POCUS Introduction and Workshop

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Conflict of Interest Statement

We have none; our opinions expressed are based on our experiences with specific interfaces/products

Our views do not express those of our employers

Objectives

At the end of this lecture you will better

- **Understand Ultrasound language and descriptors**
  -just the basics, but a brief foundation
- **Perform a FAST abdominal exam**
  -Identify abdominal organs and anatomic landmarks
- **Discuss how to implement POCUS into clinical practice**
  -where do we go from here

What do we mean with the term POCUS or point-of-care ultrasound?

An innovative handheld tool available at the bedside to answer a specific clinical question for diagnostic and/or therapeutic purpose.

(With a little help from your smartphone)

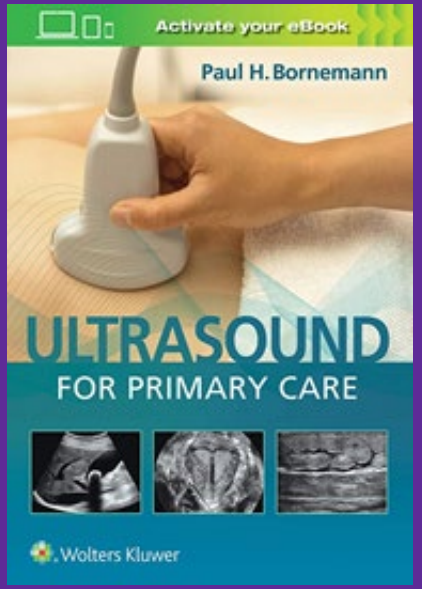
POINT-OF-CARE ULTRASOUND USES

POCUS uses	Scope of use	Example questions
Physical exam extension	Focused	"Is this palpable mass a cystic or solid structure?" "Is the baby in the cephalic or breech presentation?"
Procedural	Focused	"Where is the best location to insert a needle?" "Where is the foreign body?"
Diagnostic	Focused	"Are there stones in the gallbladder?" "Is there a pregnancy in the uterus?"
Multi-organ scans	Extended	"Is the patient's hypotension due to sepsis, heart failure, or acute blood loss?" "What is causing the patient's dyspnea?"

Our Experiences:

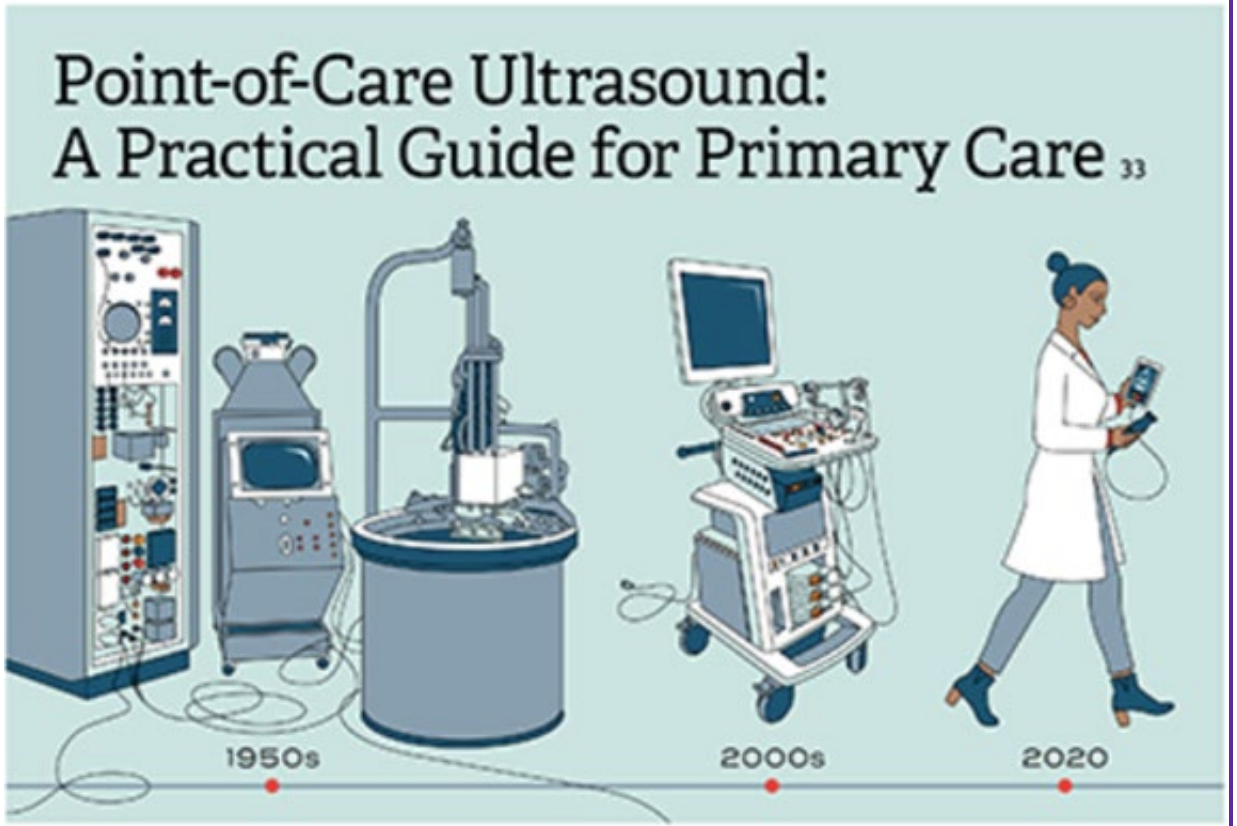
-AR – 2 day 16 hour course through GUSI at STFM National Conference
-GF – 1 day course at Upstate through EM program
-NK – Elective during PGY3 year in rural Family Medicine Office

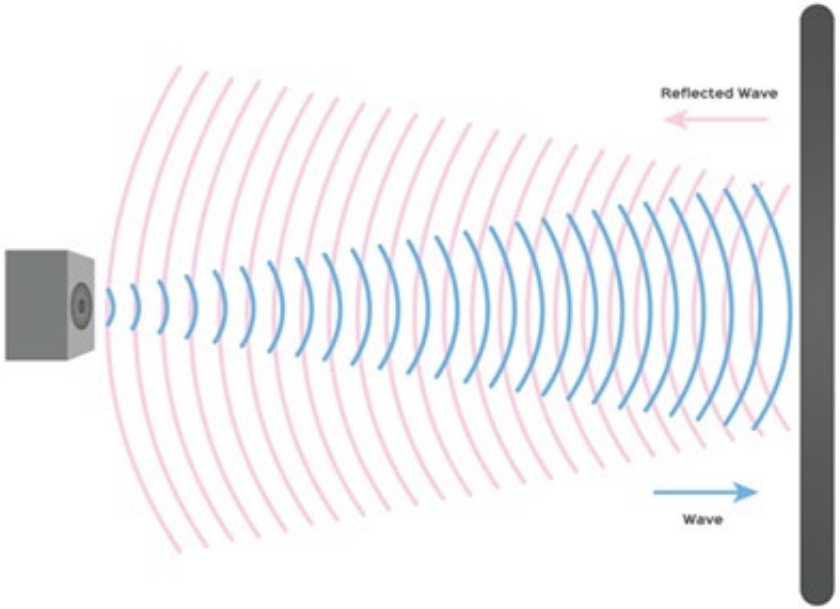
-Today is a BRIEF intro; there are year long fellowships in POCUS!



