Ultrasound as a Second Language (USL): Learning the Lingo of Ultrasound for the Clinician Educator

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Disclosures

- **None**

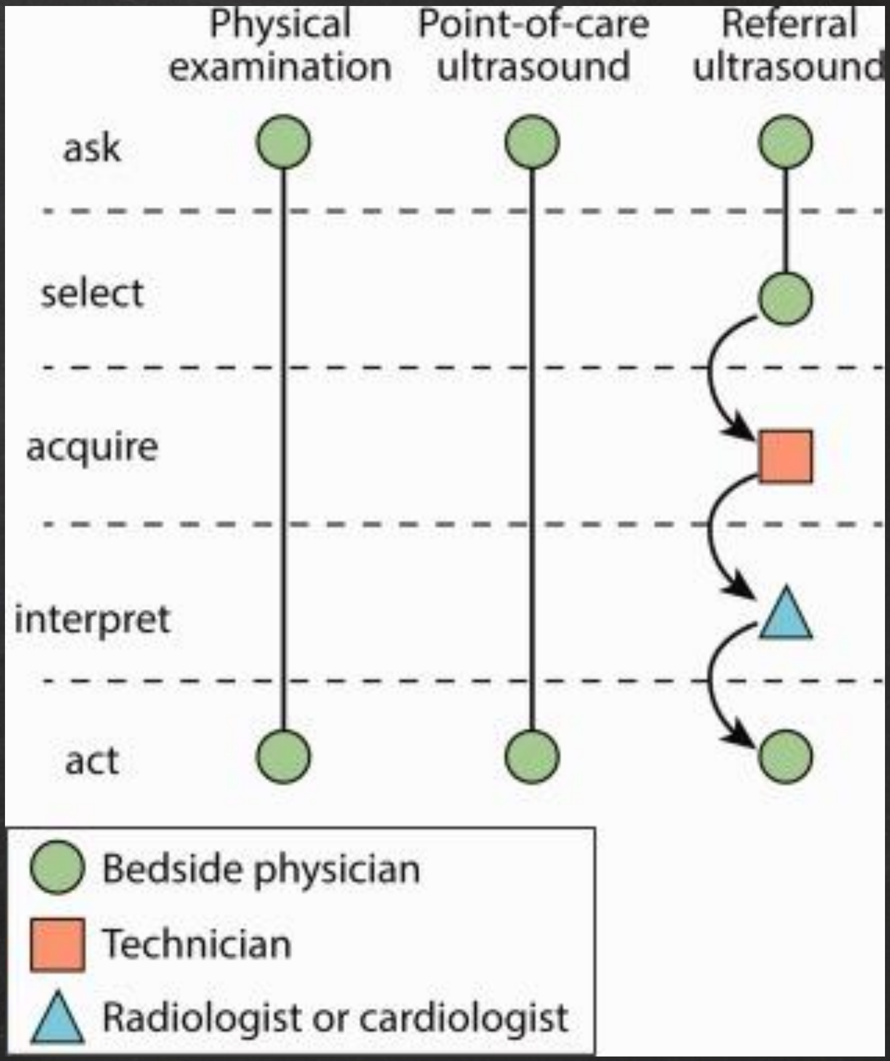
Learning Objectives

- Describe point of care ultrasound and what sets it apart from comprehensive, sonographer-performed ultrasound
- Explain at least 5 point of care ultrasound signature terms (sliding, A-lines, B-lines, PLAX, PSAX) Signature Term
- Identify at least four ultrasound findings pertinent to educators' everyday practice

Point-of-care Ultrasound (POCUS)

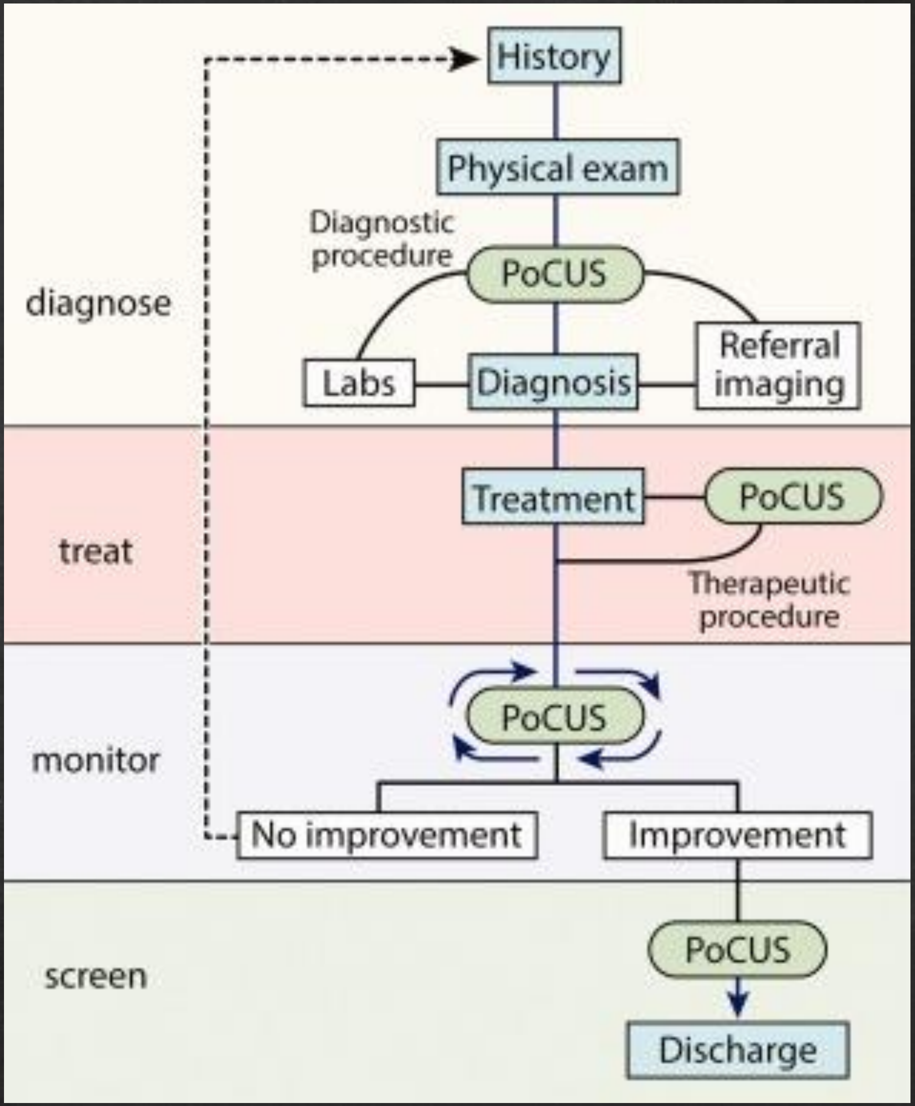
- A goal-directed, bedside ultrasound examination performed by a clinician to answer a focused diagnostic question or to guide performance of an invasive procedure

Comparison of physical examination, point-of-care and referral ultrasound examinations



Soni, N. Lucas, B. Diagnostic Point of Care Ultrasound for Hospitalists JHM 2014

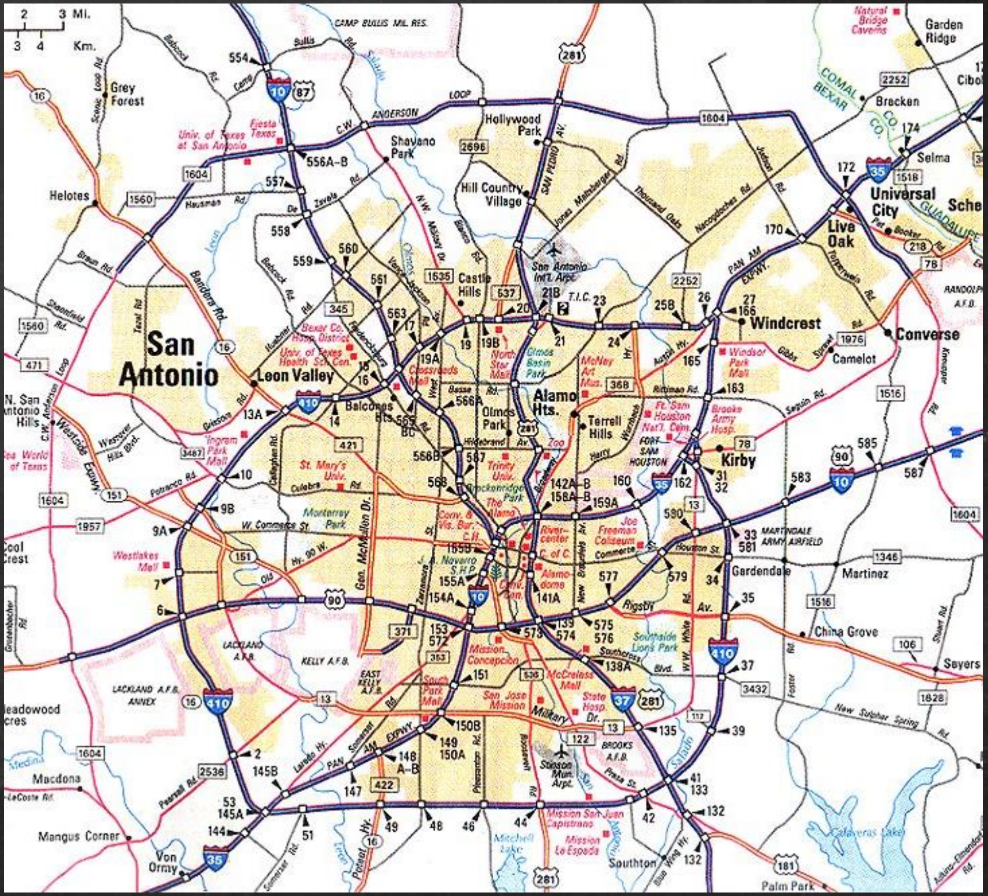
Point of Care Ultrasound (Hospitalized patients)



Soni, N. Lucas, B. Diagnostic Point of Care Ultrasound for Hospitalists JHM 2014

Roadmap

- Learning the Lingo – Point of Care Ultrasound of the *Lungs*
  - Focused Didactic
  - Immersion Experience with Cases in Smaller Groups
- Learning the Lingo – Point of Care Ultrasound of the *Heart*
  - Focused Didactic
  - Immersion Experience with Cases in Smaller Groups
- Learning the Lingo – Point of Care Ultrasound of the *Inferior Vena Cava*
  - Focused Didactic
  - Large Group Case Review
- Review of Terminology

