Today’s Objectives

- Understand basic principles of ultrasonography
- Identify potential uses for ultrasound in the field
- Differentiate between common, normal, and abnormal findings

Basic Physics

- **Transducer**
  - High frequency vibration
  - Sound waves transmitted into body
  - Reflected back toward probe
  - Picture produced on screen

Ultrasound Physics for Dummies

- **Transducer**
  - Sound waves transmitted into body
  - Reflected back toward probe

A Whole Lotta Grey ...

- **Grey Scale**
  - White = high reflection
  - Black = high transmission

- Detects change in density
  - Sound “bent” by change

- Liquid is black
- Bone, connective tissue is white
- Solid organs in between

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Transducer Types

- Transvaginal Medium & Low Frequency
- High Frequency

Orientation

- M Dot
- Probe
- Bed
- Marker Dot

Anatomic Planes

- Transverse
  - Cross section
  - Separates superior from inferior
- Sagittal
  - Separates left from right
- Longitudinal
  - Long axis of an organ

Advantages and Disadvantages of Ultrasound

Advantages
- Non-invasive
- No radiation
- Rapid
- Can repeat without harm
- Decrease procedure complications
- Dynamic

Disadvantages
- Operator dependent
- Not as sensitive as other tests in certain conditions
- Miss diaphragm, bowel, solid organ and retroperitoneal injuries
- Difficult in obese patients
- Bowel gas / fat decreases image quality

How can we use ultrasound in the field?
Assessment & Procedural
- eFAST
- Aortic Aneurysm
- Cardiac Arrest
- Shock
- IV Access

Extended Focused Abdominal Sonography in Trauma (eFAST)

What Are We Looking For?
- Identify hemoperitoneum
- Identify pericardial tamponade
- Identify pneumothorax / hemothorax

Where’s The Fluid??
- Fluid between liver & kidney
  - Morrison’s Pouch
  - Inferior liver edge
  - Inferior kidney
  - Right thorax
  - Trendelenberg

Right Upper Quadrant
Left Upper Quadrant
- Fluid between spleen and kidney
  - Splenorenal recess
- Between spleen and diaphragm
- Left thorax
- Trendelenberg

Side Bar: Hemothorax
Pelvis
- Posterior pelvis
  - Pouch of Douglas in females
- Bladder used as “acoustic window”
- Reverse trendelenberg

Pelvis: Normal Scan Male

Pelvis: Normal Scan Female

Pelvis: Abnormal Scans

Subcostal Cardiac
- Fluid in pericardium
- Ventricular contraction
  - Tamponade physiology
    - RV collapse
    - Trauma code
    - Hypotensive patient
  - Any position

Subcostal: Normal Scan
Subcostal: Abnormal Scans

Tamponade Physiology

Pneumothorax

- Extrapleural air
- Anterior chest in supine patient
- Assess at multiple positions
- Supine flat

Pneumothorax: Video

Ultrasound During Resuscitation
How Does Ultrasound Help?

- Hypotension
  - Restrictive cause
  - Pump problem
  - Fluid status
  - Aortic Aneurysm

- Cardiac Arrest

Cardiac Motion

- Wall motion fast or slow, normal or abnormal?
  - Fast – likely hypovolemic
  - Slow – cardiogenic shock, bradycardia, normal volume
  - Normal – noncardiac, neurologic, beta blockers
  - Abnormal – MI, heart failure, tamponade physiology

  *Look at entire clinical picture*

Cardiac Motion

Hyperdynamic

Hypodynamic with abnormal wall motion

Abdominal Aorta

Technique

Normal Aorta – Upper
Normal Aorta – Mid to Lower

Normal Scan – Abd Aorta

Normal Scan – Abd Aorta

Aortic Aneurysm

Diameter > 3cm

Aneurysm With Thrombus

Aneurysm With Thrombus
Distal Aneurysm

Cardiac Arrest
- Cause for Pulseless Electrical Activity (PEA)
- Response to therapy
- Resuscitation futility

Ultrasound Guided Line Placement

Geometry

Peripheral Intravenous Line

Review
Review
- Reviewed benefits and limitations of ultrasound in EMS environment
- Discussed potential field applications
- Application of the eFAST exam in trauma patients

References
- Ultrasound Guide for Emergency Physicians
- Paramedic Ultrasound
- Jehle D, Heller MB. Ultrasonography in trauma. ACEP, Dallas, TX. 2003
- Smith CA. Ultrasound assessment tool: EMS crews begin using portable ultrasound units in the field. JEMS 2003;28(7):40-54

Questions?
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"Dr. Myers: may I be excused? My brain is full."
References

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