GUSI

US Basics


Point-of-Care Ultrasound:
A Practical Guide for Primary Care 33
1950s
2000s
2020



Works by sending out sound waves; the returning waves help determine the location of objects/structures

Definitions:

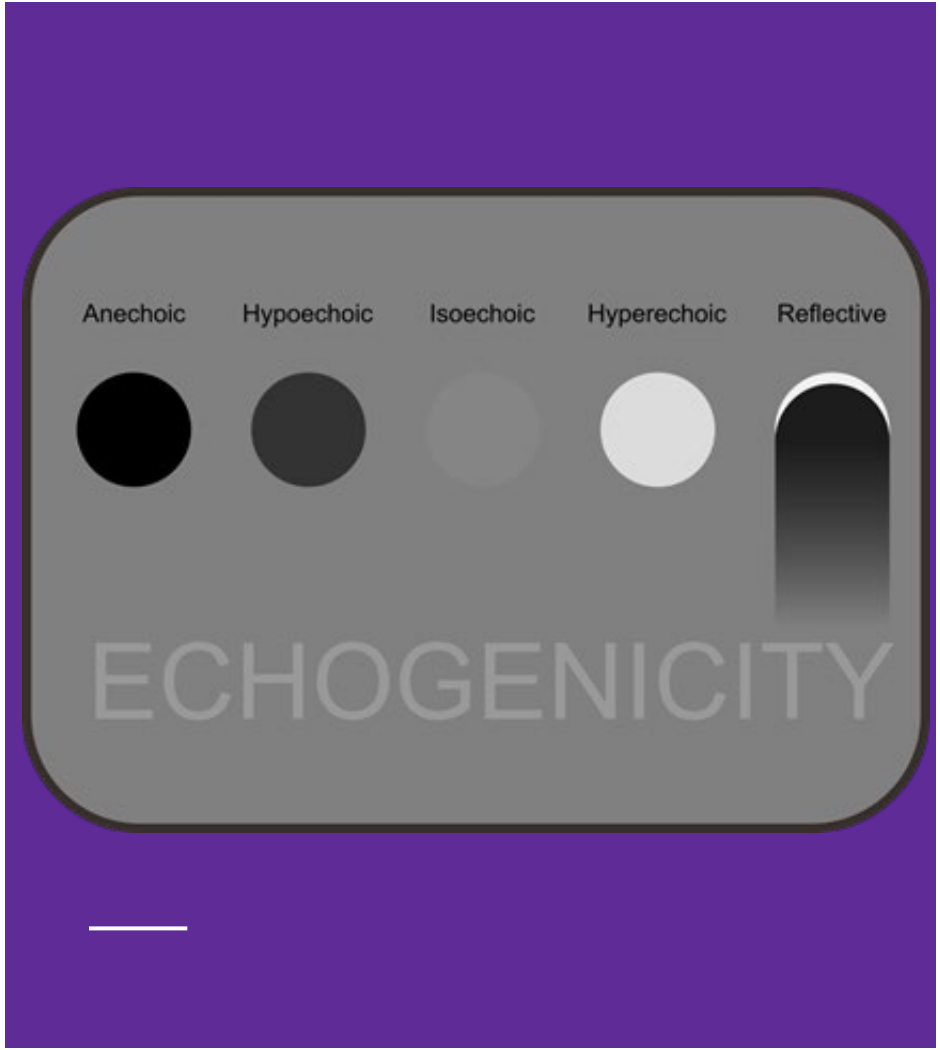
Echogenicity

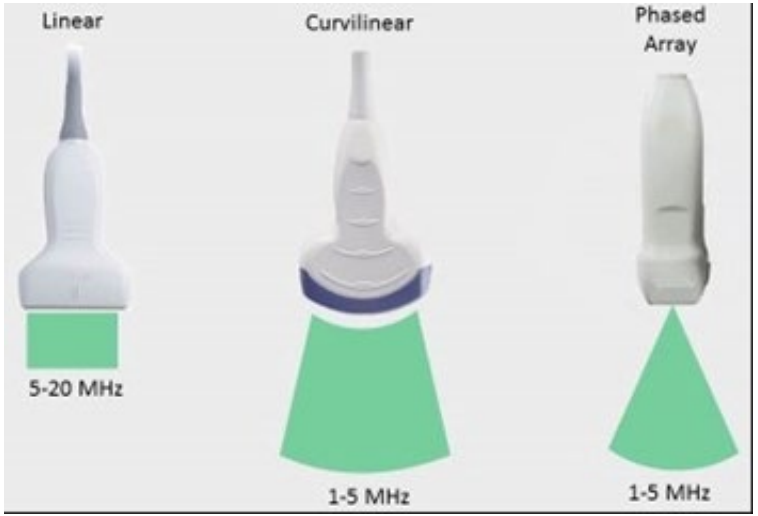
-Hyperechoic-more returning sound waves (bones, stones); brighter

-Hypoechoic- fewer returning sound waves

-Anechoic-no returning sound waves; black

-Isoechoic-grey scale, similar in appearance (organs)





Closer to the probe, more superficial

Further from the probe deeper

Probe choice will often default settings:

Low frequency has longer wavelengths, deeper penetration, though quality not as clear (Abdominal)

High frequency has shorter wavelengths, more superficial penetration, better quality (MSK, vascular)

Types of Probes:

-Curvilinear-low frequency, deep penetration. General OB and abdominal applications
-linear-higher frequency, more superficial penetration. MSK, procedures
-cardiac (phased array)-low frequency, smaller head; easier to fit between ribs
-Intracavitary-vaginal, oropharyngeal

Tip

For most phone/tablet compatible US probes, there are presets for each organ system that adjust frequency, and other settings to best capture images.

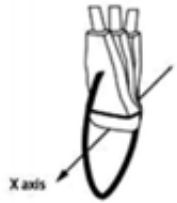
How to scan? What movements are there?

What is indicated by the indicator?
-usually oriented to the top left of the screen

-probe marker is usually oriented to the patient's right (short axis) or the patients head (long axis); the probe has an index marker to indicate proper orientation

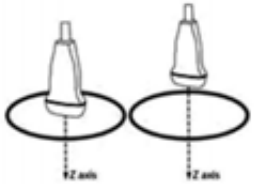
Example:
https://www.pocus101.com/ultrasound-machine-basics-knobology-probes-and-modes/

Fan



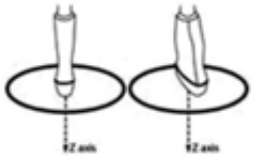
Motion in the short axis of the probe along a fixed point on the body while changing the angle of insonation away from 90°

Pressure/compression



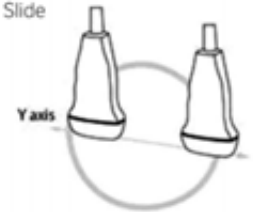
Pressure on the probe into the body, compression of the body by applying force on the probe toward the patient's body

Rotation



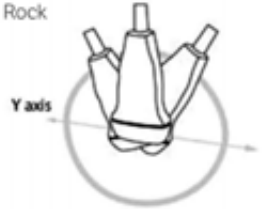
Movement around the compression axis in a clockwise or counter-clockwise direction

Slide



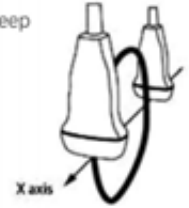
Motion in the long axis of the probe across the body with a consistent angle of insonation at 90° to the target

Rock



Motion in the long axis of the probe along a fixed point on the body while changing the angle of insonation away from 90°

Sweep



Motion in the short axis of the probe across the body with a consistent angle of insonation at 90° to the target

Modes of Ultrasound

-B-Mode/2D Mode

-default view; generates 2D black and white image

- M Mode

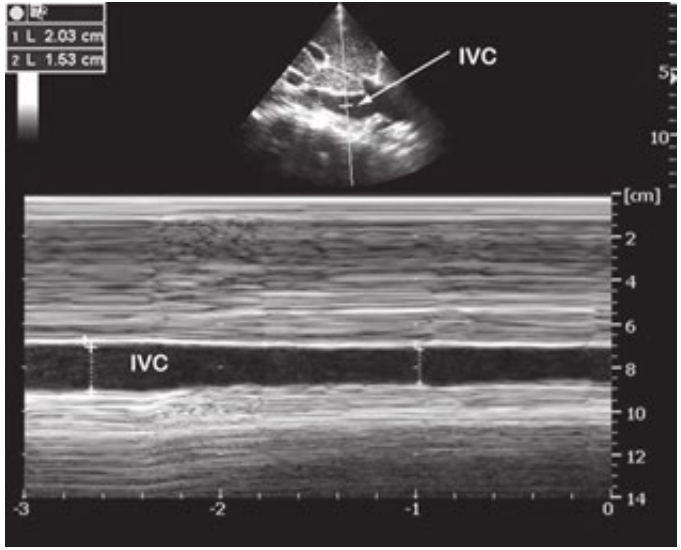
-motionscape mode; displays one dimensional information obtained within a specific spike. (x axis represents time, Y axis captures pixels). Often useful for cardiac wall motion, IVC compression

