# Learning Objectives

- Understand cardiac anatomy
- Understand image acquisition
- Recognize common findings and pitfalls
- Understand basic clinical applications
- Recognize a few advanced applications

# Outline

- Information Gained and its Applications
- Cardiac Anatomy & Image Acquisition
- The Basics:  Effusions, Function
- Advanced:
  Tamponade, RV Strain,  Asc. Aorta Dilation

# Information Provided By Bedside Ultrasound

The Basics:

- Pericardial Effusion
- Cardiac Function
- (Central Venous Pressure)

# Applications

| Pericardial Effusion | Cardiac Function | Central Venous Pressure |
| --- | --- | --- |
| • Trauma | • Dyspnea | |
| • Cardiac Arrest | • Sepsis | |
| • Hypotension | • Fluid Resuscitation | |
| • Chest Pain | • Diuresis | |

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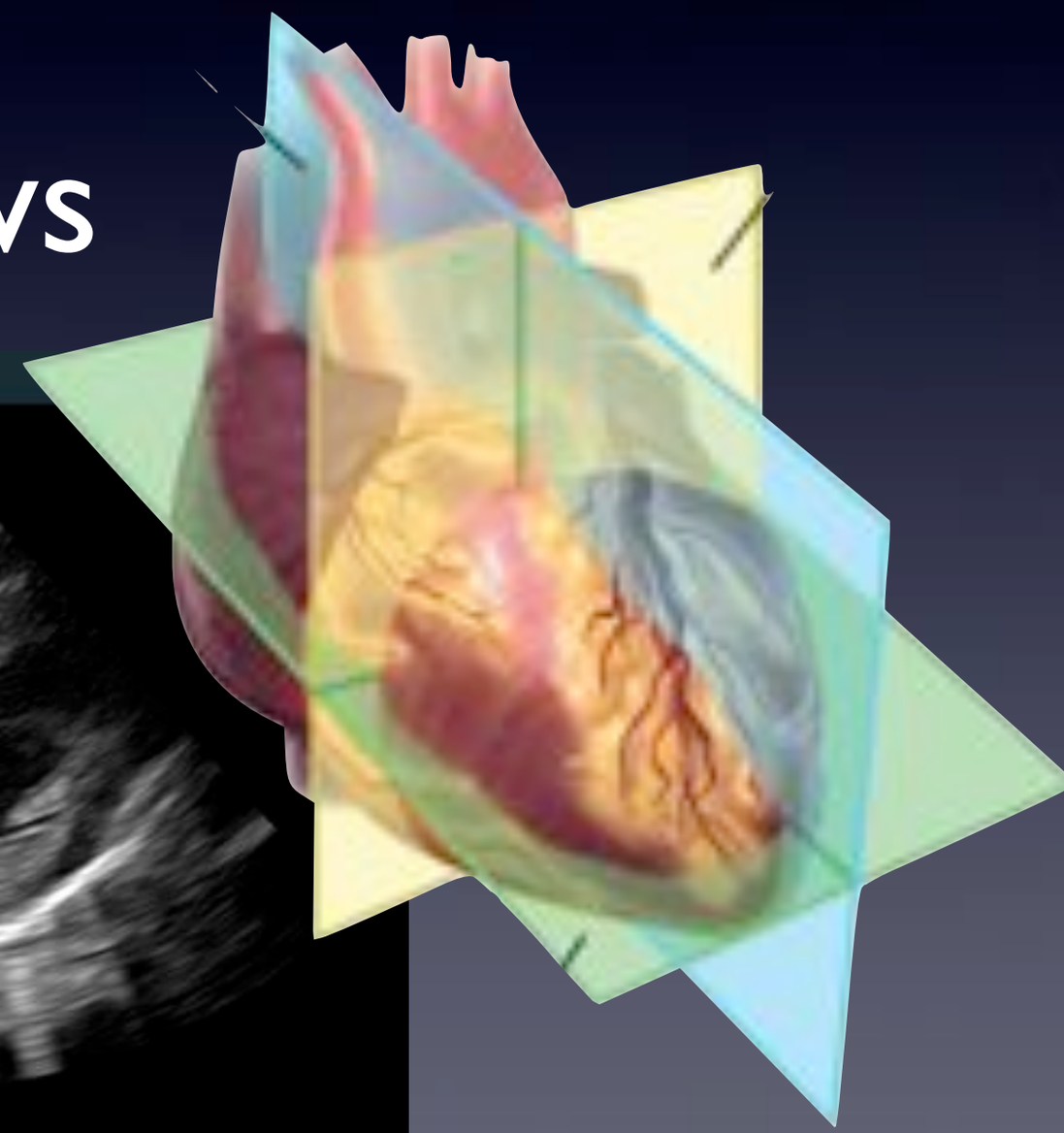
# Echocardiogram Anatomy

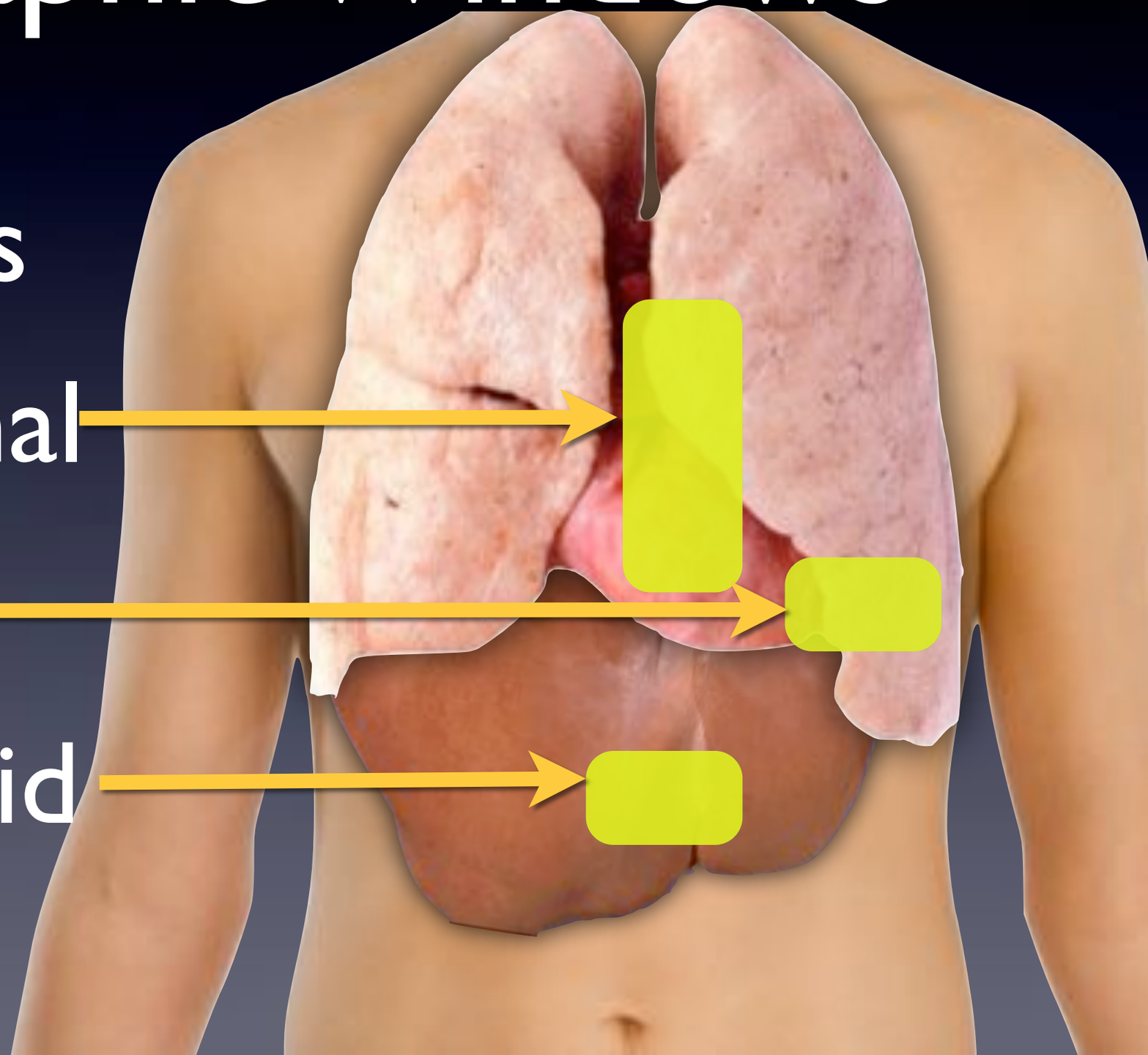
Windows + Planes

= Views

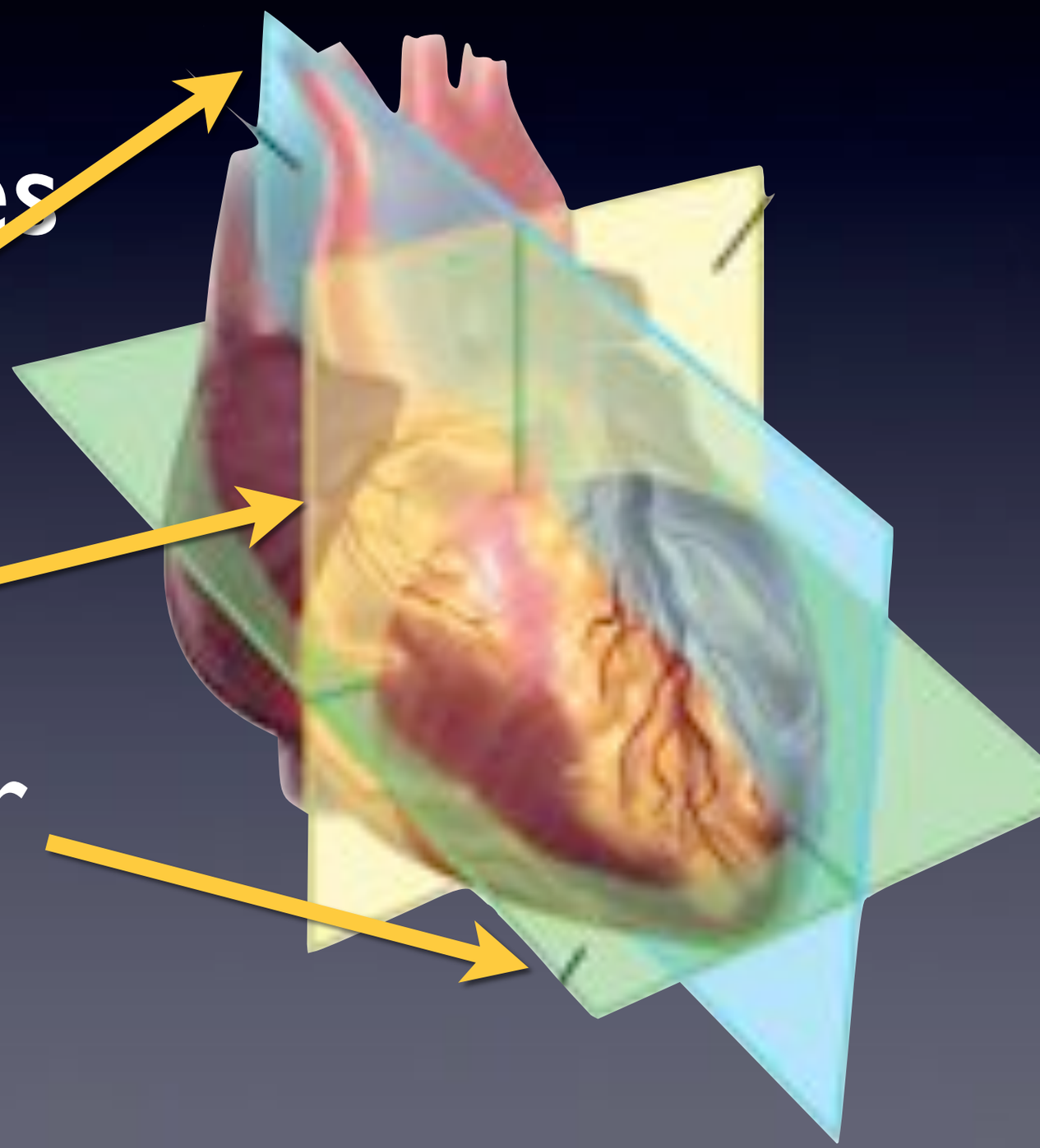
# Bedside Echo: Sonographic Windows

- 3 Windows
- Parasternal
- Apical
- Subxiphoid

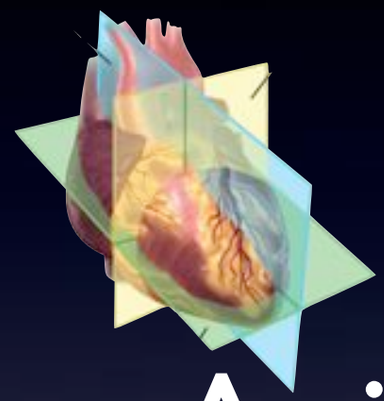


# Bedside Echo: Cardiac Planes

- 3 Primary Planes
  - Long Axis
  - Short Axis
  - Four Chamber



# 4 Echocardiogram Views



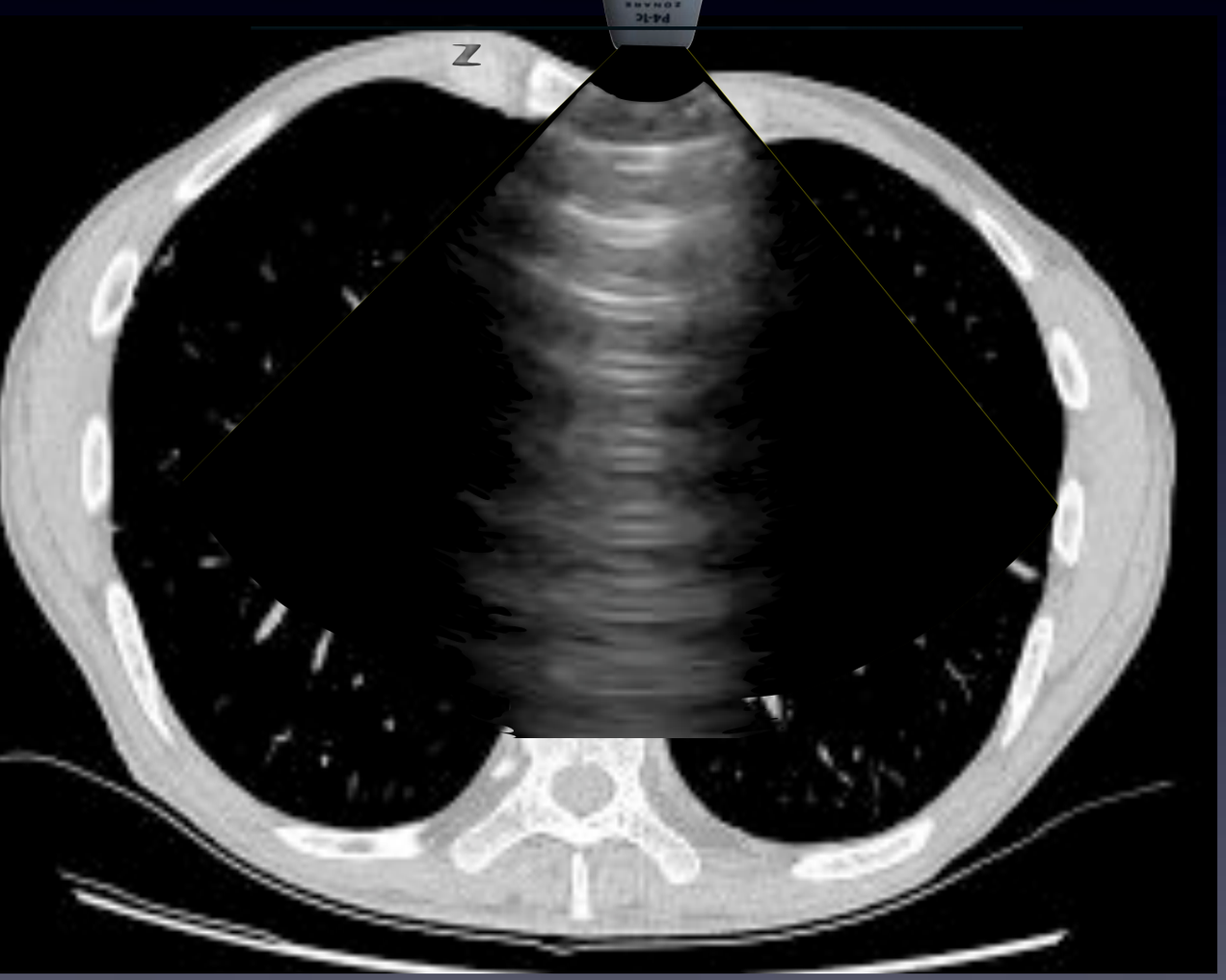
- Parasternal Long Axis
- Parasternal Short Axis
- Apical 4 Chamber
- Subxiphoid 4 Chamber