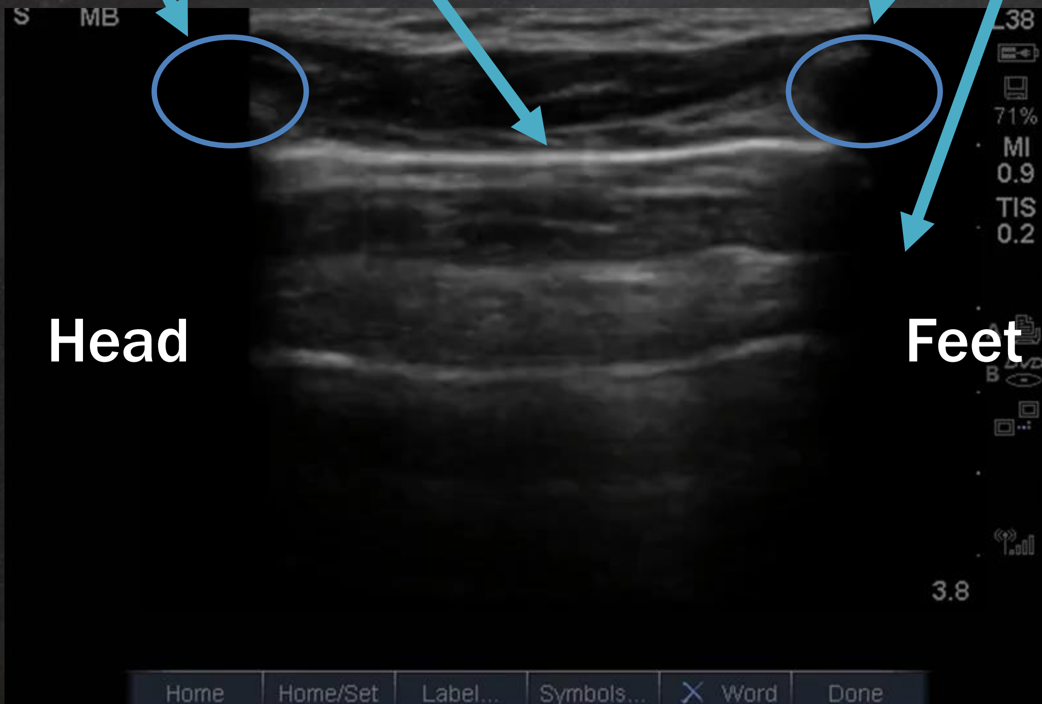


Learning the Language of Lung Ultrasound

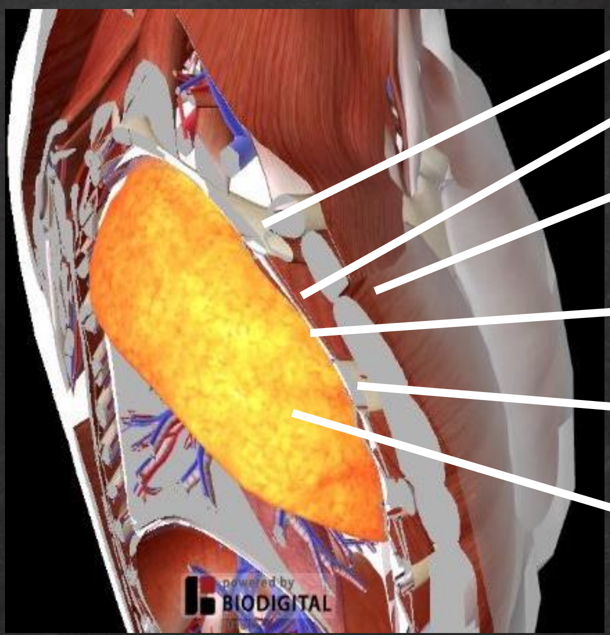
Objectives

- List 4 terms important to lung ultrasound and describe their meaning
- Describe a systematic 4 step approach to assess the lung
- Apply these terms to ultrasound images in 2 clinical cases

Anatomy



Visceral-parietal pleural interface (VPPI)
Rib + rib shadow
Rib + rib shadow
S
MB
L38
71%
MI
0.9
TIS
0.2
Head
Feet
3.8
Home
Home/Set
Label...
Symbols...
Word
Done



Rib
Intercostals
Pectoralis Major
Pleura
Rib
Lung

Signature Term

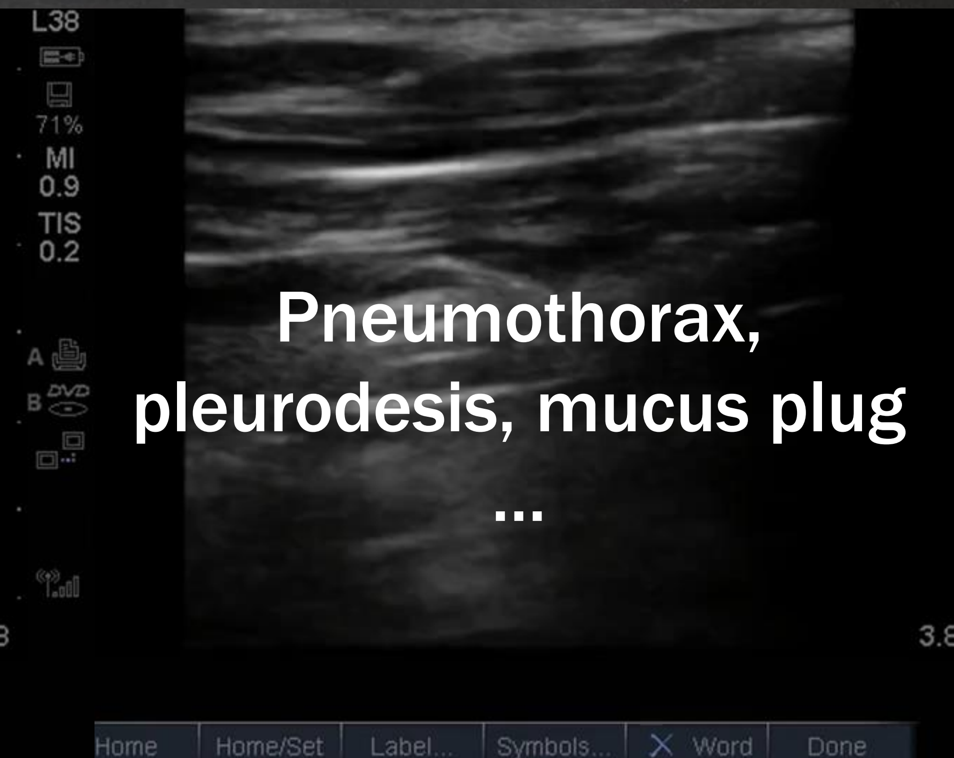
#1: "Lung Sliding"

