Jeff Myers, DO, EdM, NREMT-P, FAAEM
Clinical Assistant Professor Emergency Medicine
University at Buffalo, Buffalo, NY

ULTRASOUND FOR EMS CLINICIANS

http://www.photoemsdoc.com/lectures/ultrasound/

Today's Objectives

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

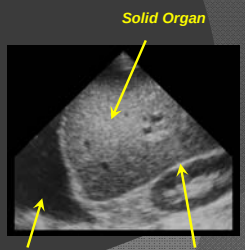
Ultrasound Physics for Dummies

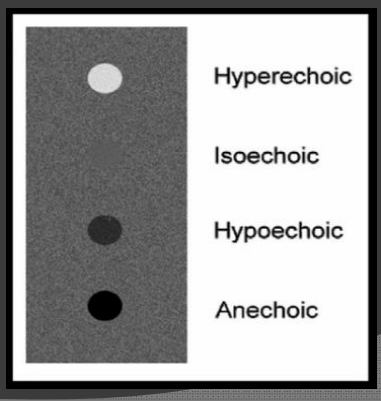
Basic Physics

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

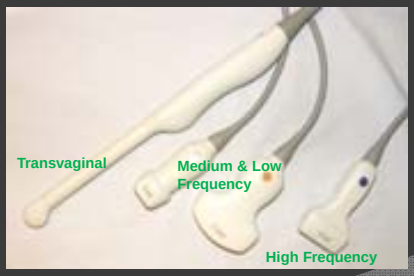
A Whole Lotta Grey …

- Grey Scale
  - White = high reflection
  - Black = high transmission
- Detects change in density
  - Sound "bent" by change
- Fluid is black
- Bone, connective tissue is white
- Solid organs in between

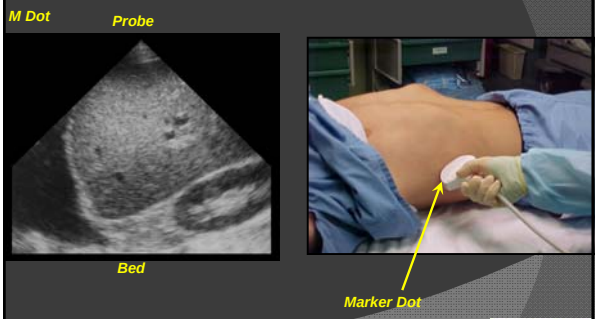




Transducer Types

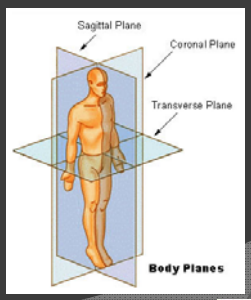


Orientation



Anatomic Planes

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



Advantages and Disadvantages of Ultrasound

The Use 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?

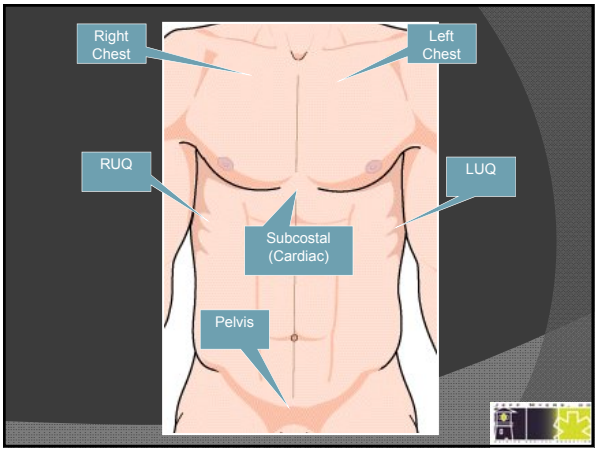
Assessment & Procedural

- eFAST
- Aortic Aneurysm
- Cardiac Arrest
- Shock
- IV Access

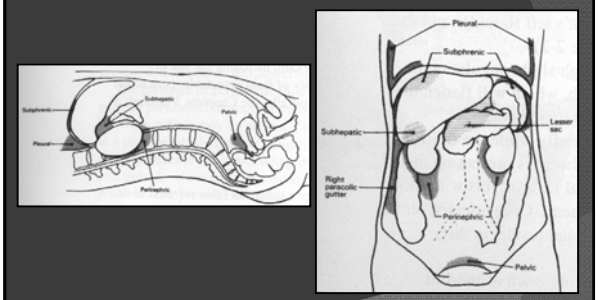
Extended Focused Abdominal Sonography in Trauma (eFAST)

What Are We Looking For?

- Identify hemoperitoneum
- Identify pericardial tamponade
- Identify pneumothorax / hemothorax



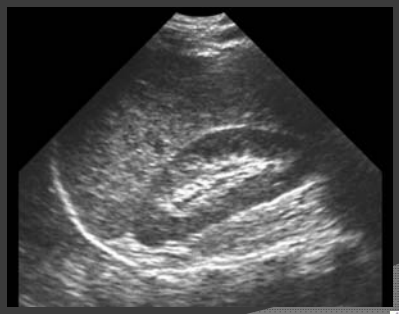
Where's The Fluid??



