Bedside Ultrasound in Primary Care
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Topic Discussion

- What is POCUS
- Emergence of POCUS
- Interventional US
- Ultrasound Basics
- Thoracic US, BLUE Protocol
- Critical Care ECHO
- FAST Exam
- Clinical Scenarios
Just the other day…

- 58 y/o M came to the hospital with worsening shortness of breath x 1 week
- PMH of CHF, CAD, COPD, H/o DVT post treatment, and ETOH abuse
- PE: 99.8/108/24/ (88/58), 80% sat; Obtunded, distant heart sounds, minimal breath sounds, and benign abdomen.
- No IV access, ER unable to obtain labs
- Before the patient goes for a CXRAY...he arrests

So what do you do?

- Apart from obtaining IO/IV access and perform ACLS...
- We need to figure out what is the root cause:
  - Too unstable of CT /VQ Scan
  - Cardiology fellow texts you “its not the heart”
  - Radiology doesn’t do ECHO
  - *#(%&@$
What is POCUS?

✤ POCUS = Point of Care ultrasound, bedside ultrasound, critical care/ER ultrasound, clinician ultrasound

✤ Answers the “Yes or No” questions

✤ A rapid, patient-focused bedside ultrasound

✤ Initial scan usually includes Lungs/IVC/Heart and other affected areas

✤ Following resuscitation- repeated as a more rigorous exam including Heart/Lungs/Abdomen/venous exam
Why POCUS?

- A disruptive technology that can potentially:
  - make a more rapid diagnosis
  - Improve procedure efficacy and safety
  - lower health care costs
  - improve patient satisfaction and outcomes
- An essential skill for future physicians
- The new “stethoscope”

Emergence of POCUS

- Allows the physician to directly move beyond a physical exam and spend more time evaluating a patient face to face.
- Finally removes the disconnect from imaging and clinical scenario beyond the ability of traditional ECHO or radiology.
- Budding usefulness in hemodynamical unstable patients from the ER-> GMF->ICU
Ultrasound Machine Evolution

$2-5K 
$10-50K 
$100-200K

Utility of POCUS
Barriers

- Lack of POCUS training, uncomfortable to interpret US images without over-read by radiologist
- Limited or no access to US machine
- Clinical or hospital policy restrictions
- Cost and reimbursement concerns
- Time constraints

Limited ECHO vs POCUS

<table>
<thead>
<tr>
<th>Limited ECHO</th>
<th>POCUS in Critical Care</th>
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<tbody>
<tr>
<td>1. Exam only evaluates the heart</td>
<td>1. Covers the heart, lungs, IVC, veins</td>
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<td>2. Difficult windows</td>
<td>2. Simple windows</td>
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<td>3. Slow learning curve</td>
<td>3. Rapid learning curve</td>
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<td>4. If cardiac windows are not visible=no information</td>
<td>4. Useful even without good visualization of the heart</td>
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<td>5. Takes several minutes</td>
<td>5. Quick exam</td>
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Limited ECHO vs POCUS

- Differences between left sided pleural effusions and pericardial effusions are subtle. on ECHO
- But not with a thoracic US

Interventional Ultrasound

- Ultrasound guidance can assist in decrease procedural time during venous/arterial access, thoracentesis, paracentesis
- In many scenarios, ultrasound guidance is the standard of care
- ATS, SCCM, ACCP have all supported the use of ultrasound guidance when possible to improve safety, decrease procedure, and provide live feedback
Before we talk about Thoracic US, let's discuss the basics…

Solid Organ U/S vs Lung Artifact ultrasound
Ultrasound Probe Selection

- Linear - High frequency probe (5-10 Hz)
  - Limited to depth of approx. 6cm, higher resolution
- Phased/Sector probe
  - Produces a fan like image that widens with depth
  - Can be advantageous between ribs
- Curvilinear - Low frequency probe (2-5 Hz)
  - Deeper penetration but lower resolution

Ultrasound basics

<table>
<thead>
<tr>
<th>Table 2.1. Acoustic impedances of different body tissues and organs.</th>
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<tr>
<td><strong>Body tissue</strong></td>
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<tr>
<td>-----------------</td>
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<tr>
<td>Air</td>
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<tr>
<td>Lung</td>
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<td>Fat</td>
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<td>Blood</td>
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<td>Kidney</td>
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<tr>
<td>Muscle</td>
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<tr>
<td>Bone</td>
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Specular Reflection