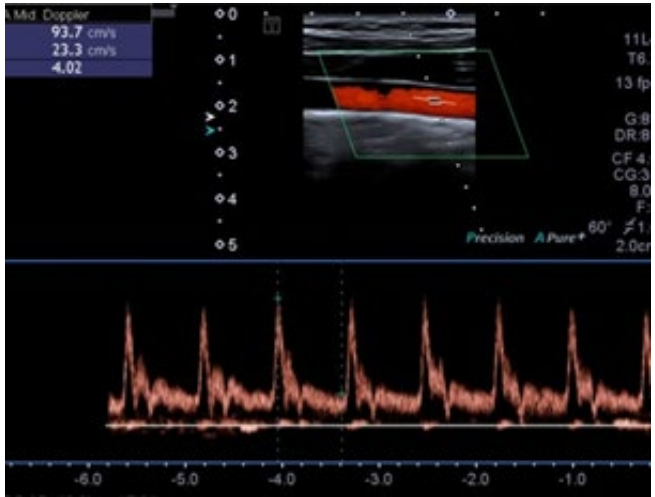
-Doppler Mode- detects flow

-Color doppler-indicates direction of flow in a specific area

-Power doppler-similar to color, but better for low flow (can quantify, but doesn't give directionality of flow)

-Spectral doppler-provides quantitative information on the flow at a specific location (Can determine stenosis in a blood vessel, heart valve)





Ultrasound Artifacts

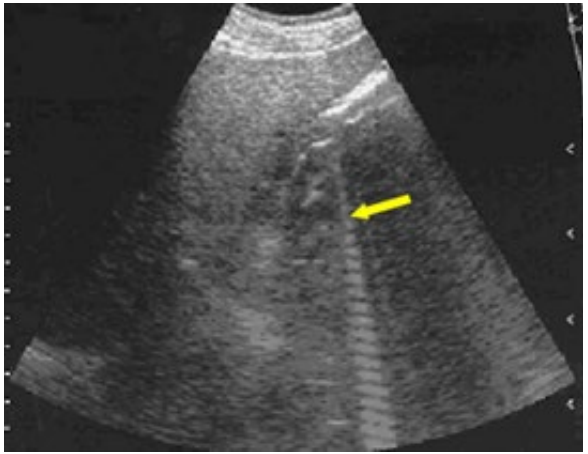
Acoustic Shadow-occurs when US waves hit a highly reflective structure. All waves are reflected back to the transducer and none pass through the structure.

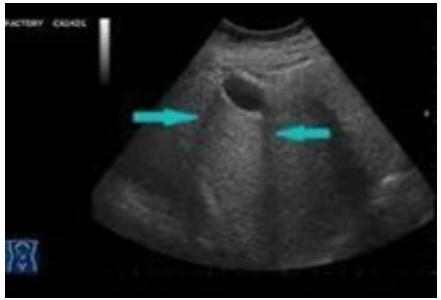
Posterior Acoustic Enhancement- opposite of acoustic shadow. US beam passes through low attenuation structure which amplifies the signal and causes deep hyperechoic zone.

Edge Shadow Effect-occurs at the edge of a circular structure (hypoechoic line parallel to the beam–US waves bounce off edge of the structure)

Mirror Image Artifact-occurs with strong reflectors a mirror image will appear on the other side of the structure. Seen with the diaphragm

Ring Down Artifact-also called comet tail. Similar to a reverberation effect. Seen with needles, prosthetics; also A lines in pleura

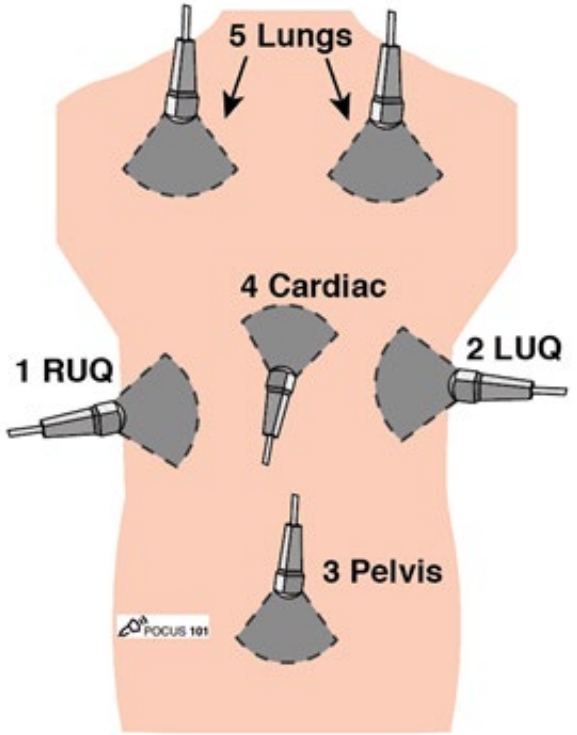


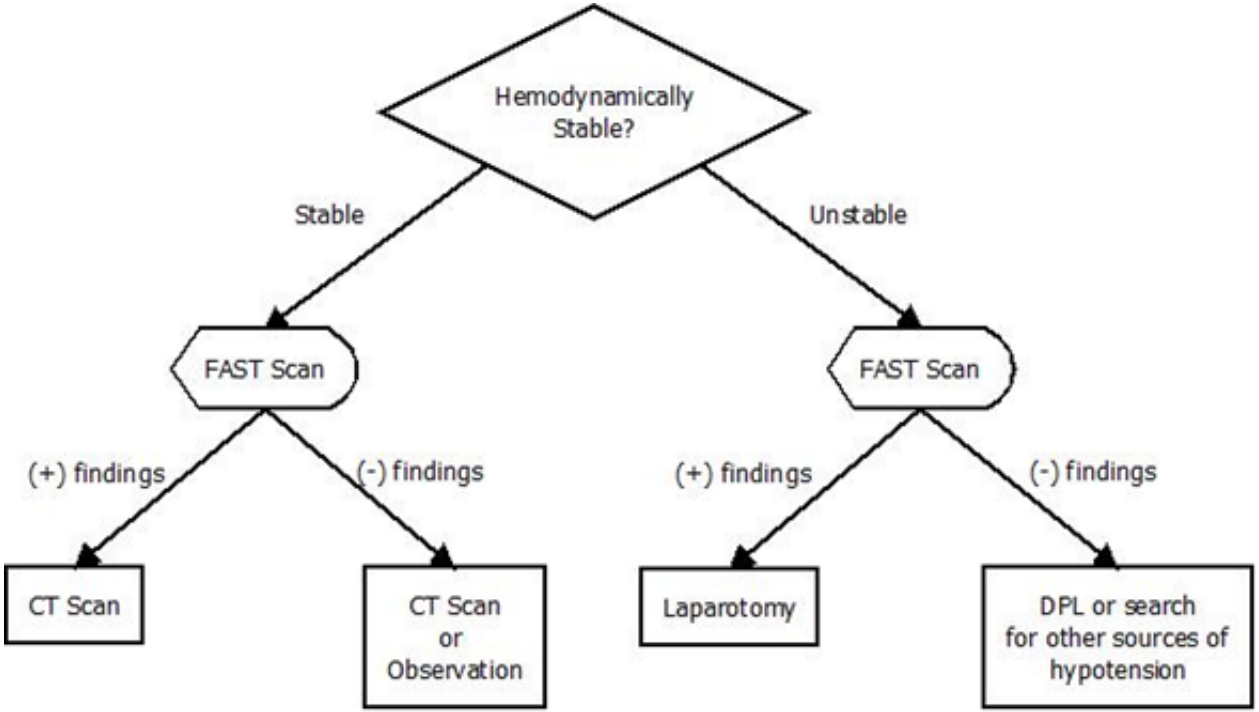


The E-FAST exam

E-FAST

1. Right upper quadrant view (RUQ)
2. Left upper quadrant view (LUQ)
3. Pelvic View
4. Cardiac view (Parasternal Long axis or Subxiphoid)
5. Lungs (Right and left)