# Image Acquisition & Probe Selection

- Small footprint
- Low frequency



# Echocardiogram Anatomy Window Differences

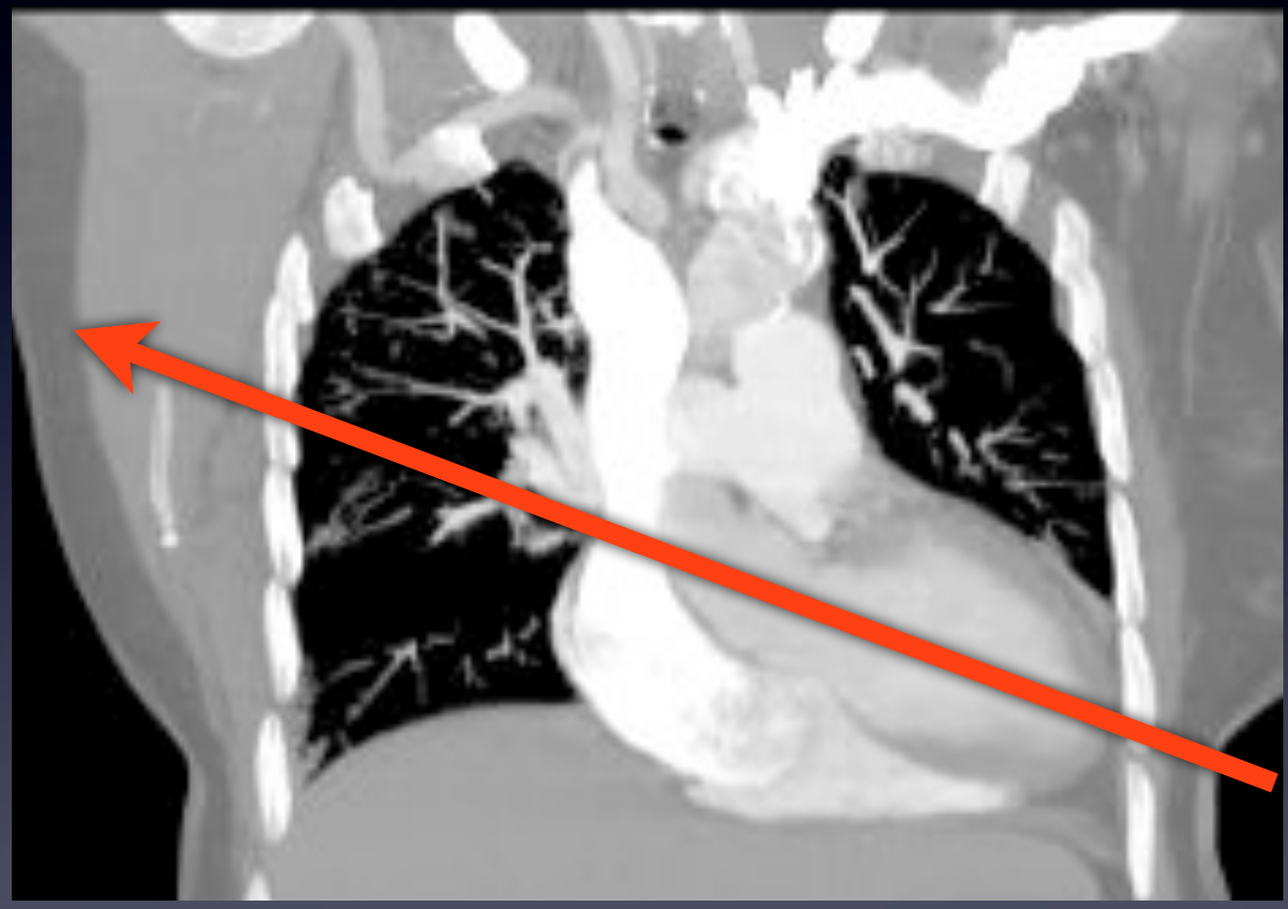


COPD, Barrel Chest, Tall and Thin

Cardiomegaly, Large Abdomen

# Echocardiogram Anatomy Axis Differences

Vertical Axis



Horizontal Axis

# Echocardiogram Anatomy Windows and Axes

- Windows & axes vary

- First: Find your Window
- THEN: Adjust the Axis

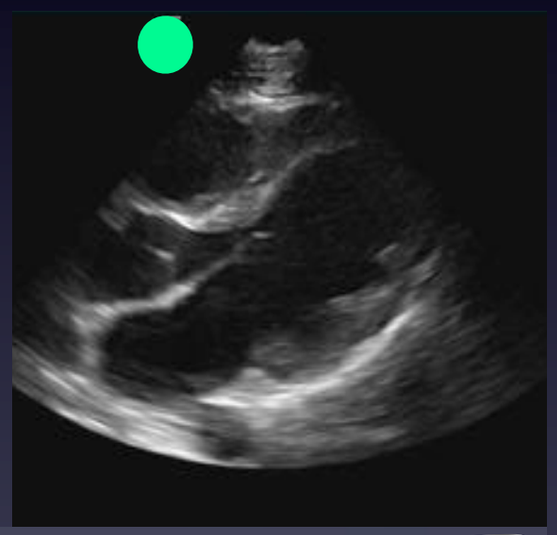
# Window Shopping

# (Don’t do this)

# Controversy: Probe Orientation

## General Radiology/EM

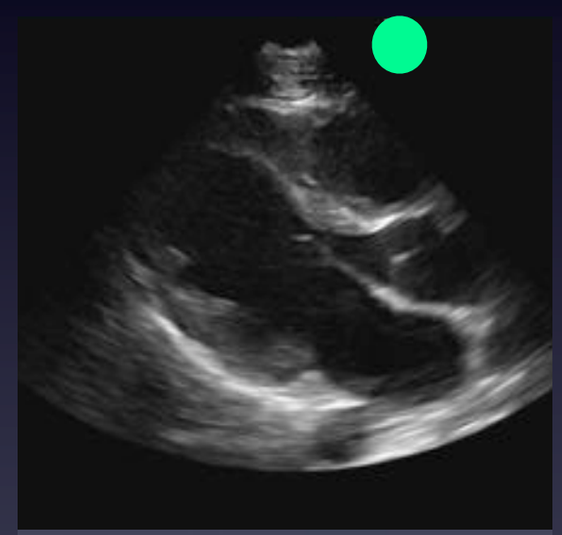
- Indicator Screen LEFT



- Scan from pts RIGHT

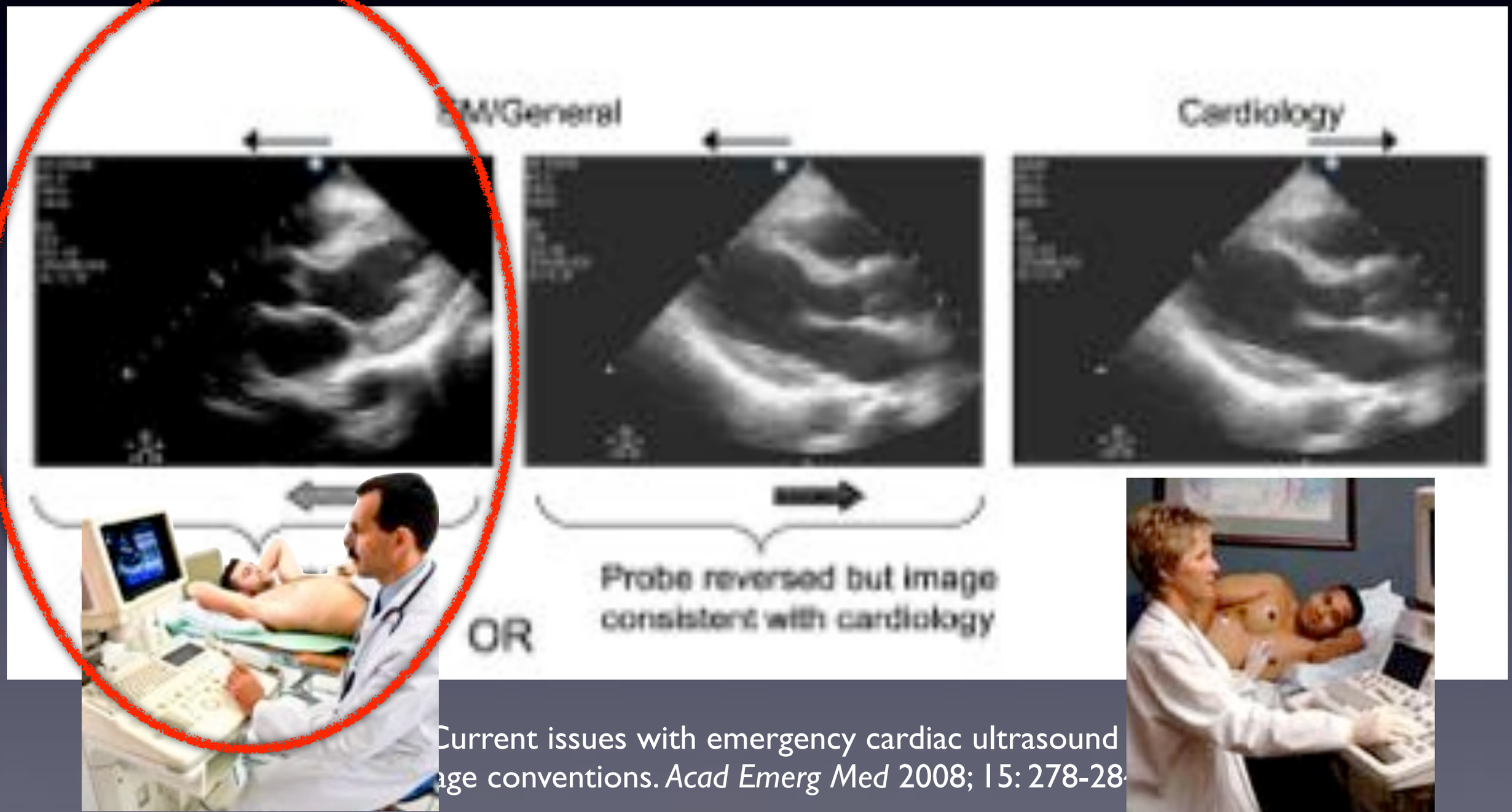
## Cardiology

- Indicator Screen RIGHT



- Scan from pts LEFT

# Parasternal Long Axis View
## (The only one that differs)





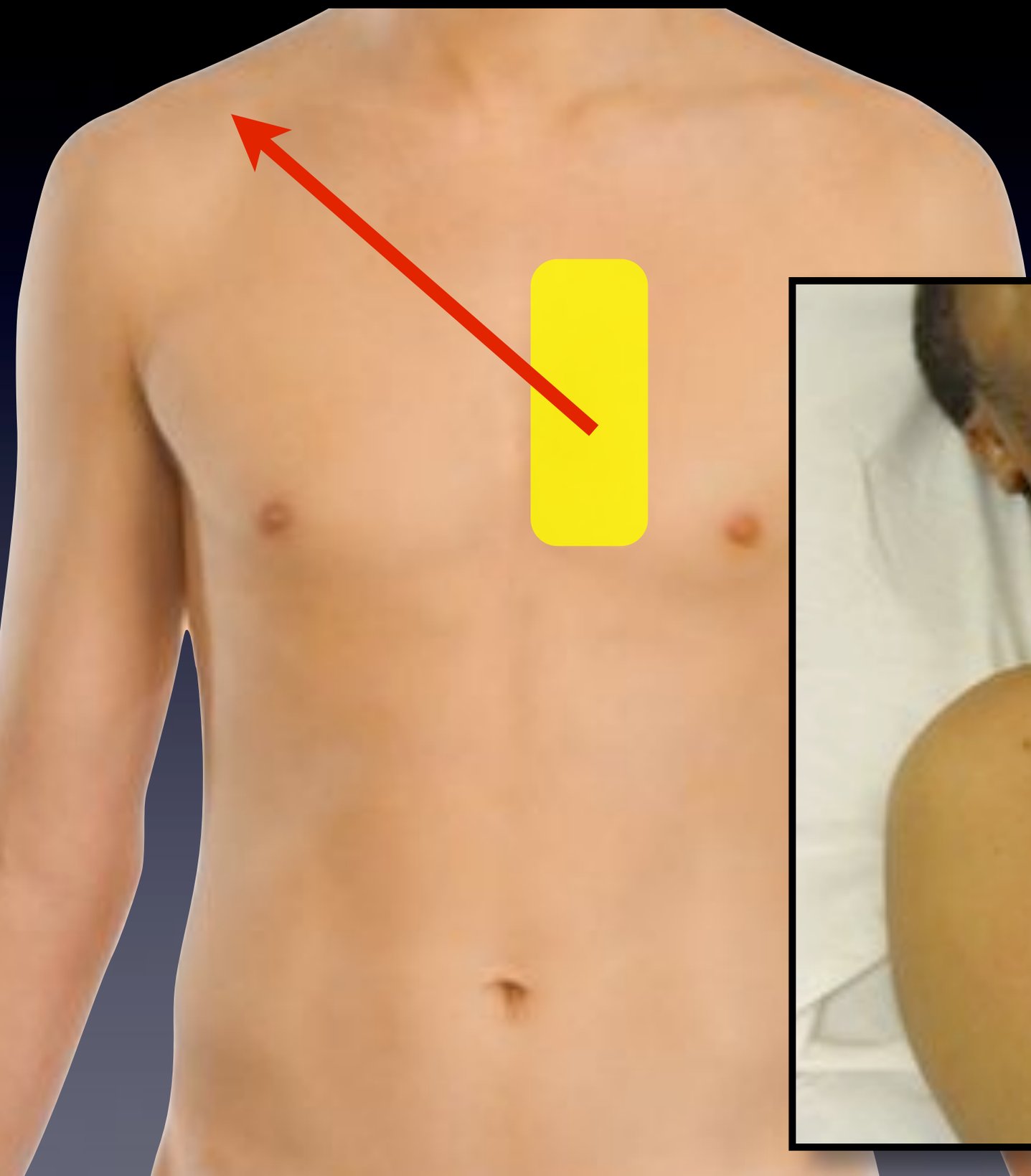



Current issues with emergency cardiac ultrasound
age conventions. *Acad Emerg Med* 2008; 15: 278-28

