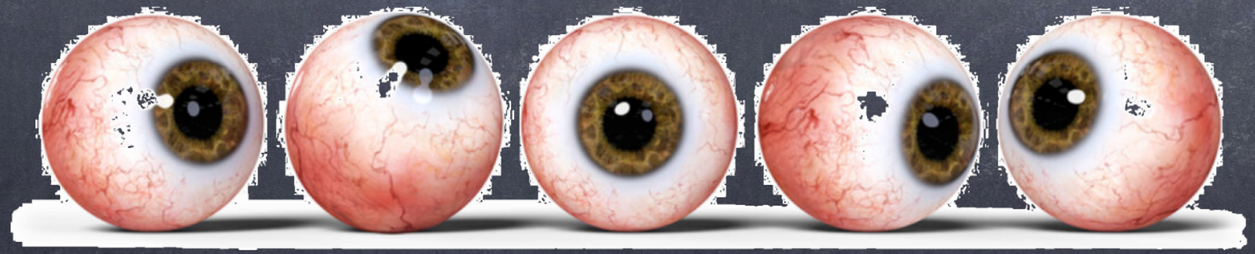
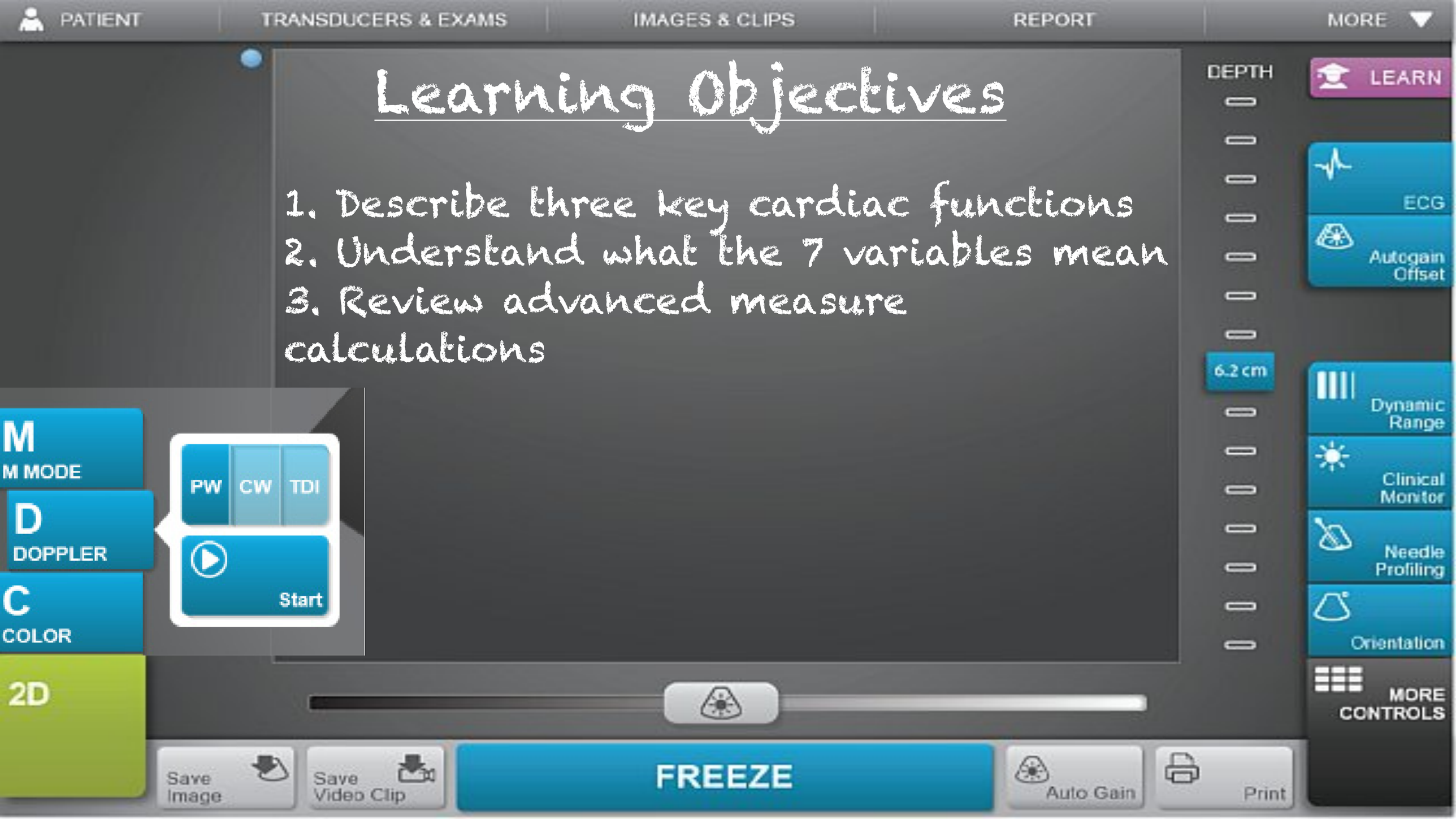
Simple 7: Beyond the eyeball

❤️ size & fxn



Enyo Ablordeppey MD MPH


PATIENT
TRANSDUCERS & EXAMS
IMAGES & CLIPS
REPORT
MORE
Learning Objectives
1. Describe three key cardiac functions
2. Understand what the 7 variables mean
3. Review advanced measure calculations
DEPTH
6.2 cm
LEARN
ECG
Autogain Offset
Dynamic Range
Clinical Monitor
Needle Profiling
Orientation
MORE CONTROLS
M
M MODE
D
DOPPLER
C
COLOR
2D
PW
CW
TDI
Start
Save Image
Save Video Clip
FREEZE
Auto Gain
Print

Pericardial effusion

Valve problem

Recognize echo pattern

Hyperdynamic LV

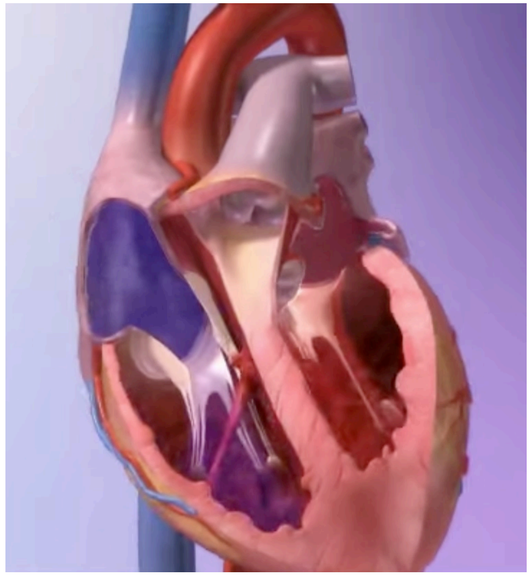
Hypokinetic LV

Dilated hypokinetic RV

$$BP = CO \times SVR$$

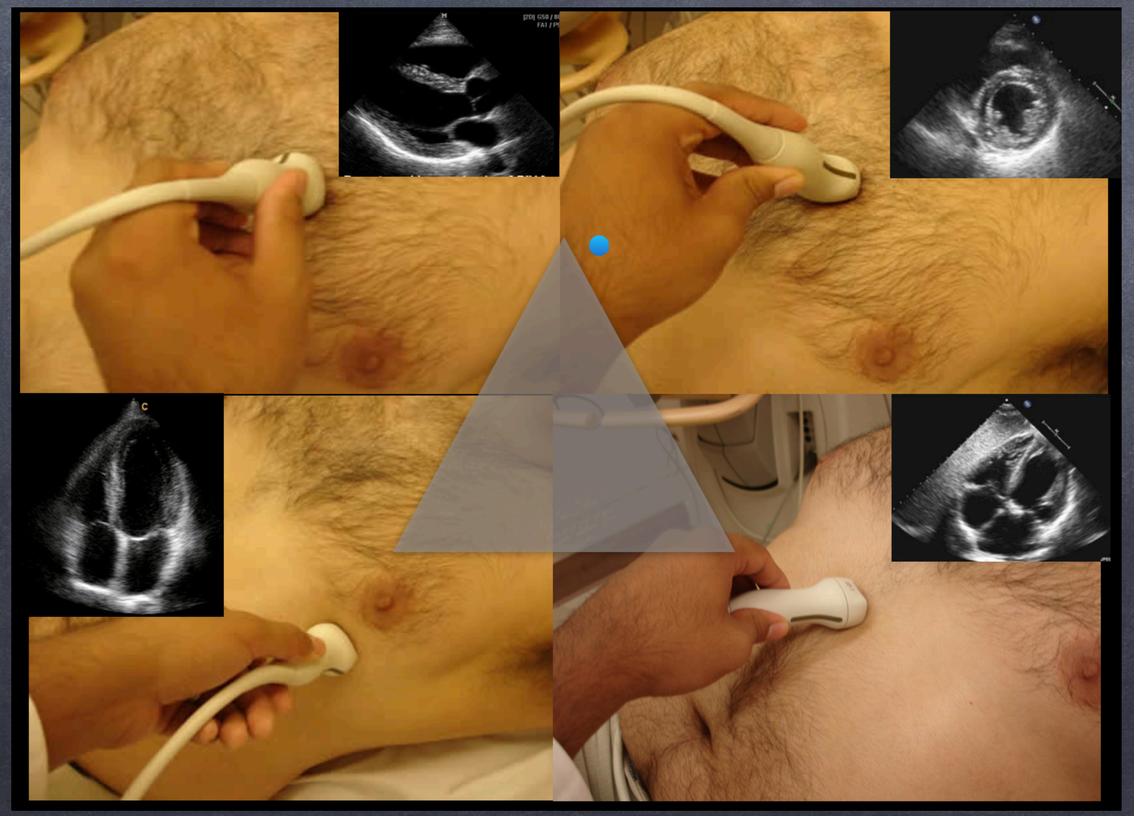
SV

HR



7 measures disclosure

- does not answer dynamic questions with one measure
- does not assess for thrombus, RWMA, valvulopathy
- Must have adequate images to obtain accurate values



Quick approach to advanced Cardiac Assessment

3 ❤️ fns:

LV systolic

RV systolic

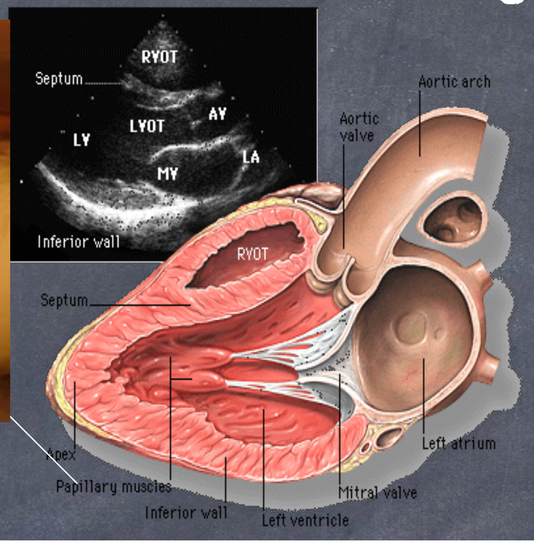
LV relaxation/diastolic

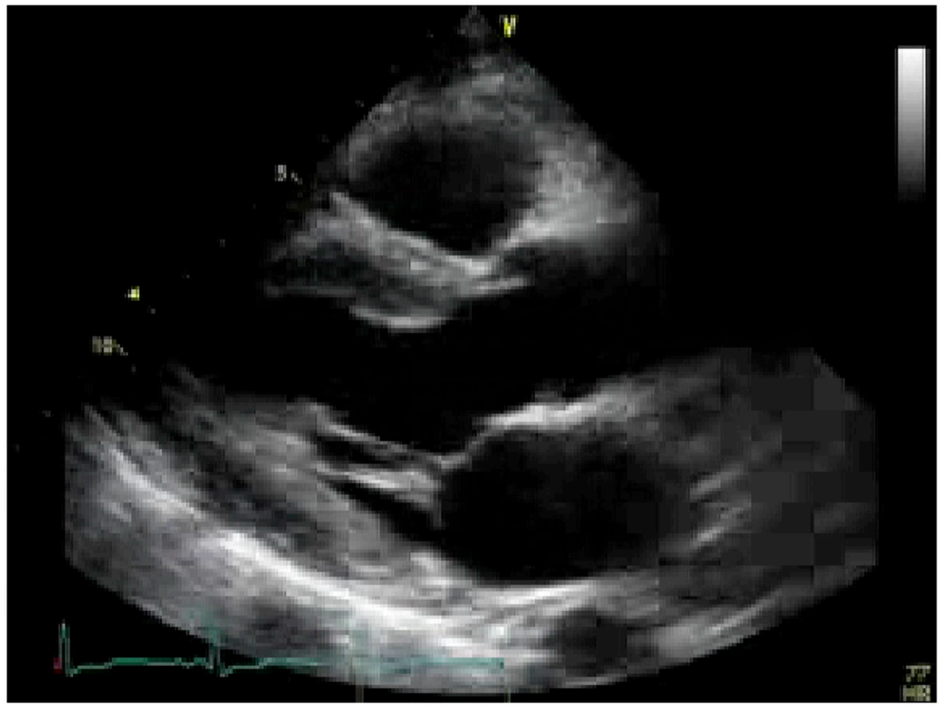
- 7 measurements
  - EPSS
  - FS
  - LVOT VTI
  - RVID
  - TAPSE
  - RV S'
  - E/e'

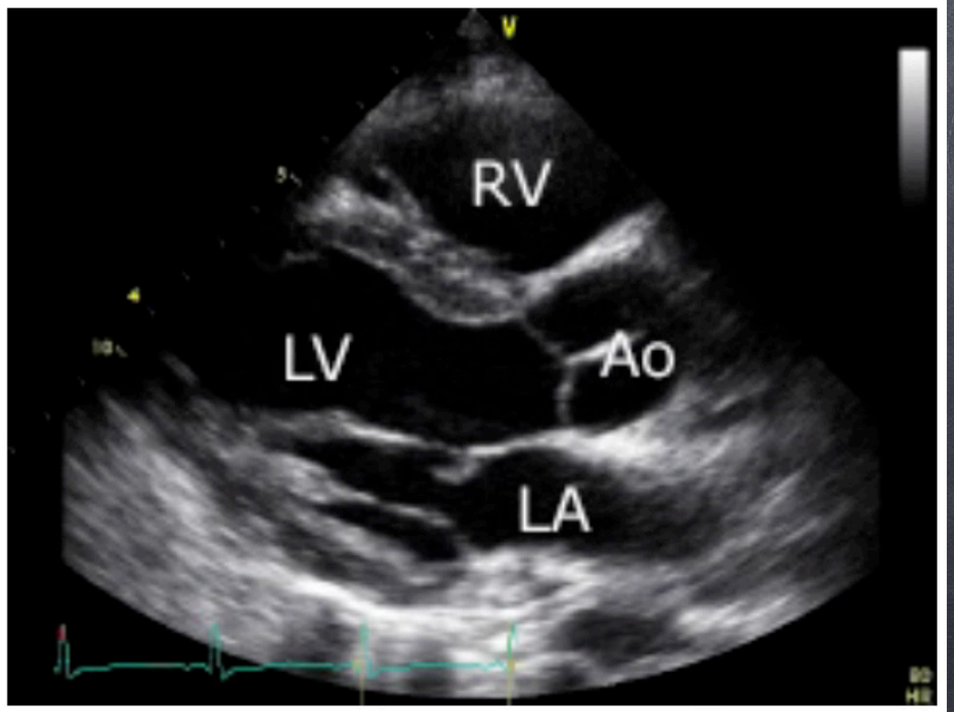
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

Parasternal Long

- Must show
  - RVOT
  - aortic valve
  - mitral valve
  - horizontal septum
  - No Apex
  - Descending Aorta

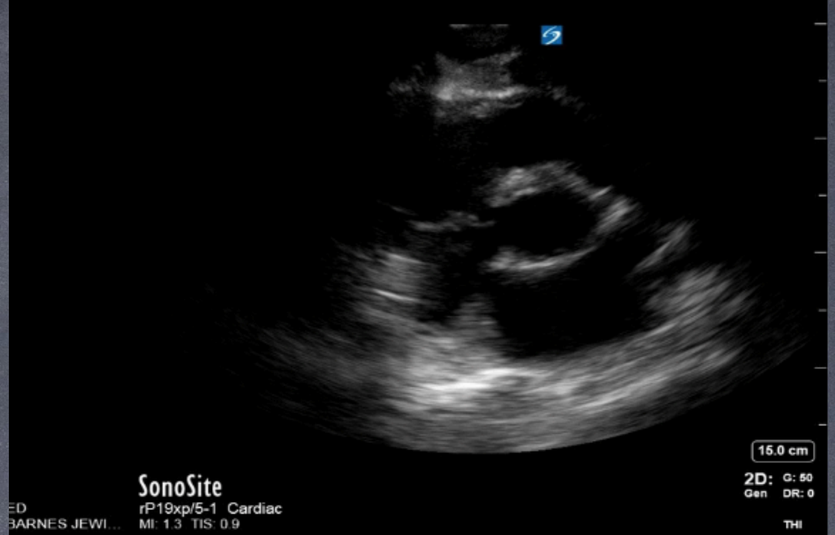


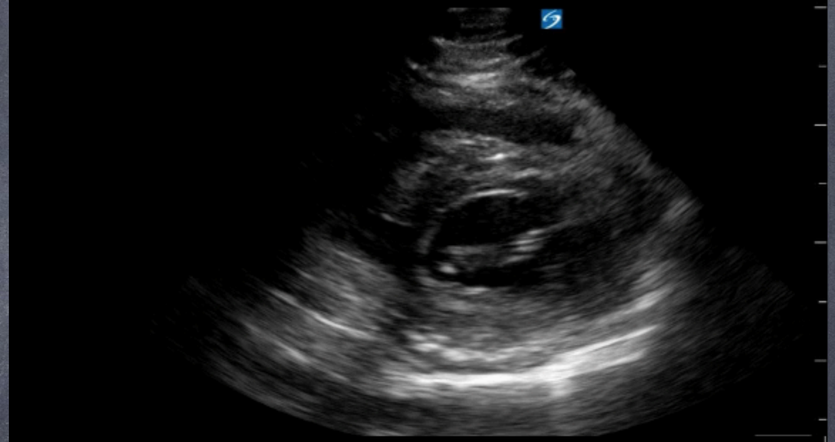


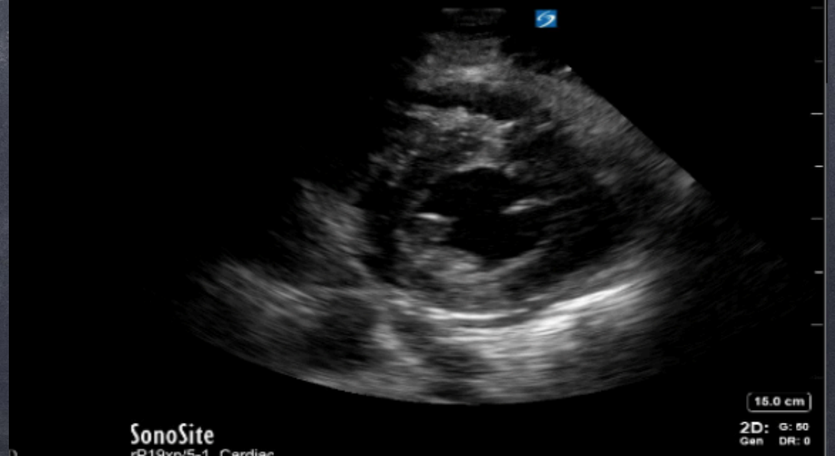


Parasternal Short

- Must Show
- Axial cut of LV and RV
- Aortic valve on tilting/fanning up towards right shoulder
- LV apex on tilting/fanning down towards Left hip