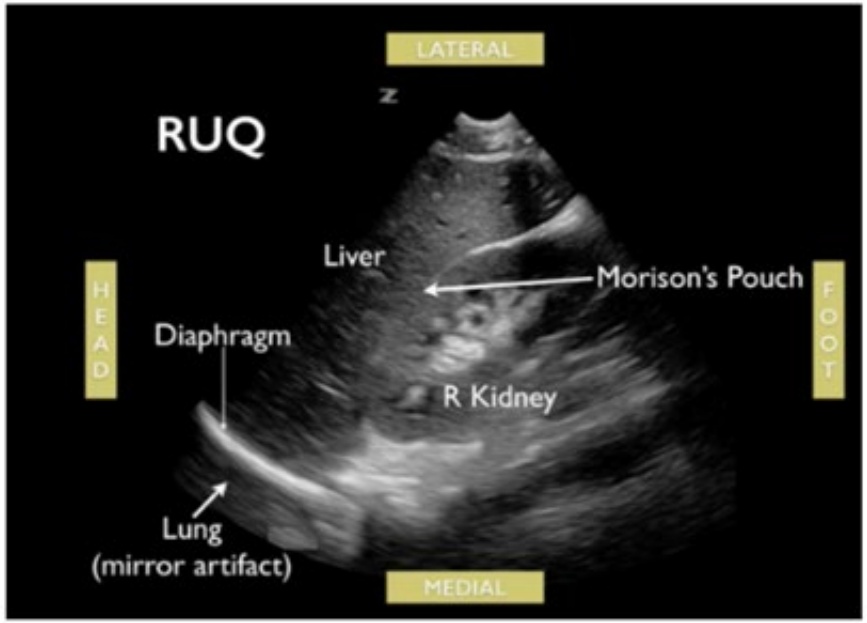

Hemodynamically Stable?
Stable
Unstable
FAST Scan
FAST Scan
(+) findings
(-) findings
(+) findings
(-) findings
CT Scan
CT Scan or Observation
Laparotomy
DPL or search for other sources of hypotension

RUQ View

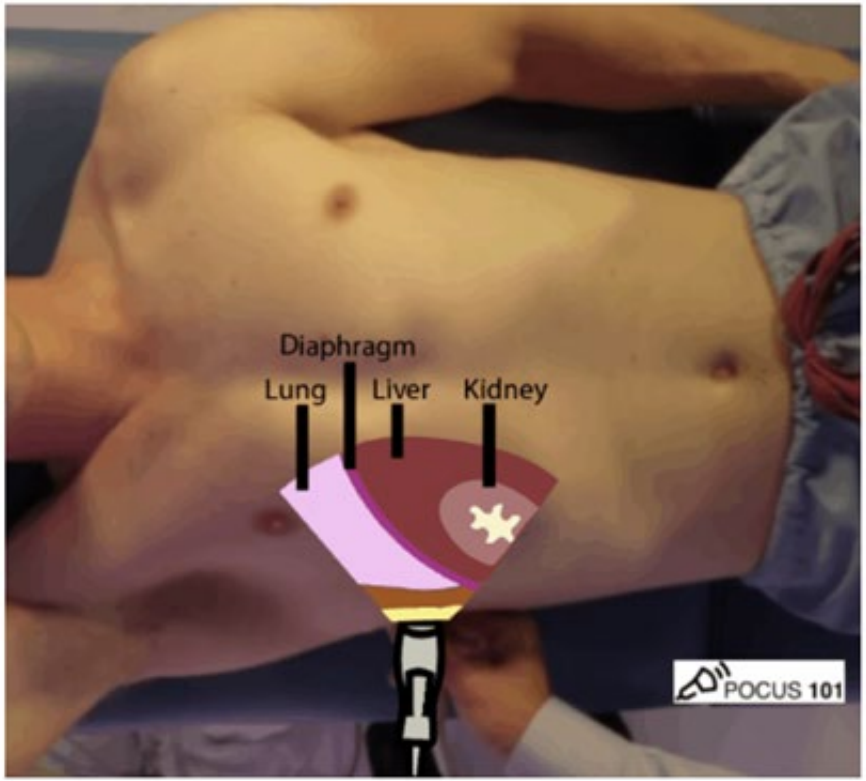
- Probe indicator facing towards patient's head
- Anchor your probe in the midaxillary line at the 10th intercostal space
- Is there free fluid in Morison's pouch?

eFAST Exam Probe Placement – RUQ

eFAST Exam Probe Placement – RUQ

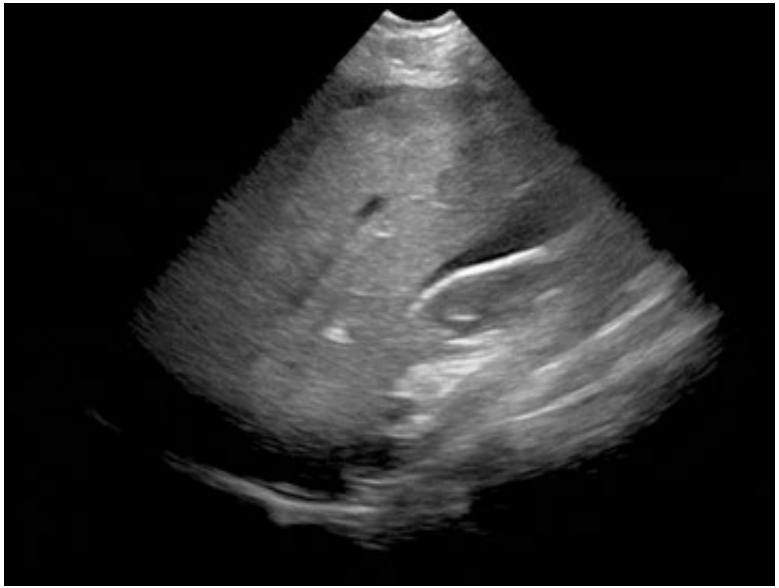


Normal RUQ – eFAST exam



RUQ eFAST exam illustration

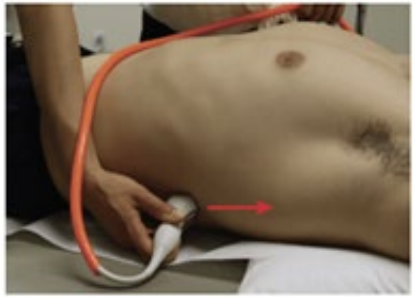
Hemoperitoneum



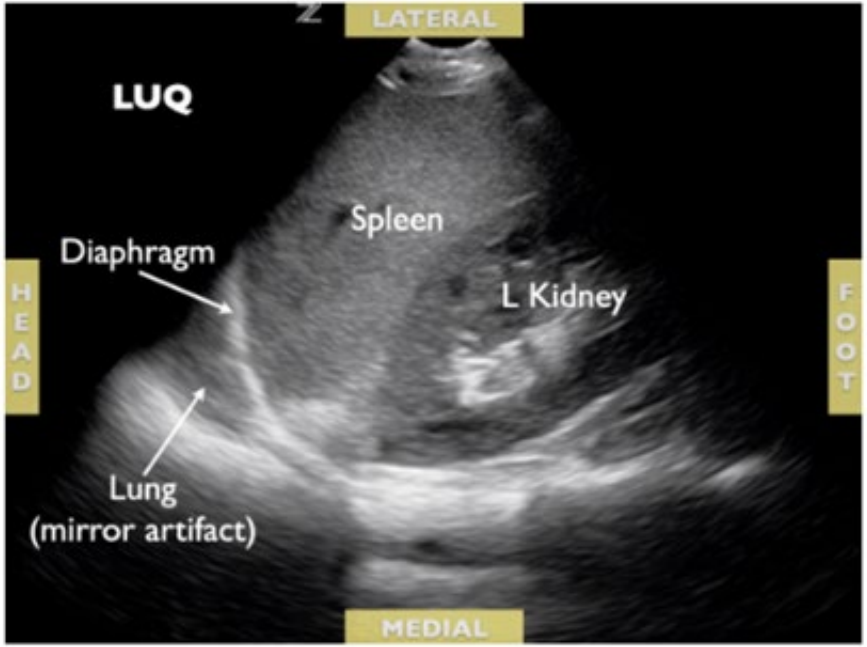
LUQ View

- Probe indicator pointing towards patient's head
- Anchor probe in the posterior axillary line around the 8th intercostal space
- Spleen is a fairly posterior structure
    - "Knuckles to the bed"