# What setting does my machine use?

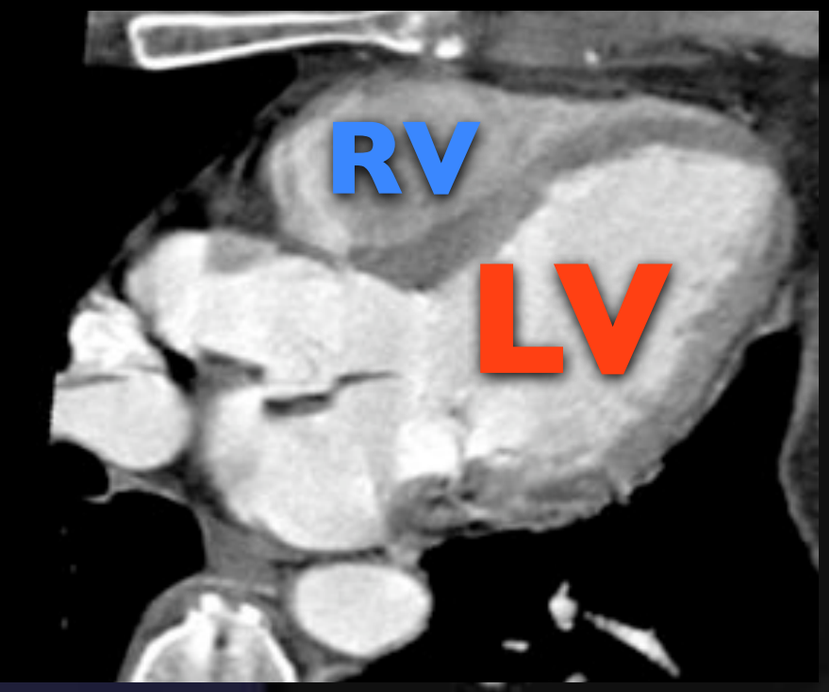
- Choose cardiac probe and preset
- Look for the indicator on the screen
- Can switch sides with L/R invert
- Can save default

# Parasternal Long Axis View



Probe Indicator
Toward right shoulder

# Parasternal Long Axis View



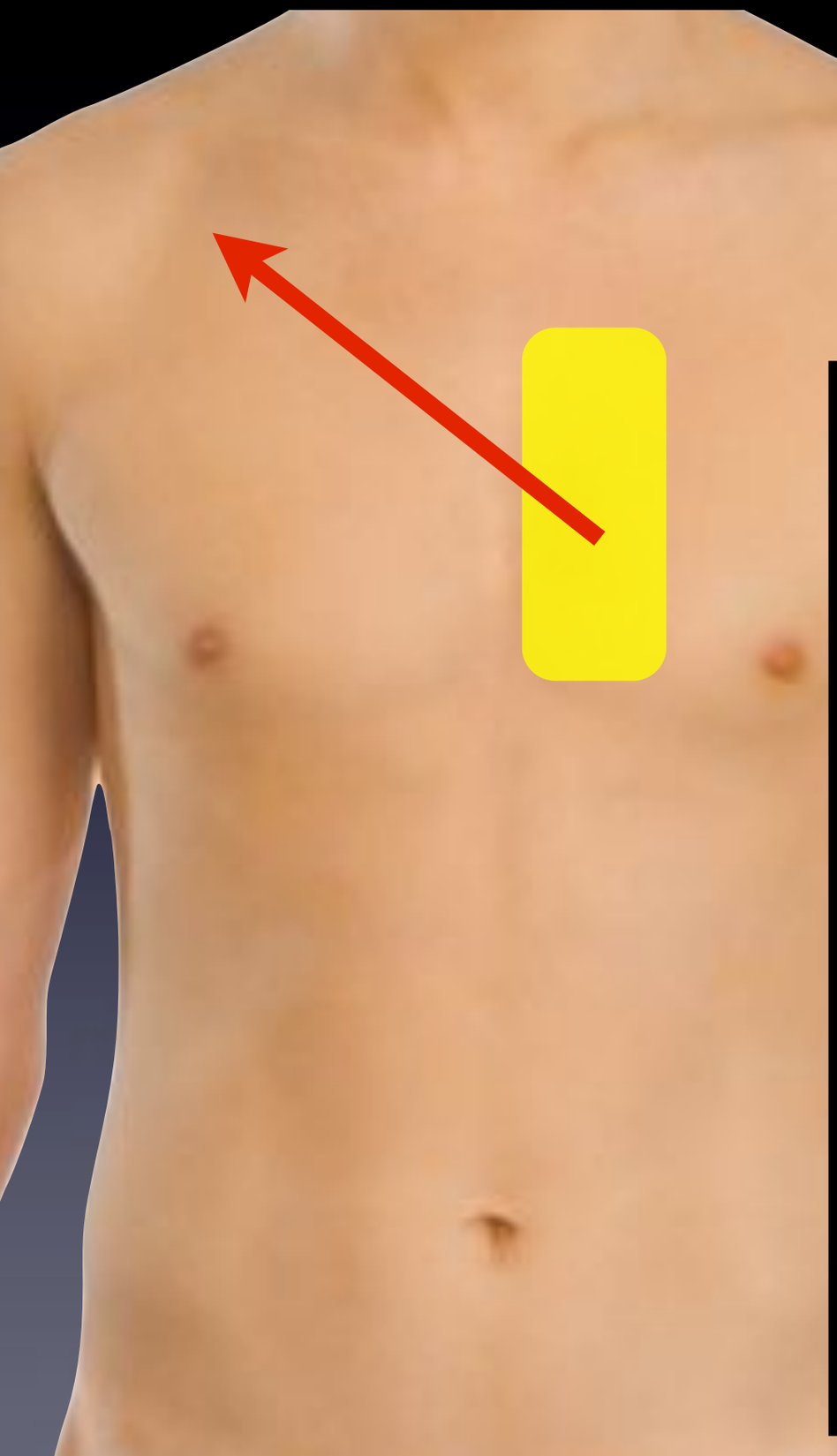
# Parasternal Long Axis View

## Tips:

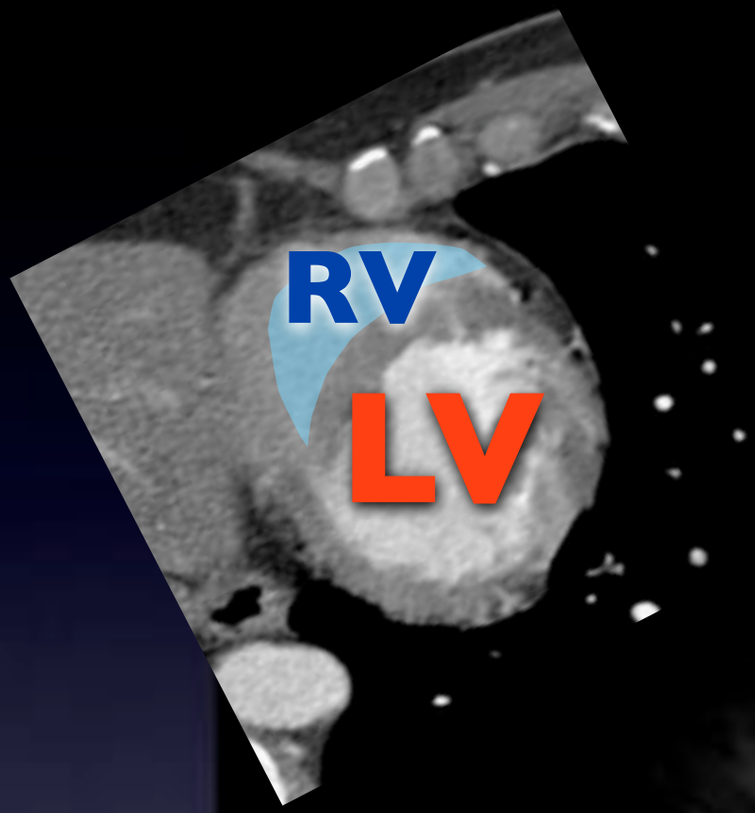
- Stay close to sternum
- End-expiratory hold
- Difficult in COPD

# Parasternal Short Axis

Indicator 90° CCW
from Long Axis



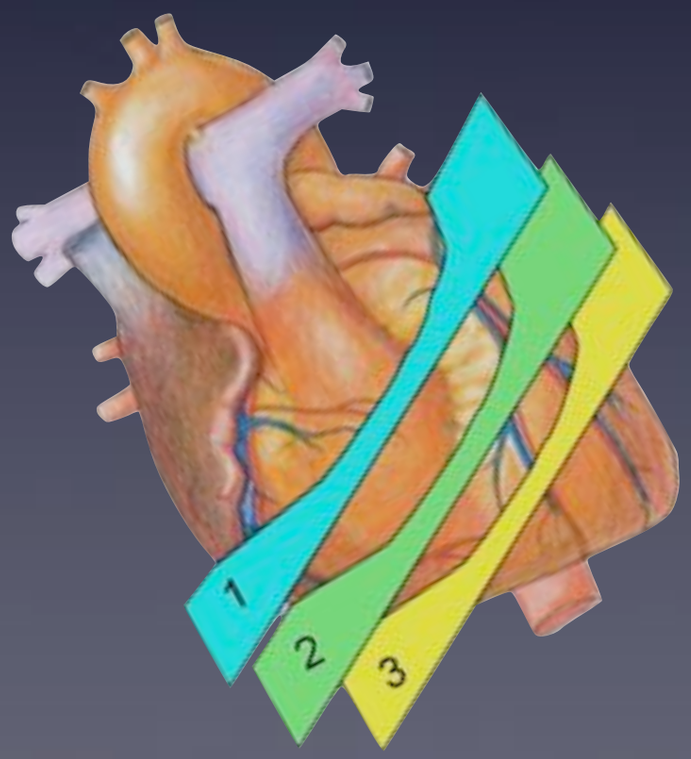
# Parasternal Short Axis View

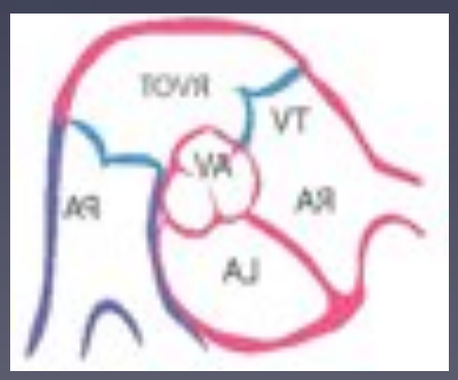


# Parasternal Short Axis View

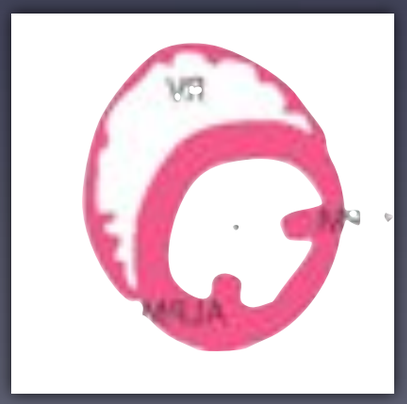
## Tips:

- Try to maintain circular LV
- End-expiratory hold
- View varies depending on level of heart