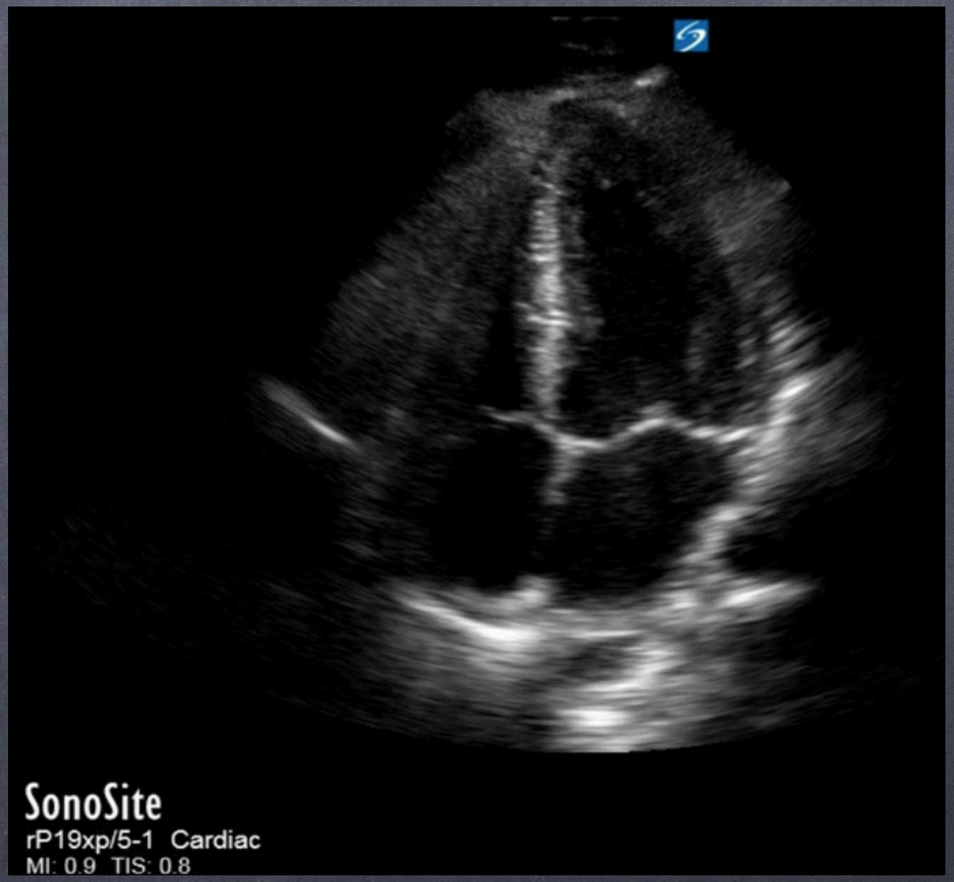




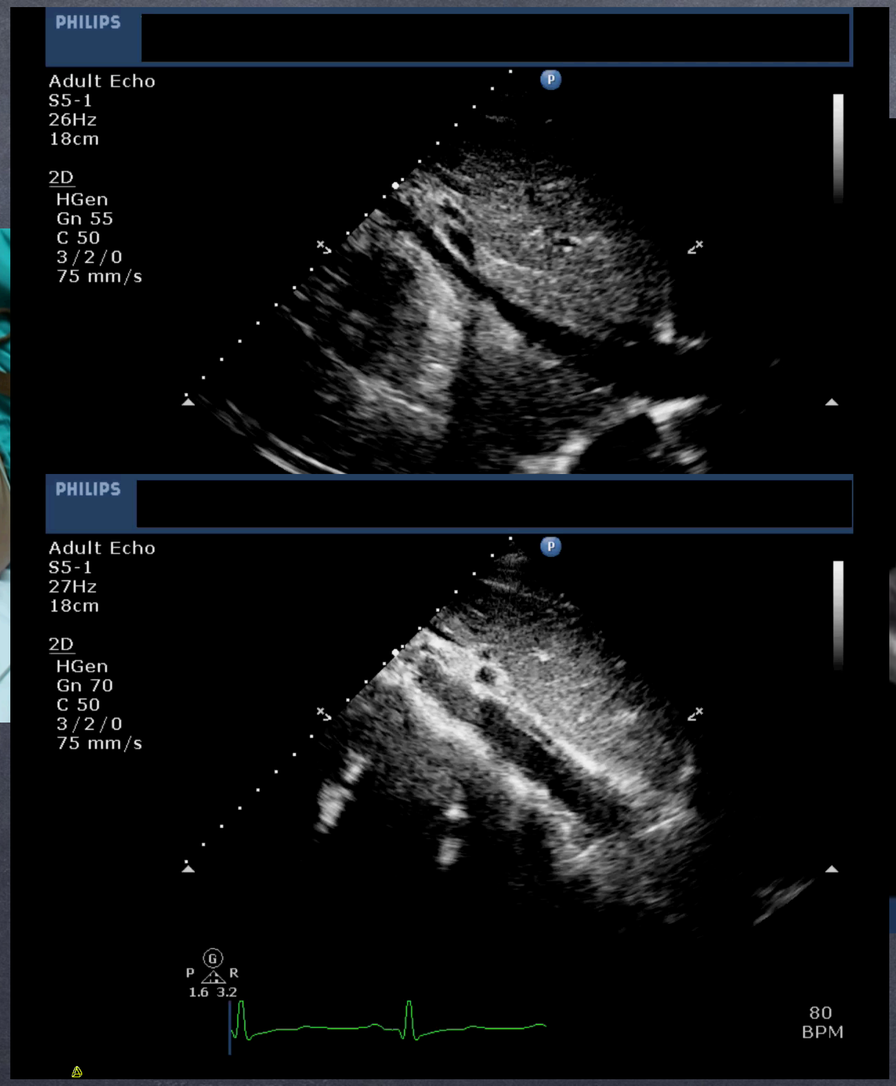


Apical 4 chamber

- Must show
  - all 4 chambers
  - septum vertical
  - TILT probe up to see aortic outflow track



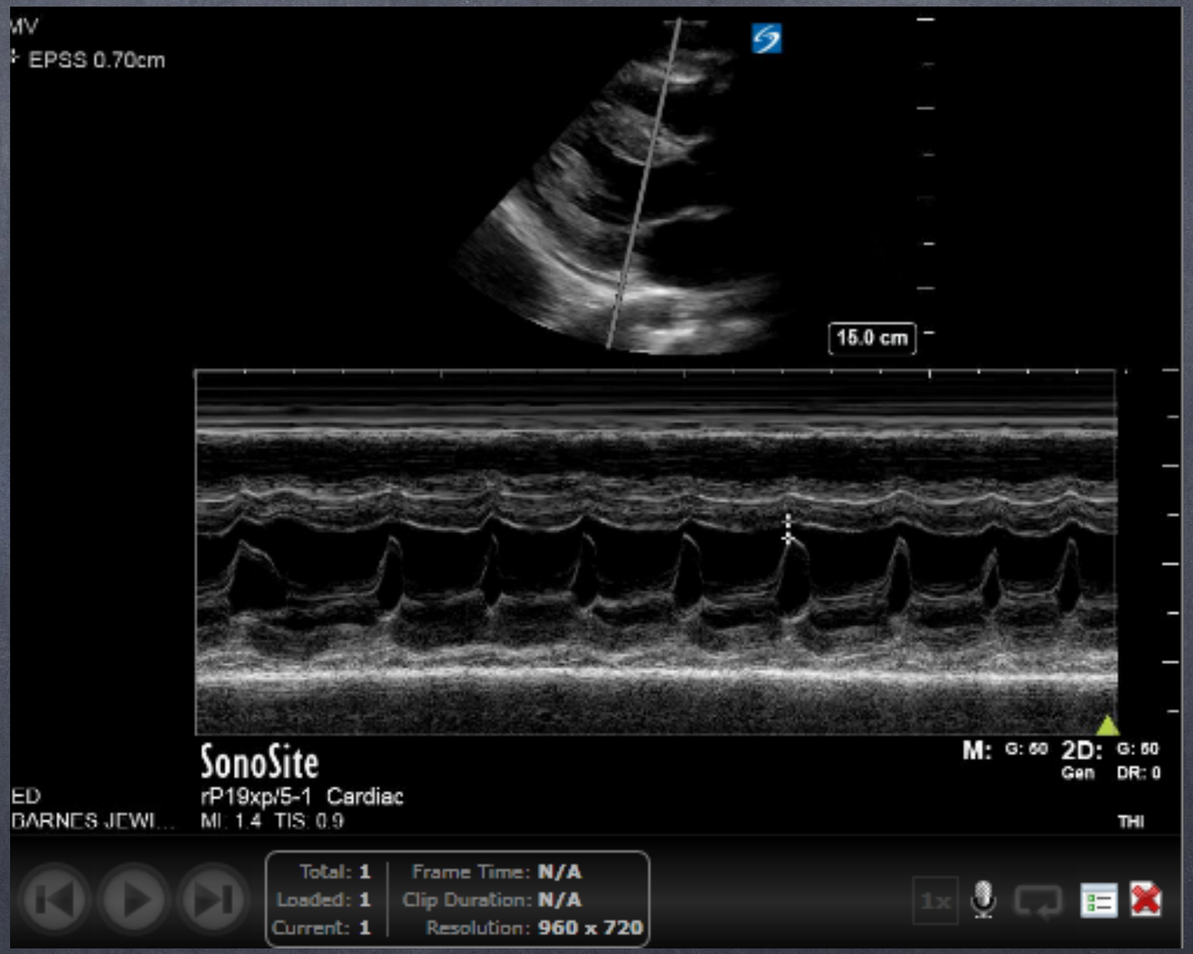
Subcostal short



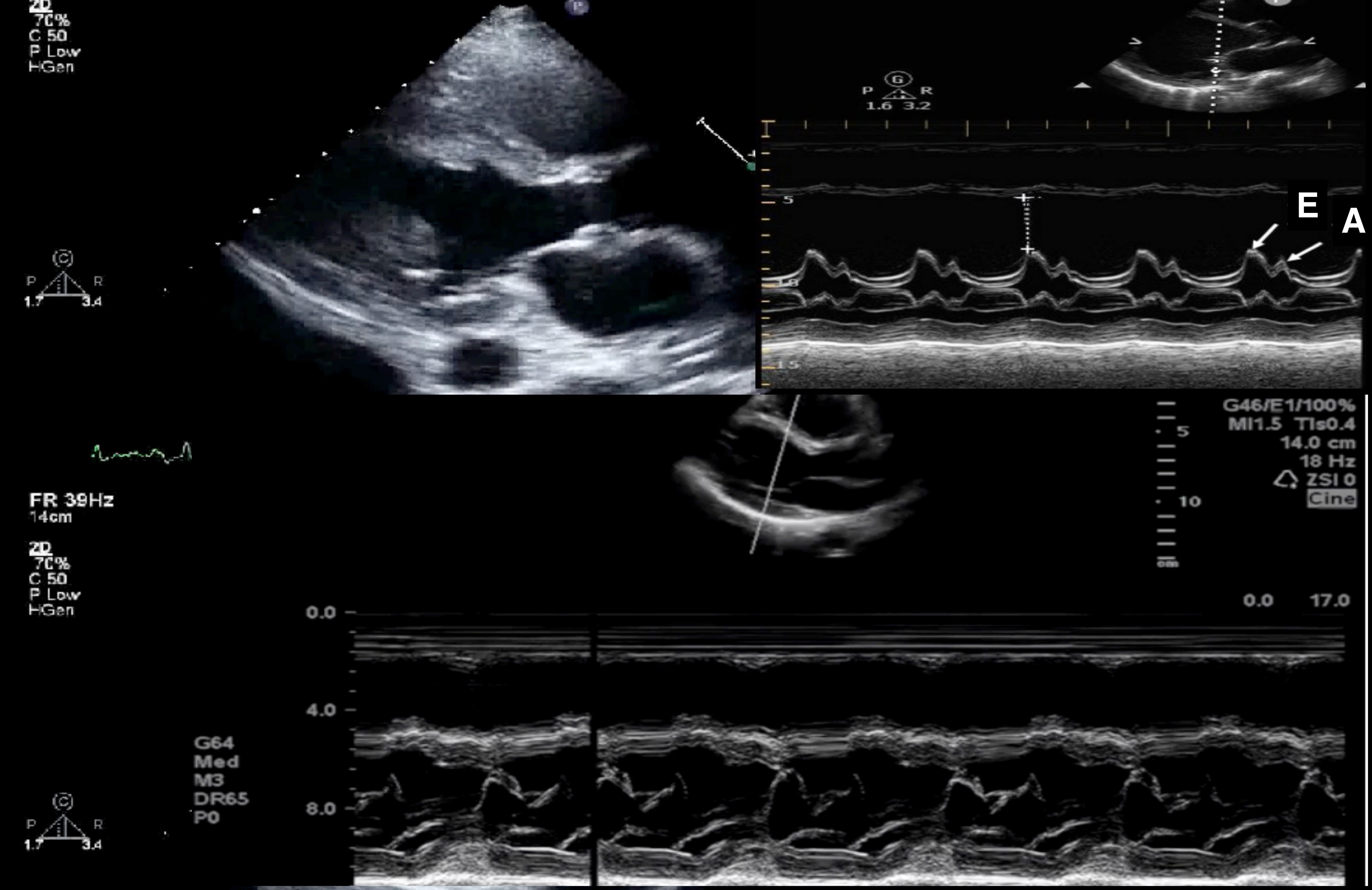
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

E-point septal separation

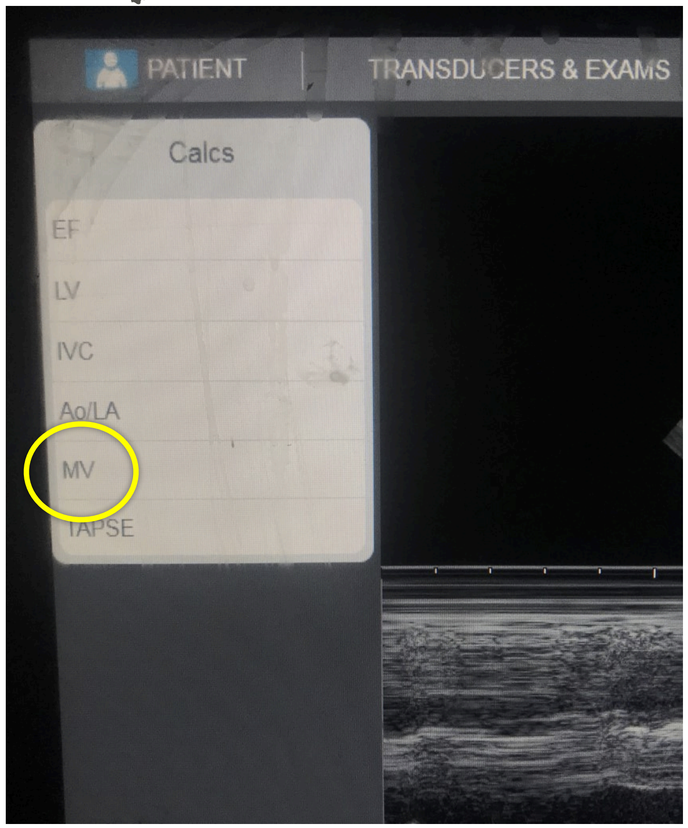
- EPSS
- Measure of LV dilation
- Parasternal Long View or PSAX
- M-mode distal aspect of anterior mitral leaflet
- Normal Values <1cm
- EPPS >2cm ~ LV EF < 30%