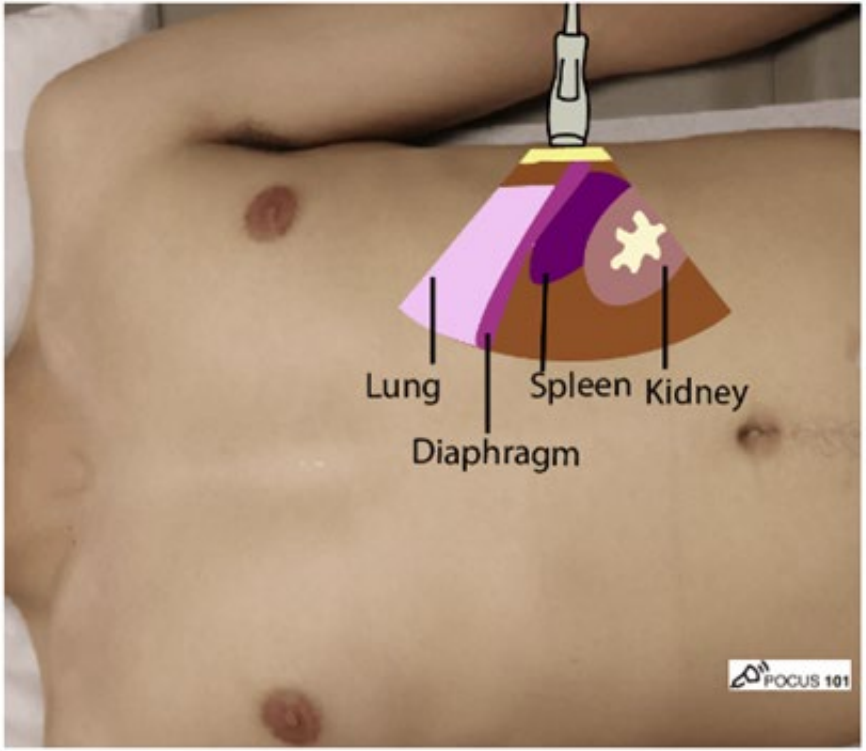
eFAST Exam Probe Placement – RUQ



"Knuckles to the Bed" for the LUQ eFAST exam view



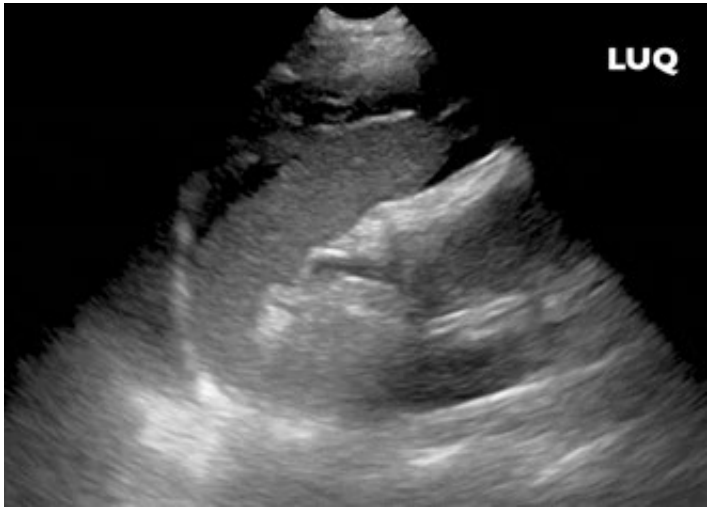
Normal LUQ – eFAST exam



LUQ eFAST exam illustration

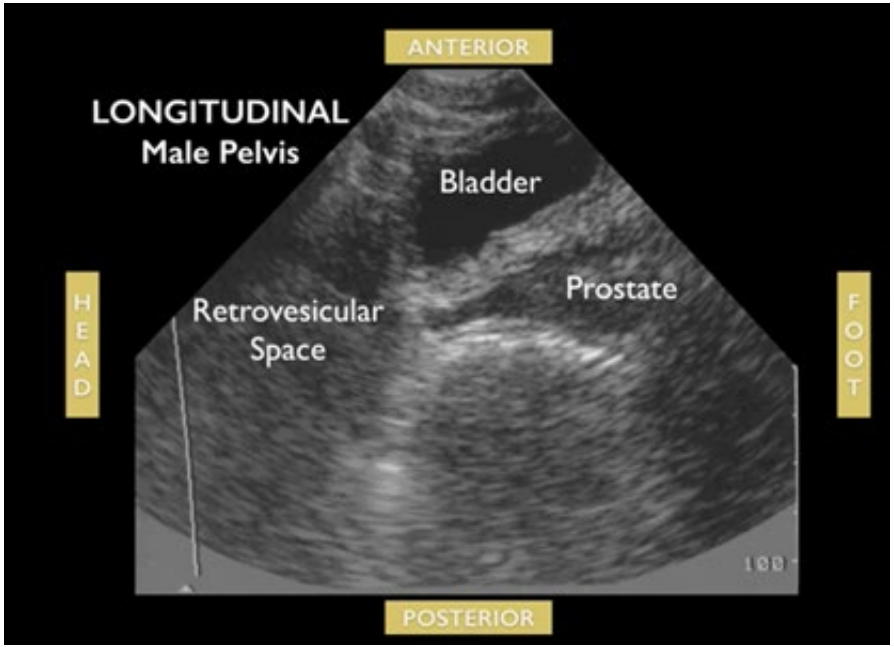
LUQ Hemoperitoneum

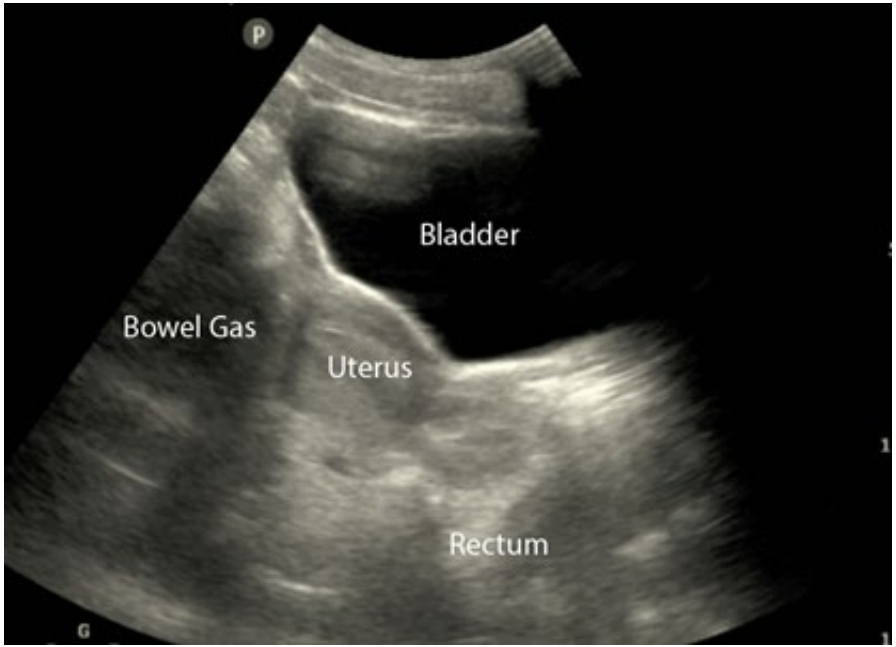
- Perisplenic Space
- Spleen tip
- Splenorenal Recess



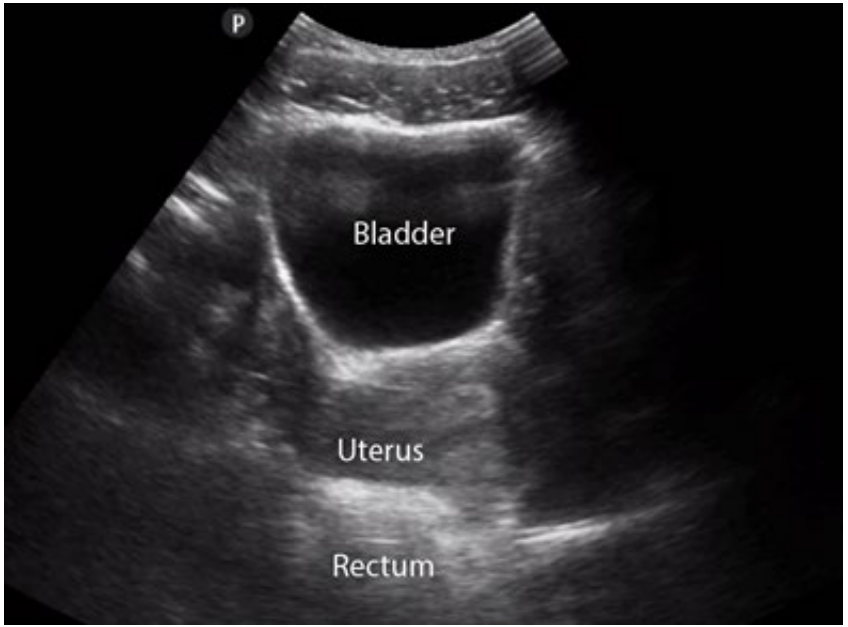
Pelvic View

- Transducer with indicator pointing towards patient's head
- Midline right above the pubic symphysis
- Rock the probe so that it points downward towards the pelvic cavity