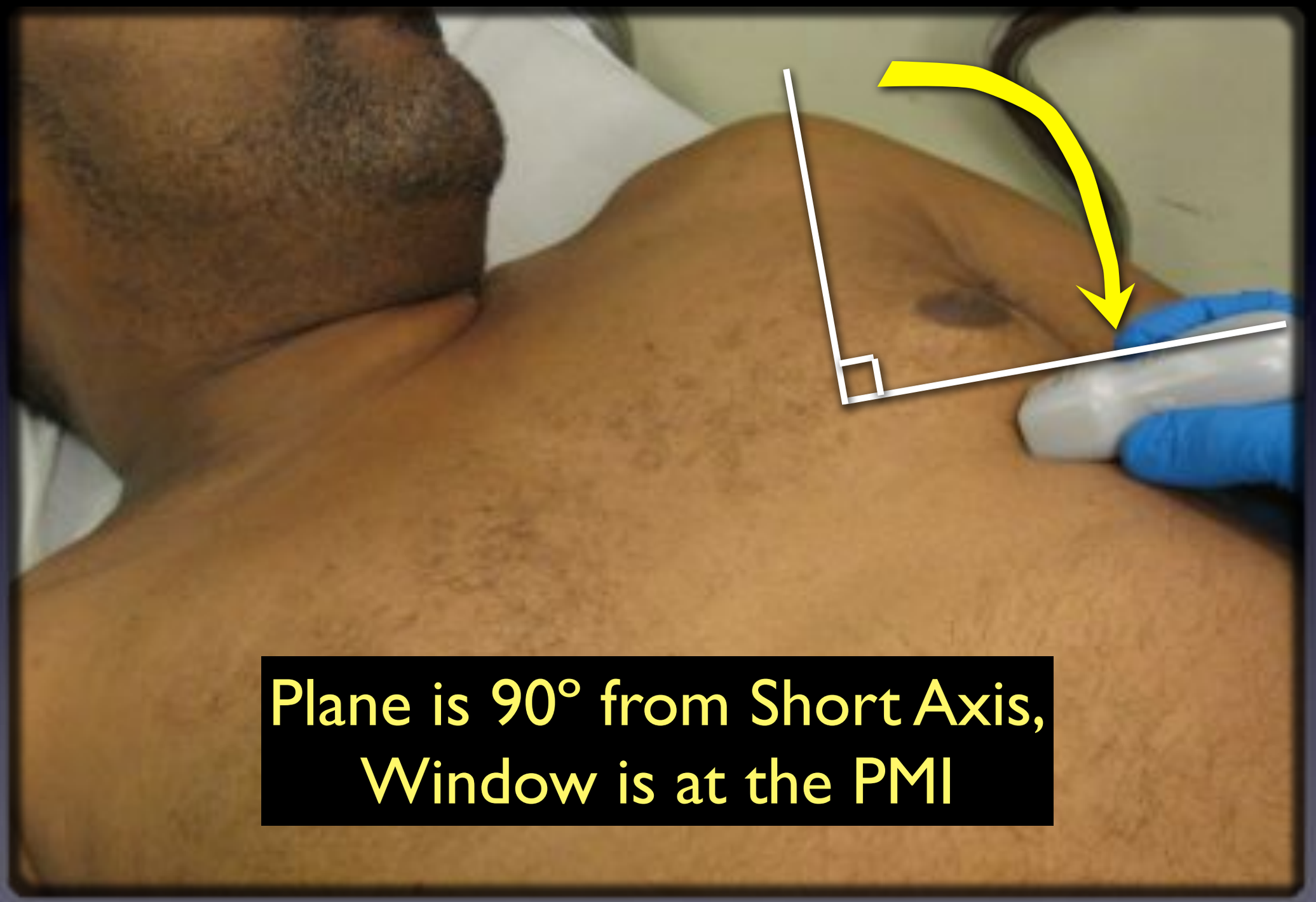






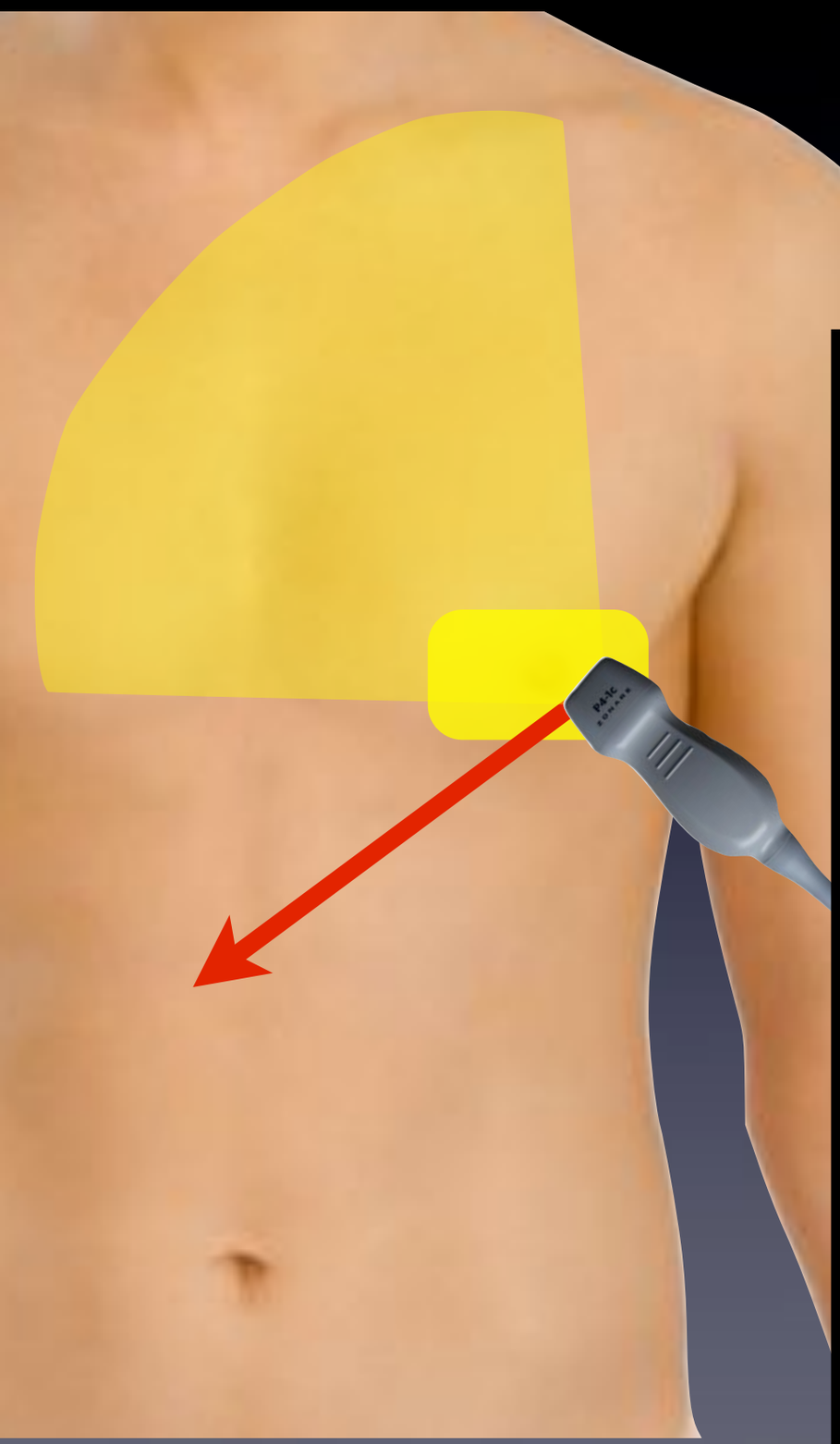
# Apical 4 Chamber View



Plane is 90° from Short Axis,
Window is at the PMI

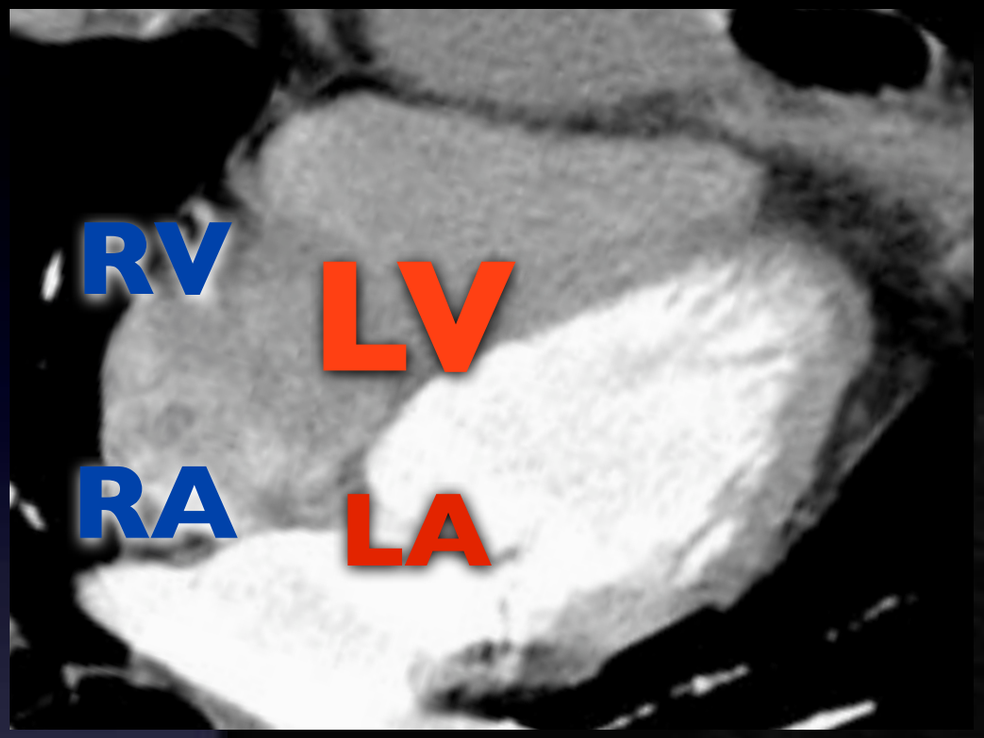
# Apical 4 Chamber View

Indicator similar to Short Axis,
Perpendicular plane



# 4 Chamber Plane

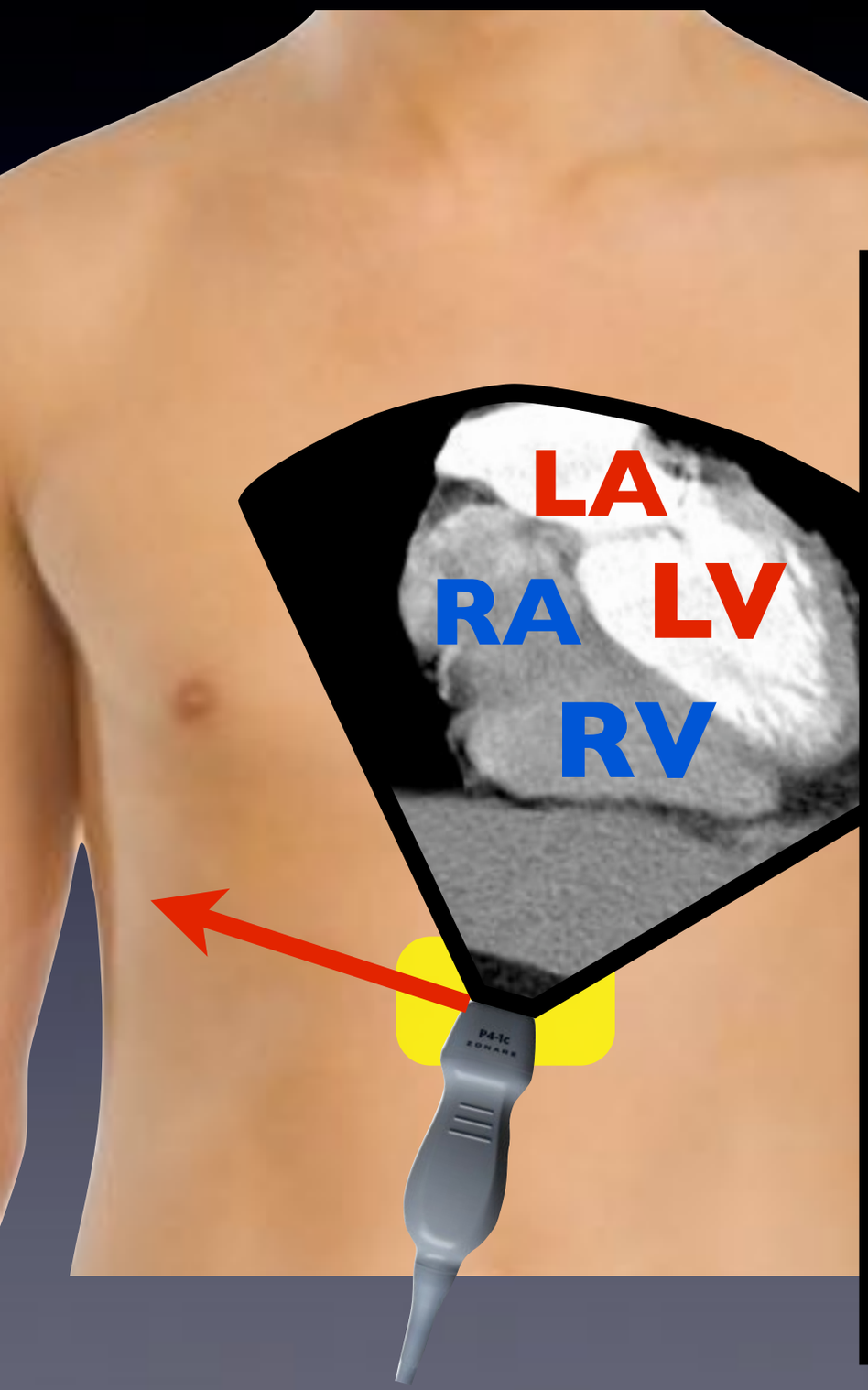
# Apical 4 Chamber View



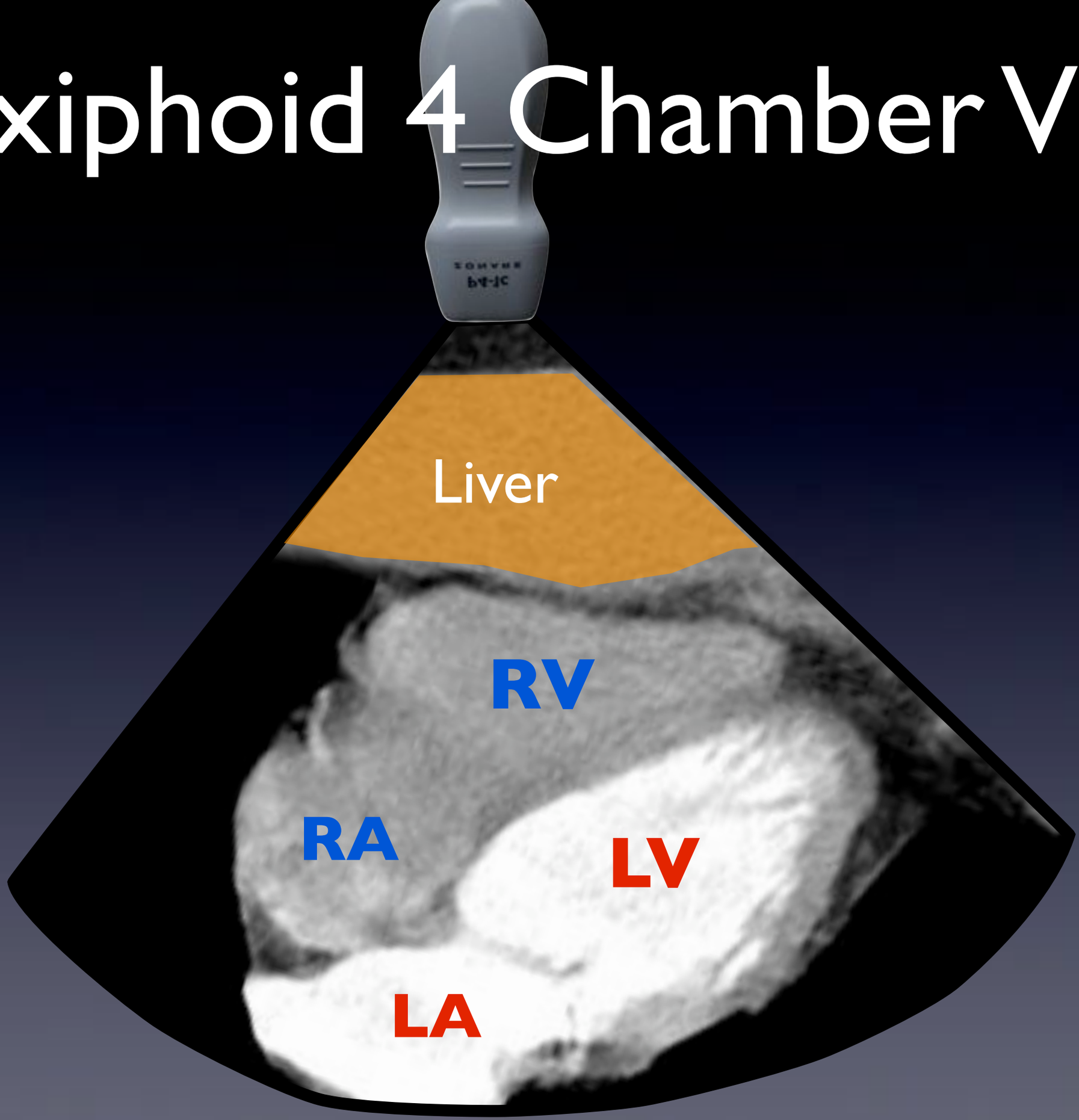
# Apical 4 Chamber View

- Tips:
  - Left lateral decubitus
  - End-expiratory hold
  - Under the breast fold
  - Aim sound waves toward right scapula