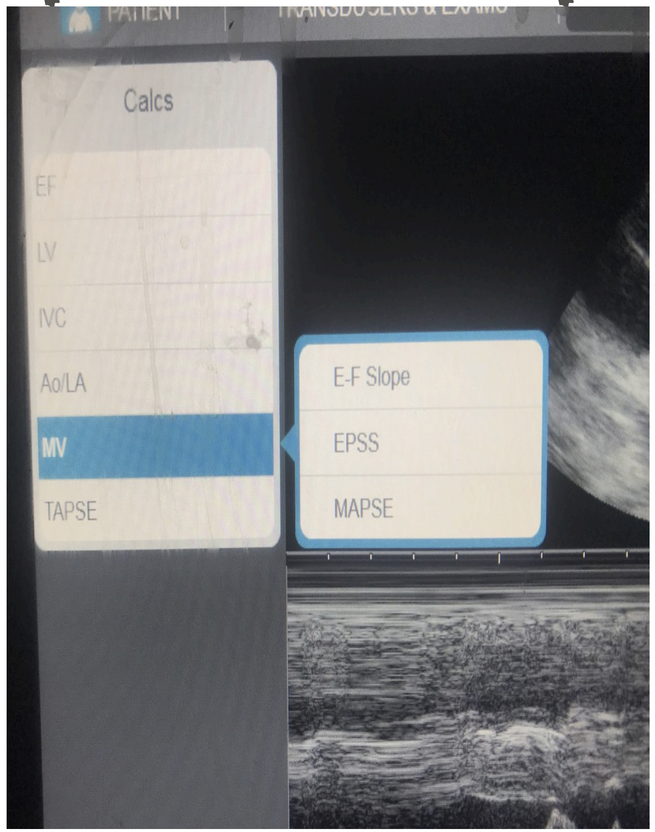


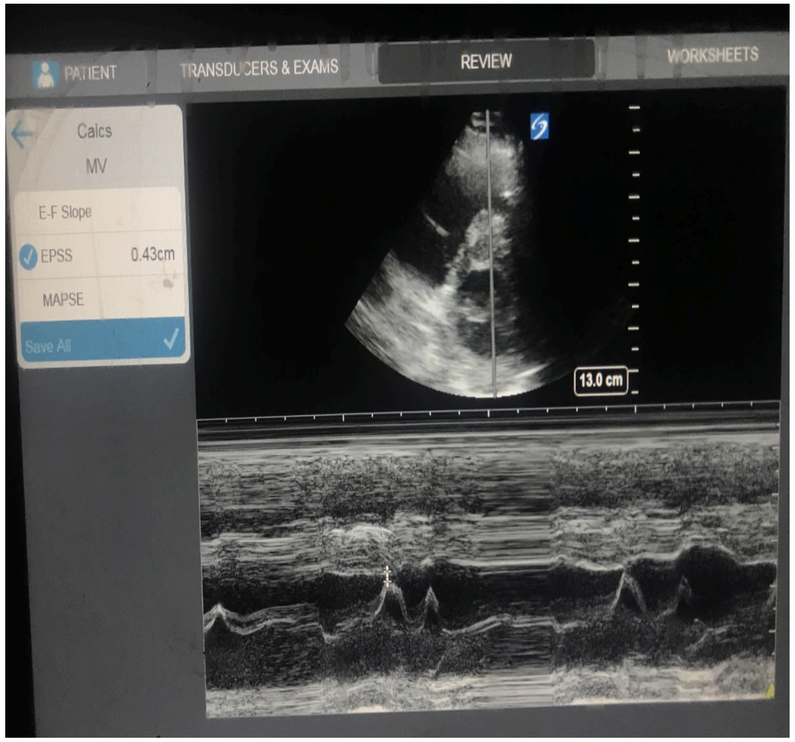
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO


2D
70%
C 50
P Low
HGen
P R
1.7 3.4
P R
1.6 3.2
5
E
A
FR 39Hz
14cm
2D
70%
C 50
P Low
HGen
G46/E1/100%
MI1.5 TIs0.4
14.0 cm
18 Hz
ZSI 0
Cine
5
10
0.0 17.0
0.0
4.0
8.0
G64
Med
M3
DR65
P0
P R
1.7 3.4

E-point septal separation

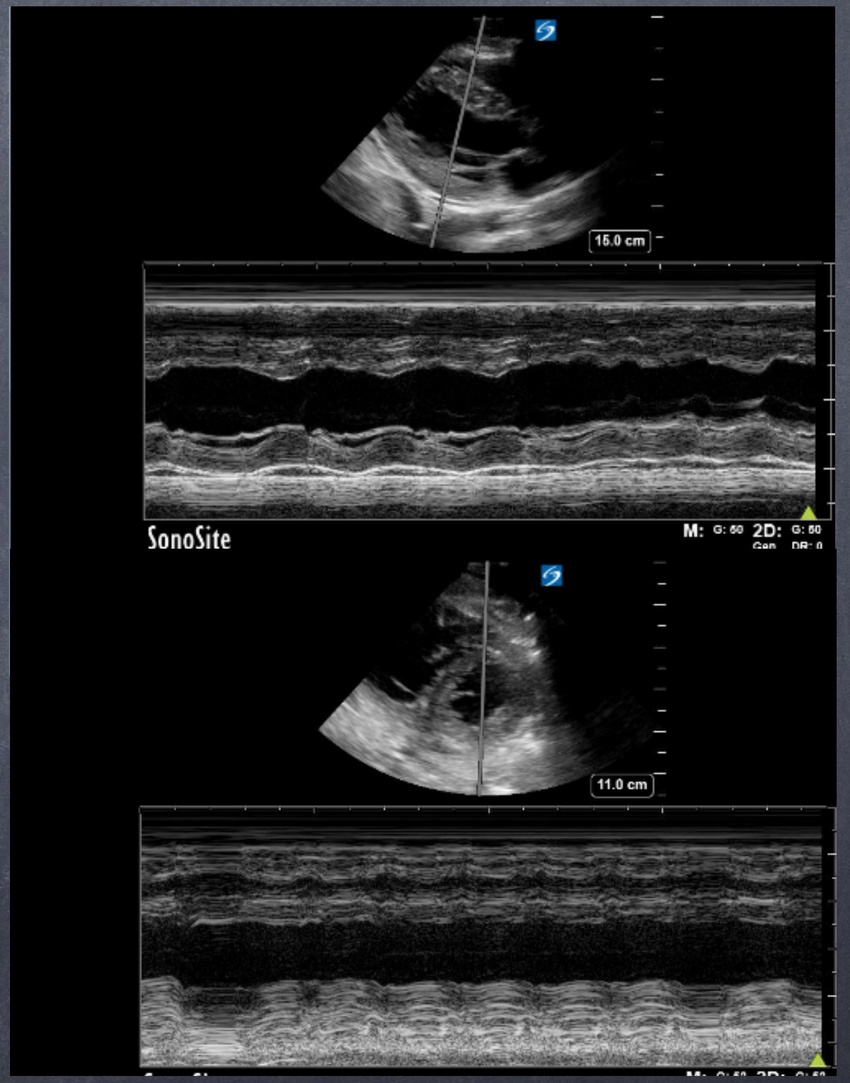






Fractional shortening

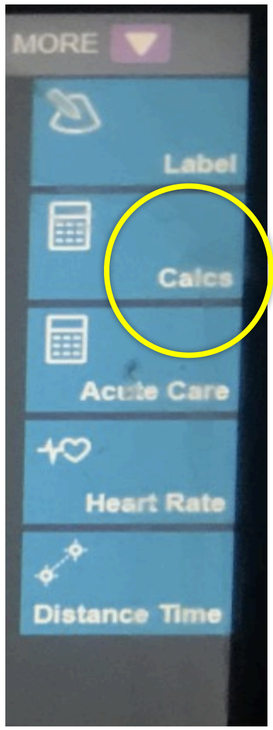
- FS
- Measure of systolic function, estimates EF
- Parasternal Long or Parasternal Short views
- M-mode- mid ventricle, just distal to anterior mitral leaflet in PSL
- or
- M-mode vertically through the mid-papillary view on PSS
- Normal Value >30% change
- limited use if RWMA present

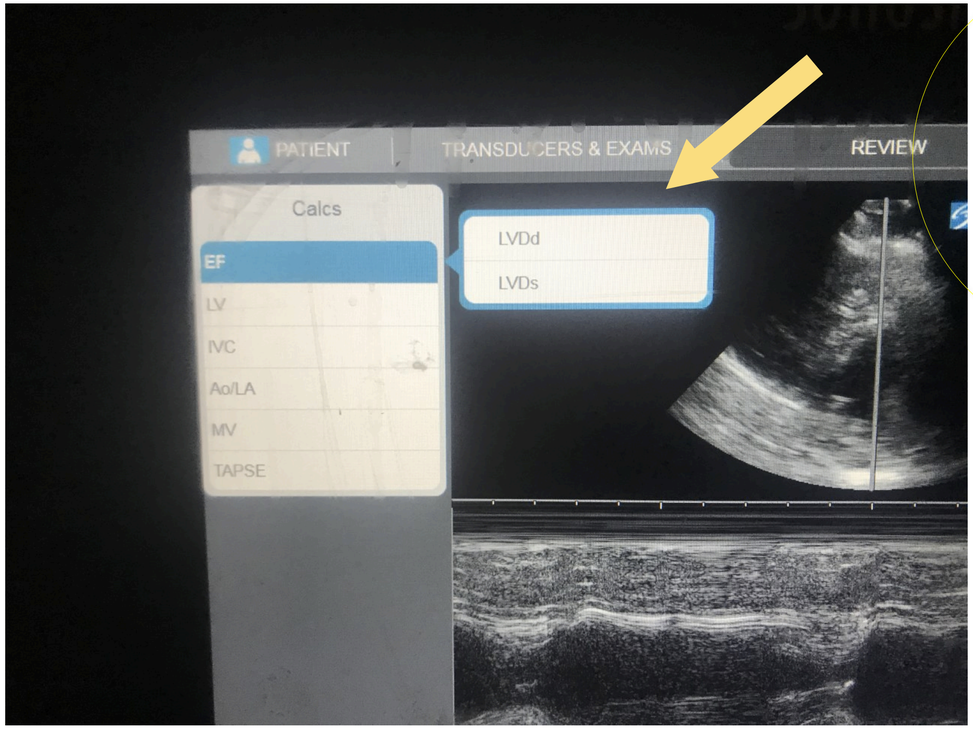


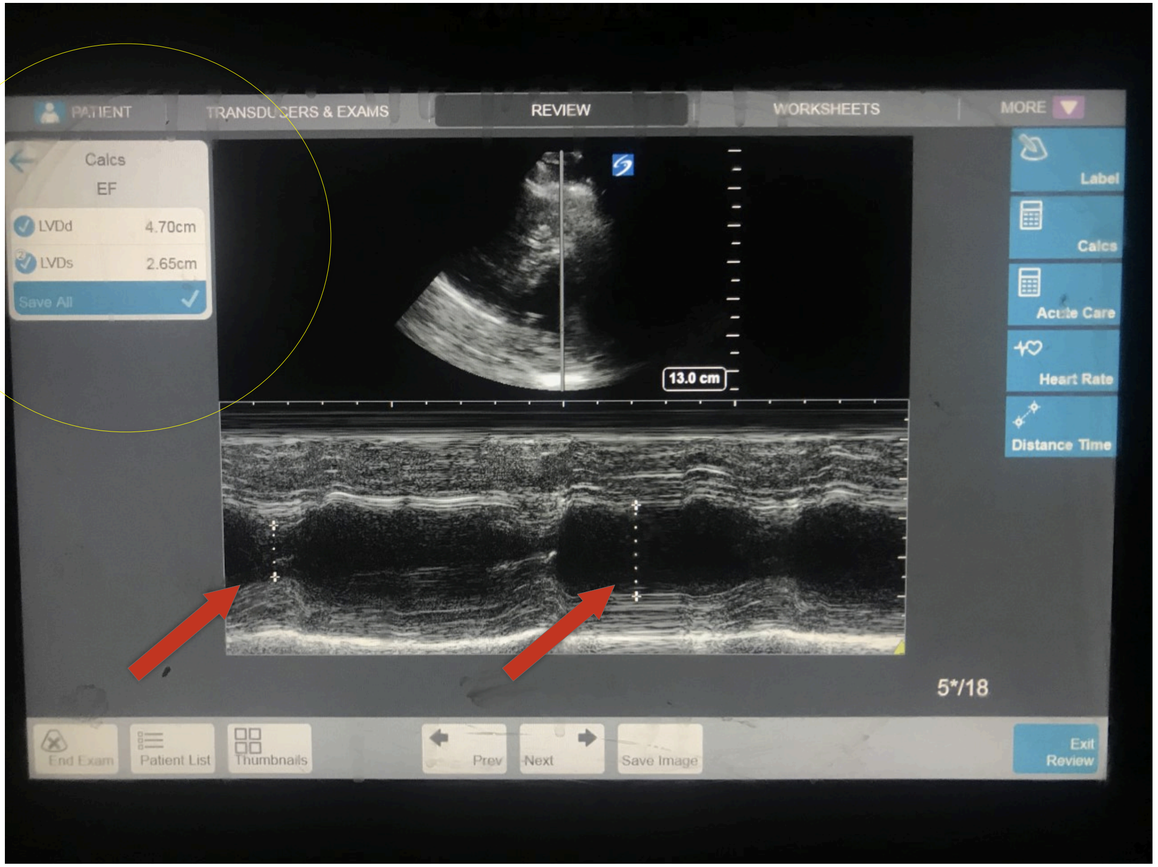
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

Fractional shortening

- Calc-> EF-> LVDd and LVDs
  - LVDsystolic and LVDdiastoliic

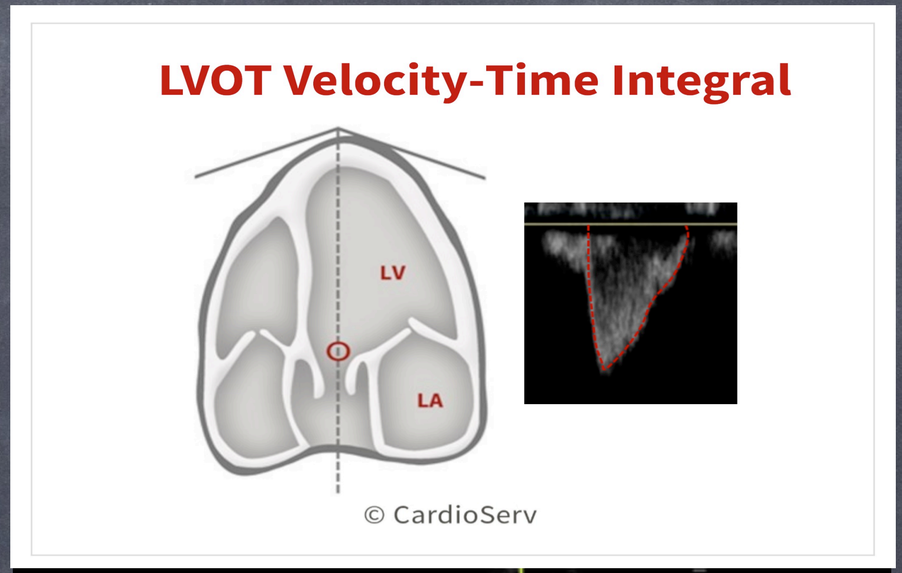


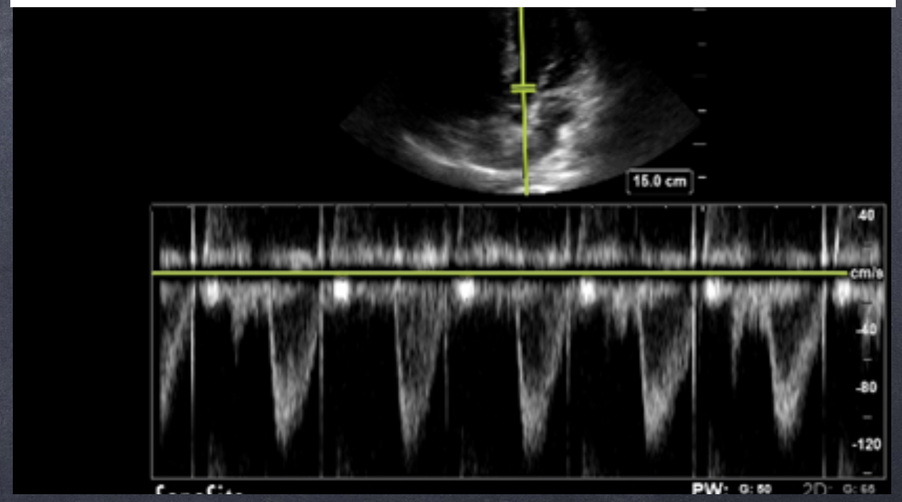




Left ventricular Outflow Track Velocity Time Interval

- LVOT VTI
- Used to calculate LVOT stroke volume & CO
- Apical 5 Chamber
- Pulse Wave Doppler above aortic valve
- aim for parallel between LV septum and doppler
- trace velocity
- Normal Values 18-22cm

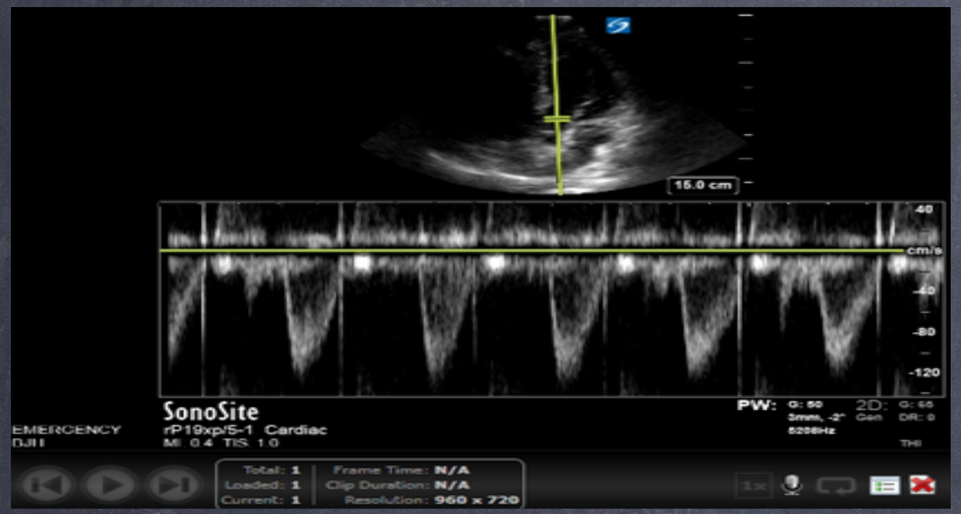


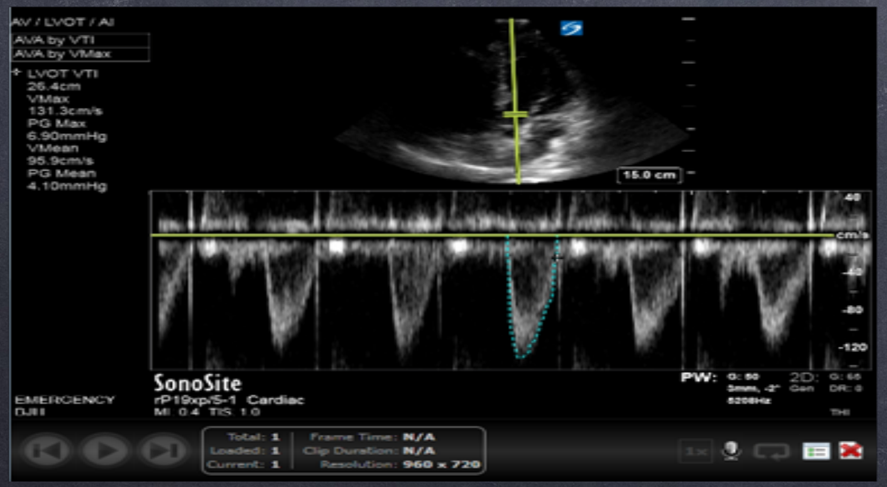


EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

LVOT VTI

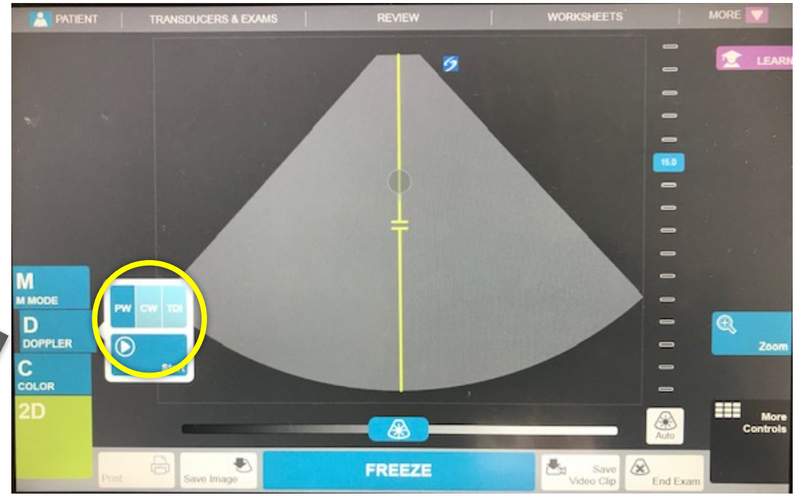
GOOD tracing! bright on outside, anechoic in middle