Look closely at pleural line …

+Lung Sliding

Normal visceral-parietal pleura apposition

Absent Lung Sliding



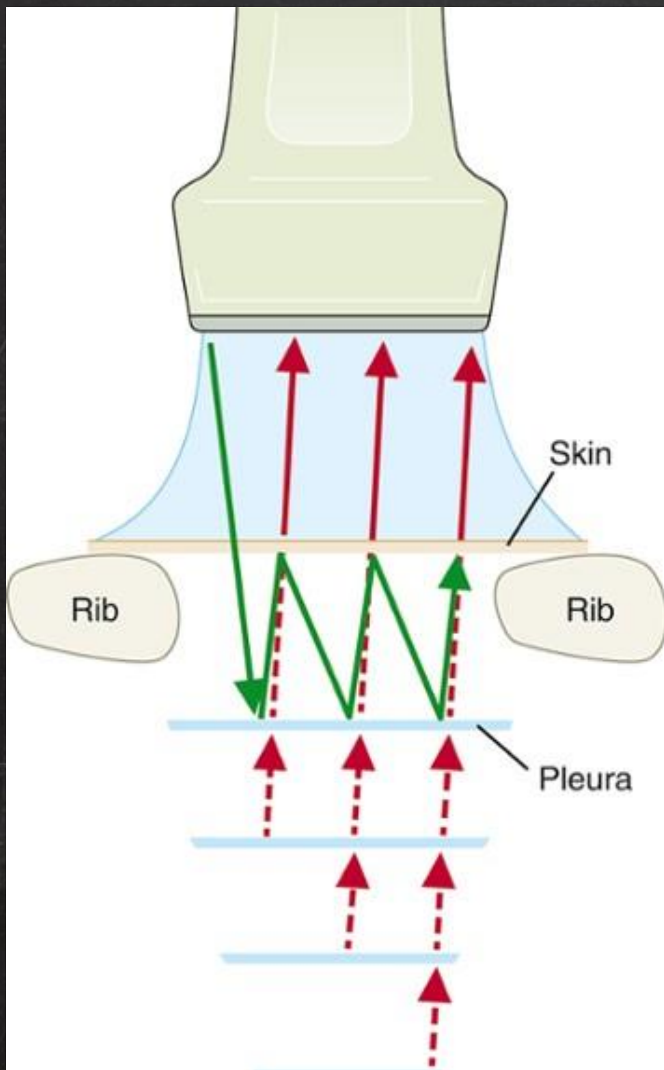
Pneumothorax, pleurodesis, mucus plug

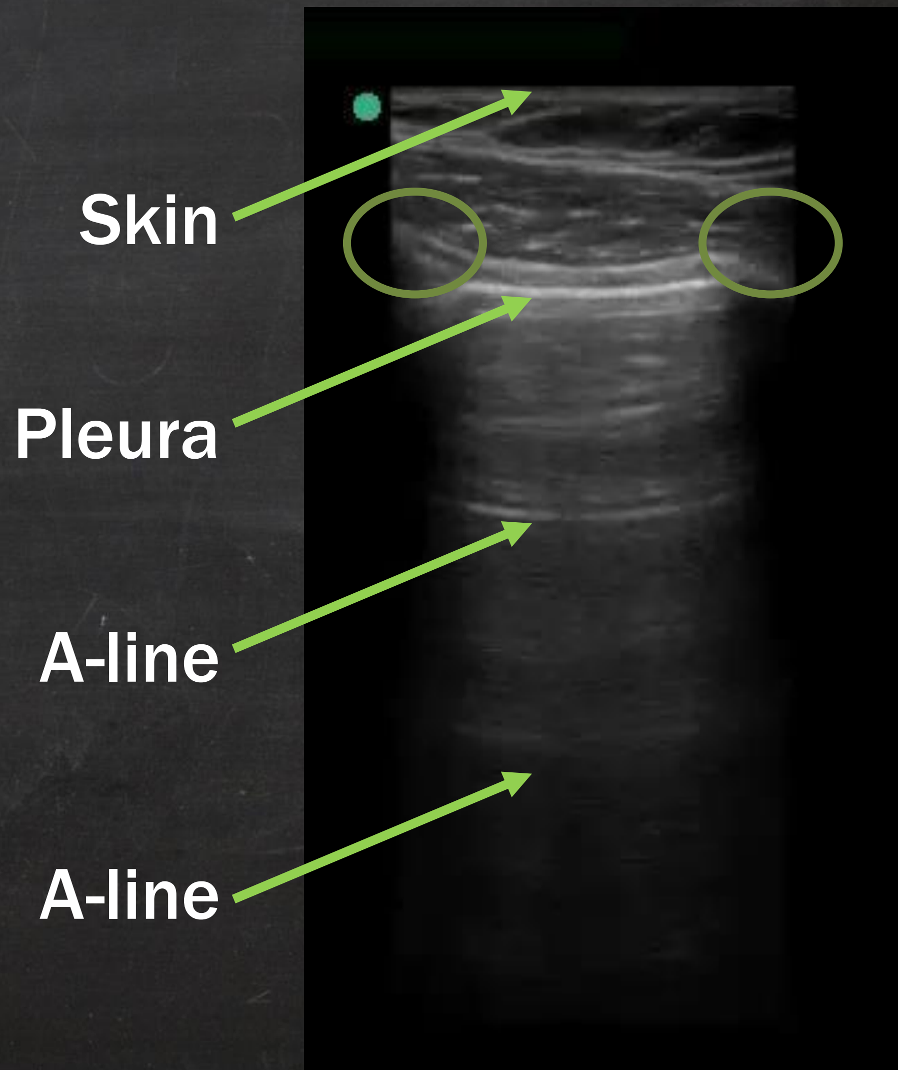
…

Signature Term

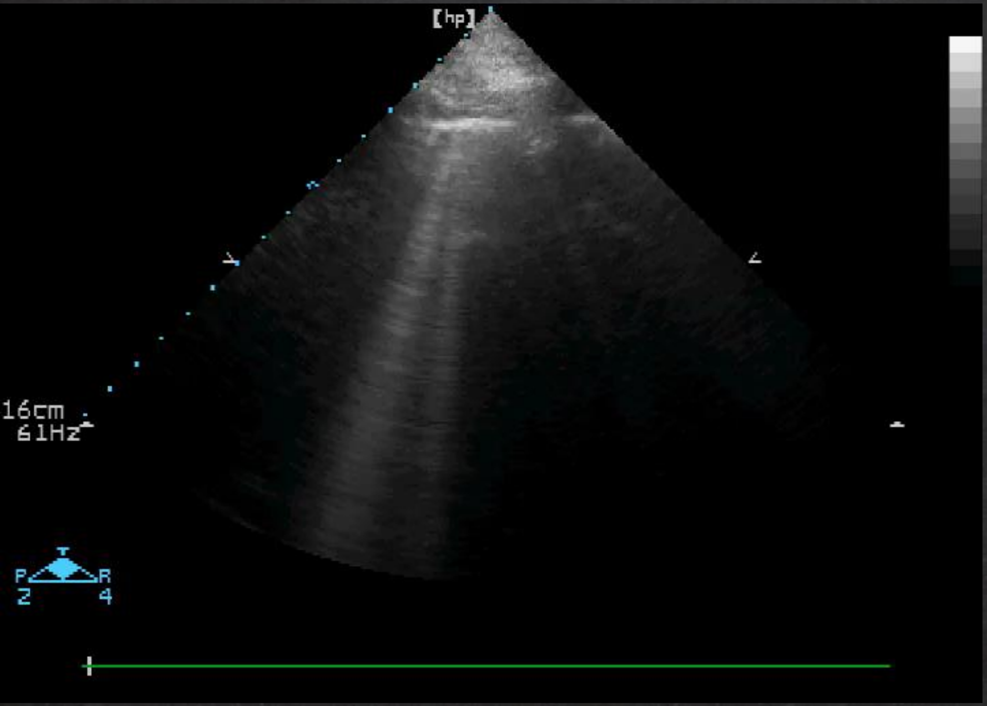
#2: "A-Lines"

Key Concept: Air reflects/scatters sound waves. A-lines are ARTIFACTS





#3: "B-lines"

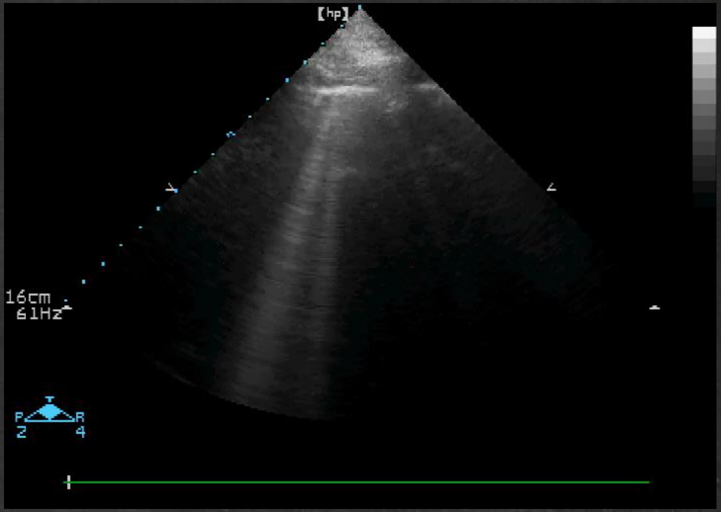


- B-lines are an artifact
- Equate to increasing density (blood, pus, water)
- Increasing density = more B-lines
- > 3 in a field is pathologic
- Must go to the bottom of the screen

Warning! Distribution matters and you need to clinically correlate

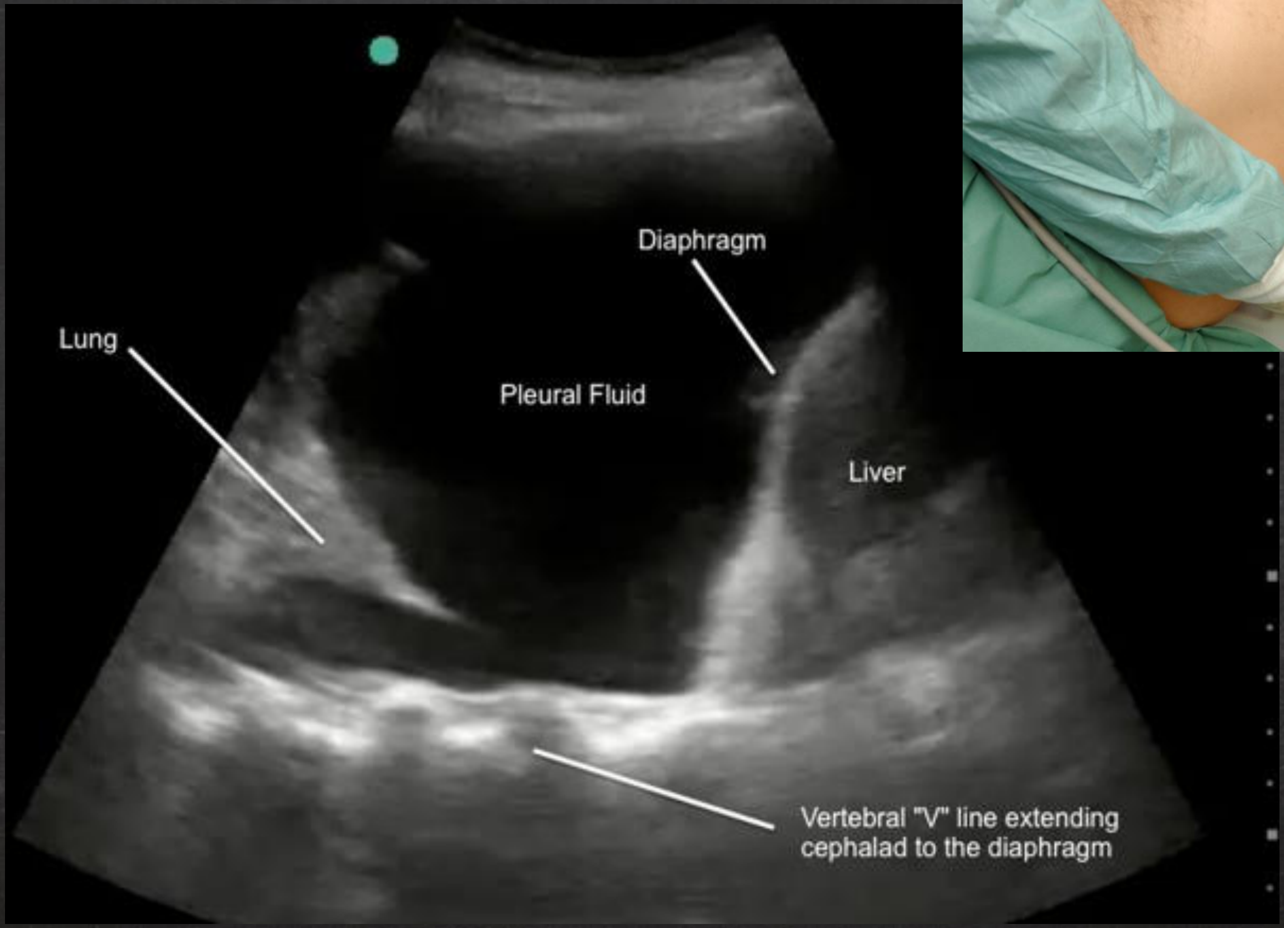
- Diffuse interstitial syndrome:
  - Pulmonary edema (cardiogenic or non)
  - Interstitial lung disease

- Focal interstitial syndrome:
  - Pneumonia
  - Infarct
  - Contusion



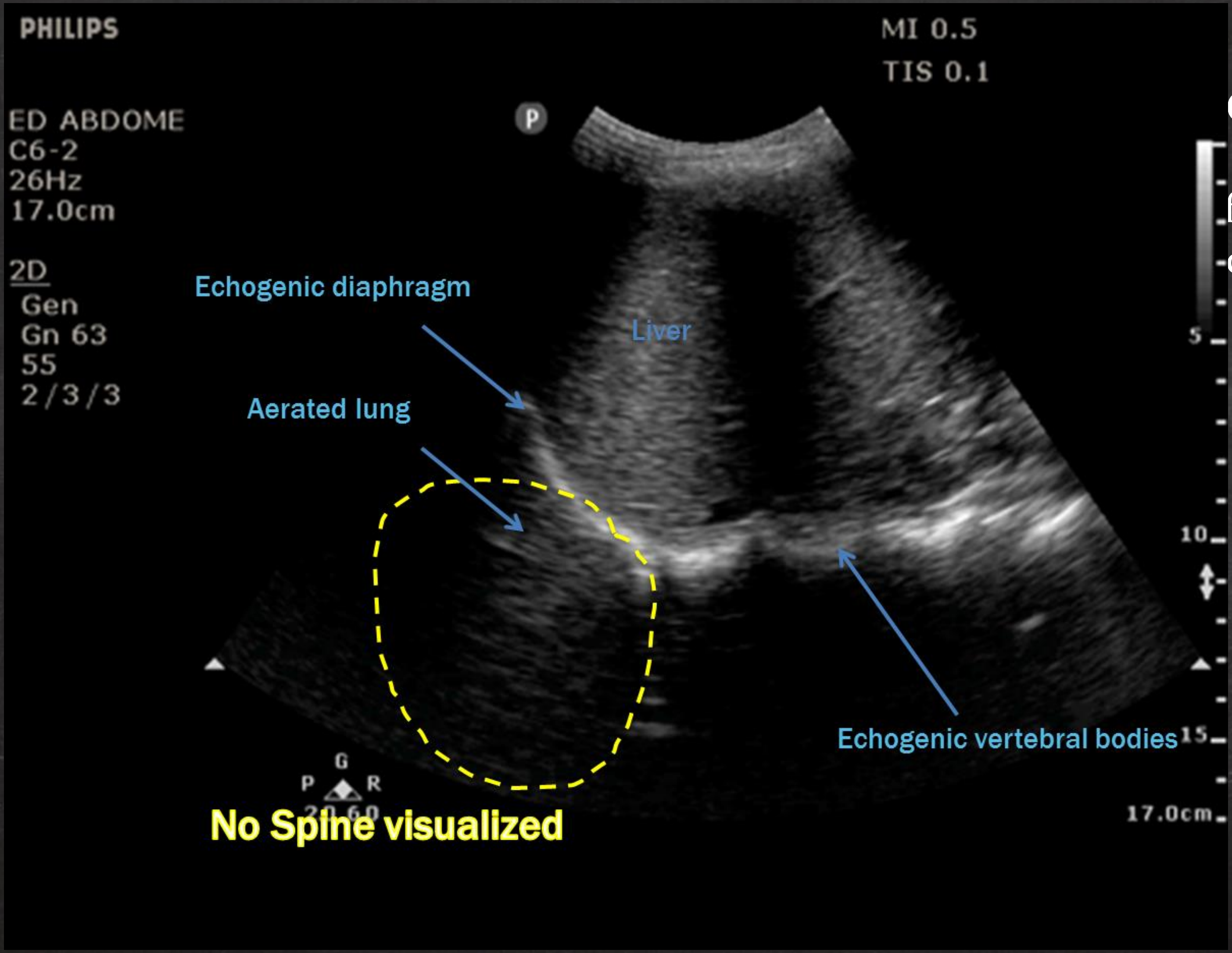
Signature Term

#4: "Spine Sign"



Atkinson P, Milne J, Loubani O, Verheul G. The V-line: a sonographic aid for the confirmation of pleural fluid. *Crit Ultrasound J*. 2012;4(1):19. doi:10.1186/2036-7902-4-19.