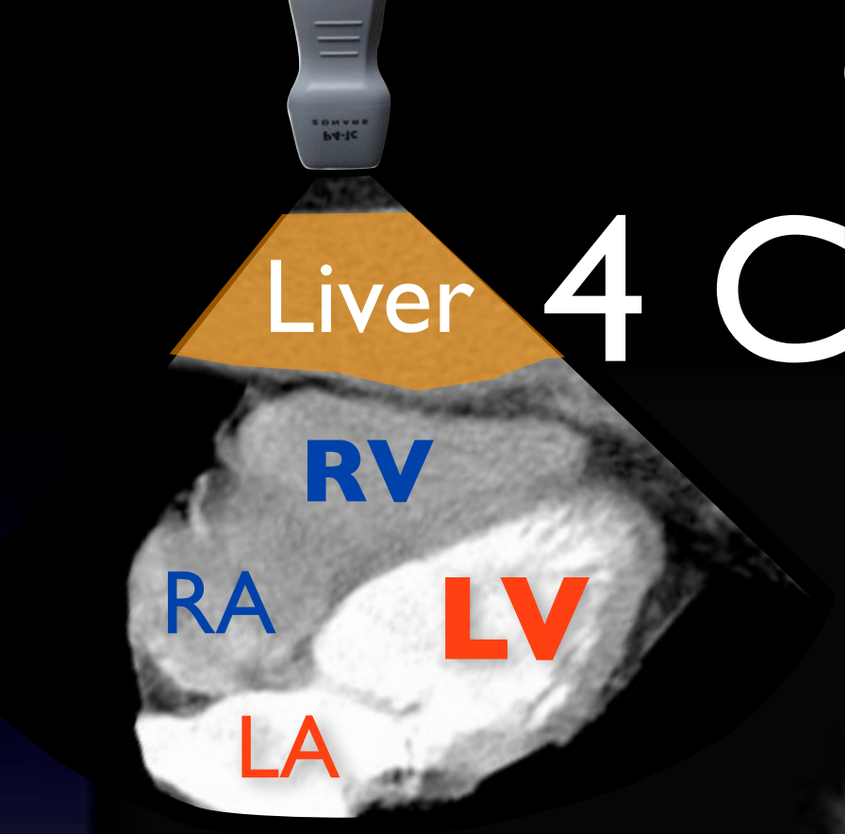
# Subxiphoid 4 Chamber View

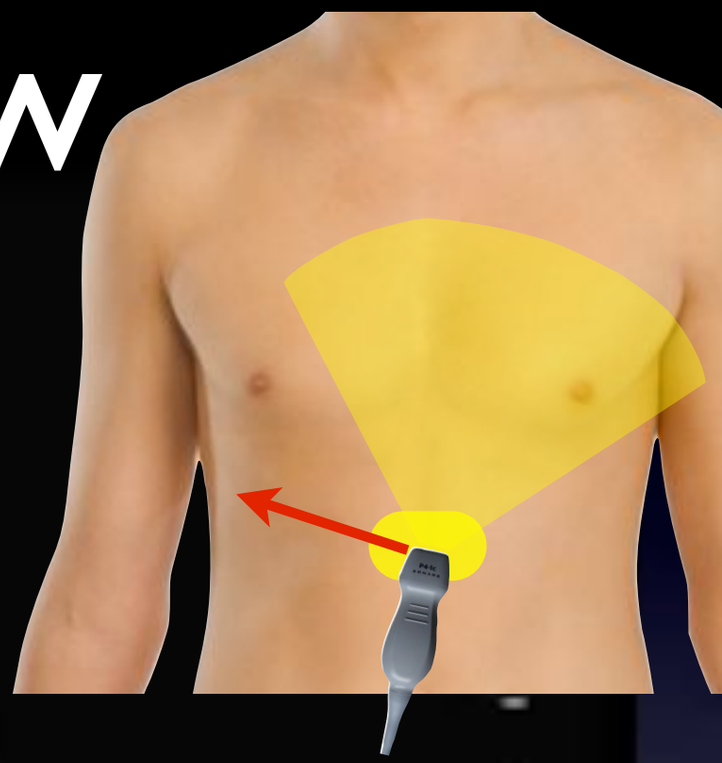



# Subxiphoid 4 Chamber View

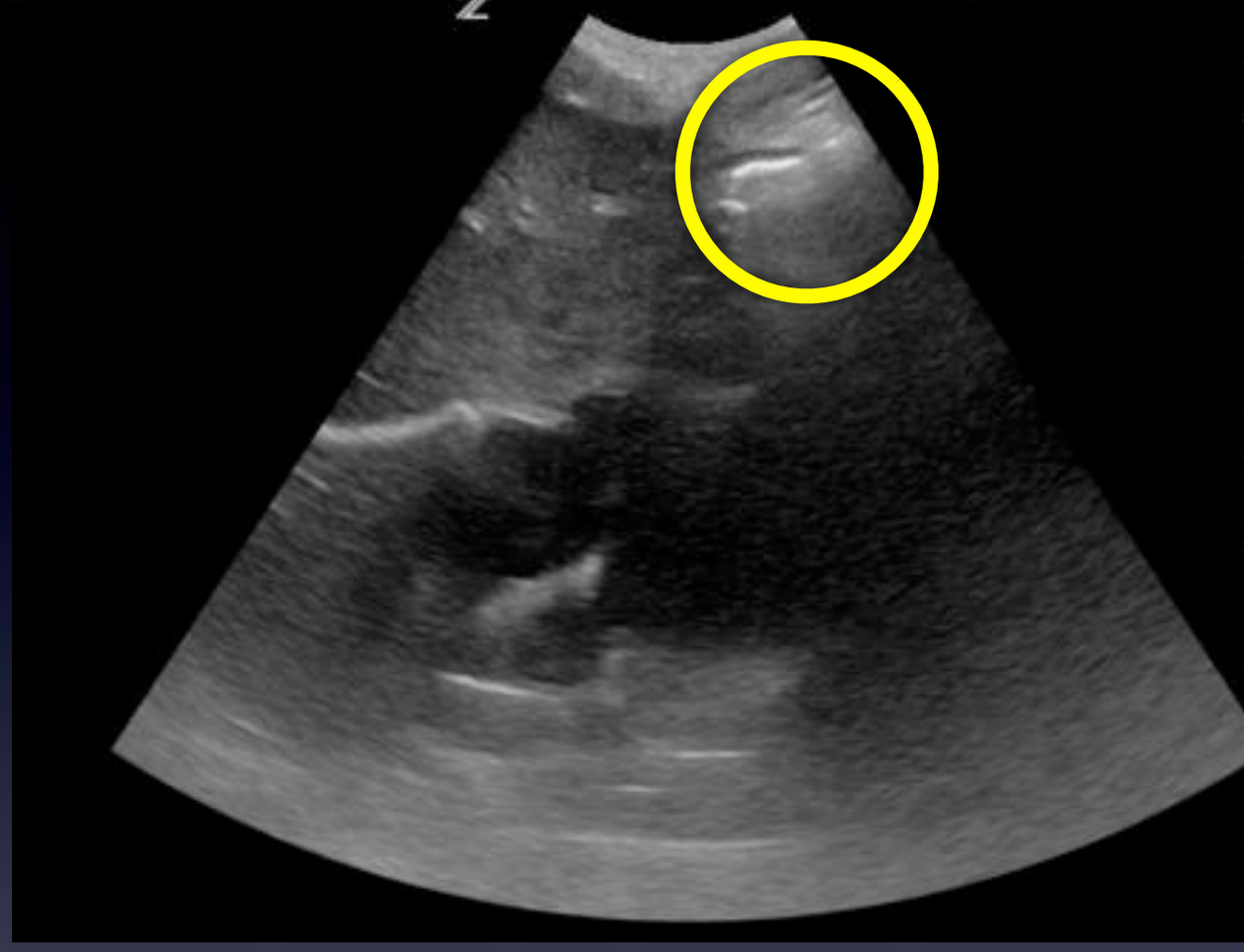


# Subxiphoid 4 Chamber View



# Subxiphoid 4 Chamber View



- Tips:
  - Firm pressure
  - Inspiratory hold
  - Bowel Gas? Try right of midline

# Outline

- Information Gained and its Applications
- Cardiac Anatomy & Image Acquisition
- The Basics: Effusions, Function
- Advanced:
  Tamponade, RV Strain, Asc. Aorta Dilation

# Basics:
# Pericardial Effusions

- *Anechoic* signal (Black)
- *Between* myocardium and pericardium
- Effusion should be *dependent*
- Except in trauma or post-op, clinically significant effusions are *circumferential*

# Pericardial Effusions

## Parasternal Long Axis

# Pericardial Effusions

## Subxiphoid 4 Chamber

# Pericardial Effusions False Positives

- Epicardial fat pad
- Left pleural effusion
- Ascites

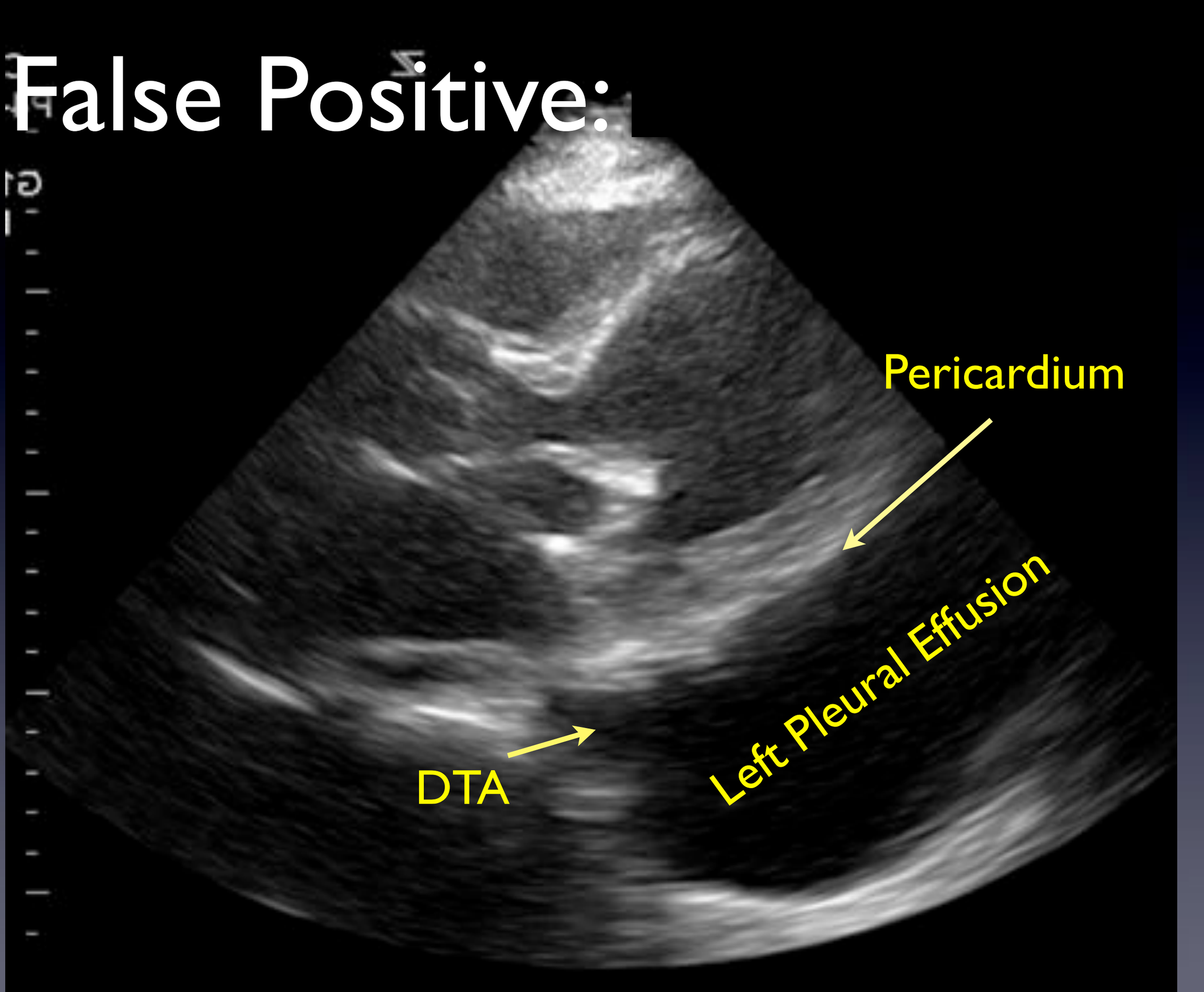
# False Positive: Fat Pad

# Pericardial Effusions False Positive: Fat Pad

- Echogenic
- Moves with myocardium
- Not displaced by heart motion
- Usually not dependent

# False Positive: Fat Pad

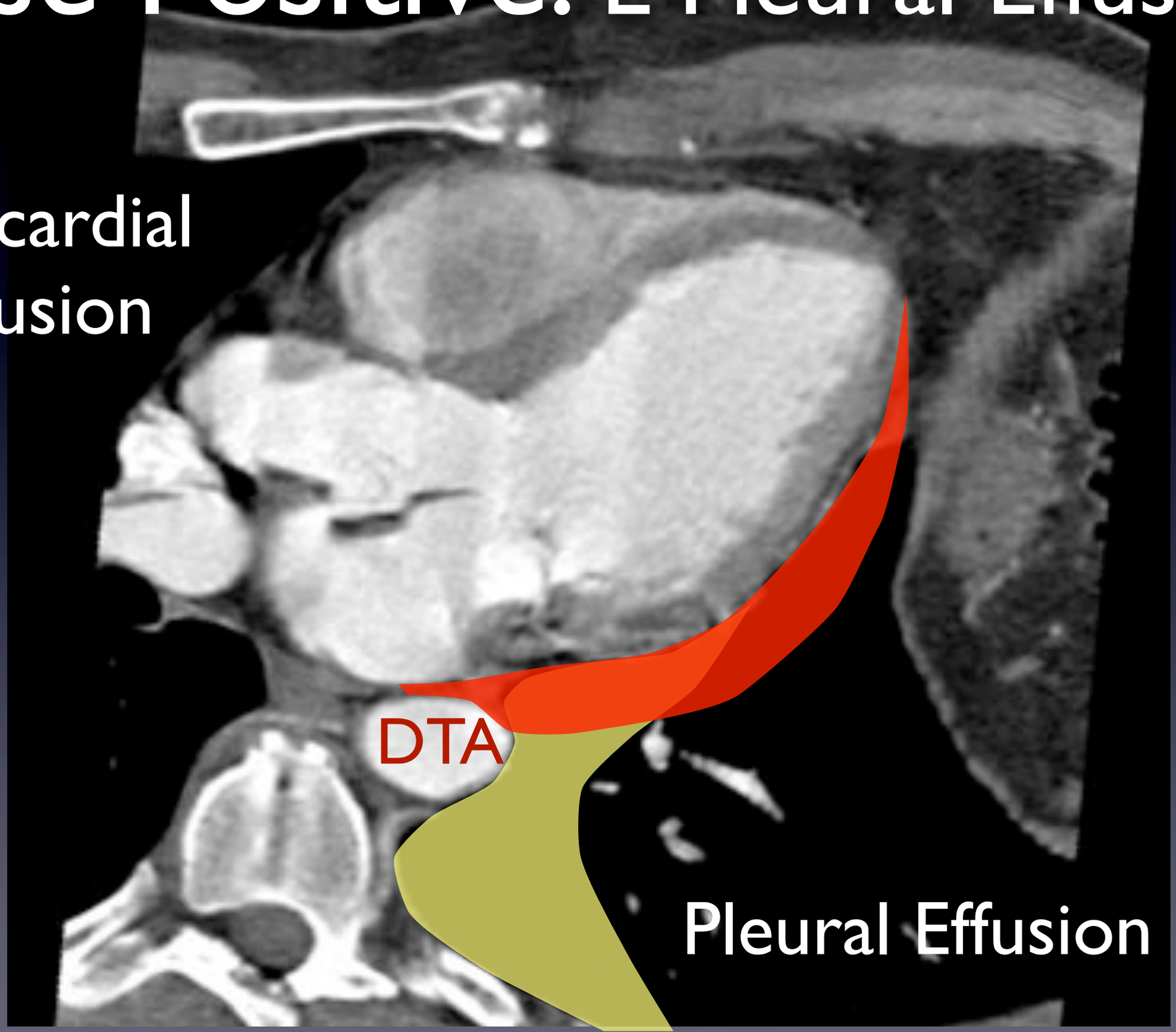
# False Positive:



# Pericardial Effusions
# False Positive: L Pleural Effusion

- Only seen posterior/lateral views
- In parasternal long axis, extends deep to the descending thoracic aorta (not between DTA and heart)
- Use FAST splenorenal view to confirm

# False Positive: L Pleural Effusion



# False Positive: L Pleural Effusion

Use FAST LUQ
view to confirm

# False Positive: Ascites

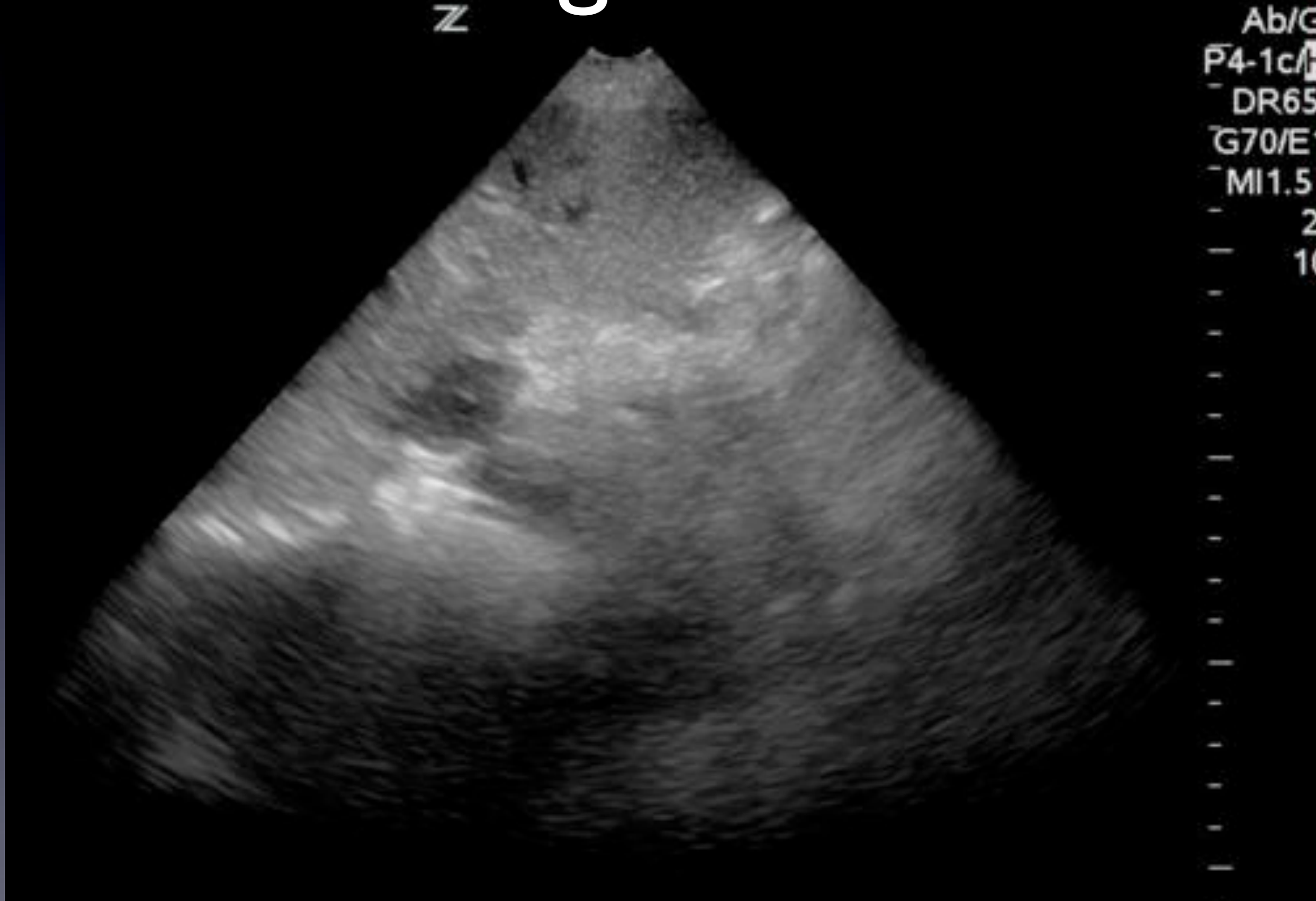
# Pericardial Effusions False Positive: Ascites

- Only seen in subxiphoid view
- Will often disappear with deep inspiration
- Confirm ascites in abdominal views

# Pericardial Effusions
# False Negative: Blood Clot

- Clotting blood can appear from anechoic to hyperechoic, to mixed.
- Look for your landmarks
- Check multiple views

# False Negative: Clot



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# Basics:
# LV Function

- General estimate
- Dead to Hyperdynamic
- Parasternal long and short axes, look at
  - Anterior mitral valve leaflet
    (should come within 1cm of septal wall)
  - General contraction of LV

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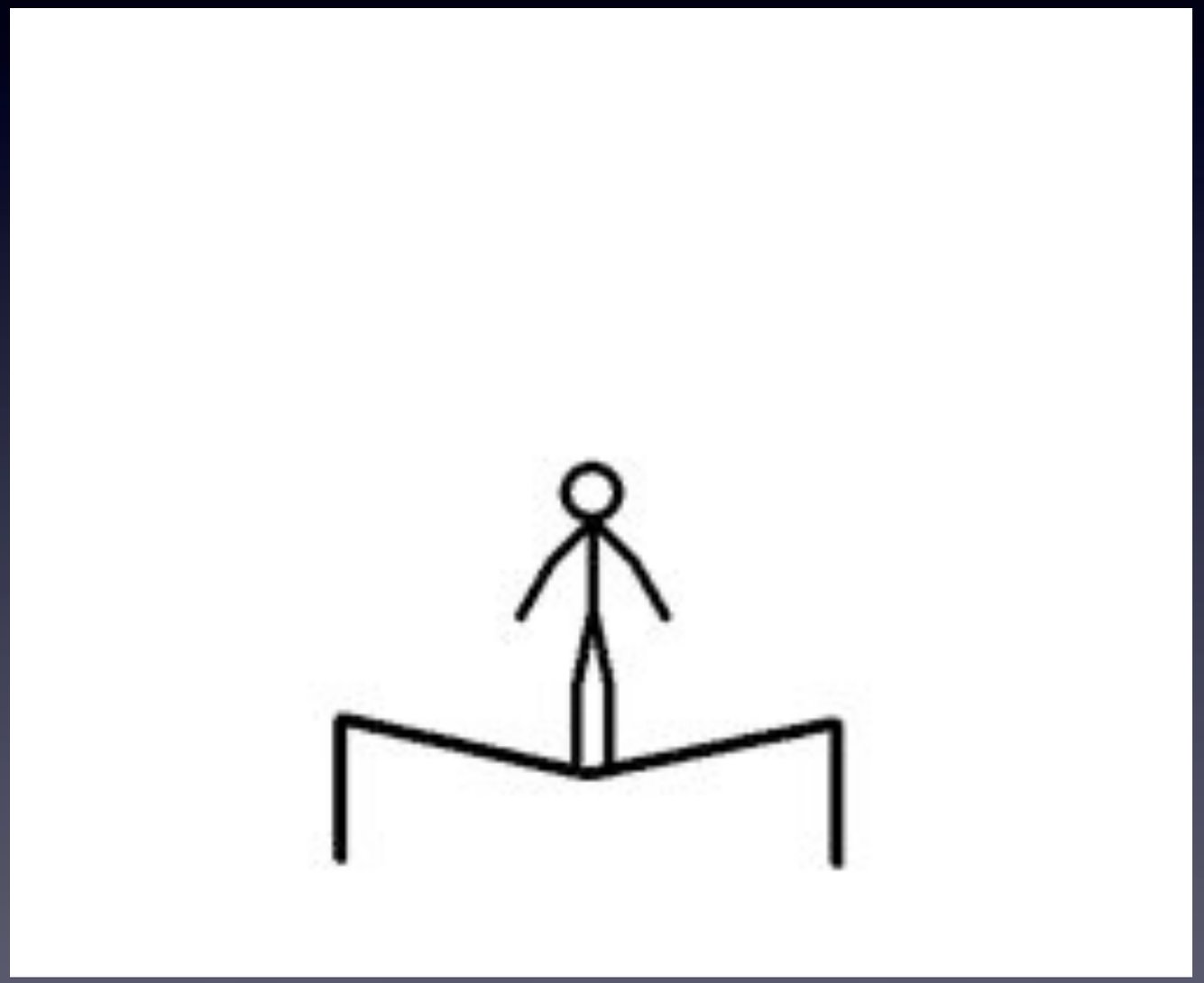
# Advanced Finding: Impending Tamponade

(Clinical Diagnosis)

- 1) In tamponade, intrapericardial pressure restricts atrial filling, therefore IVC WILL (ALMOST ALWAYS) BE DISTENDED
- 2) You may see diastolic RA or RV collapse Concave-inward displacement free wall