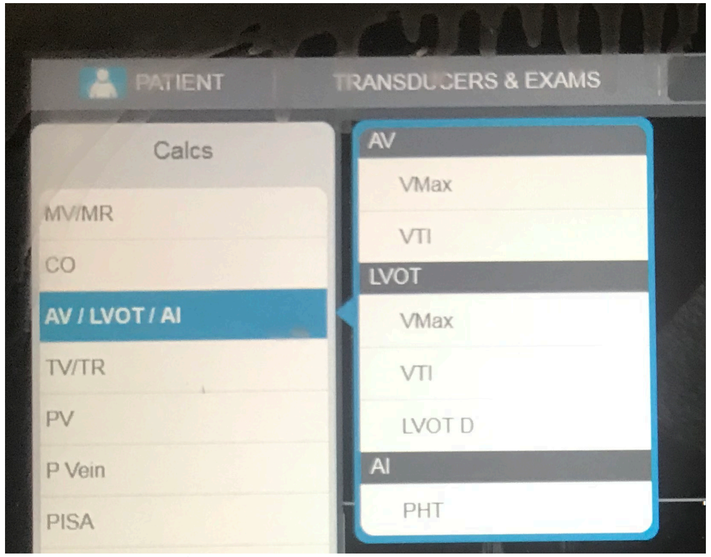




BAD tracing! thus less accurate, don't measure that

LVOT VTI

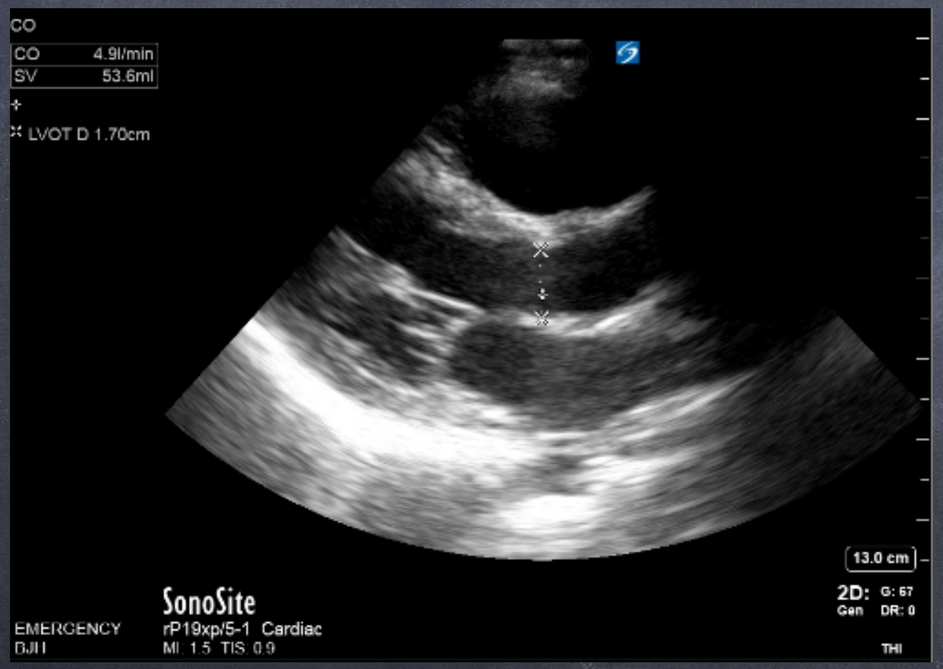


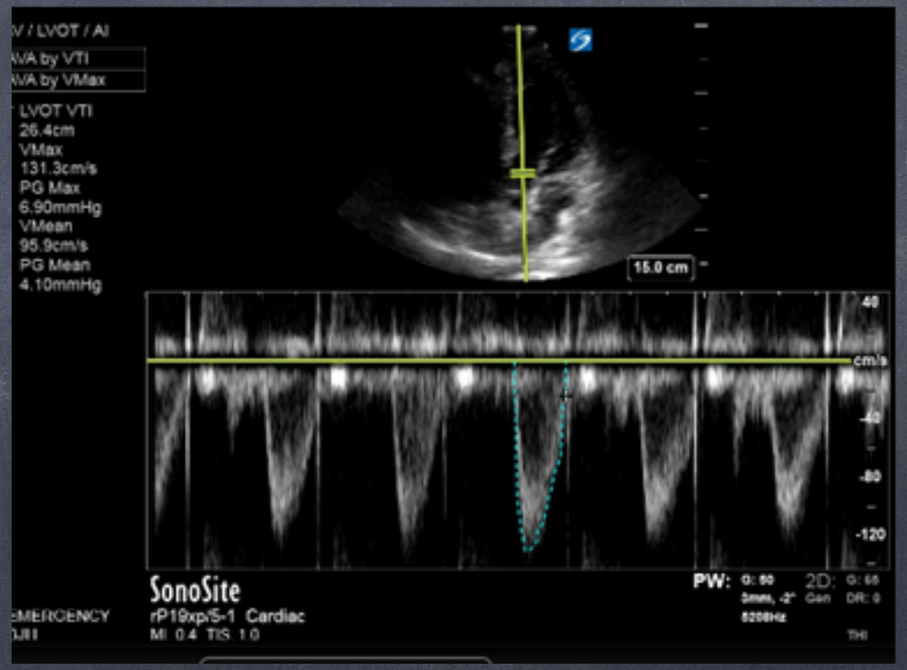


- Choose Calc Function
  - AV/LVOT/AI->VTI
- Measure perimeter of tracing
- Normal Values 18-22
- velocities should look similar unless in afib (then average 3-5 beats)

LVOT VTI-> SV

- LVOT SV = LVOT CSA x LVOT VTI
- CSA = πR2 = 3.14 x (LVOT Dia/2)2



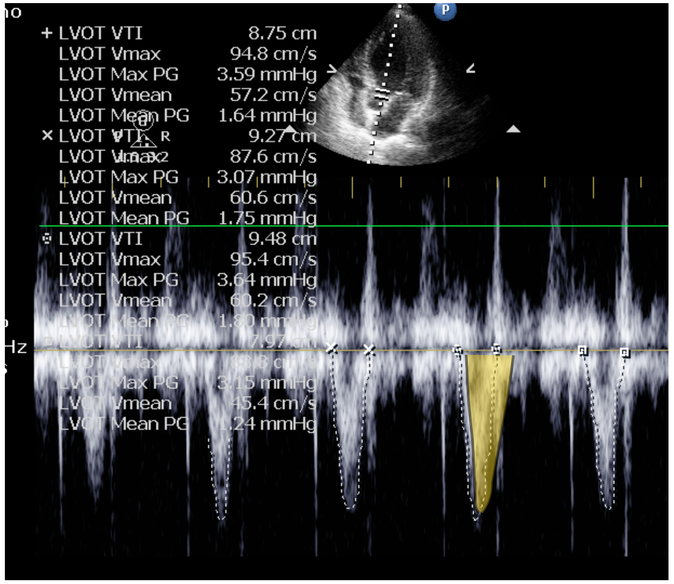


3 x LVOT VTI → LV SV

Stroke volume: LVOT VTI as a surrogate

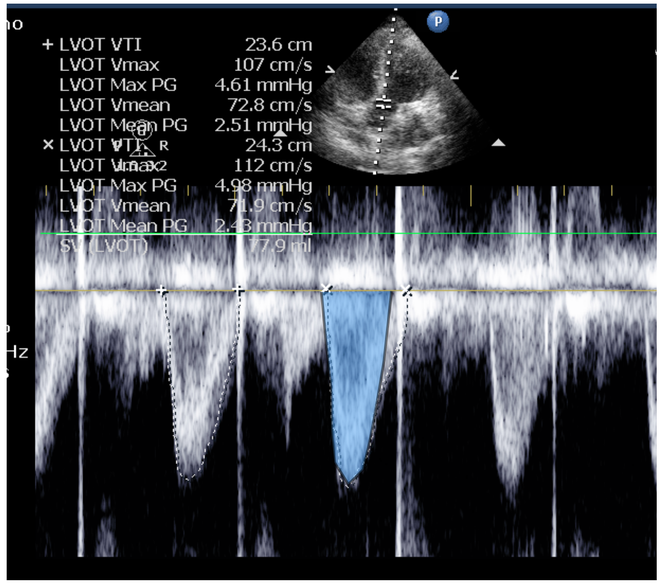
Cardiogenic shock

(also: hypovolemic, obstructive)



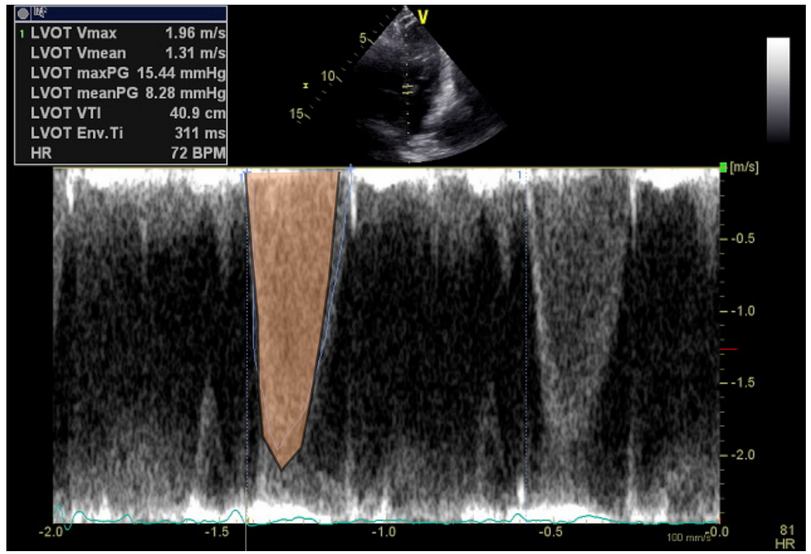
VTI 8.8 cm

Normal



VTI 21.6 cm

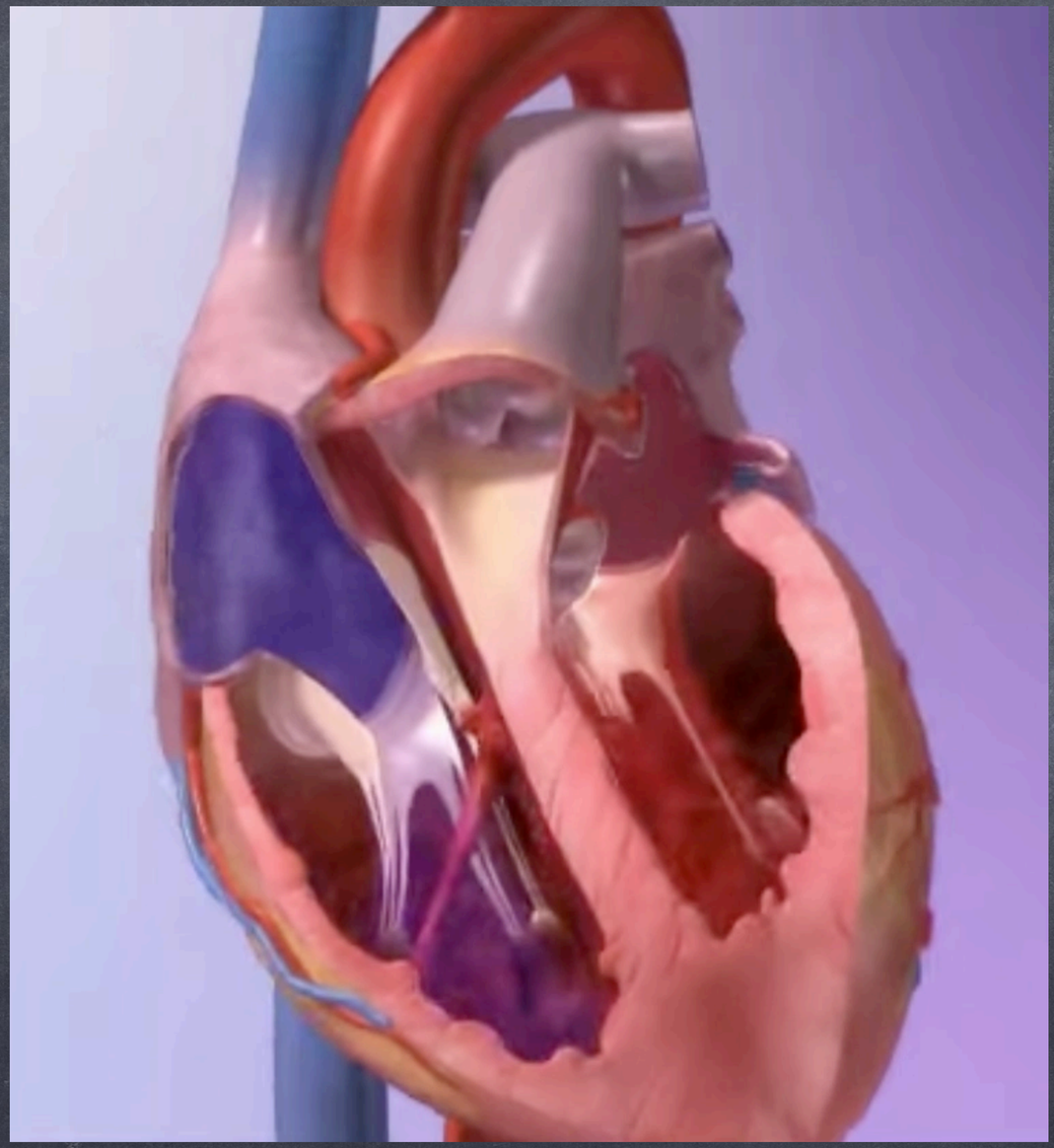
Septic shock



VTI 35.9 cm

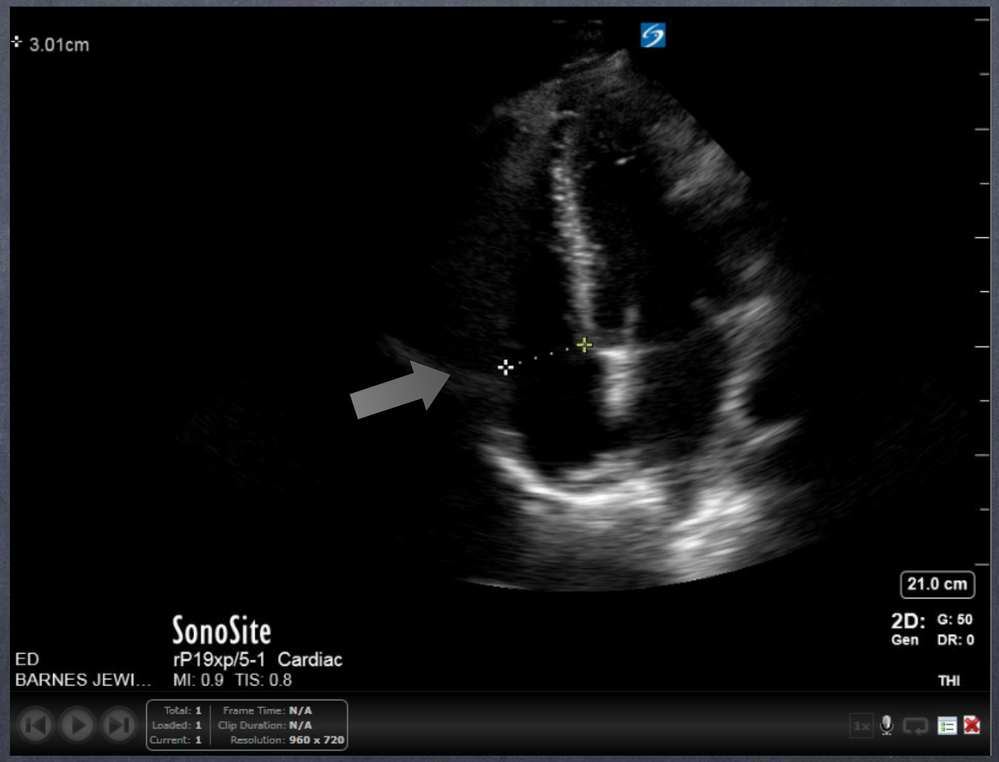
LV systolic Summary

Measurement	Role	Value
EPSS	LV dilated?	<1cm
FS	LV EF?	>30%
LVOT VTI	LV stroke volume?	18-22 cm