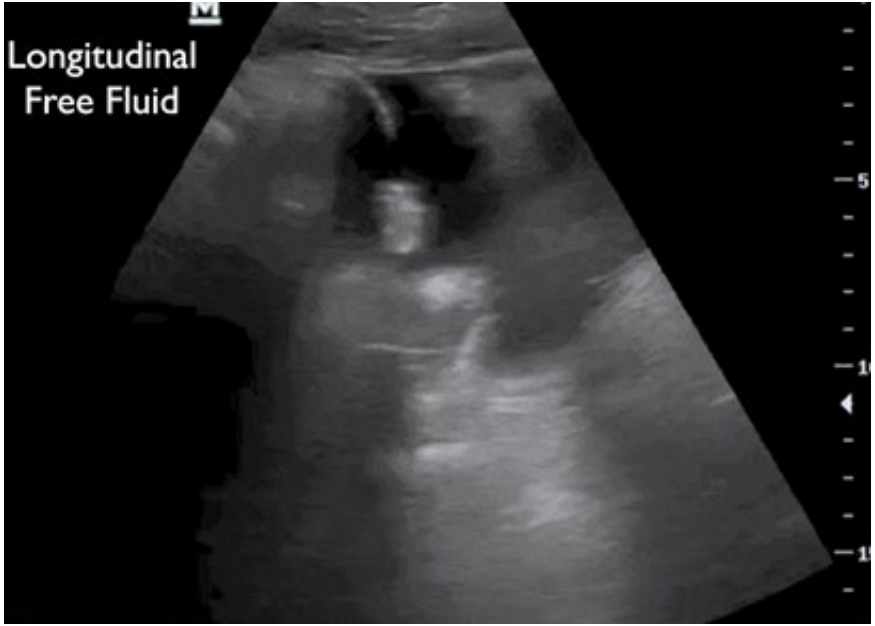

ANTERIOR
LONGITUDINAL
Male Pelvis
Bladder
Prostate
Retrovesicular
Space
HEAD
FOOT
POSTERIOR


Bladder
Bowel Gas
Uterus
Rectum

Transverse pelvic view

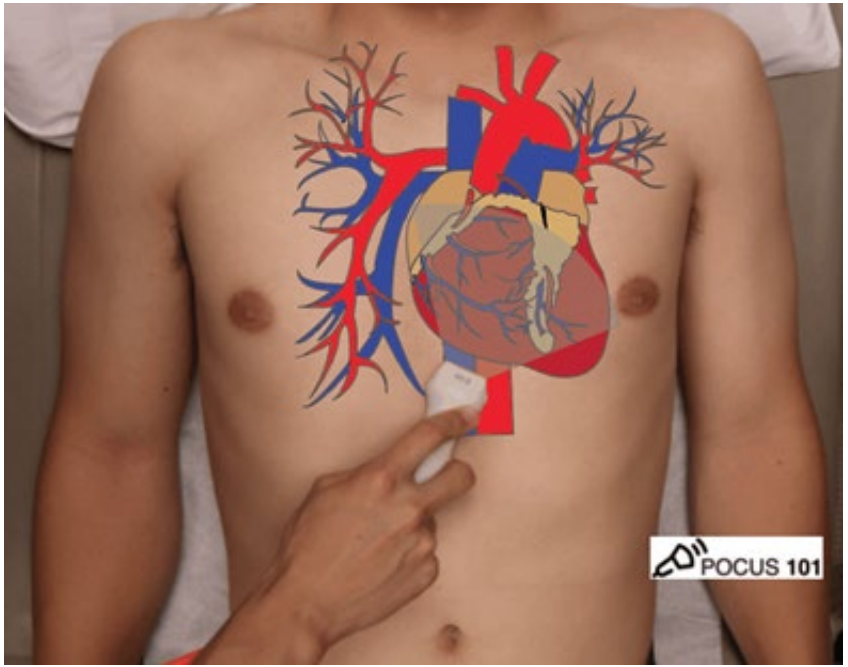


Hemoperitoneum

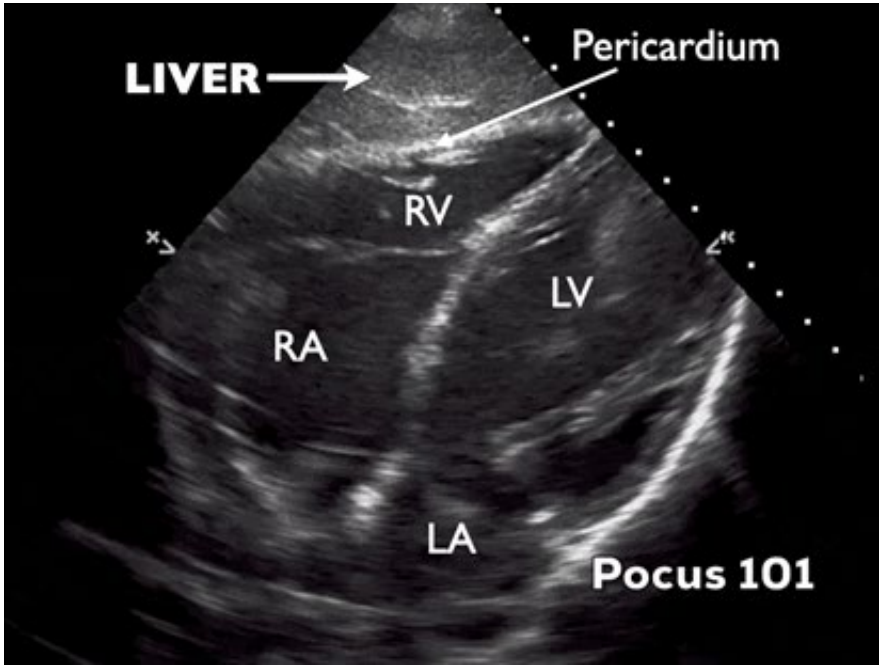


Cardiac Views- Subxiphoid view

- Overhand grip
- Point the probe indicator to the **patient's right**
- Press the probe into the patient's abdomen while tilting the tail of the probe down towards the bed/table
- Aim ultrasound beam towards patient's left shoulder

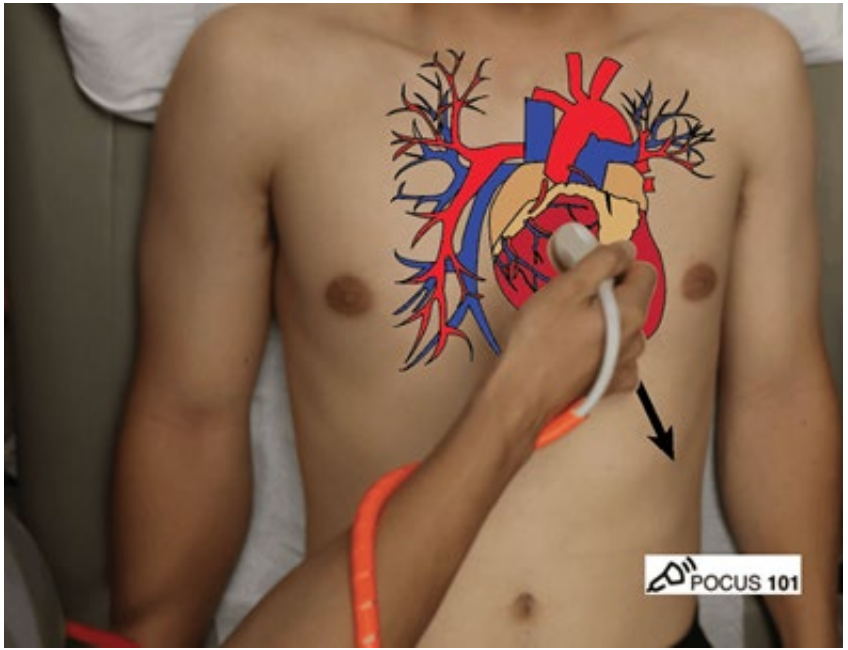


- Identify:
  - Liver
  - Pericardium
  - Right atrium/ventricle
  - Left atrium/ventricle
- Is there free fluid in the pericardial sac?