# What does RA or RV collapse look like?

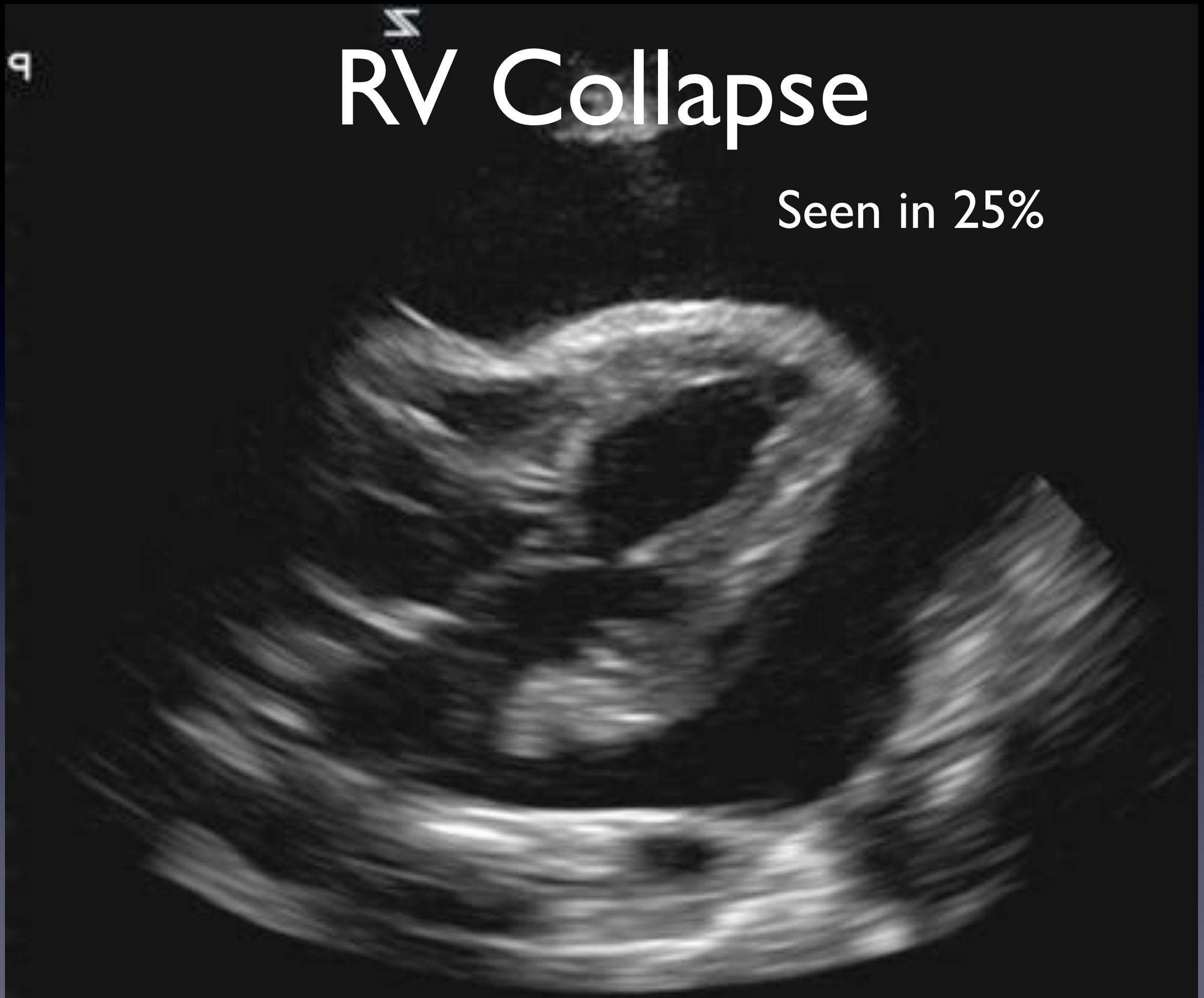


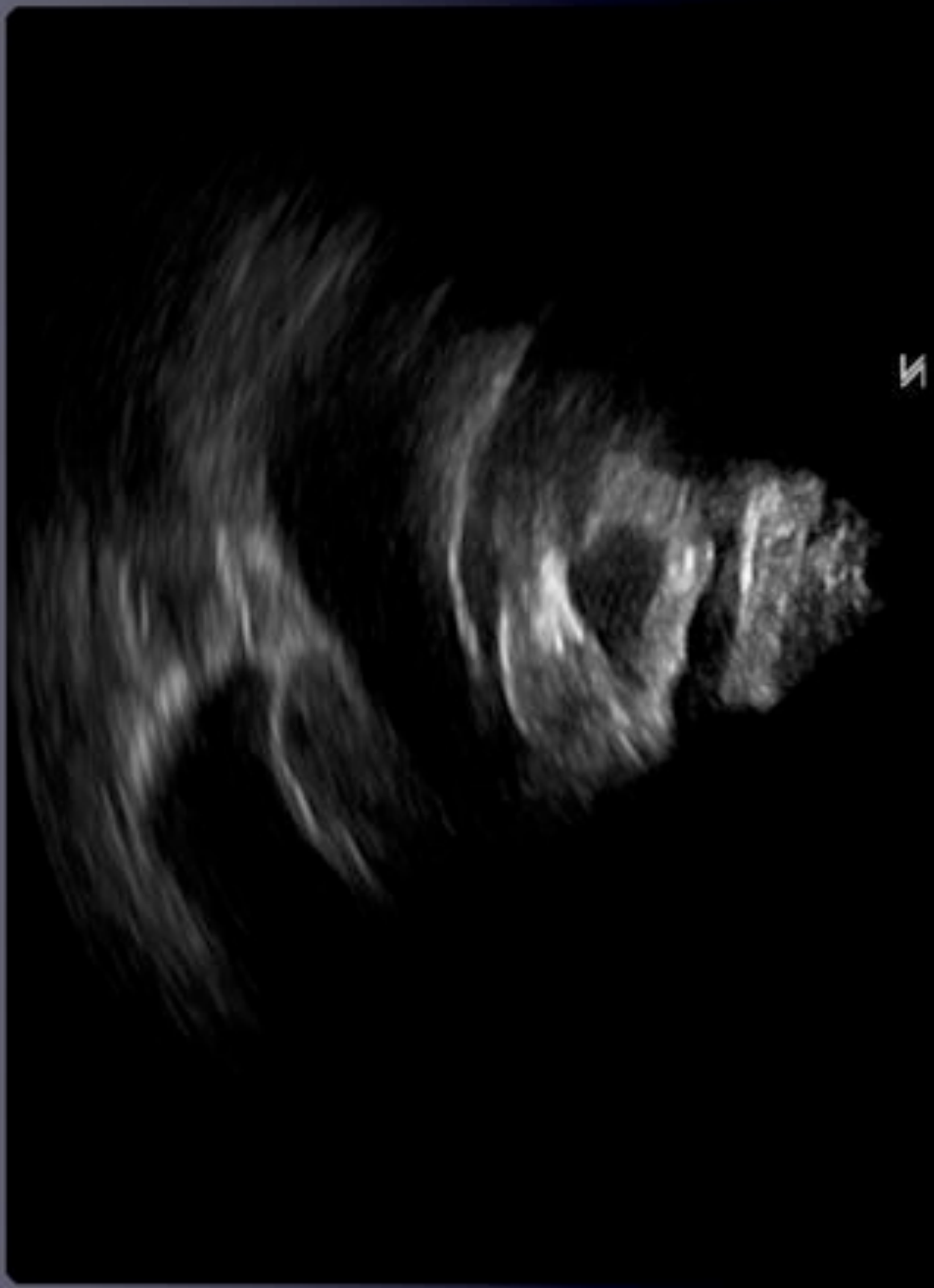
# RA Collapse

Seen in 75%

# RV Collapse

Seen in 25%



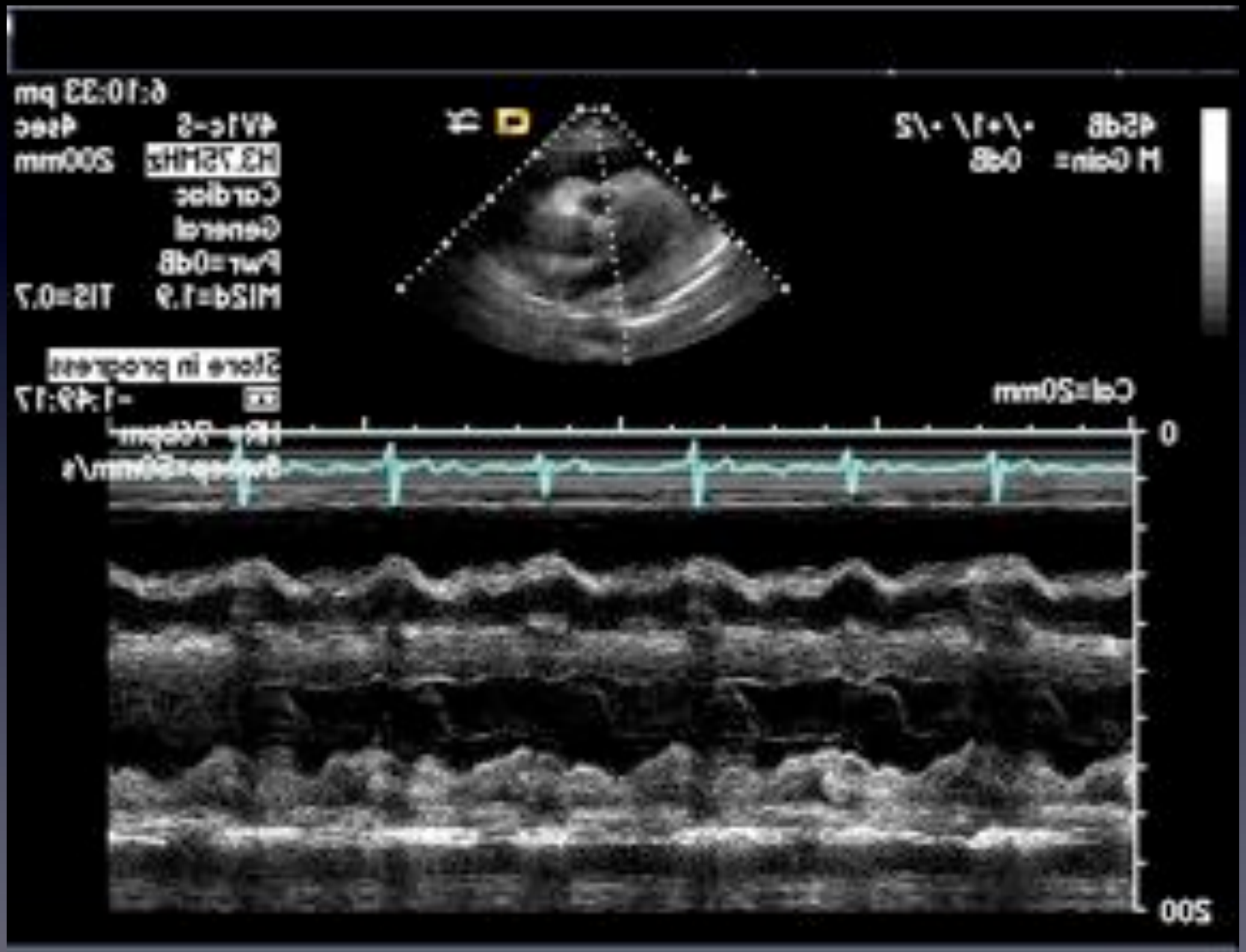


Geek Nugget !

# M - Mode
# RV Collapse


- Is it collapsing in Diastole?
- In diastole the Mitral Valve is open....

# M - Mode



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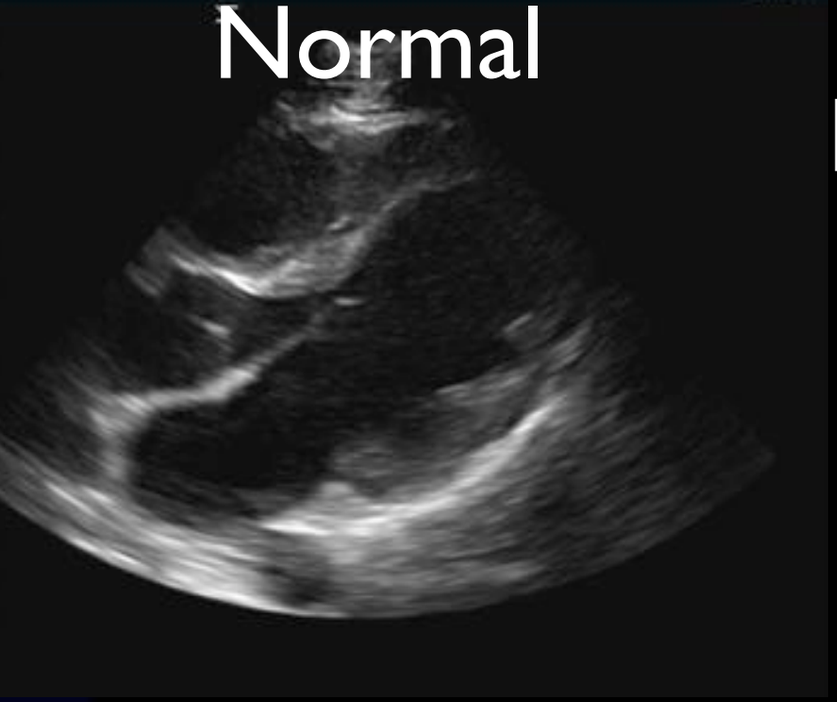
# Advanced Finding: RV Strain

- Simple explanation: when RV is pushing against high pressure (massive PE) you see:
  - RV distended and hardly squeezing
  - LV maybe compressed and under-filled

Normal



Parasternal Long Axis

LV - Small &
Hyperkinetic

RV - Large &
Hypokinetic

Normal

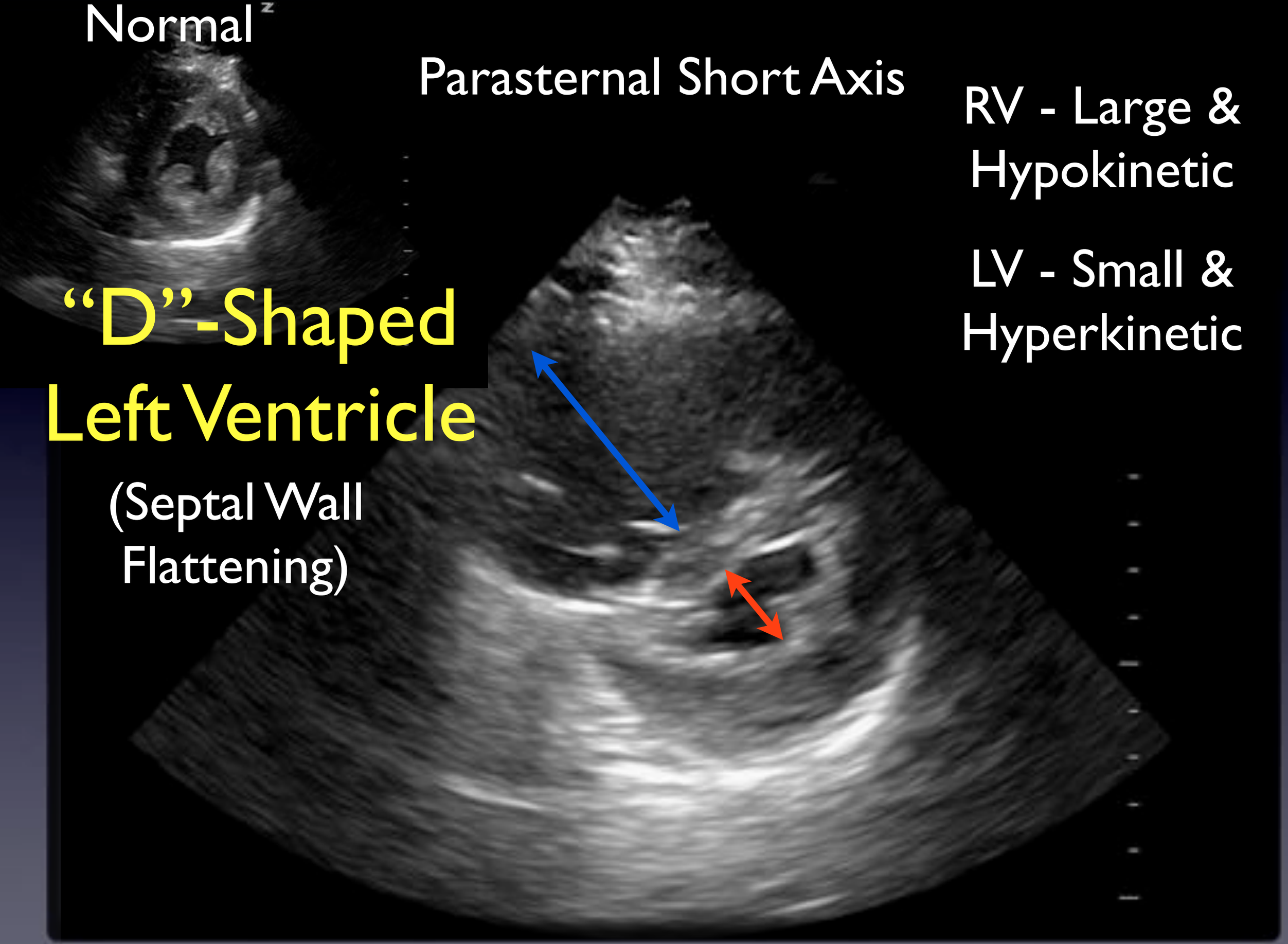
Parasternal Short Axis

RV - Large & Hypokinetic

LV - Small & Hyperkinetic

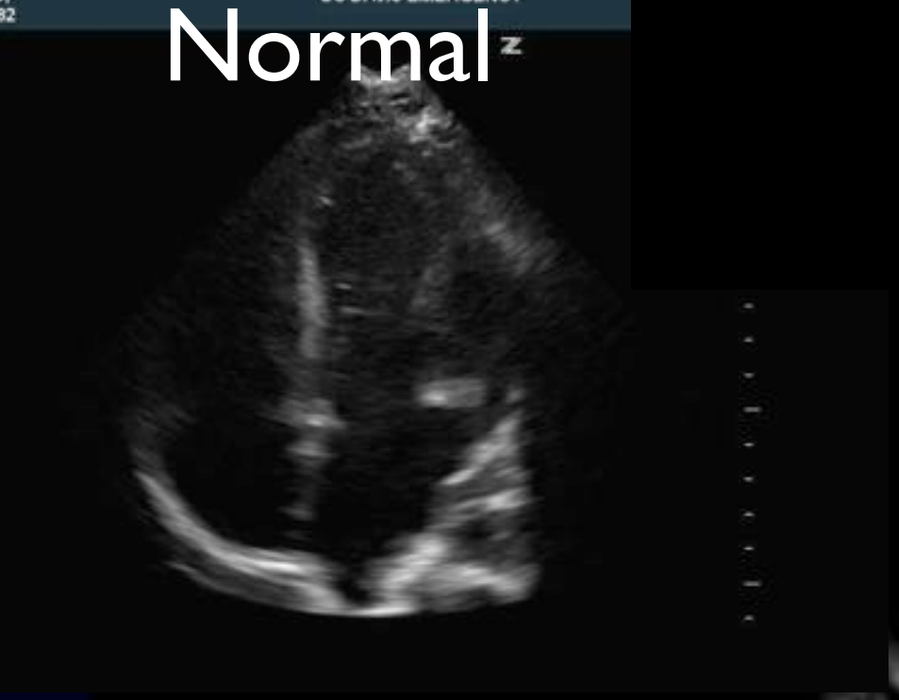
"D"-Shaped Left Ventricle

(Septal Wall Flattening)



Normal

# Apical 4 Chamber





LV - Small & Hyperkinetic

RV - Large & Hypokinetic

RVD:LVD >1 (normal<1)

# IVC

IVC= Plethoric
(Full, Stiff)

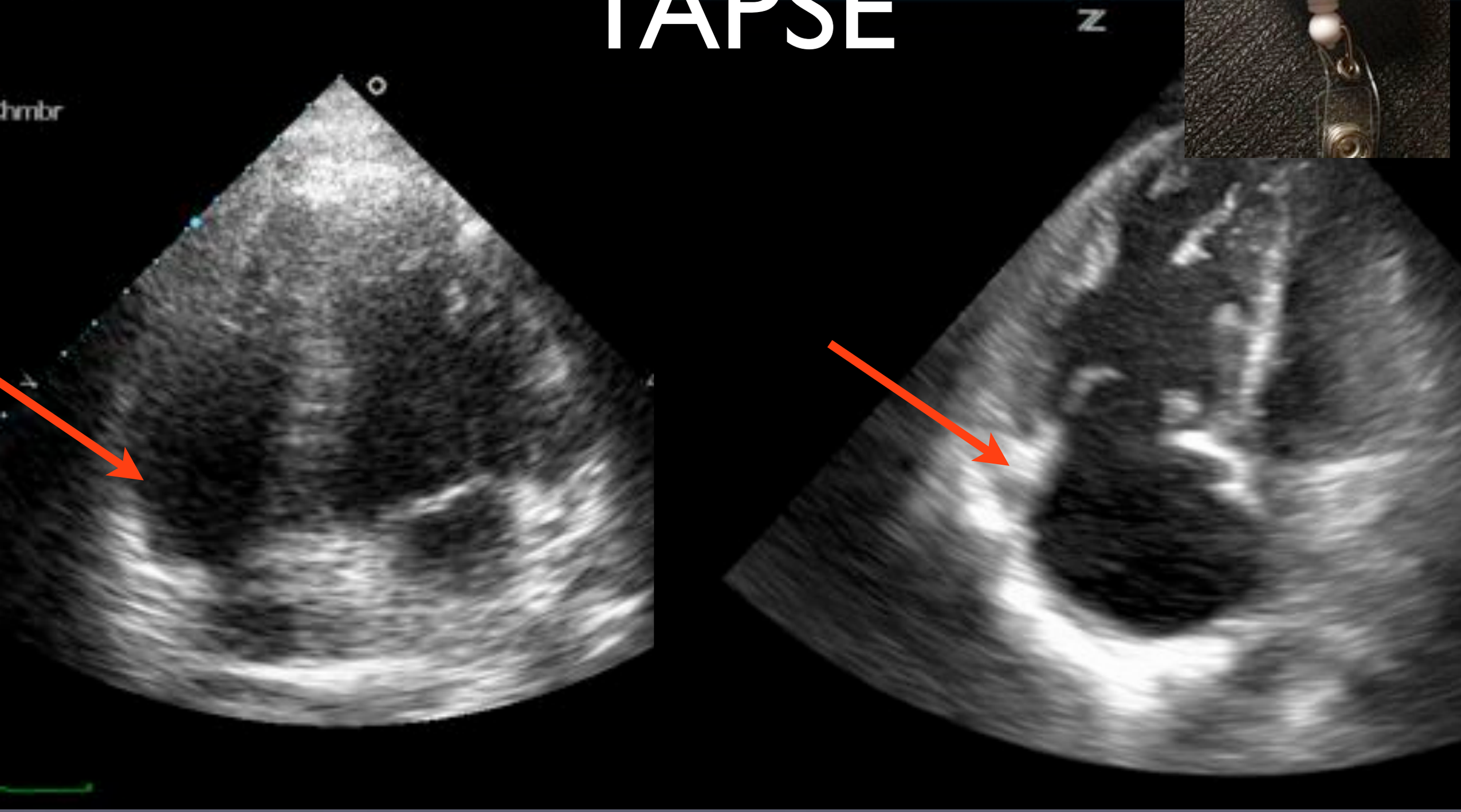
Geek Nugget !