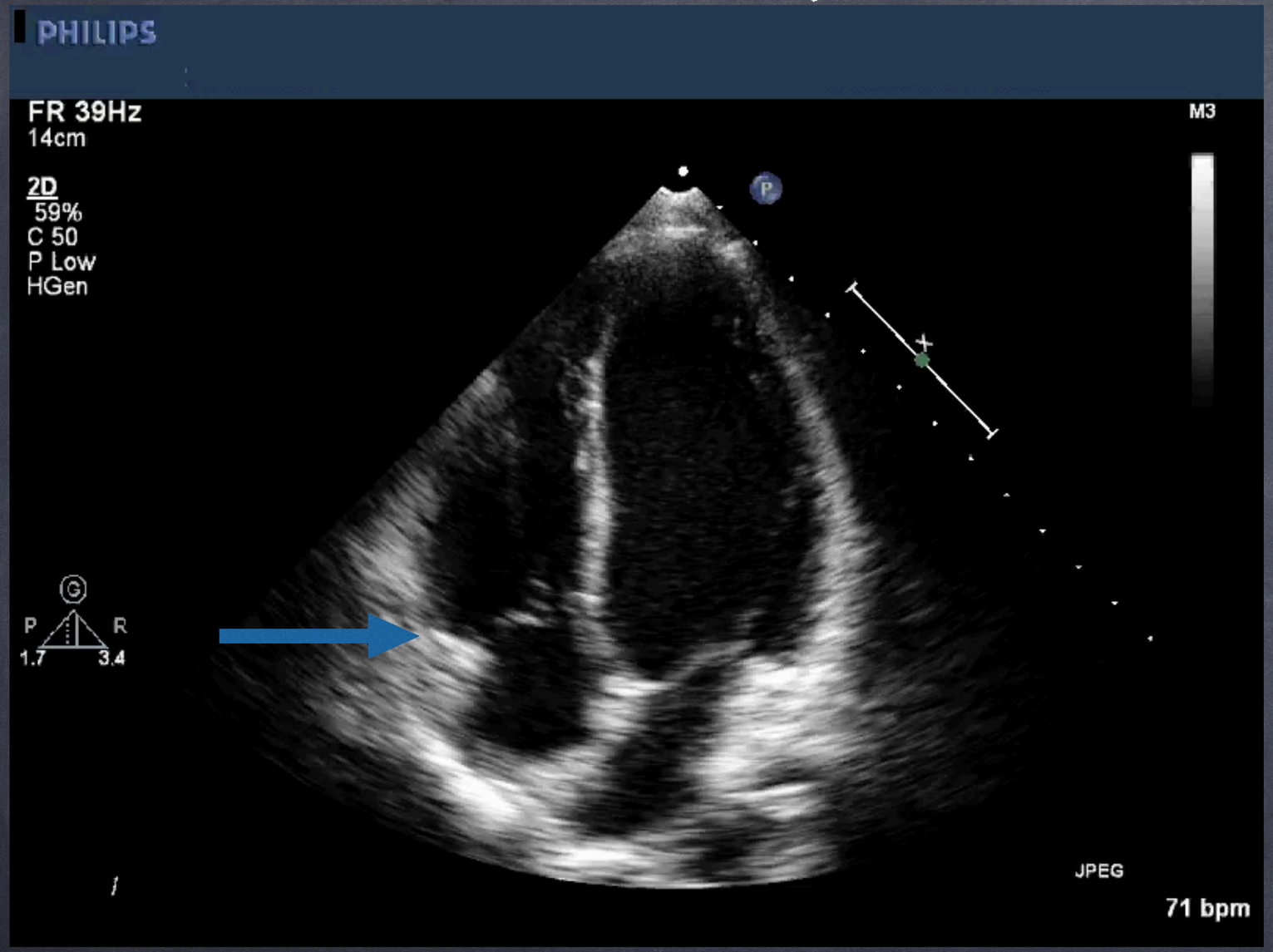
RV internal Diameter

- RVID
- Measure of RV dilation
- Apical 4 Chamber
- Measure near tricuspid annulus
  - At peak diastole (widest)
- Normal Values <4.2 cm



EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

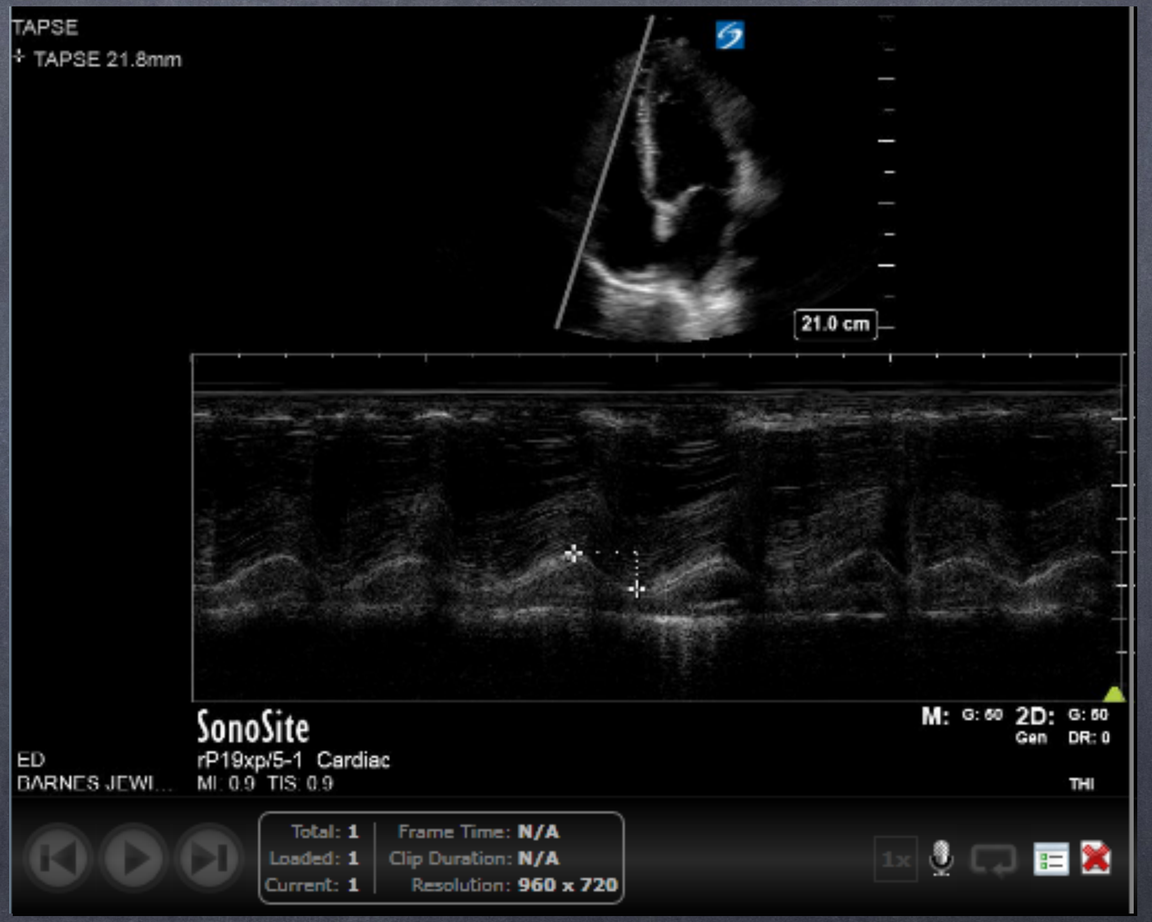
RV vs LV



1. Tricuspid annulus
2. LVOT
3. Descending Ao
4. Moderator Band

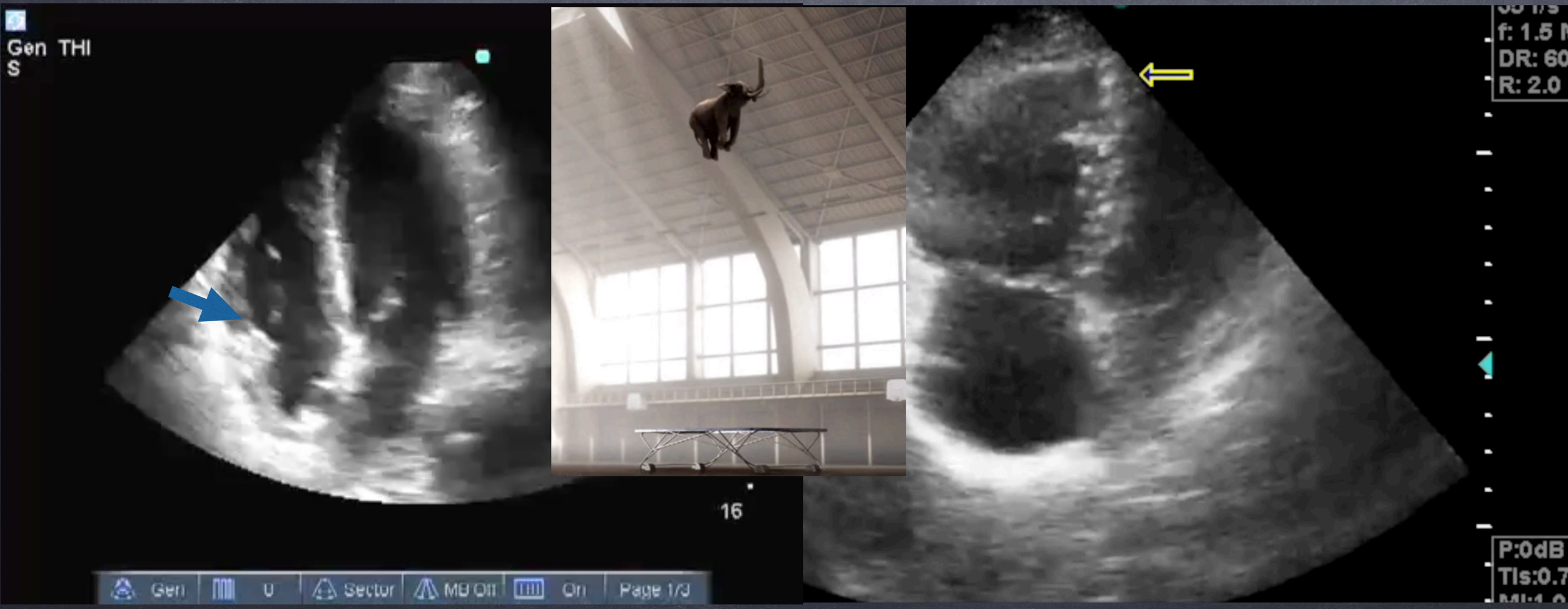
Tricuspid Annular Plane Systolic Excursion

- TAPSE
- measure of RV systolic function
- Apical 4 Chamber
- M-mode at lateral tricuspid annulus
- Normal Values > 1.7 cm
- <1.3 suggest mod-severe dysfunction



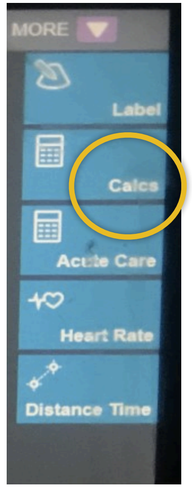
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

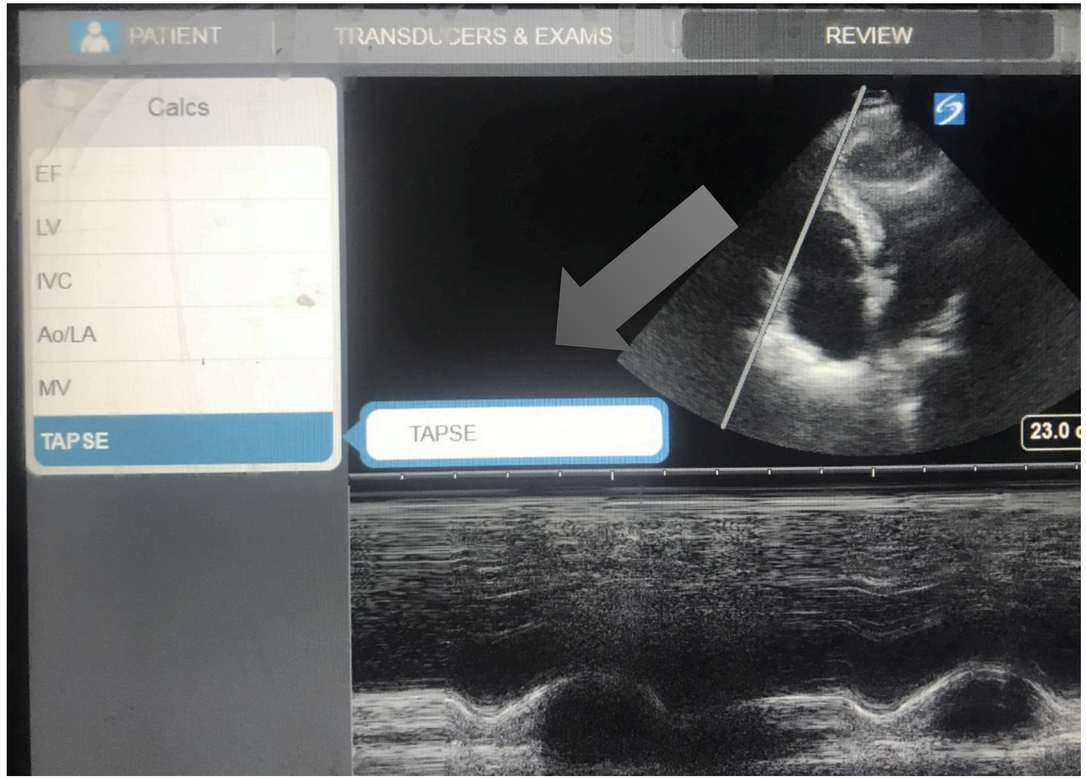
Visual TAPSE

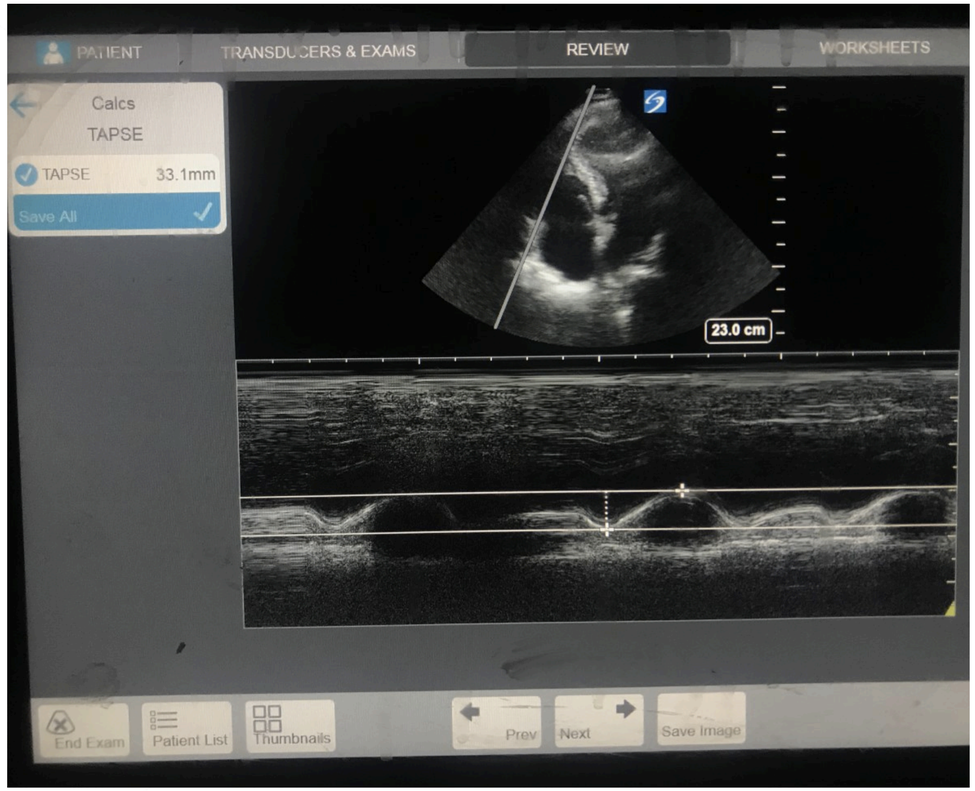


TAPSE

- Choose Calc Function
- Measure highest to lowest vertical distance of tricuspid tracing