Normal lung base



OR:

fluid collection
diaphragm

aka V line

Atkinson P, Milne J, Loubani O, Verheul G. The V-line: a sonographic aid for the confirmation of pleural fluid. *Crit Ultrasound J*. 2012;4(1):19. doi:10.1186/2036-7902-4-19.

4 Steps to Interpreting Lung Ultrasound

#1: What is the pleural line doing? Is there "lung sliding"?

#2: What is the pattern? "A or B-lines"

#3: What is the distribution of the pattern? Define and then clinically correlate.

#4: Is there a pleural effusion? Remember to look for a "spine sign".

ON TO THE CASES!

Case #1: "He's at his dry weight"

- 92 y/o man with hx of diastolic heart failure, recent ground level fall with hospitalization for rib fractures and pneumothorax (discharged 5 days ago), and CKD presents with 2-3 days of progressive dyspnea.
- Had been at a SNF with multiple provider evaluations.

- ROS: No cough or fevers. +wheezing. No recent infectious symptoms, no chest pain.

- Vitals: HR 104 (sinus tach), BP 142/72, RR 24, SpO_2 94% on room air.
- Weight: unchanged from previous discharge (166 lbs)

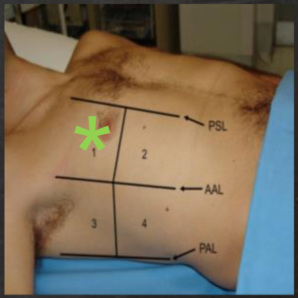
- Exam: notable for frail dyspneic man, JVP at 13 cm, bilateral wheezes, extremities warm and without edema.

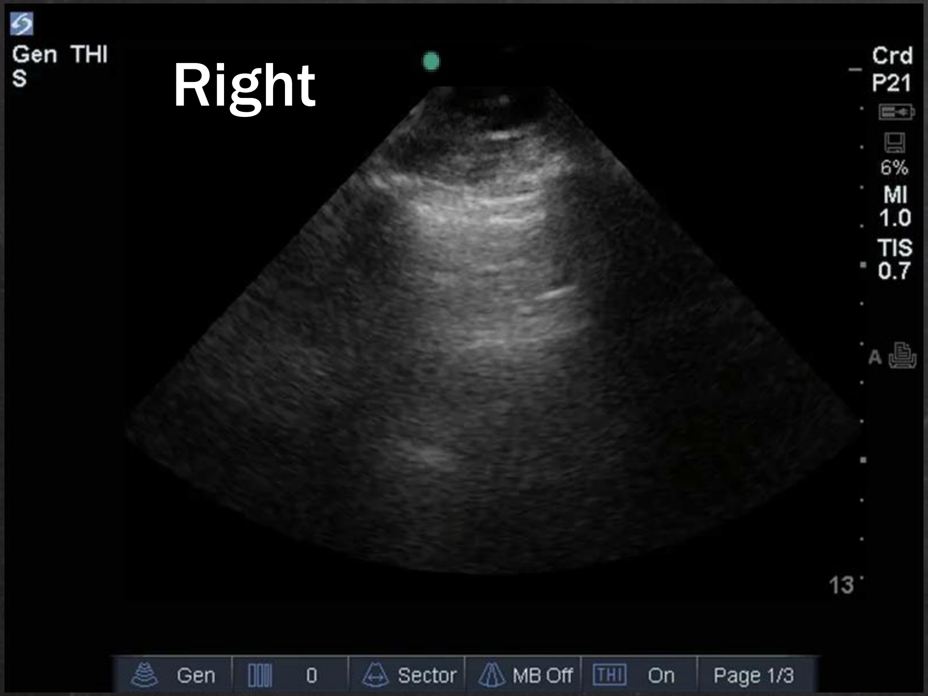
- Labs notable for stable Cr and otherwise normal electrolytes, WBC not elevated.

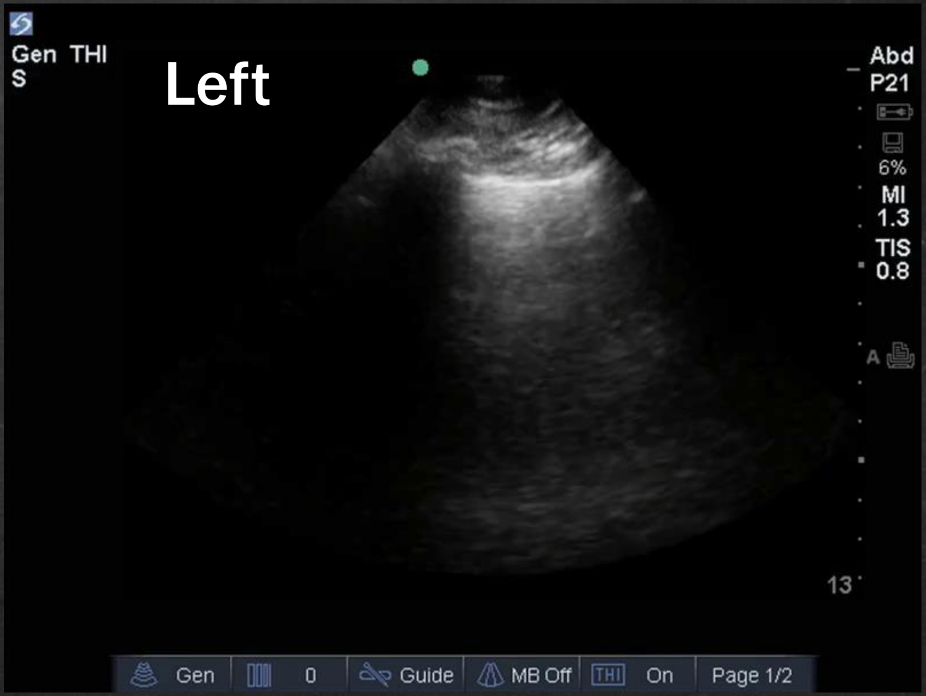
IMPRESSION:

Mild bibasilar atelectasis and trace right pleural effusion. No evidence for pulmonary edema or new consolidation. Cardiomegaly as before.

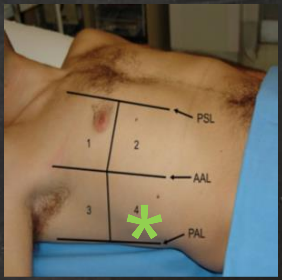
Initial right and left lung apex show this finding

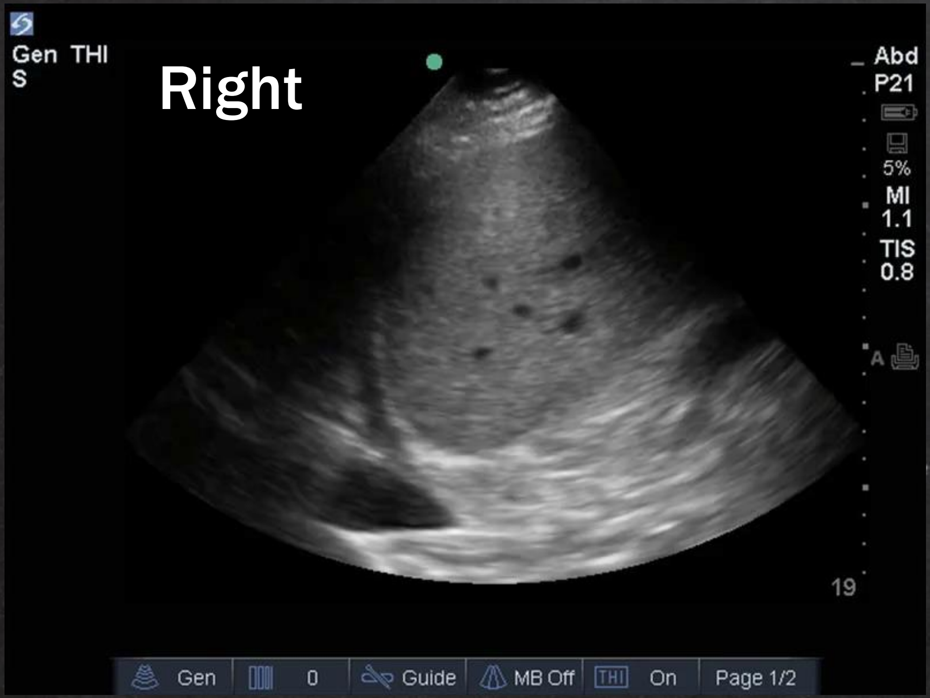


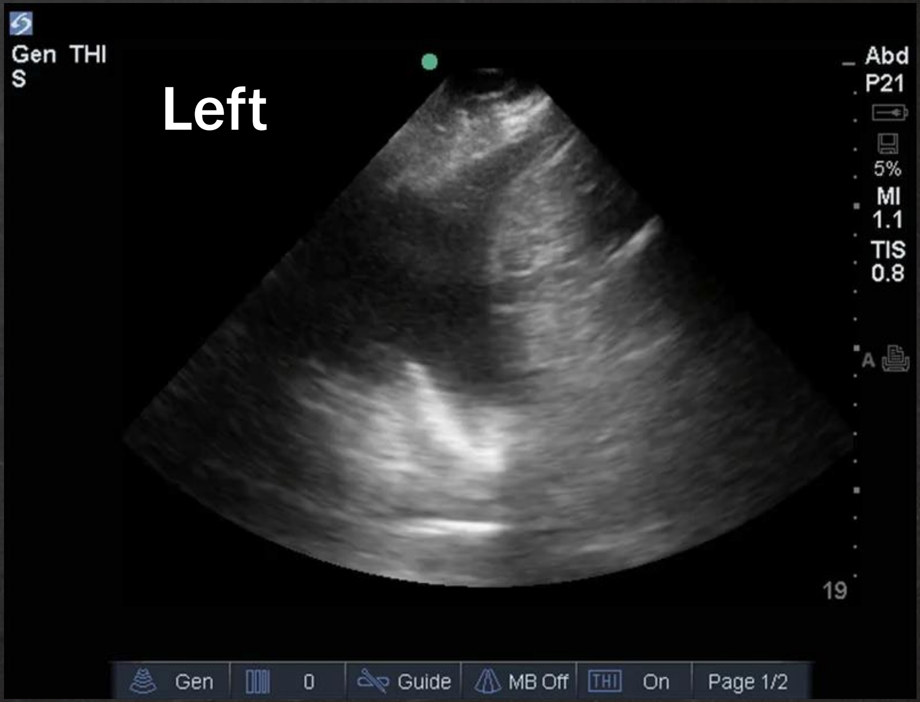




And right and left lung base shows this …







Group Questions

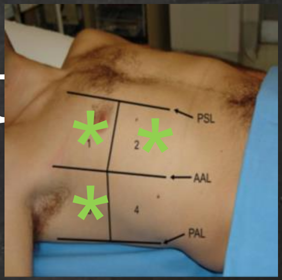
- What was your differential for this patient prior to the ultrasound? What was most likely?
- What key lung ultrasound terms/patterns apply to this patient?
- How do the lung ultrasound findings affect your thinking? Would it change you clinical decision-making? Change your confidence level?