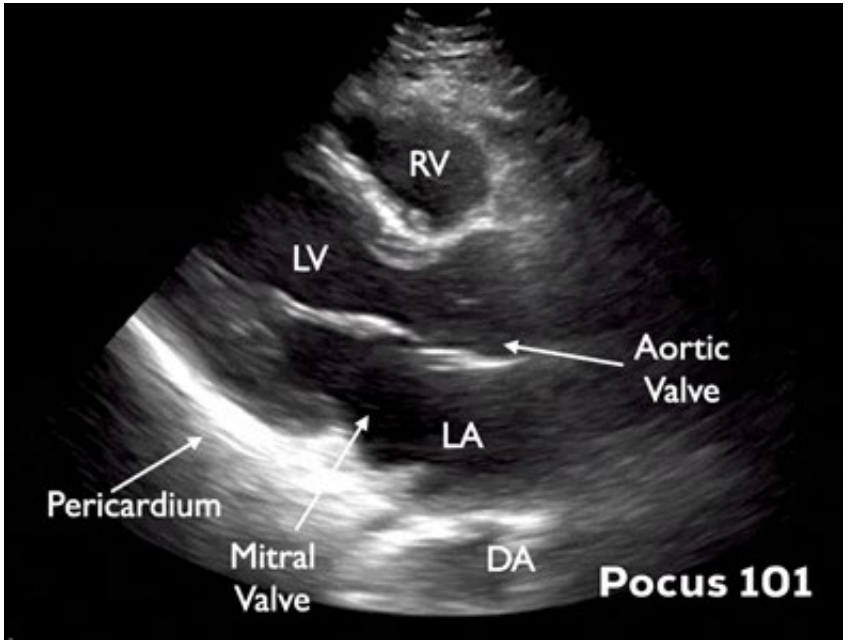


Cardiac Views- Parasternal Long Axis

- Anchor 3rd and or 4th finger in the 2nd or 3rd left intercostal space just lateral to the sternum holding probe like a pencil
- Probe indicator facing towards the patient's **LEFT HIP**



- Identify
  - Pericardium
  - Mitral valve
  - Aortic valve
  - R ventricle
  - Descending aorta
  - L atrium
  - L ventricle
- May need to go up or down a rib



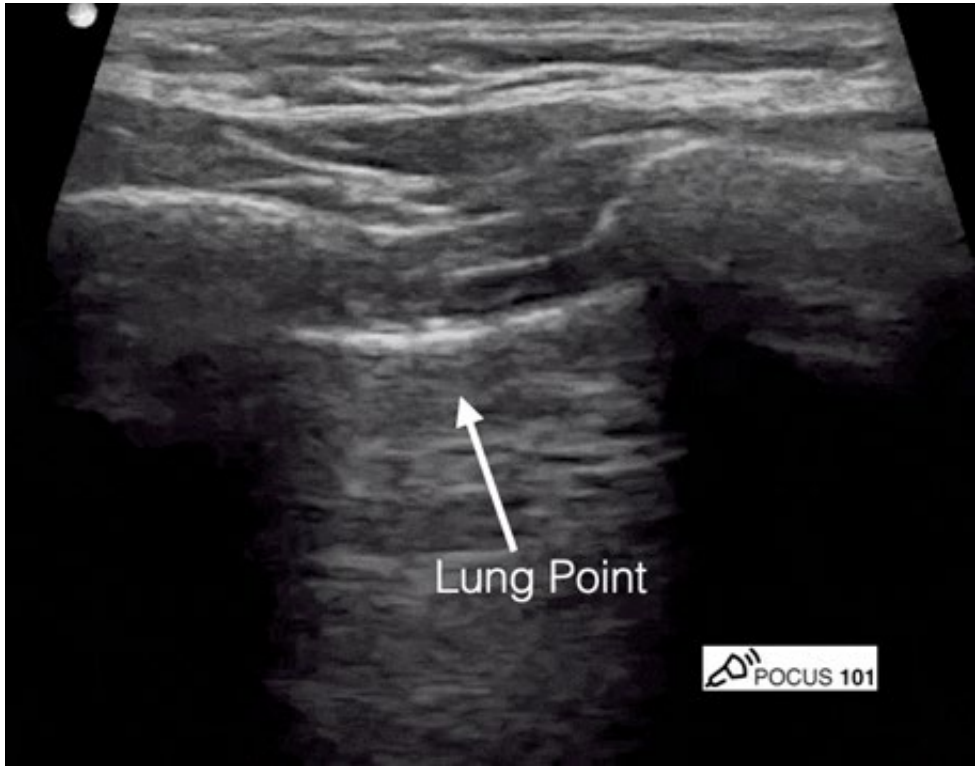
Pericardial Effusion and Tamponade

Lung Views

- Indicator pointing towards patient’s head
- Place probe at the midclavicular line at the 2nd intercostal space of the R and left lungs
- Anchor probe between ribs

Identify lung sliding

- Normal finding
- “Ants Marching” sign
- Lung sliding indicates the visceral and parietal pleura are next to each other
    - No pneumothorax

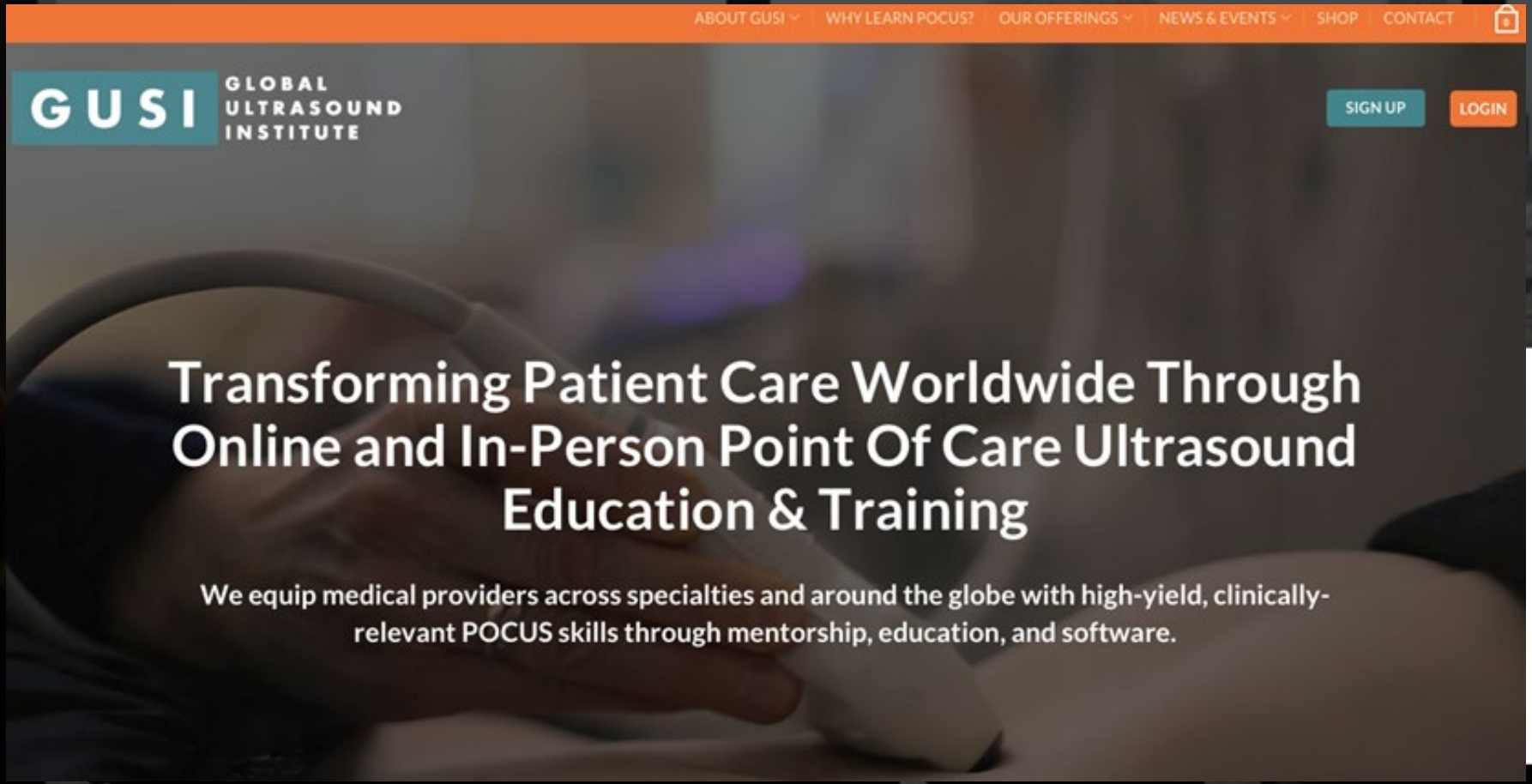

Lung Point
POCUS 101

Implementing POCUS

Learning to practice

- Equipment
- Start with training or a course
  - In person, online, hybrid
  - Conference
- Educational scans
  - Not used to affect management
  - Known pathology or formal study pending
- Work with radiology
- Credentialing
  - Numbers vary by system