Diffuse Reflection (Scattering)

Diffuse Reflection (Scattering)

One Direction

Multiple Directions
Low Amplitude

Multiple Directions
Low Amplitude
Thoracic US: Lung Anatomy

Normal Lung  Pulmonary Edema

- A Lines
- B Lines
- Lung sliding vs Fixed lung
- Effusion identification
- Consolidation identification
Lung Artifact/Lung Signs

- **A Lines**
  - Horizontal regularly spaced hyper-echoic lines representing reverberations of the pleural line
  - Present when ultra sounding air
  - Normal Lung
  - Essentially ruling out fluid related pathology

- **B Lines**
  - Vertically oriented lines extending from the pleural surface to the maximum depth of the image
  - A single B line may be normal
  - Most common reason for multiple B lines is pulmonary edema
  - Essentially differentiates airspace disease from pulmonary edema
Pleural Effusion

U/S is a fast and effective way to diagnose a pleural effusion

Allows physician the ability to pursue small effusions

Appear Hypoechoic

A pleural effusion evaluation should identify an anechoic space, anatomic boundaries (chest wall, diaphragm and lung), and dynamic changes related to breathing and cardiac motion.

PTX evaluation

Best identified using the linear probe

Is there lung sliding?

Sandy beach vs Barcode sign

Lung Point
BLUE protocol - Bedside Lung Ultrasound in Emergency

- Uses a systematic approach to reference A lines, B lines, lung sliding, and lung point to help accurately diagnose lung pathology.

- A study involving the BLUE protocol investigated 260 patients, showing >90% sensitivity in overall diagnosis.


BCCE - Basic Critical Care ECHO

- Five basic views must be mastered:
  - Parasternal long-axis
  - Parasternal short-axis
  - Apical 4 chamber
  - Subxiphoid/subcostal
  - IVC
Parasternal long-axis

LVOT  RV  LV  AV  LA

Parasternal long-axis view - right side of the image is cephalad. The pericardium is a strong echo-reflector and appears as a bright white echo.

LV  RV  AO  LA

BCCE - Basic Critical Care ECHO
BCCE - Basic Critical Care ECHO

Apical four-chamber (A4C)

Subcostal four-chamber
BCCE- Basic Critical Care ECHO

FAST Exam

- FAST Exam- originally created as a “Focused Assessment of Sonography for Trauma”
- Has been adapted by ER and critical care physicians for a screening of pericardial and abdominal pathology
- Four areas of interest
  - Pericardial
  - Perihepatic (Morrison’s pouch)
  - Perisplenic
  - Pelvis
FAST Exam

踹 RUQ- Perihepatic (Morrison’s pouch)

FAST Exam

踹 LUQ- Perisplenic
Going back to our coding patient...

- 58 y/o M came to the hospital with worsening shortness of breath x 1 week
- PMH of CHF, CAD, COPD, H/o DVT post treatment, and ETOH abuse
- PE: 99.8/108/24/ (88/58), 80% sat; Obtunded, distant heart sounds, minimal breath sounds, and benign abdomen.
- You whip over the ultrasound
Case Review
Case Review

- The cardiology fellow was wrong!
  - It was the heart!
  - Now you can prove it.
Summary

▸ Ultrasound is becoming more common place and expect to be part of your residency/fellowship training
▸ For thoracic ultrasound: Know how to identify: A line, B lines, Lung sliding and pleural effusions
  ▸ To identify a PTX- look for the absence of lung sliding, a lines, lung point and barcode sign
▸ Basic critical care ECHO- to evaluated ejection fraction, right heart strain, IVC variability, pericardial pathology
  ▸ 5 basic views are Long and Short Parasternal, Apical, Subcostal and IVC
▸ FAST exam for abdominal pathology
  ▸ 4 areas of interest include the perihepatic, perisplenic, pericardial and pelvic
  ▸ If you don’t look you won’t find anything

Questions?

✦ Thank You.
References

Stamos TD & Soble JS. The use of echocardiography in the critical care setting in Crit Care Clinics (Acute Cardiac Care) 2001; 2: 253 – 270
Sloth E. Echocardiography in the ICU. Intensive Care Med. 2006; 32: 1283