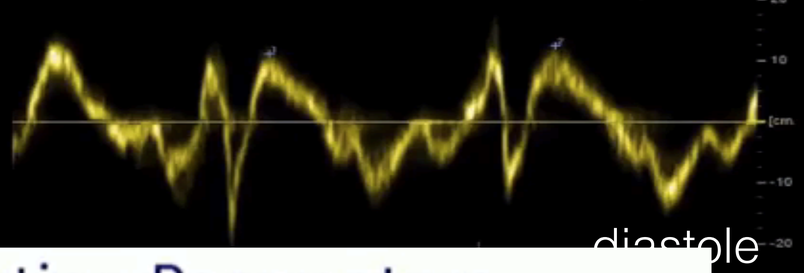




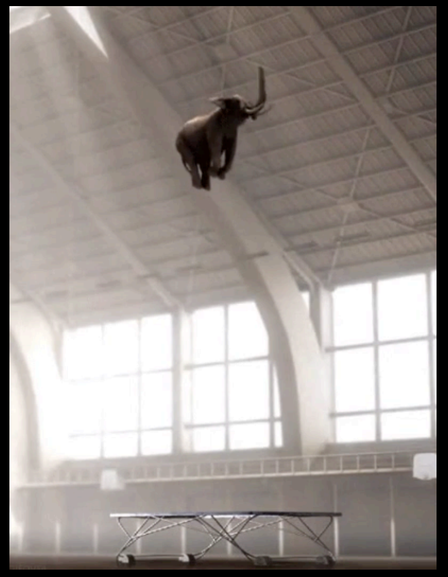


Tissue Doppler

systole

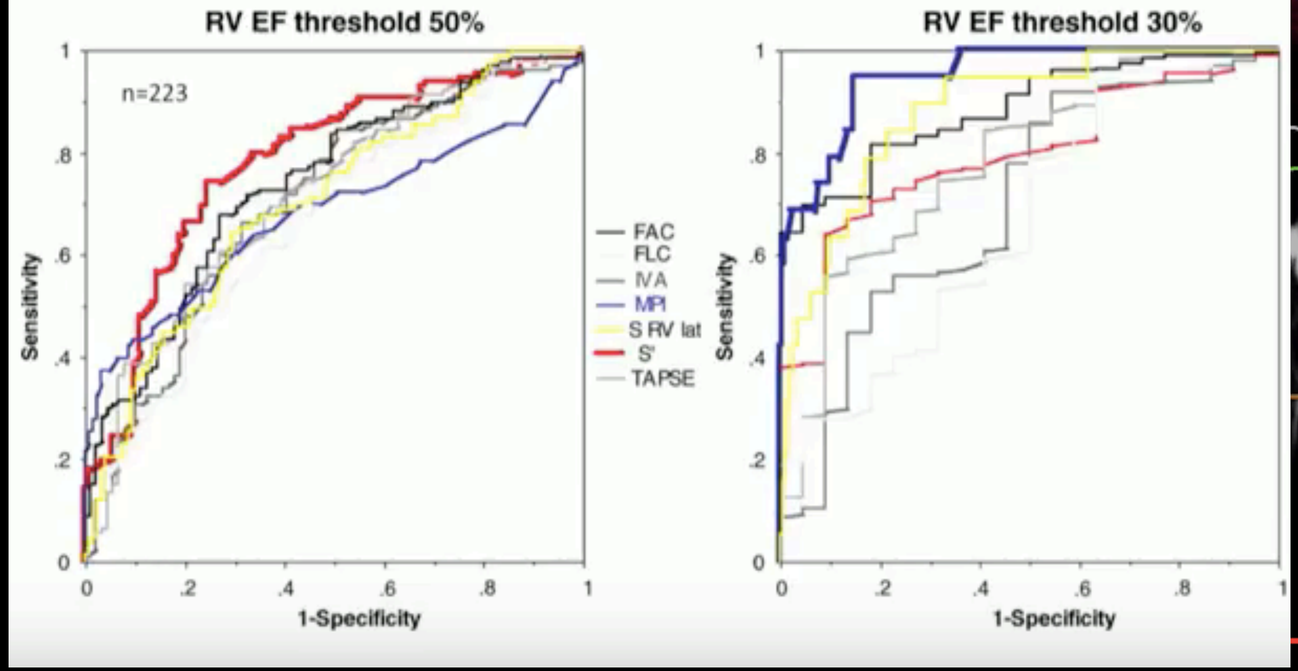


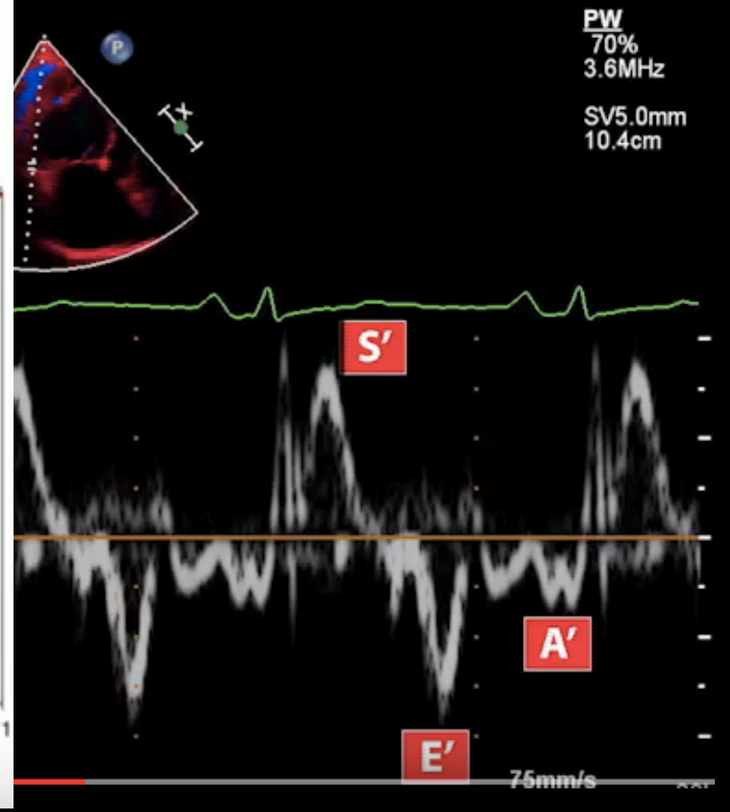
diastole



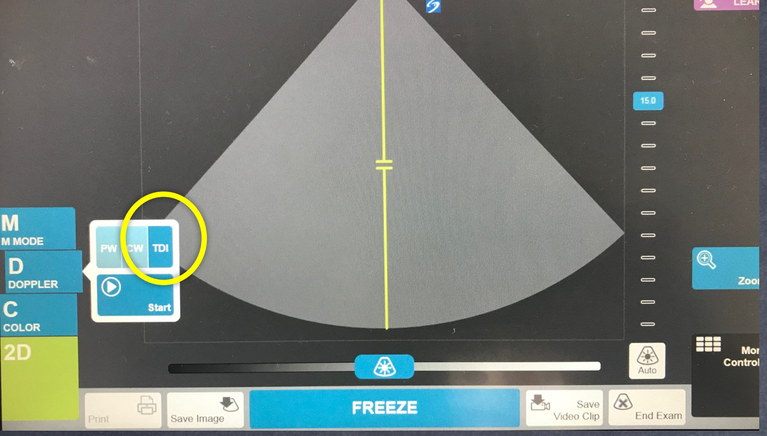
2-D RV Function Parameters

Prediction of RV EF

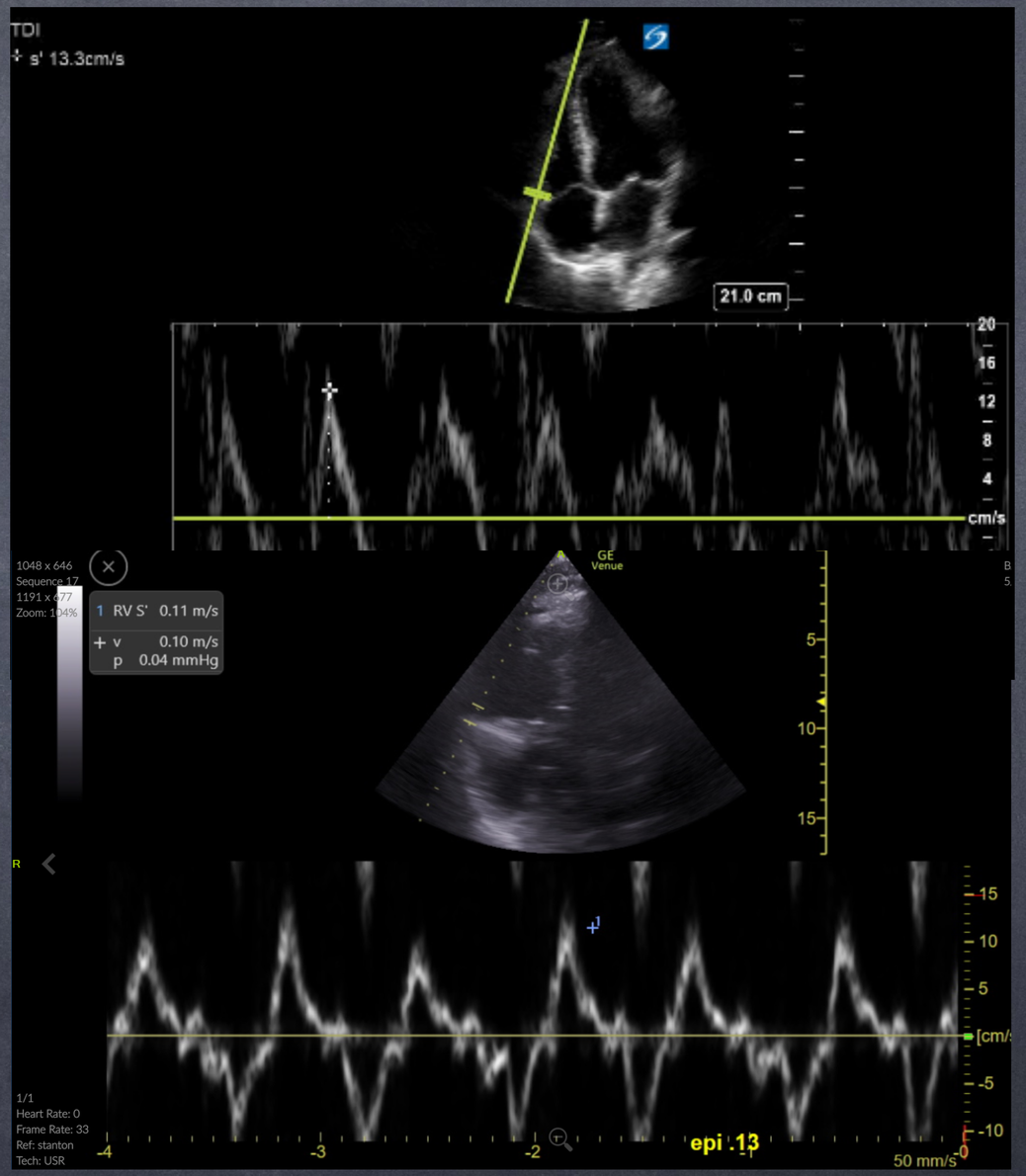




RV S'



- Measure of RV systolic function
- Apical 4 Chamber
- Tissue Wave Doppler
- PW TDI at lateral tricuspid annulus (same spot at tapse)
- Normal Values > 10 cm/s

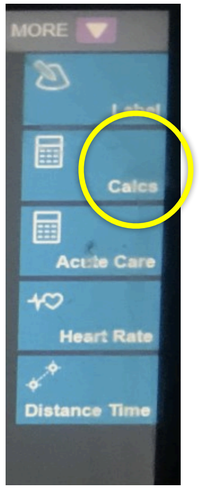


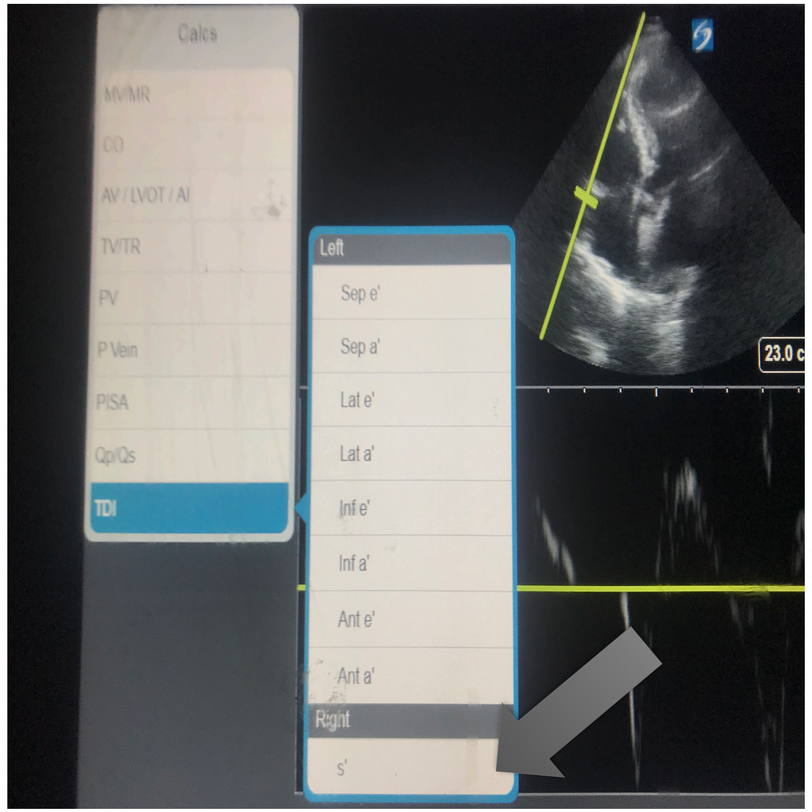
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

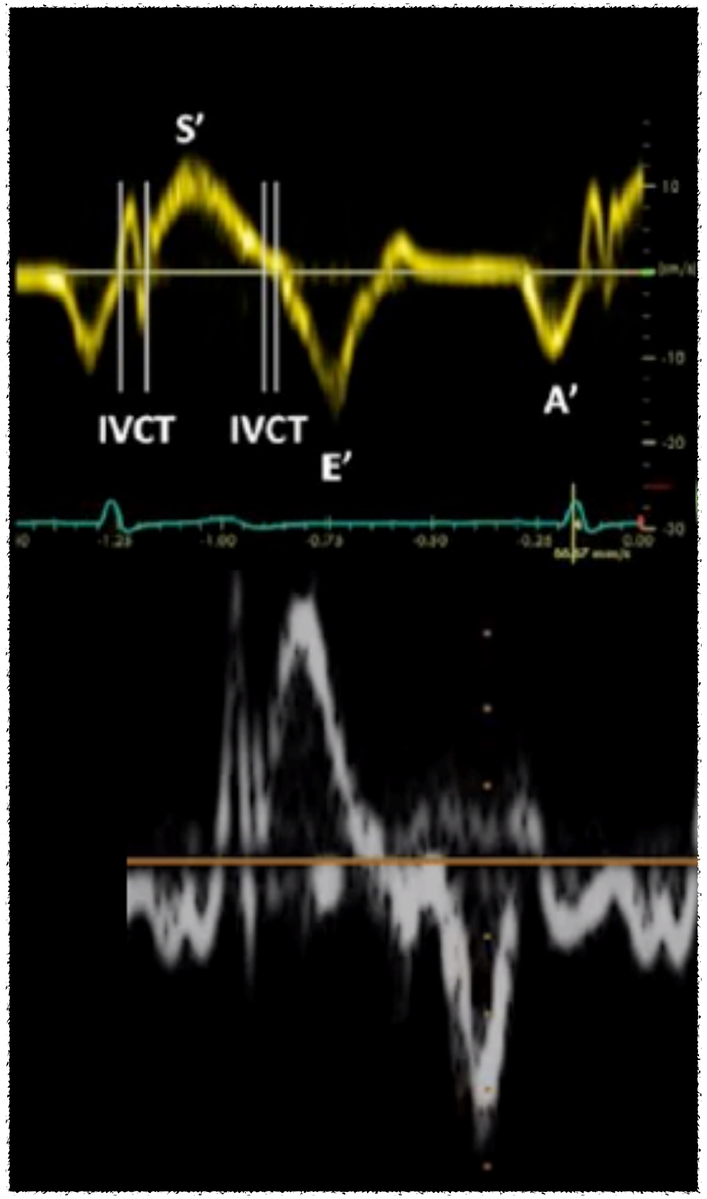
RV S'

Choose Calc Function

- TDI->S'
- Measure height of systolic peak (above the baseline)
- Normal Values >10 cm/s

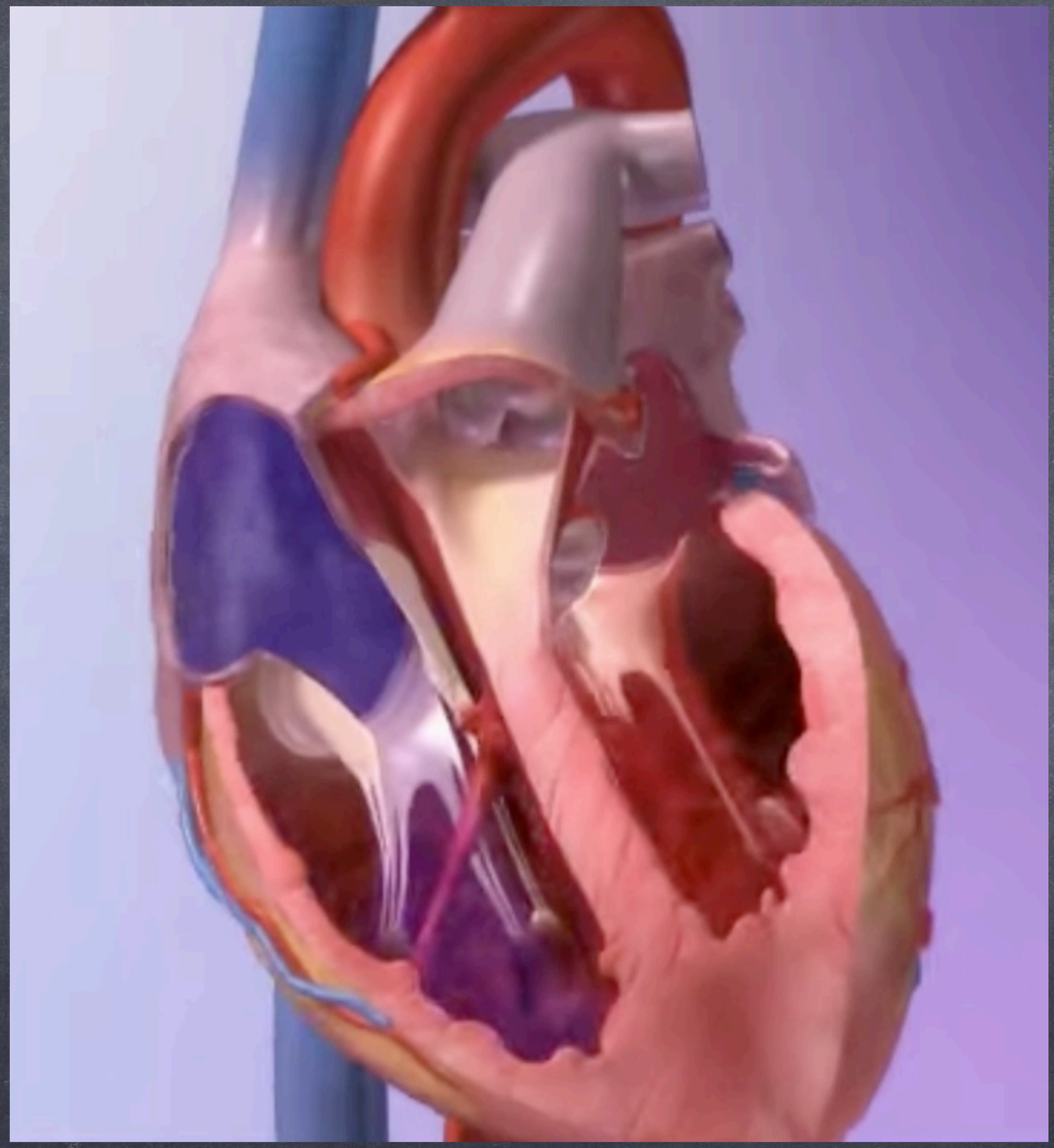






RV systolic Summary

Measurement	Role	Value
RVID	RV dilated?	<4.2cm
TAPSE	RV EF?	>1.7 cm
RV S'	RV stroke volume?	>10 cm/s