CLICK TO SEE CASE CONCLUSION

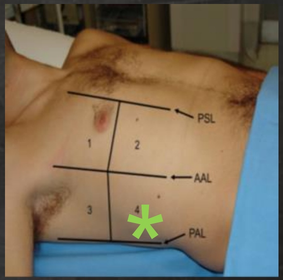
Case #2: "A common Veteran case"

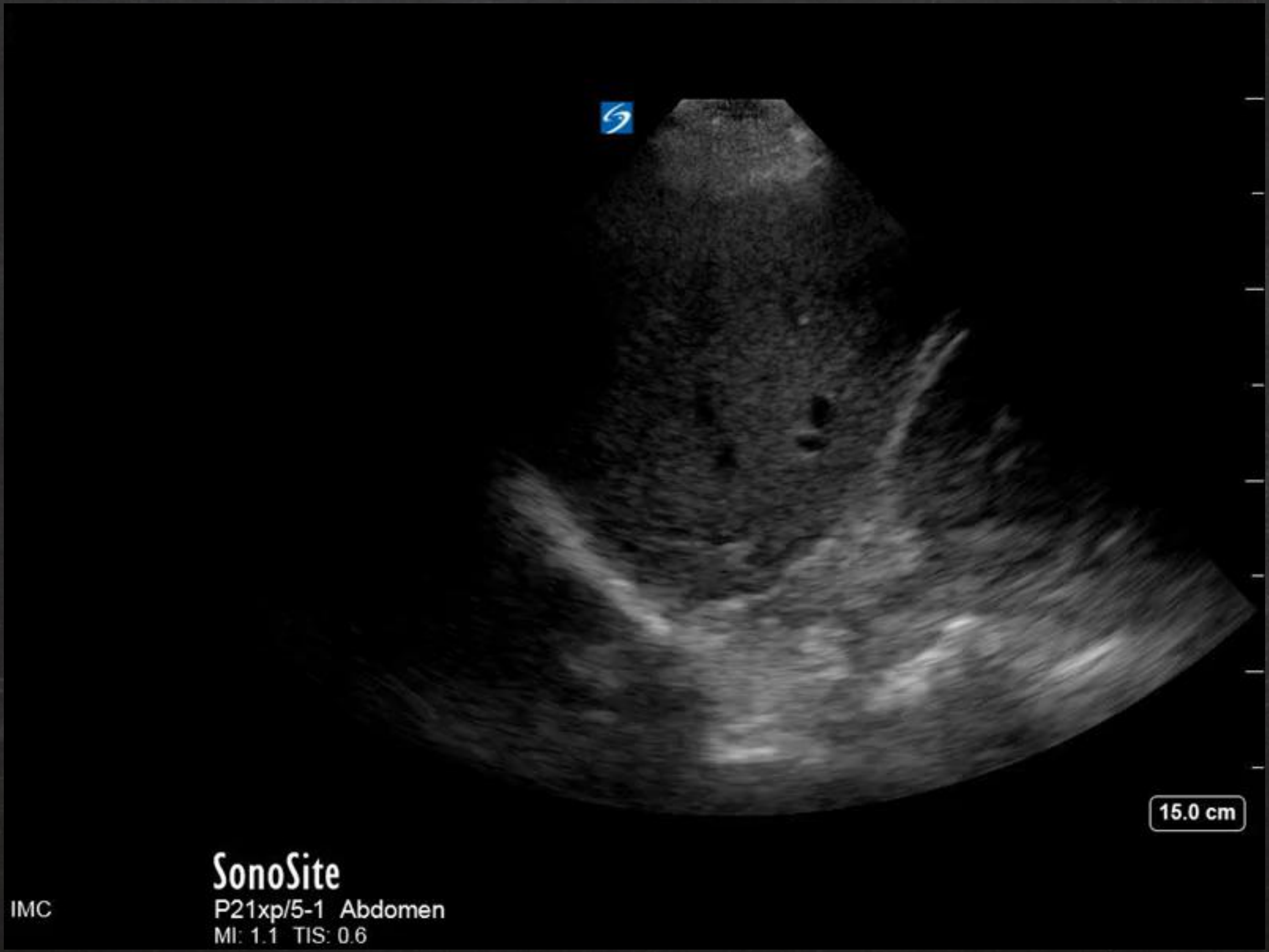
- 67 y/o man with hx of HFrEF (EF < 40%), COPD, > 50 pack year history of smoking, CAD, diabetes, obesity, and chronic back pain presents with progressive shortness of breath.
- ROS: no orthopnea, no PND, no weight gain, +productive cough with green sputum, no chest pain, +wheezing, no known sick contacts, no fevers, +swelling in his legs
- VS: T 100.2 F, HR 88, BP 112/84, RR 20, SpO2 91% on RA, BMI 34
- PE: fatigued, no oral exudates, distant lung sounds, occ expiratory wheeze bilaterally, no crackles, distant heart sounds, no murmur, neck veins not visible, mild (1+) bilateral LE edema, rest of the exam unremarkable
- Basic labs: electrolytes within normal limits, Cr 1.2 (at baseline), WBC 9 K with 76% neutrophils, BNP 1,200 (unknown baseline), lactate within normal limits
- EKG unremarkable

Initial lung ultrasound shows t finding



Lung bases shows this bilaterally …





Group Questions

- What was your differential for this patient prior to the ultrasound? What was most likely?
- What key lung ultrasound terms/patterns apply to this patient?
- How do the lung ultrasound findings affect your thinking?

CLICK TO SEE CASE CONCLUSION

CASE RESOLUTIONS

Case #1 Resolution

- US Findings: +lung sliding, B-lines pattern, + bilateral pleural effusions, + spine sign

- B-lines tracked over several serial ultrasound. Apical B-lines resolved, scattered B-lines remained at bases.
- Left pleural effusion resolved, right pleural effusion was trace
- Patients end weight was 143 lbs (22 lbs below his admission weight)
- He reported his breathing was the best he had felt in years …

- Click here to return to case #2

Case #2 Resolution

- US Findings: + lung sliding, A-line pattern, no pleural effusion
  - Unlikely to be heart failure – no B-lines
  - Unlikely to be pneumonia – no B-lines, no consolidations
- Patient treated with steroids, nebulizers, antibiotics
- Dyspnea rapidly resolved
- Discharged from the hospital a few days later with breathing back to baseline