Resources/References



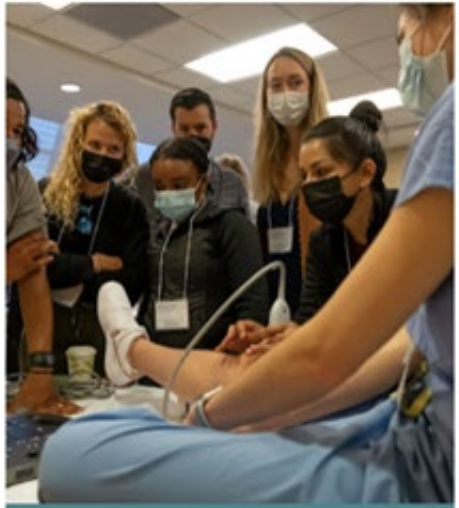
ESSENTIALS COURSE CONTENT (25 CME HOURS)

The Essentials Course features in-depth modules on dozens of topics; each one covers literature, scanning techniques, pathology, clinical integration, and more.

Ultrasound Basics 5 Modules	**FAST/E-FAST** 7 Modules	**Cardiac Echo** 10 Modules	**Pulmonology** 7 Modules
Gallbladder 6 Modules	**Abdominal Aortic Aneurysm** 6 Modules	**Renal** 6 Modules	**Deep Venous Thrombosis** 6 Modules
Musculoskeletal 9 Modules	**Skin Soft Tissue** 6 Modules	**Dermatology** 6 Modules	**OB 1st Trimester** 6 Modules
Obstetrics: 2nd & 3rd Trimester	**FASH: Tuberculosis-HIV**	**Pediatric Ocular**	**Pediatric Lung**

Pediatrics Essentials

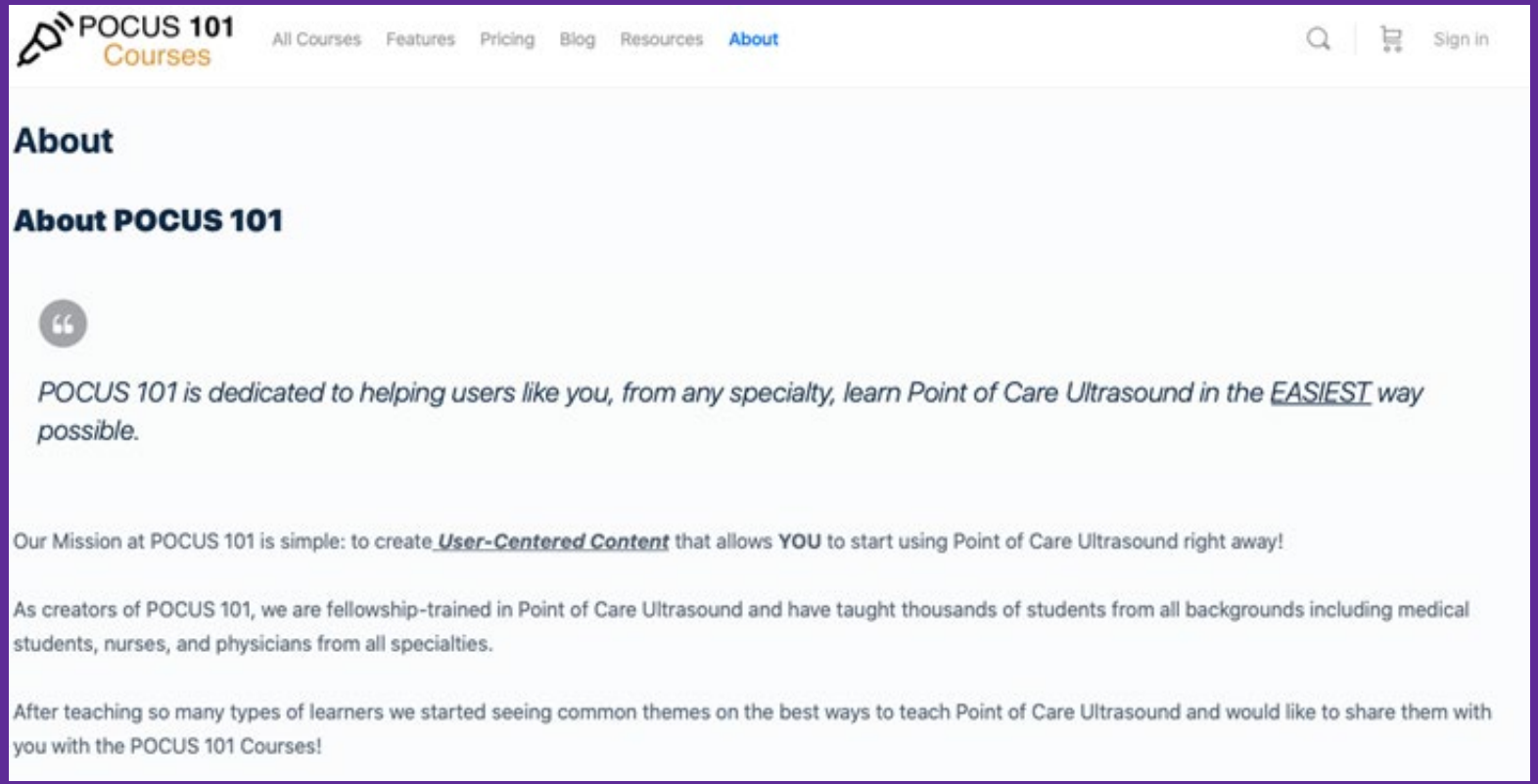
GET STARTED



MSK Essentials

GET STARTED

Resources/References



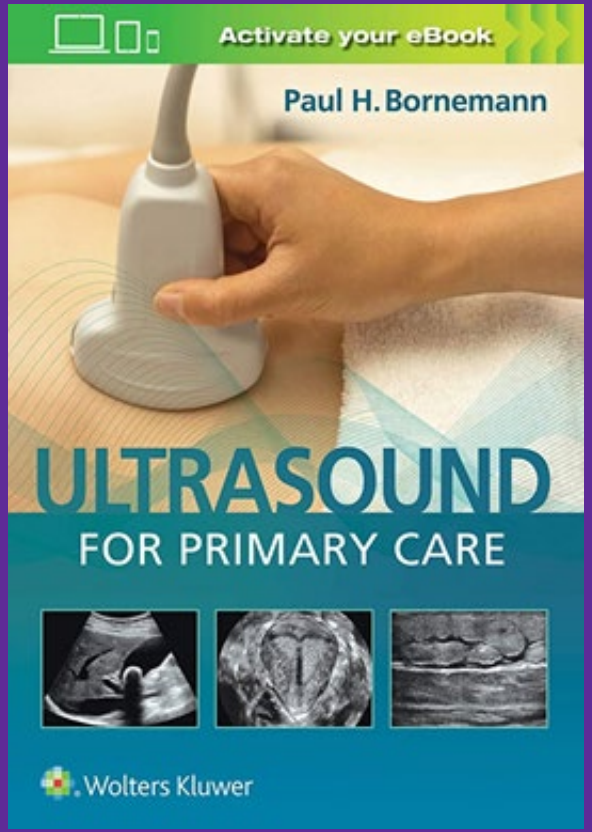
Resources/References

Each chapter is set up as a clinical vignette:

-Does the patient have cholecystitis/ cholelithiasis?

-Does the patient have nephrolithiasis?

-Does the patient have cellulitis or an abscess?



SUMMARY

-This was just an introduction. Most intros are set as 2 day workshops, but today we reviewed the basics

-remember the resources! These are great comprehensive references that can help in addition to in person classes.

-will end with FAST exam to practice our hands on skills and image review!

References:

Bornemann, P. (2021). Ultrasound Basics: Physics, Transducers, Conventions, Terminology, and Artifacts. In *Ultrasound for Primary Care*. essay, Wolters Kluwer.

Ultrasound Essentials Course: Ultrasound Basics. Global Ultrasound Institute. (2023, February 22). Retrieved March 7, 2023, from https://globalultrasoundinstitute.com/

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