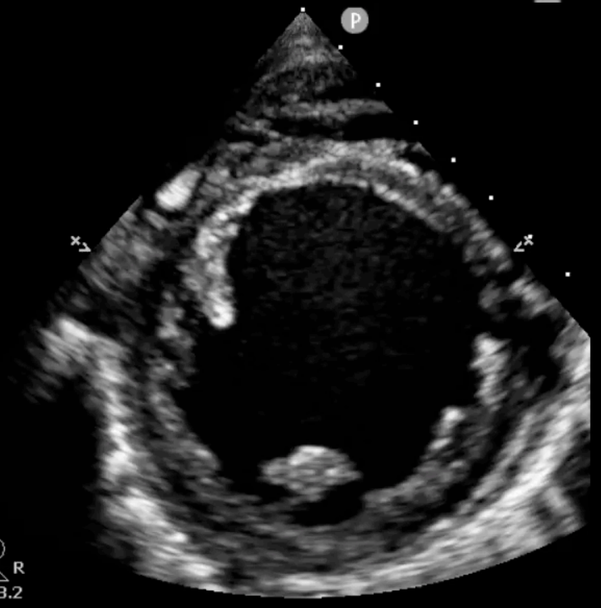


HFrEF

- Eccentric LVH
- Systolic LV-Dysfunction
- Reduced LVEF

HFpEF

- Concentric LVH
- Diastolic LV-Dysfunction
- Preserved LVEF



E/e'

- LV tissue should move (compliance) relative to the amount of blood volume entering LV during early diastole
- An already dilated LV is very FULL and tissue cannot move more (HFrEF)
- A stiff LV cannot move tissue well enough (HFpEF)
- measurement of blood flow velocity over tissue movement velocity
- not accurate if HR too fast (>100), mitral valve pathology

EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

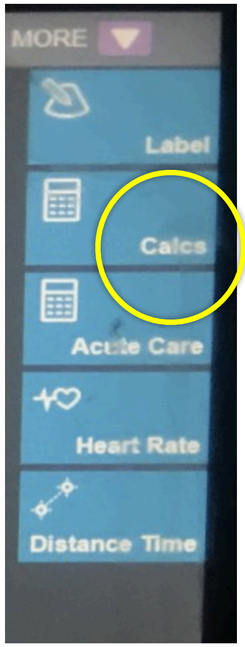
E/e'

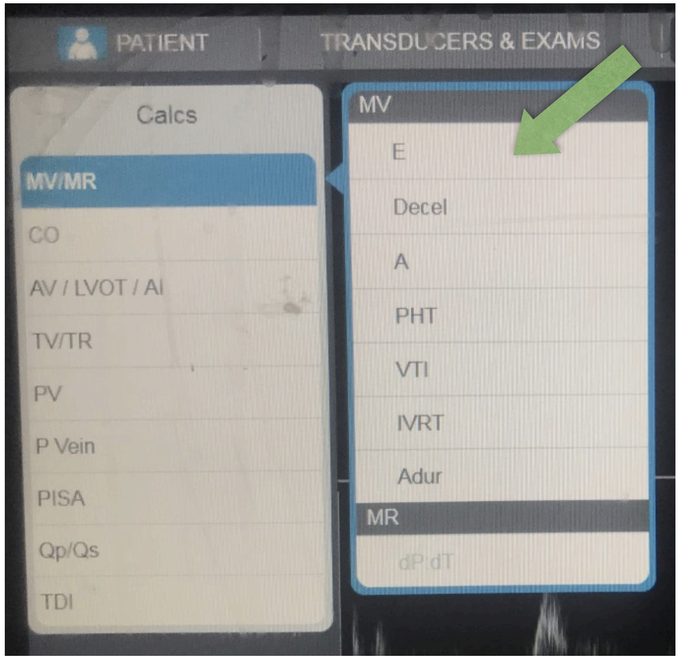
- Measure of LV filling pressure = surrogate of diastolic function
- Apical 4 Chamber, 3 separate measures
- E- Pulse Wave Doppler at mitral valve tips
- Septal e'- Tissue Wave Doppler at mitral annulus
- Lateral e'- Tissue Wave Doppler at mitral annulus
- Normal ratio Value < 8 (>15 = high LV filling, diastolic dysfunction present)

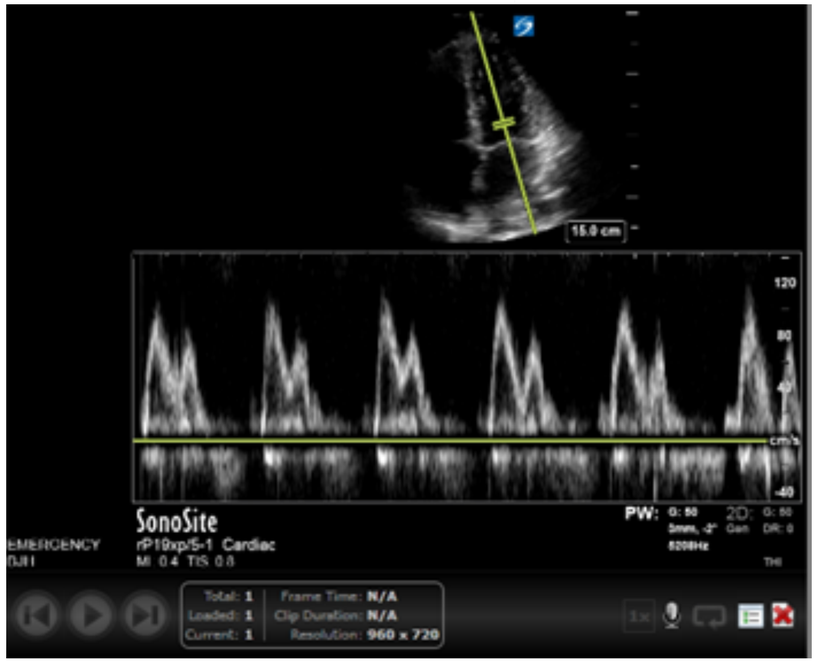
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

E

- E wave = early diastolic filling (first inflection)
- Pulse Wave Doppler at mitral valve
- Choose Calc Function
  - MV->E
- Measure height of systolic E peak

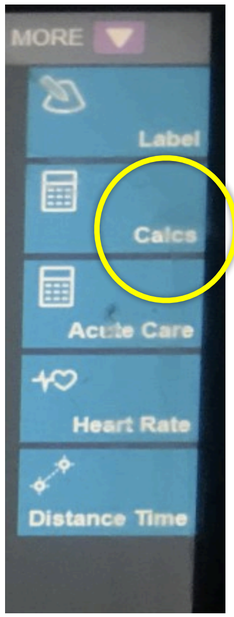


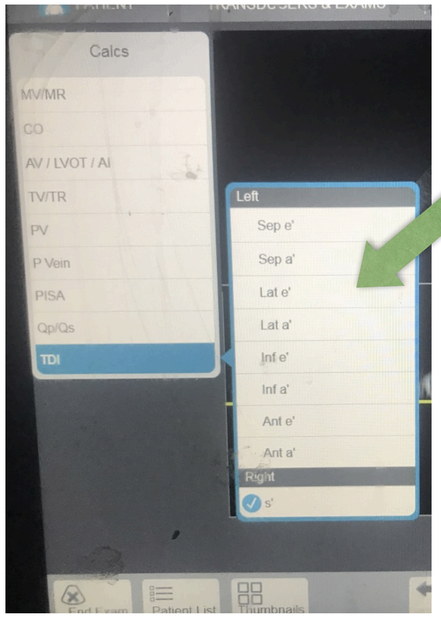


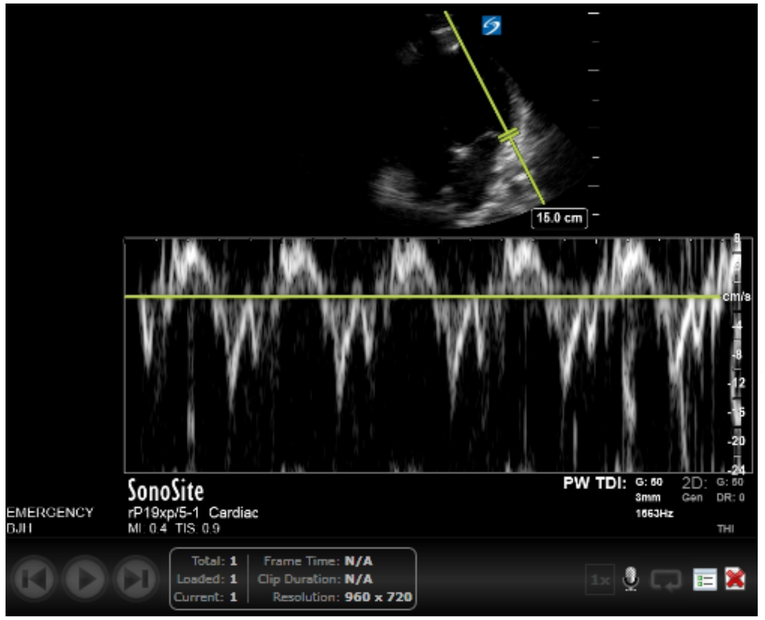


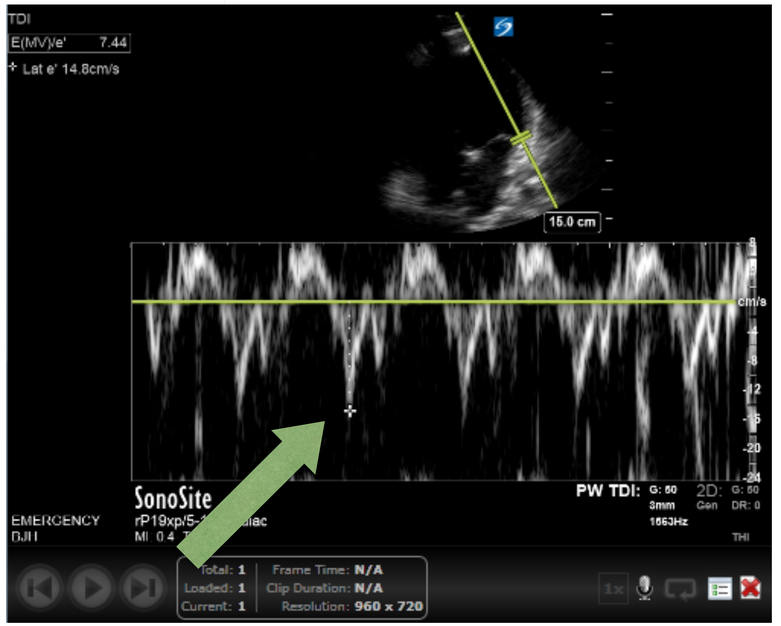
Lateral e'

- e'- tissue movement during early diastolic filling
- Tissue Wave Doppler at lateral mitral annulus
- Choose Calc Function
  - TDI-> lat e'
- Measure height of Diastolic E peak (under the baseline, first inflection)
- Save the values to obtain e/e'



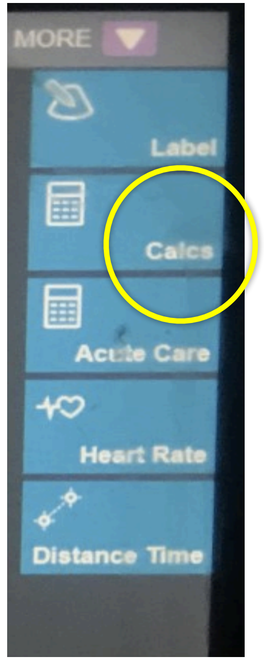


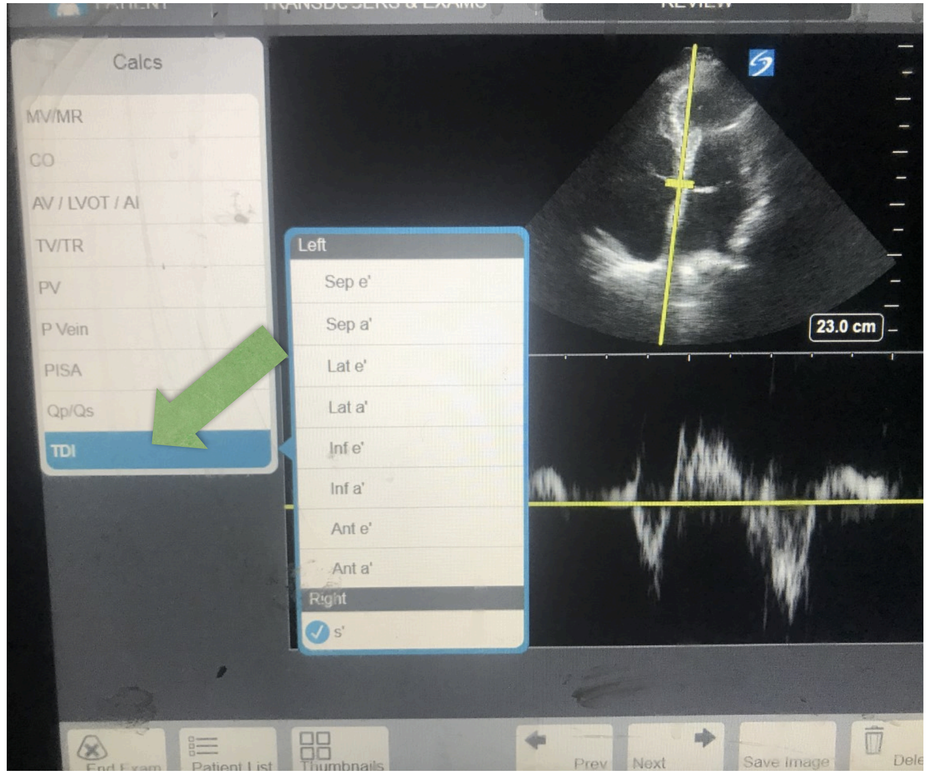


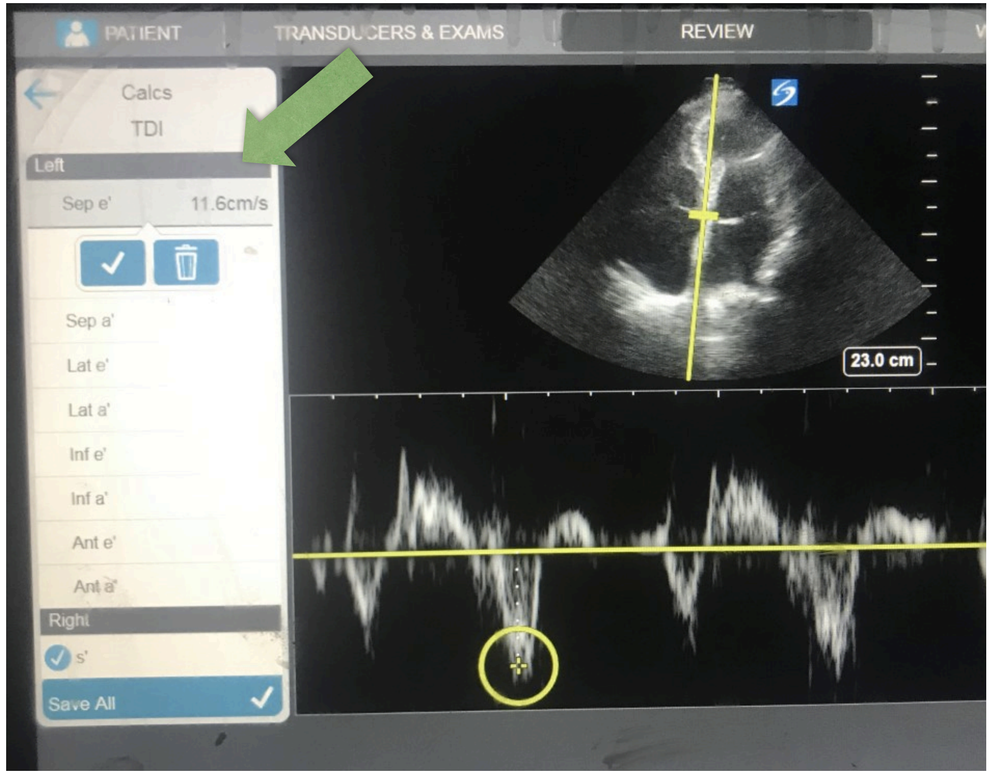


Septal e'

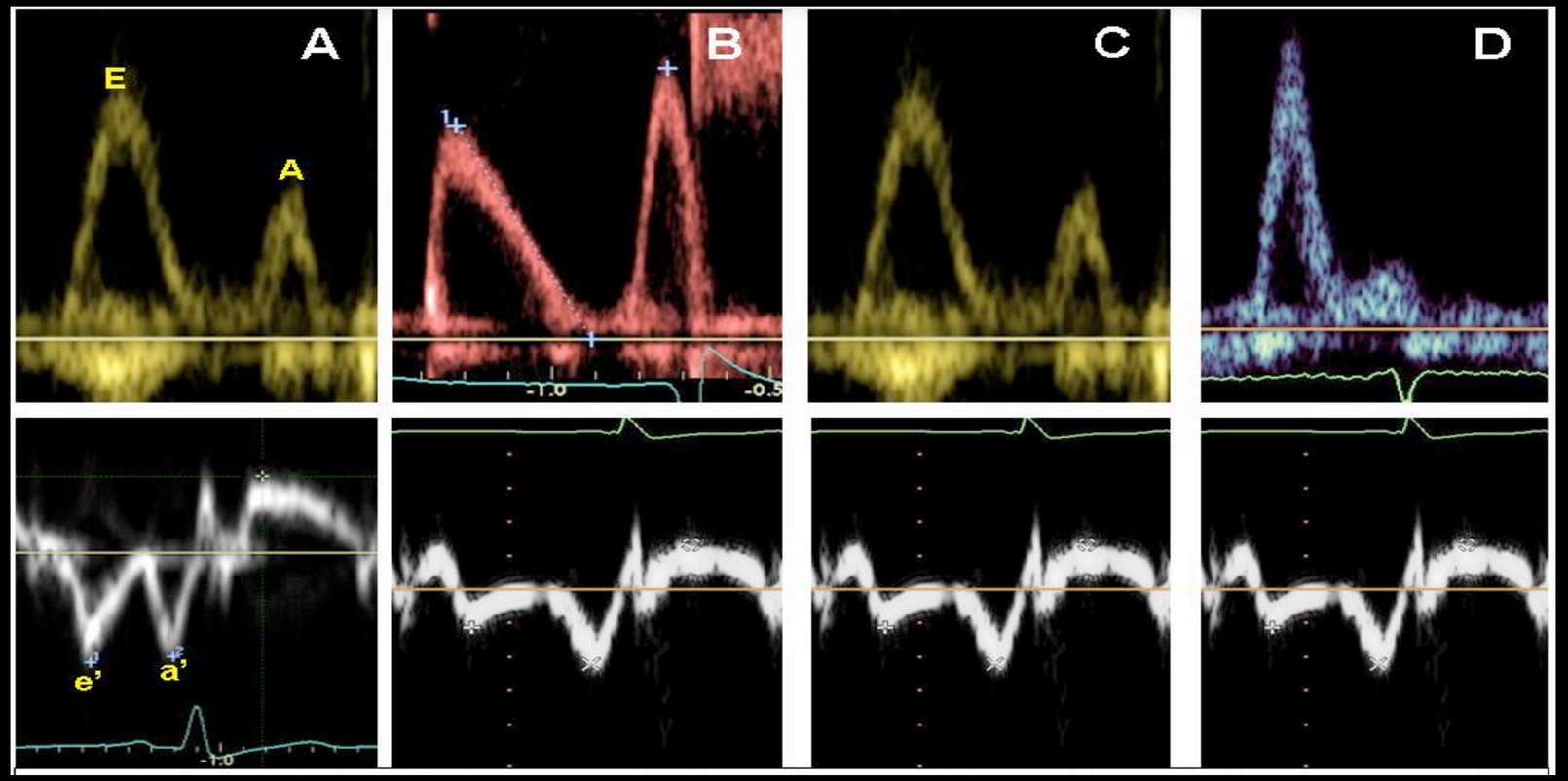
- e'- tissue movement during early diastolic filling
- Tissue Wave Doppler at lateral mitral annulus
- Choose Calc Function
  - TDI-> Septal e'
- Measure height of Diastolic E peak (under the baseline, first inflection)
- Save the values to obtain e/e'