Learning the Language of Cardiac Ultrasound

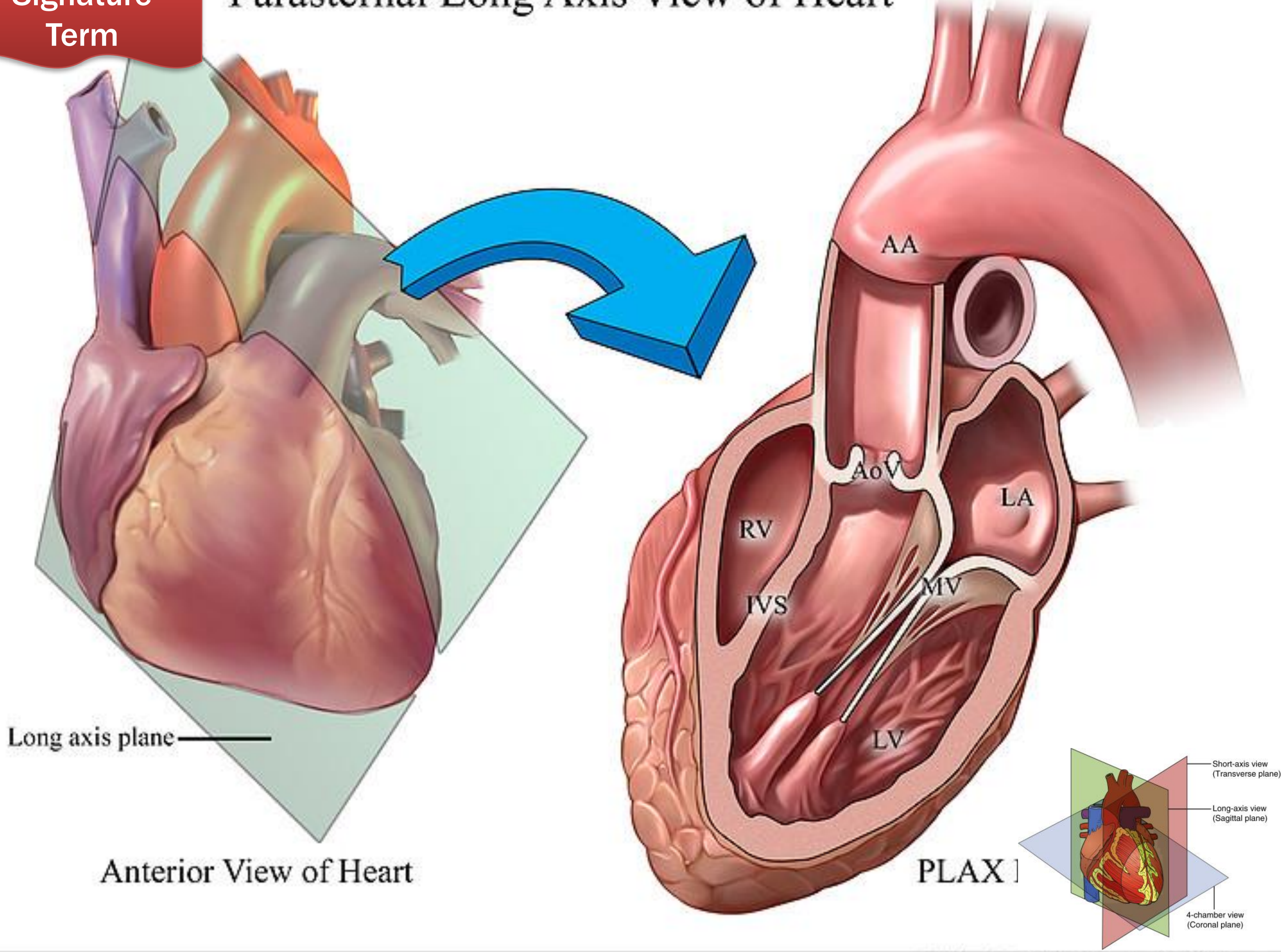
Goals and Objectives

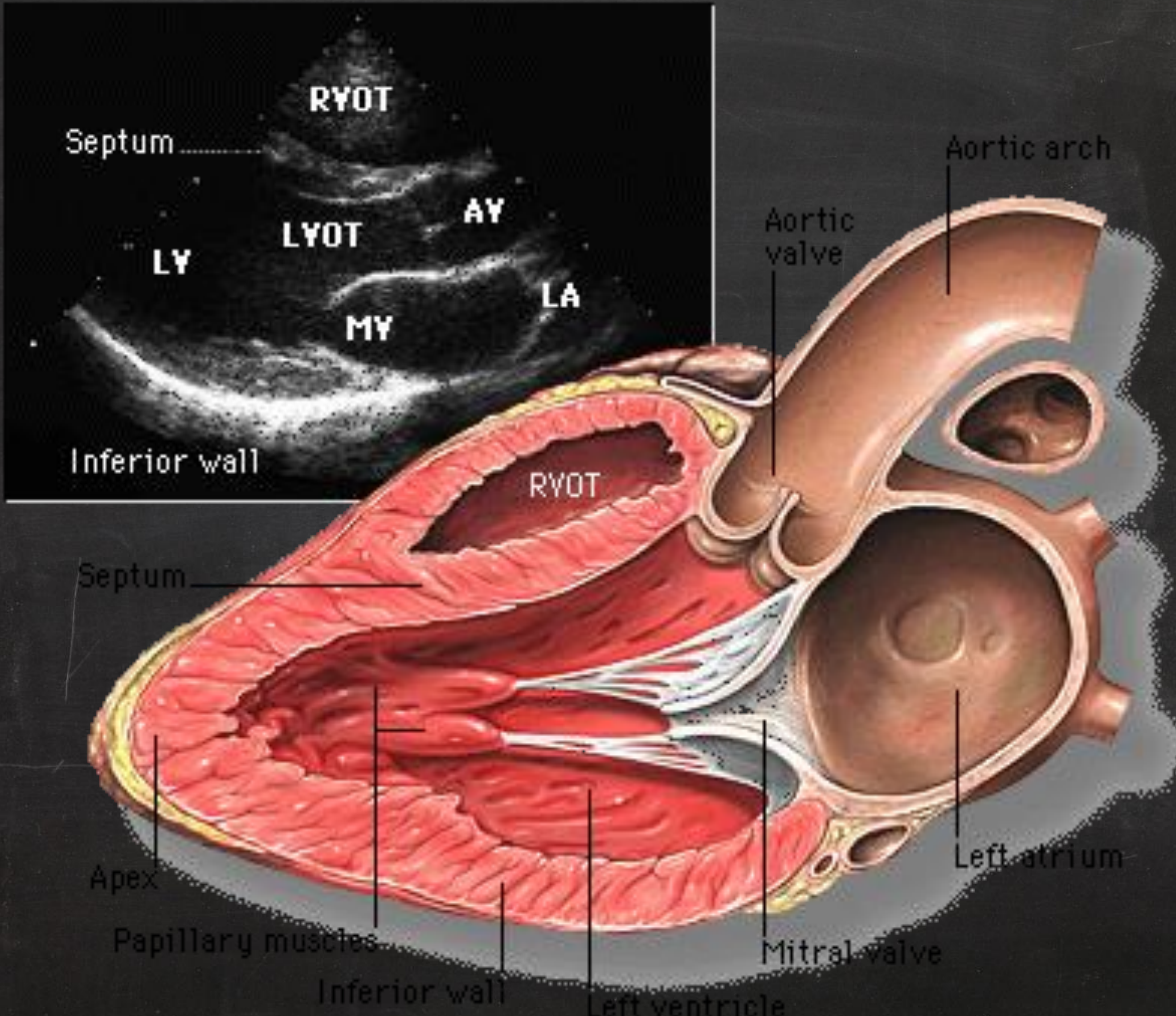
Signature Terms

- Point out key features in Parasternal Long Axis (PLAX) and Parasternal Short Axis (PSAX) at Papillary Muscle views to evaluate left ventricular systolic function
- Differentiate normal, hyper-dynamic, and severely reduced left ventricular systolic function for PLAX and PSAX at Papillary Muscle Views
- Identify pericardial effusion

Signature Term

Parasternal Long Axis View of Heart





RVOT
Septum
AV
LVOT
LV
LA
MV
Inferior wall
Aortic arch
Aortic
valve
RVOT
Septum
Left atrium
Apex
Papillary muscles
Mitral valve
Inferior wall
Left ventricle

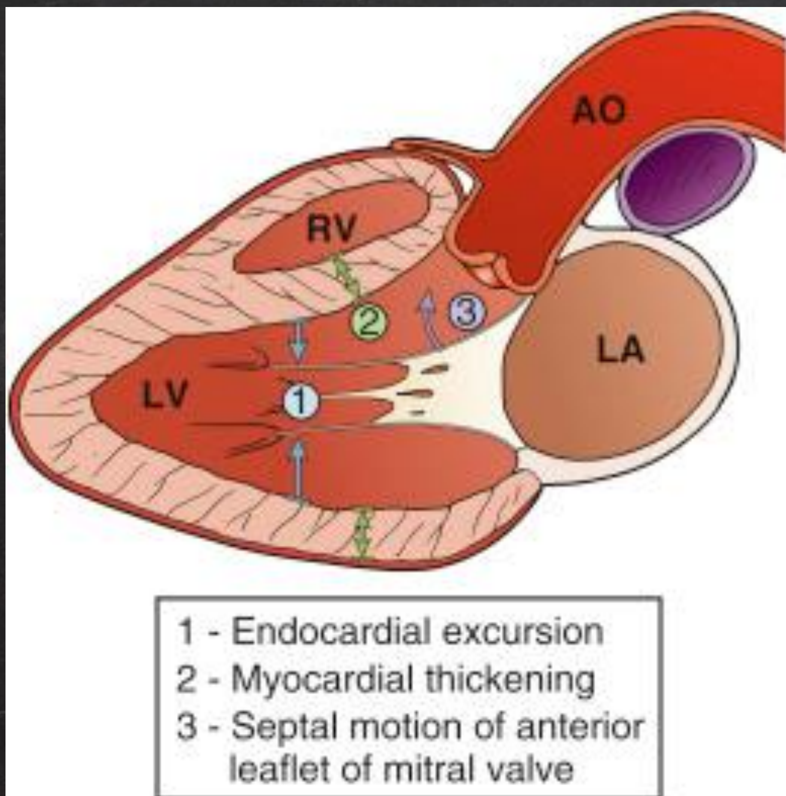
Signature Term

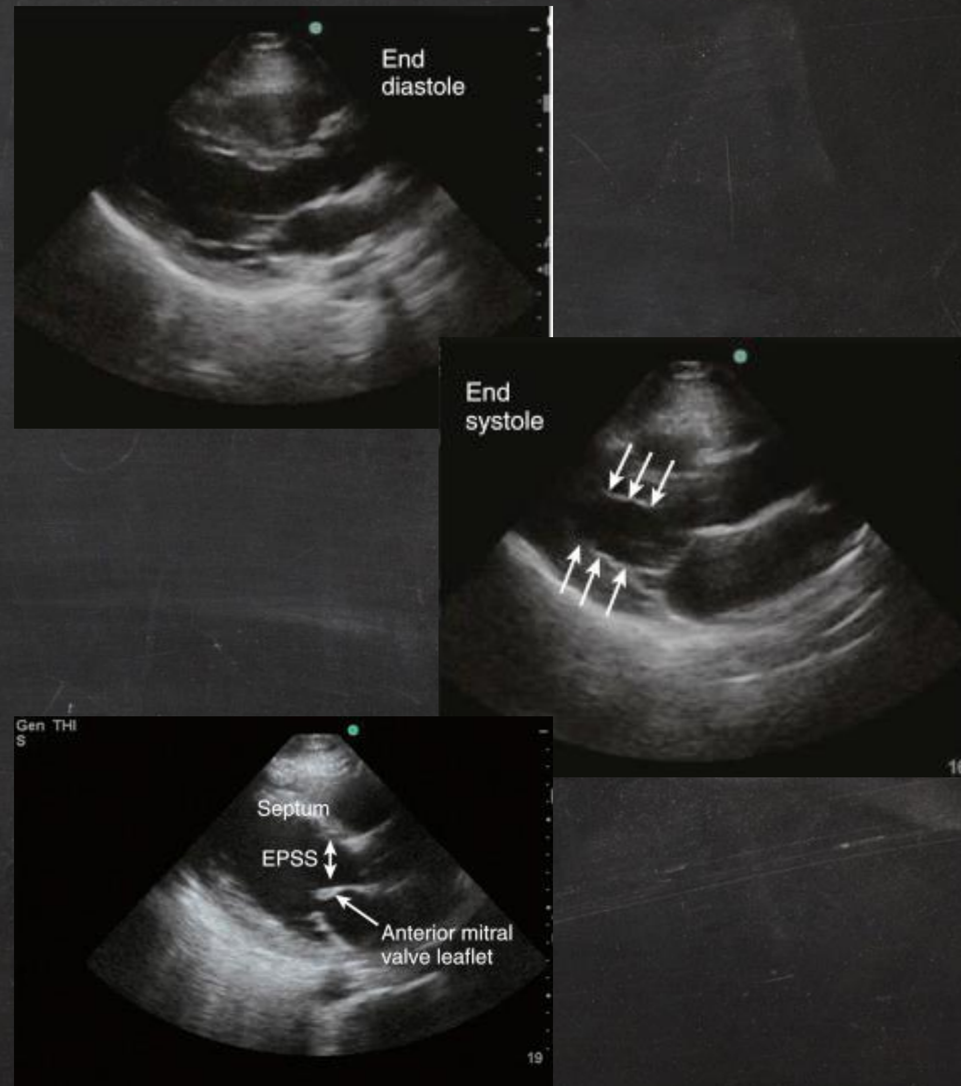
Pericardial Effusion

Pericardial Effusion

Pericardial Effusion in Motion!

Features to evaluate LV systolic Function in PLAX





Point of Care Ultrasound. Arntfield, Robert; Soni, Nilam J.; Kory, Pierre. Published December 31, 2014. Pages 103-109.e2. © 2015.