# RV Dysfunction: TAPSE


- **T**ricuspid **A**nnular **P**lane **S**ystolic **E**xcursion
- Apical 4 Chamber
- M-mode Tricuspid Annulus at RV free wall
- Normal excursion > 16mm

Geek Nugget !

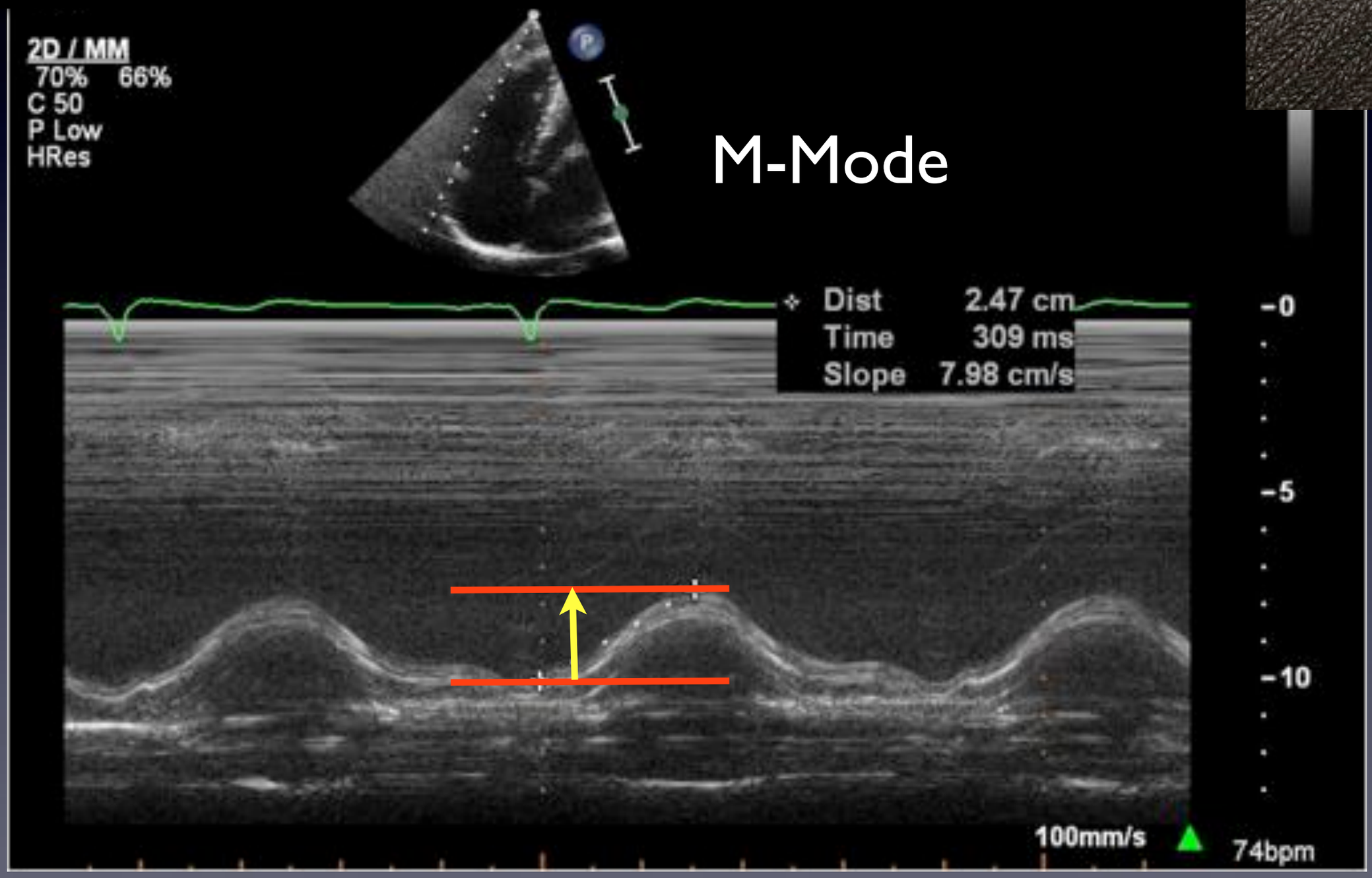
# RV Dysfunction: TAPSE

Geek Nugget !

# RV Dysfunction: TAPSE


## M-Mode



Kaiser Oakland ED4

01/30/17
8:44:58 PM

Card/Echo
P4-1c H3.5
DR60/M4/P1
G72/E2/100%
MI1.3 TIs0.3
20.0 cm
18 Hz
ZSI 0
Measure

0.0 12.5

G62
Med
M3
DR55
P0

Distance 1.41cm

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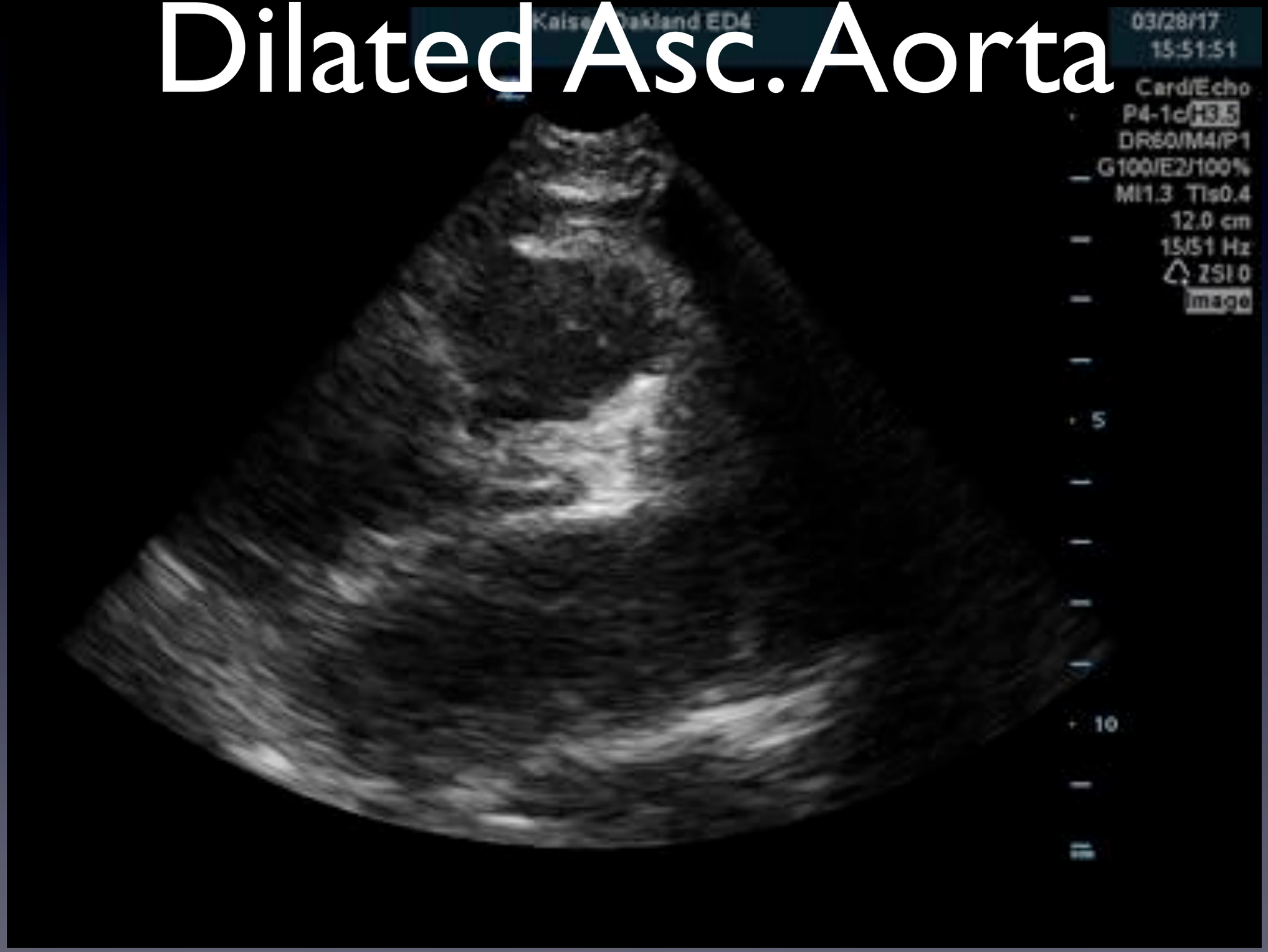
# Advanced Finding Dilated Asc. Aorta

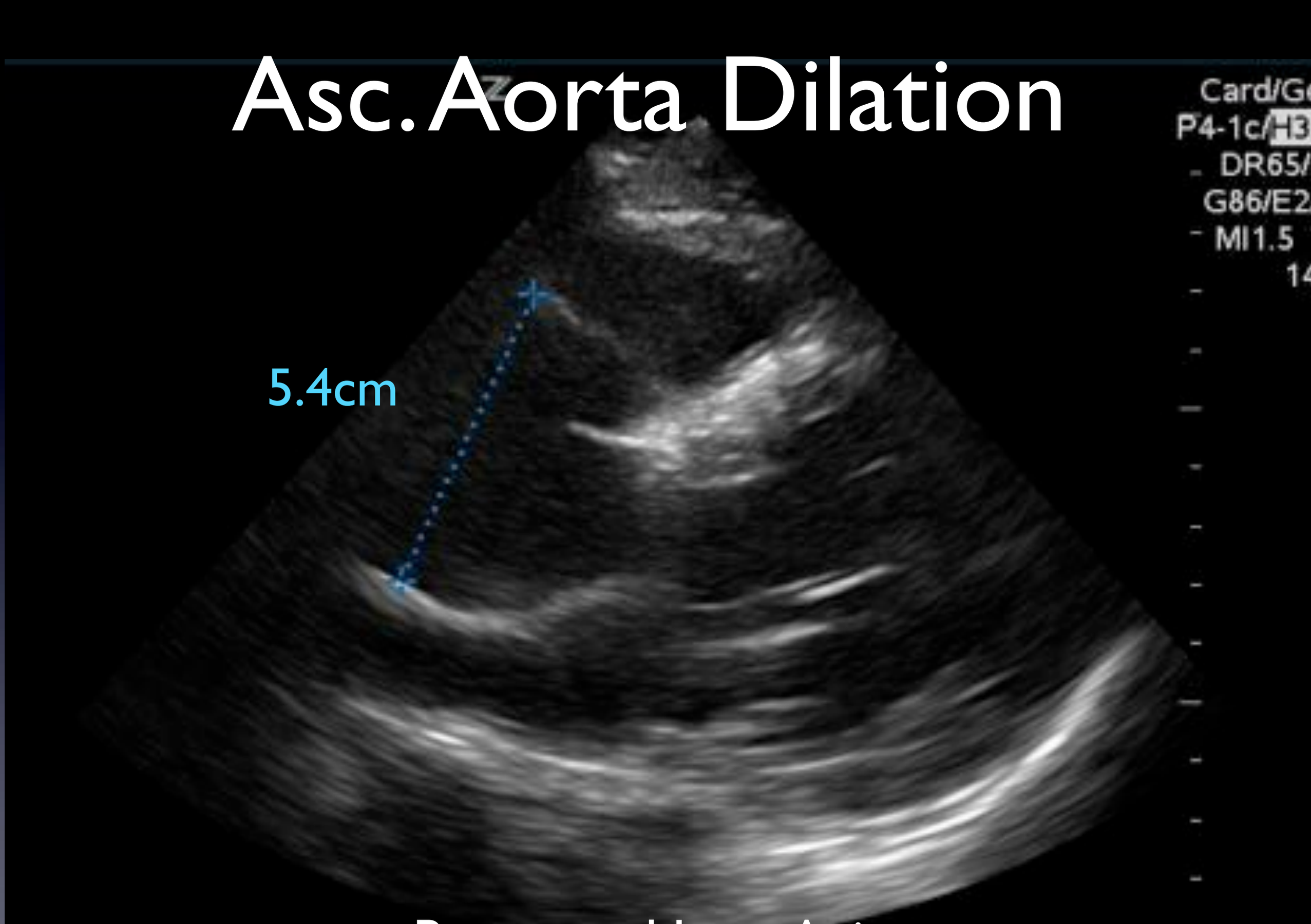
- 90% of Ascending aortic dissection have dilated ascending aorta (>4cm)
- Parasternal long axis, angle cephalad and1-2 rib spaces superior
- Measure several cm along ascending Ao
- Neither sensitive nor specific, but may push you along towards the diagnosis

# Advanced Finding
# Dilated Asc. Aorta



# Asc. Aorta Dilation

# Asc. Aorta Dilation




Parasternal Long Axis

# Bedside Echo Summary

- The Basics:
  - **Significant Pericardial Effusion:** Yes/No
    Circumferential hypoechoic fluid displaced by heart motion
  - **LV Function:** Gestalt estimate
    Note LV contraction and Anterior Mitral Valve leaflet approaching the septum
  - (**IVC:** Gestalt CVP estimation)

# Bedside Echo Summary

- Advanced Findings:
  - **Impending Tamponade:**
    Large effusion, plethoric IVC, +/- RA/RV collapse
  - **RV Strain:**
    RV appears enlarged and poorly contracting
  - **Asc. Aorta Dilation:**
    Parasternal long access, normal <4cm

# References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