Normal Normal	Grade 1 Impaired	Grade 2 Pseudo-normal	Grade 3 Restrictive



E/e > 15

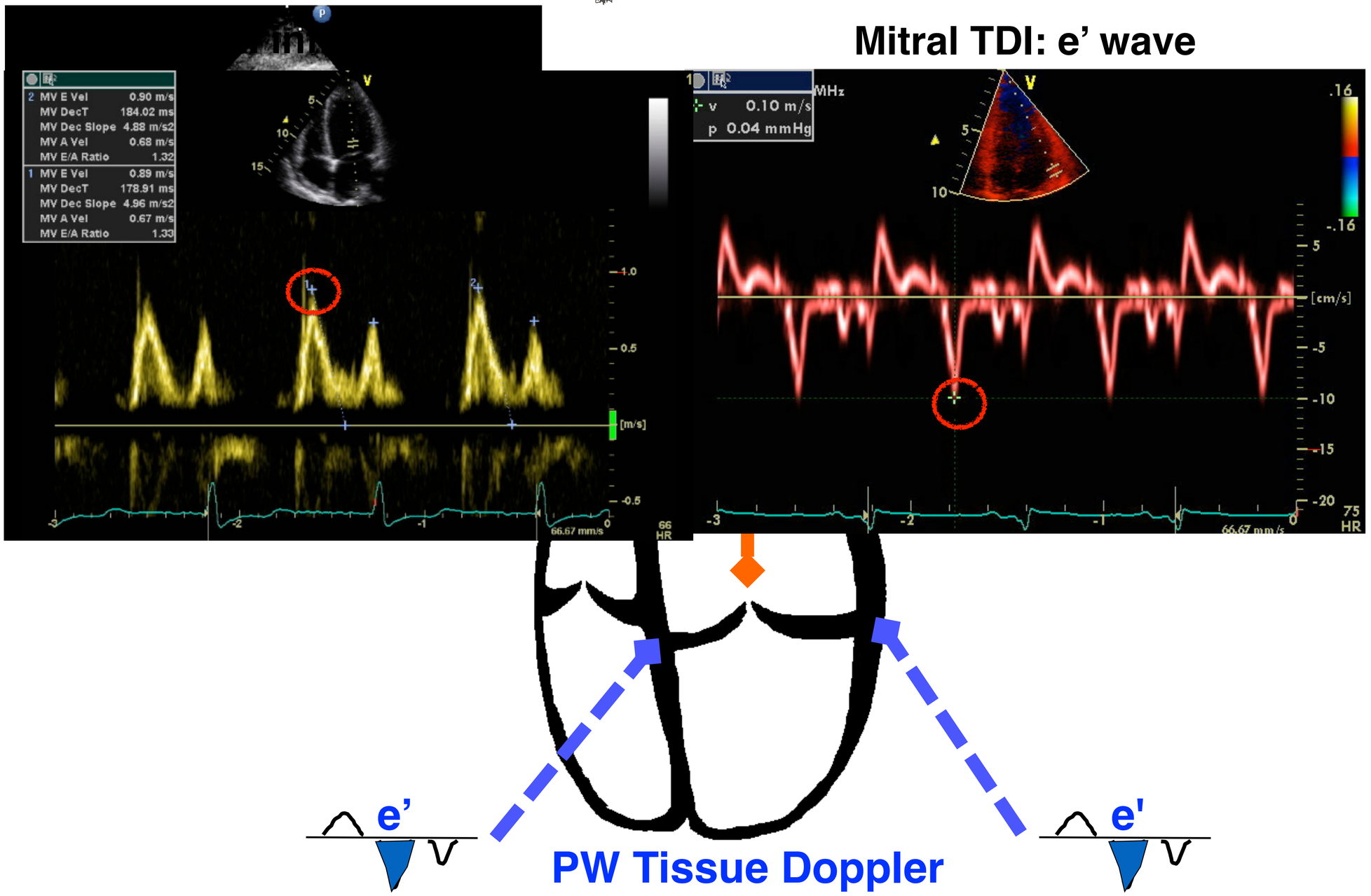
E/e 9 -14

E/e < 8

PaOP HIGH

PaOP normal

Summary E/e' ratio

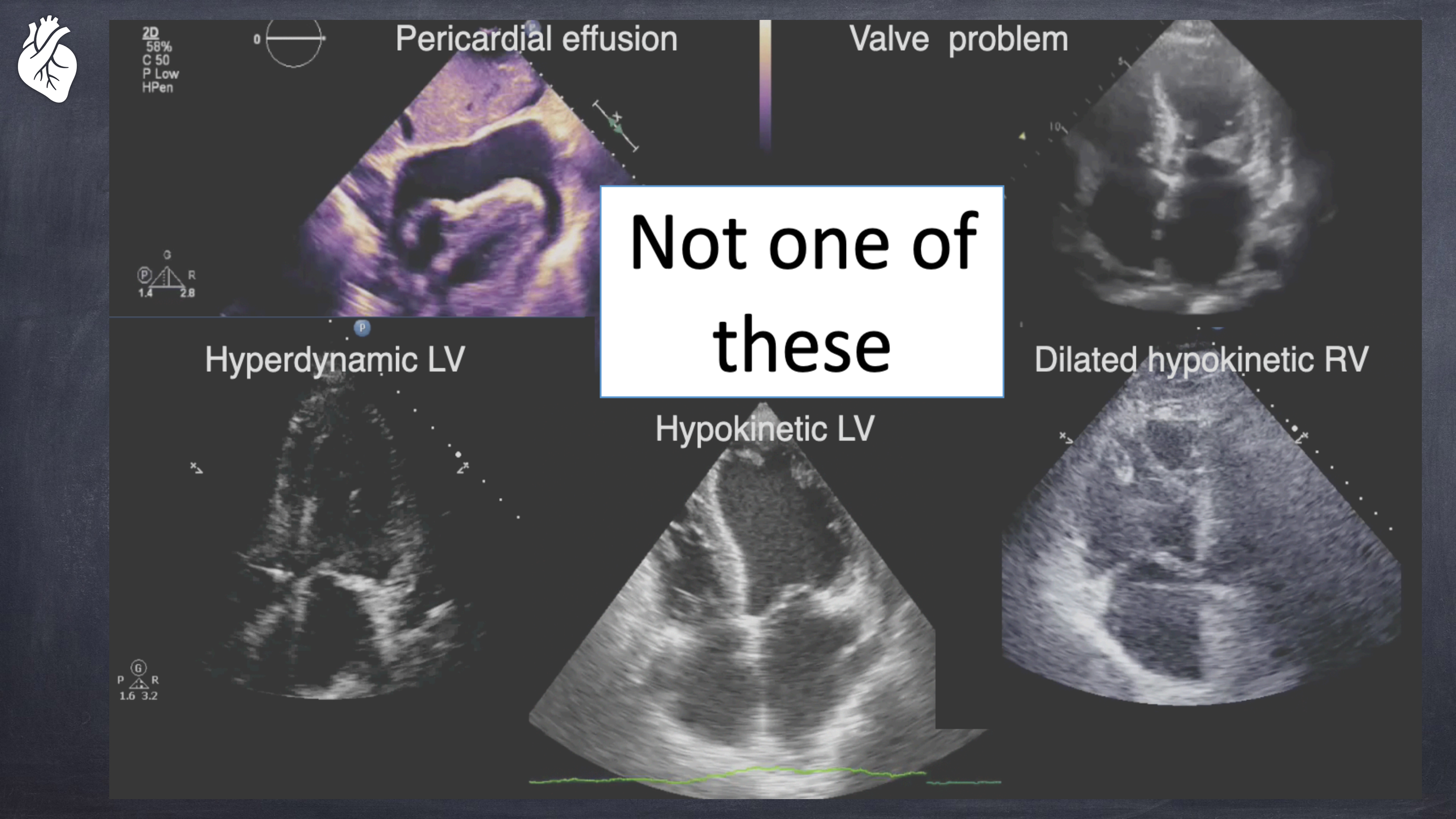


7 measures: Normal values reference

Measurement	Role	Value
EPSS	LV dilated?	<1cm
FS	LV EF?	>30%
LVOT VTI	LV stroke volume?	18-22 cm
RVID	RV dilated?	<4.2cm
TAPSE	RV EF?	>1.7 cm
RV S'	RV stroke volume?	>10 cm/s
E/e'	LV filling?	<8 (>15 bad)

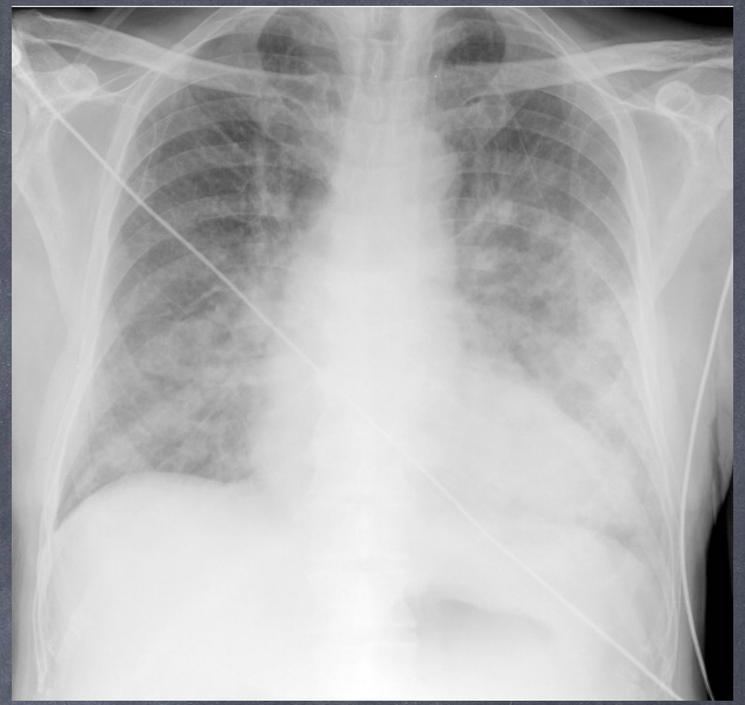
EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

Case 1


Pericardial effusion
Valve problem
Not one of these
Hyperdynamic LV
Hypokinetic LV
Dilated hypokinetic RV

45yo male presents with acute SOB after 0.4mg narcan dose for accidental fentanyl overdose. 2 episodes of bloody emesis PTA

VS: HR 120s, RR 35, BP 160/95, SaO2 93% on 50% optiflow



Q. Based on Echo 7 measures,

A. giving fluids is ok

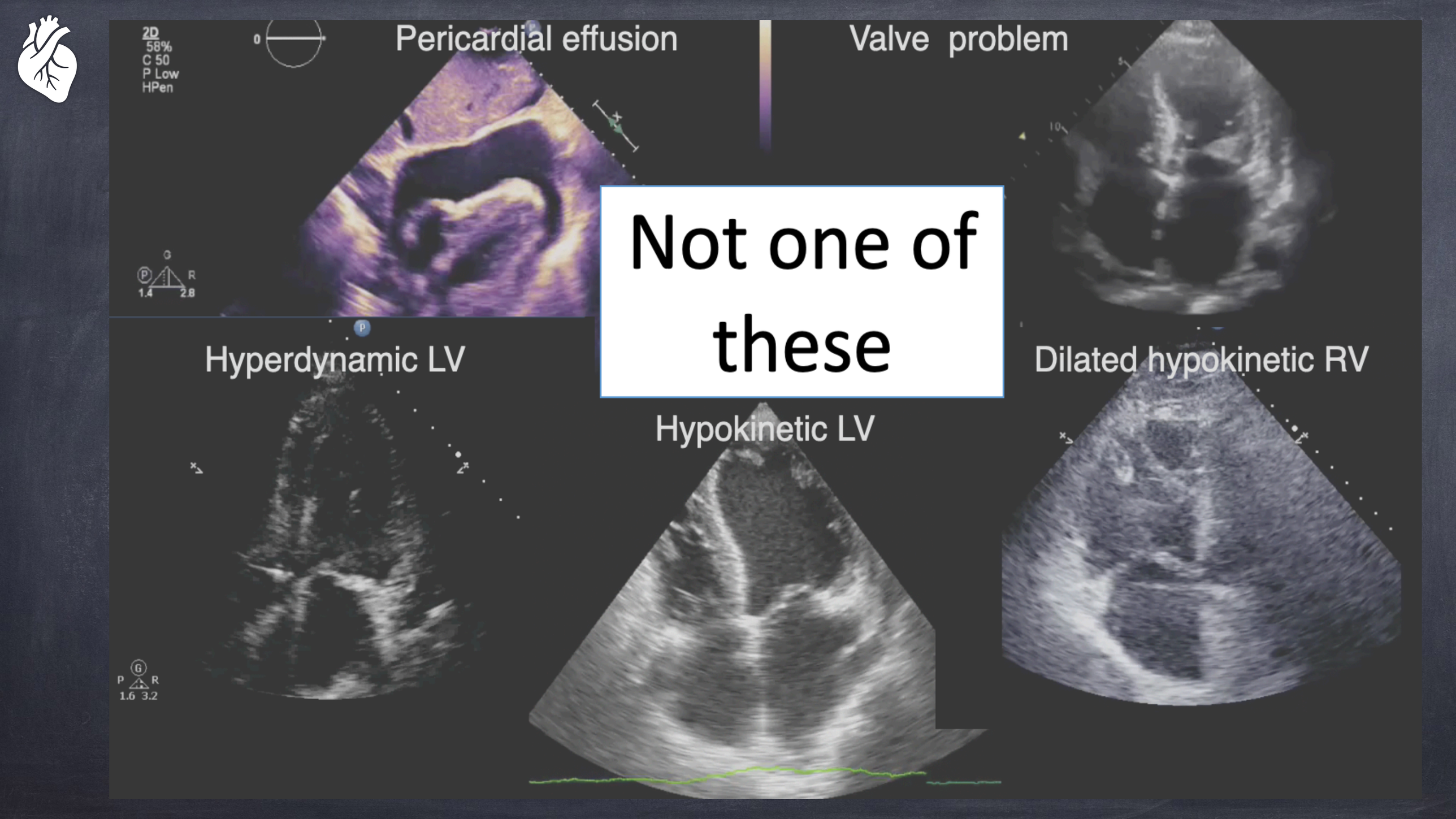
B. giving fluids is not recommended

C. diuresis is ok

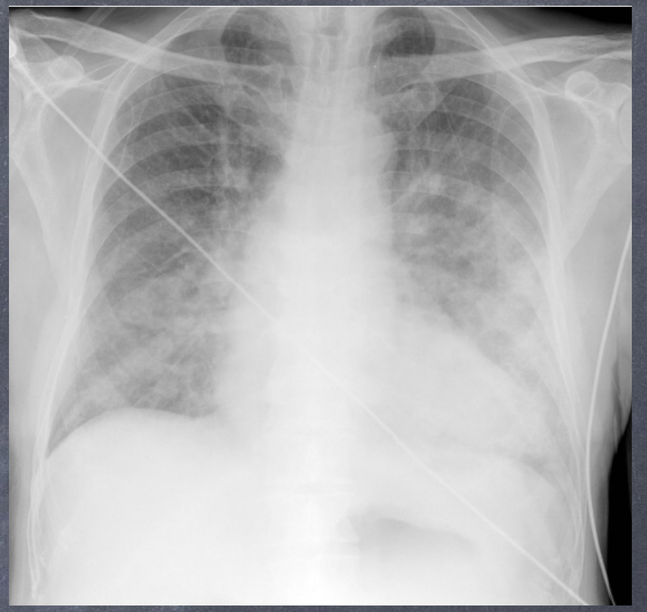
D. diuresis is not recommended

Measurement	Value	Value
EPSS	0.6cm	<1cm
FS	35%	>30%
LVOT VTI	21 cm	18-22 cm
RVID	4 cm	<4.2cm
TAPSE	2.3 cm	>1.7 cm
RV S'	15 cm/s	>10 cm/s
E/e'	4	<8 (>15 bad)

Case 2


Pericardial effusion
Valve problem
Not one of these
Hyperdynamic LV
Hypokinetic LV
Dilated hypokinetic RV

63yo female with h/o HTN, GERD presents with SOB x 4 days. Intubated in the ED for respiratory failure. Cr is 1.4 (baseline 0.7) VS: T 36.8, HR 95, RR 28, BP 170/95, SaO2 92% on ACVC 20/450/7.5/70%



Q. Based on Echo 7 measures,

A. giving fluids is ok

B. giving fluids is not recommended

C. diuresis is ok

D. diuresis is not recommended

Measurement	Value	Value
EPSS	1.5cm	<1cm
FS	18%	>30%
LVOT VTI	16 cm	18-22 cm
RVID	4 cm	<4.2cm
TAPSE	2.1 cm	>1.7 cm
RV S'	11 cm/s	>10 cm/s
E/e'	18.3	<8 (>15 bad)

EVERY FELLOW LOVES REAL TIME RESUSCITATIVE ECHO

Questions?