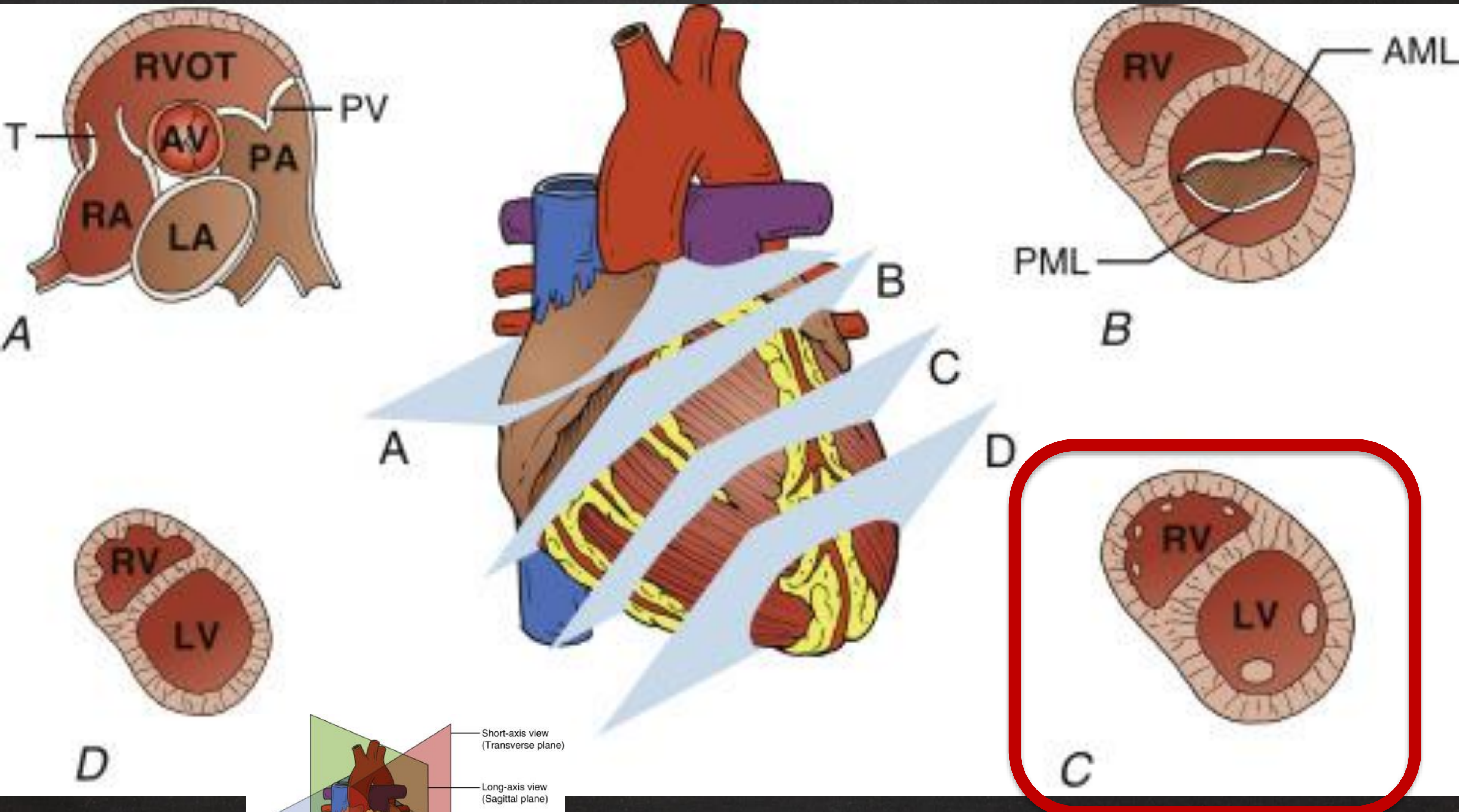
Signature Terms

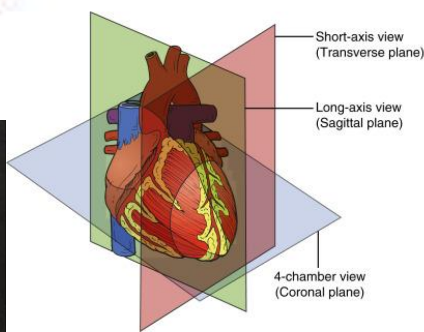
Three basic categories of Left Ventricular Systolic Functions

- Normal
- Severely Reduced
- Hyperdynamic

Signature Term

Parasternal Short Views: Papillary Muscle View





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Signature Terms

Three basic categories of Left Ventricular Systolic Functions

- Normal
- Severely Reduced
- Hyperdynamic

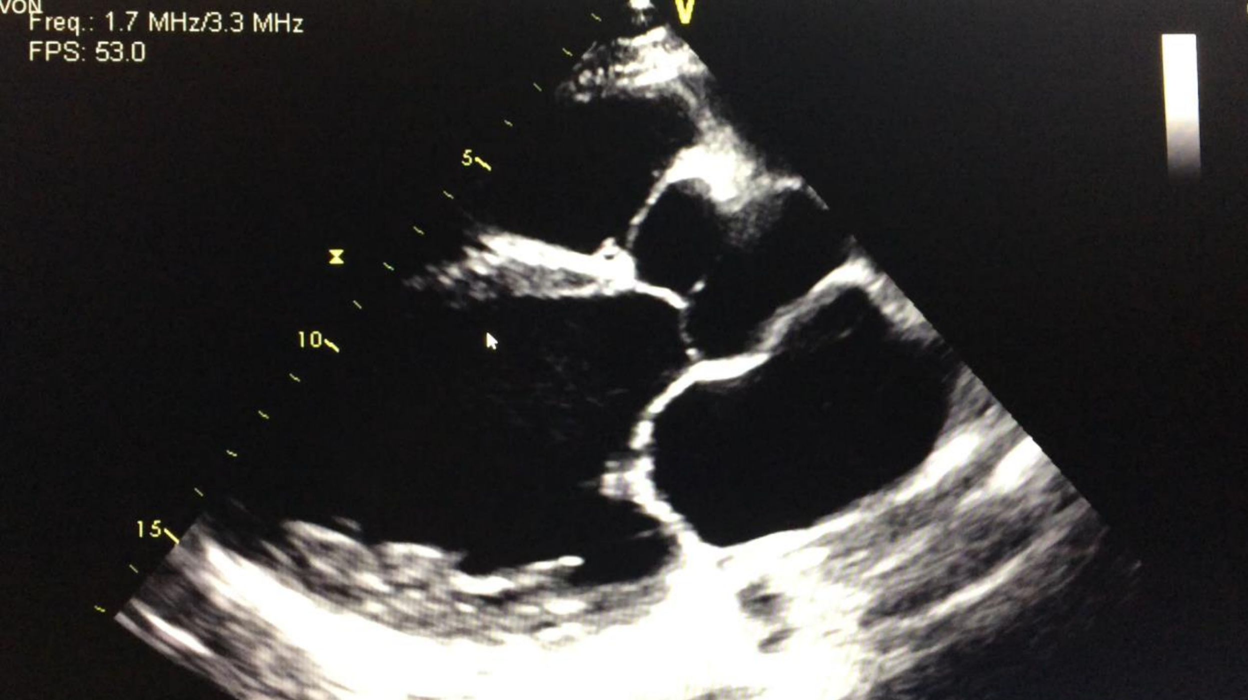
ON TO THE CASES!

Case Presentations

Cardiac function

“Loss of appetite with abdominal pain and nausea”

- 36 year old gentleman with no past medical history
- Presents with one month history of dull abdominal pain, nausea, and loss of appetite. Pain improves with standing or sitting up
- Denies chest pain, shortness of breath, orthopnea
- Afebrile, 110/90, HR 110, RR 18, 100% on RA
- Exam: JVP at 15cm, Hepatojugular reflex, Kussmal sign, S1 and S2, +S3, RV heave, palpable pulmonary artery in 2nd intercoastal space, displaced and sustained PMI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10
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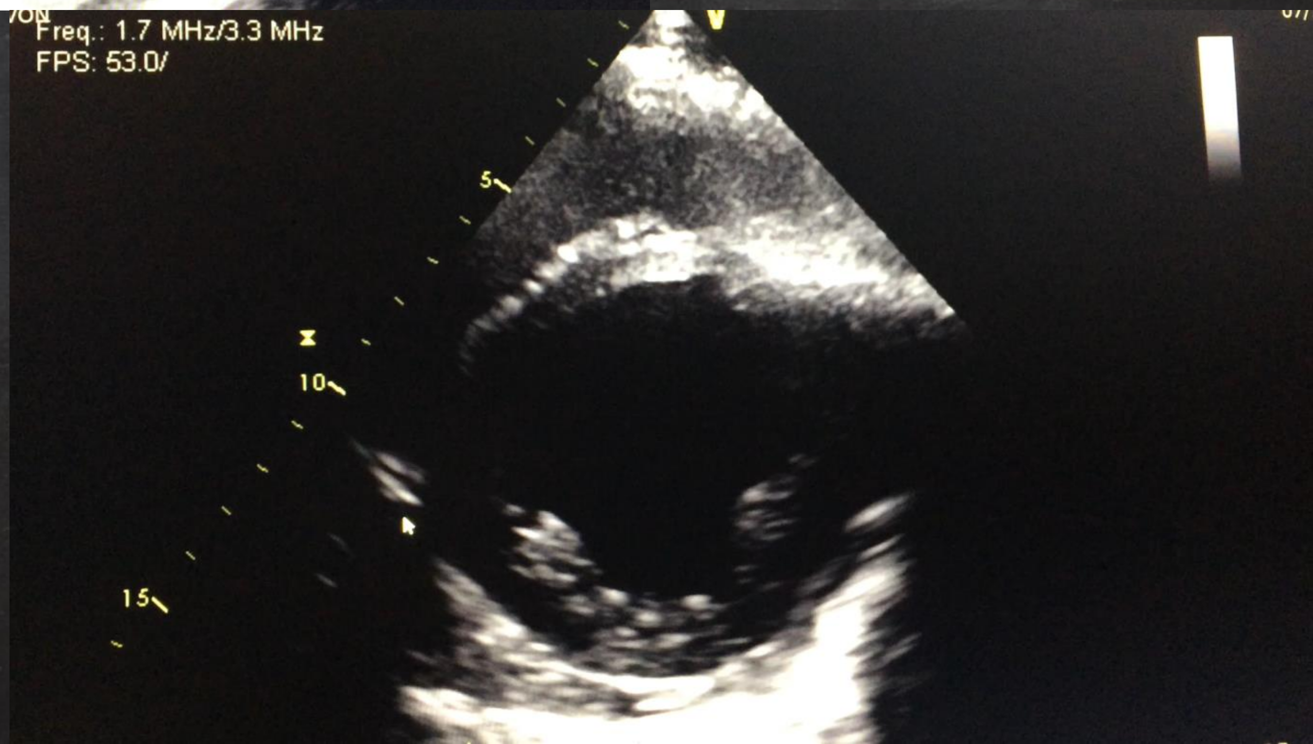
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5
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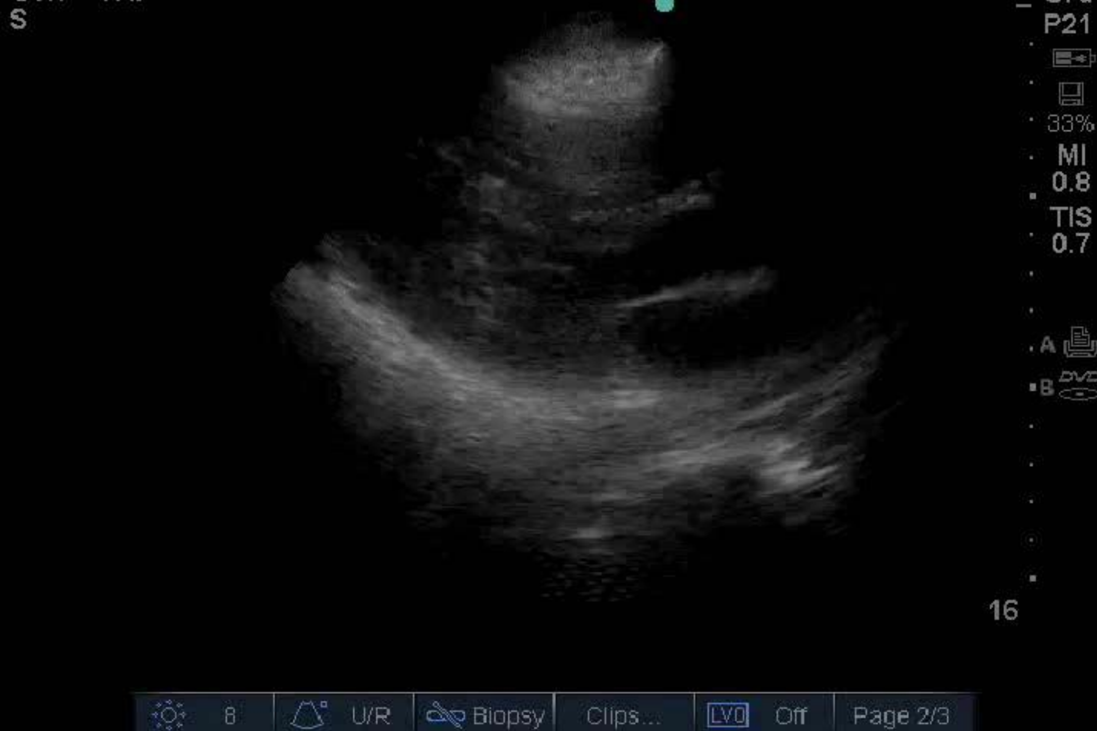
Group Discussion Questions

- Did the history correlates with the physical exam?
- How long would it take for your hospital to get a formal echocardiogram to confirm your physical finding?
- Would knowing his left ventricular systolic function before the formal echocardiogram help with your clinical management?
- What if his physical exam is not obvious for heart failure?

"Should I give more fluids?"

- 80 year old gentleman with unknown cardiac history presented with altered mental status and hypotension. Providers were not able to obtain other medical history
- Urine culture was positive for E coli. Blood cultures were pending. Antibiotics were started.
- After 6L IVF, this gentleman continues to be hypotensive with MAPs in 50s. Norepinephrine was started.
- Should the provider continue to give fluids?


S
P21
33%
MI
0.8
TIS
0.7
A
B
DVD
16
8
U/R
Biopsy
Clips...
LV0
Off
Page 2/3


P17
CF
75%
18
86
MI
0.6
16
Gen
0
Dual
Clips...
Biopsy
Page 2...

Group Discussion Questions

- Without the information from POCUS, would you have continued to give IVF?
- How does this information effect your clinical management?

Learning the Language of Inferior Vena Cava (IVC) Ultrasound

Inferior Vena Cava (IVC) in POCUS

What is the Volume Status?

Is the patient dry?

Have I diuresed enough?

Can I give more fluid safely?

What is the right atrial status?

IVC and It's Measurement

Commonly used, so what should you know?

- Not as straightforward as many think
- Shouldn't be used in isolation
- VERY easy for novices to image the aorta instead
- Extremes often helpful
  - Dilated + Minimal Collapsibility <u>or</u> Flat + Marked Collapsibility

Signature Term

IVC Diameter & Collapsibility

- 61 year old man with sepsis from pyelonephritis
- The resident team you are supervising performs a POCUS of the IVC.

Flat, collapsible IVC points towards low right atrial pressure, **fluid tolerance**

IVC Diameter & Collapsibility

- 76 year old woman admitted with acute hypoxemic respiratory failure secondary to suspected pneumonia
- The morning team obtains this ultrasound of the IVC…

- Dilated (>2cm) + minimally collapsible IVC
- Suggestive of elevated right atrial pressure, **fluid Intolerance**

76F with shortness of breath, develops hypotension

Initial Interpretation: Elevated right atrial pressure

Initial Integration: No further bolus as risk fluid overload, consider diuresis

Obtain Additional Views:
Lungs + Heart

76F with shortness of breath, develops hypotension

IVC

Initial Interpretation: Elevated right atrial pressure

Initial Integration: No further bolus as risk fluid overload, consider diuresis

Obtain Additional View: **Lungs**

Interpretation: A-line pattern, no interstitial edema
Revised Integration: Possible invitation for fluid bolus

76F with shortness of breath, develops hypotension

IVC

Initial Interpretation: Elevated right atrial pressure

Initial Integration: No further bolus as risk fluid overload, consider diuresis

Lung

Interpretation: A-line patter, no interstitial edema

Revised Integration: Possible invitation for fluid bolus

Additional View: **Heart**

76F with shortness of breath, develops hypotension

IVC

Initial Interpretation: Elevated right atrial pressure

Initial Integration: No further bolus as risk fluid overload, consider diuresis

Lung

Interpretation: A-line patter, no interstitial edema

Revised Integration: Possible invitation for fluid bolus

Additional View: **Heart**

Interpretation: pericardial effusion/tamponade. Has one of the conditions (tamponade, PE, severe OSA, pulm HTN, RV infarct), that leads to low left atrial pressure.

Revised Integration: IV fluid bolus

Clinical Integration
Approach to IVC

First Use History + Examination + Data

FAT IVC + Doesn't Collapse (<50%)
Decreased LV function
+ B-Lines

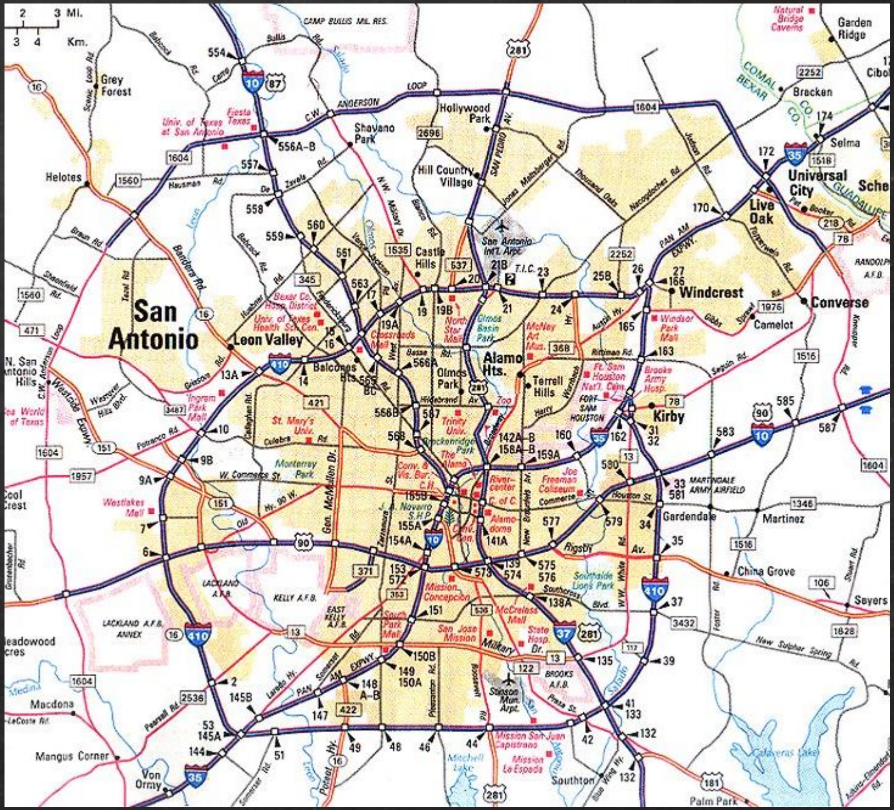
FLUID INTOLERANT
Doesn't Support Low RAP
Not Preload Responsive

FLAT IVC + Collapses (>50%)
Normal/Hyperdynamic LV
No B-Lines

FLUID TOLERANT
Supports Low RAP
Preload Responsive

Roadmap – Where we've been

Ultrasound as a Second Language: Learning the Lingo

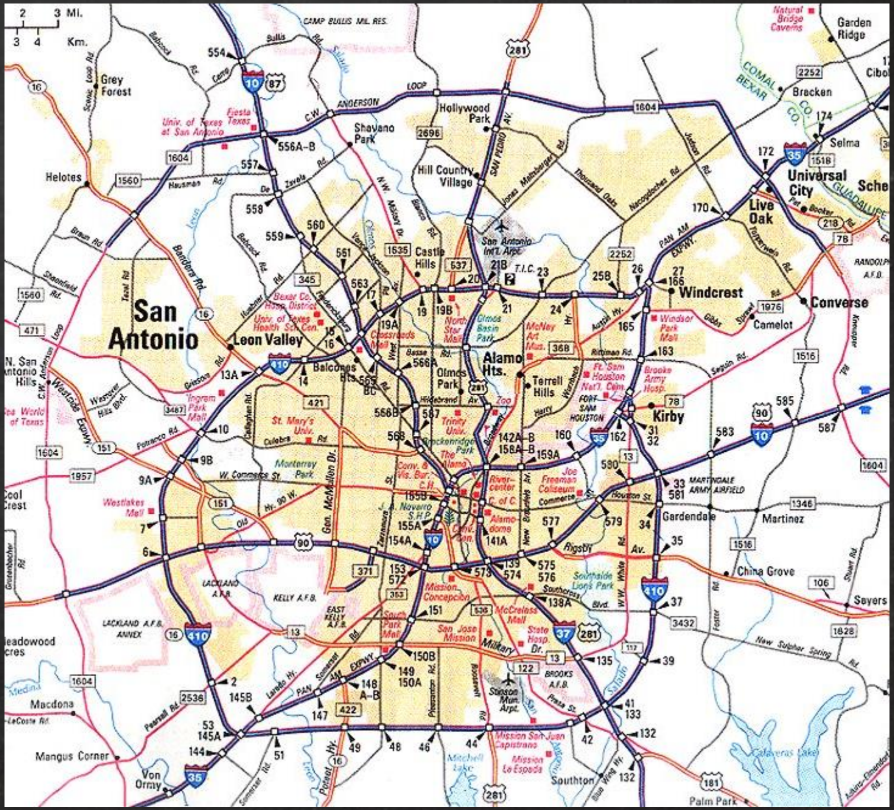


Roadmap – Where we've been

Ultrasound as a Second Language: Learning the Lingo

Lung Ultrasound

- Sliding
- A-line
- B-line
- Spine Sign

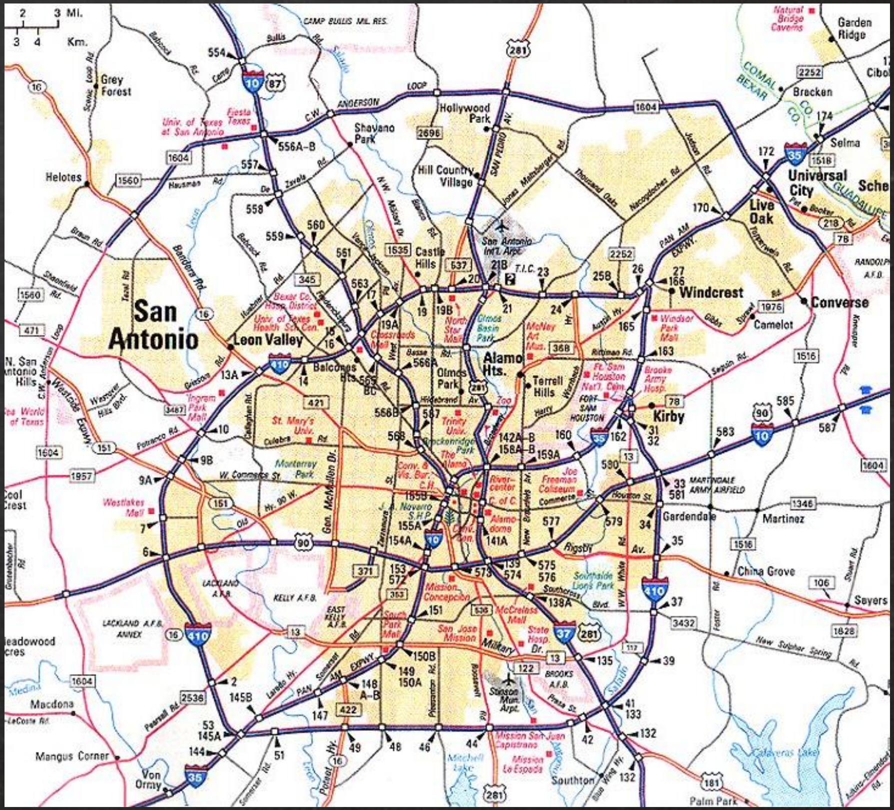


Roadmap – Where we've been

Ultrasound as a Second Language: Learning the Lingo

Cardiac Ultrasound

- Parasternal Long Axis (PLAX)
- Parasternal Short Axis (PSAX)
- Systolic Function: normal, hyper-dynamic, severely reduced
- Pericardial effusion



Roadmap – Where we've been

Ultrasound as a Second Language: Learning the Lingo

IVC Ultrasound

- Diameter
- Collapsibility
- Fluid Tolerance