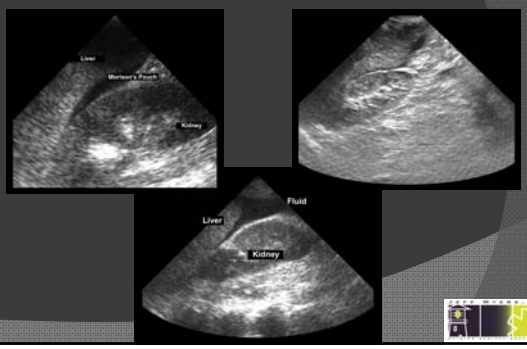
Right Upper Quadrant

- Fluid between liver & kidney
  - Morrison's Pouch
- Inferior liver edge
- Inferior kidney
- Right thorax
- Trendelenberg

RUQ: Normal Scan



RUQ: Abnormal Scans

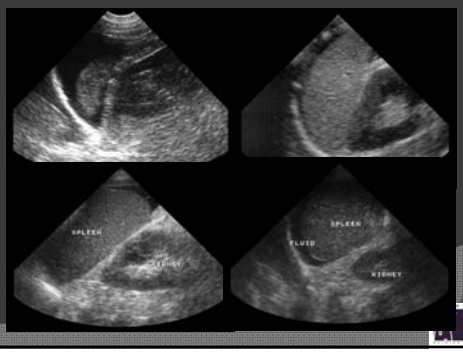


Left Upper Quadrant

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

LUQ: Normal Scan

LUQ: Abnormal Scans



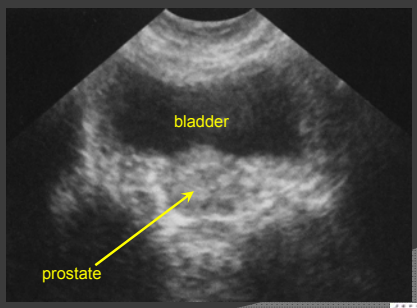
Side Bar: Hemothorax

RUQ LUQ

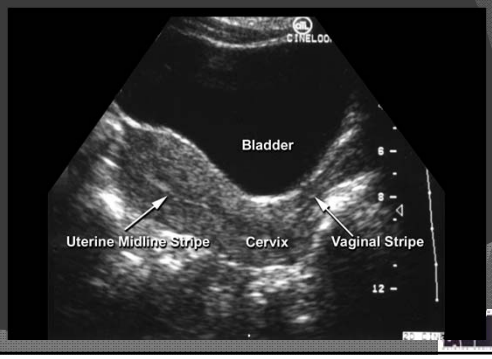
Pelvis

- Posterior pelvis
  - Pouch of Douglas in females
- Bladder used as "acoustic window"
- Reverse trendelenberg

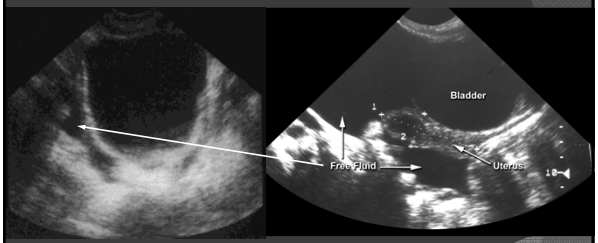
Pelvis: Normal Scan Male



Pelvis: Normal Scan Female



Pelvis: Abnormal Scans



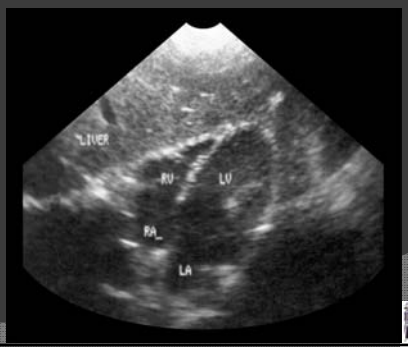
Male

Female

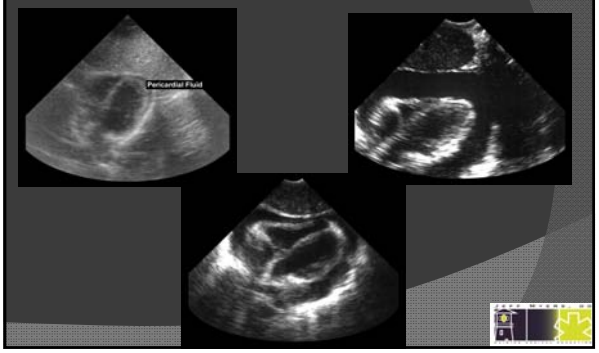
Subcostal Cardiac

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

Subcostal: Normal Scan



Subcostal: Abnormal Scans



Tamponade Physiology

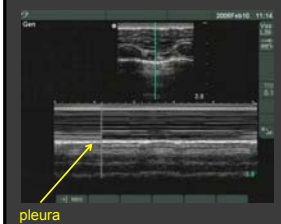
Pneumothorax

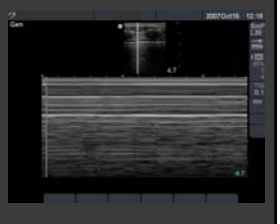
- Extrapleural air
- Anterior chest in supine patient
- Assess at multiple positions
- Supine flat

Pneumothorax: Video

Pneumothorax

Normal **Pneumothorax**





Ultrasound During Resuscitation

How Does Ultrasound Help?

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

Cardiac Motion

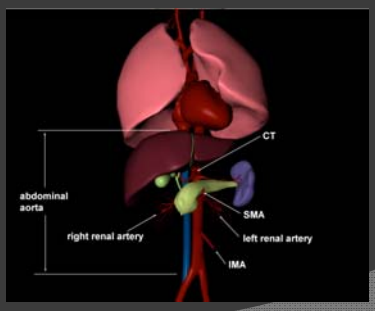
- Wall motion fast or slow, normal or abnormal?
  - Fast – likely hypovolemic
  - Slow – cardiogenic shock, bradycardia, normal volume
  - Normal – noncardiac, neurologic, beta blockers
  - Abnormal – MI, heart failure, tamponade physiology
- ***Look at entire clinical picture***

Cardiac Motion

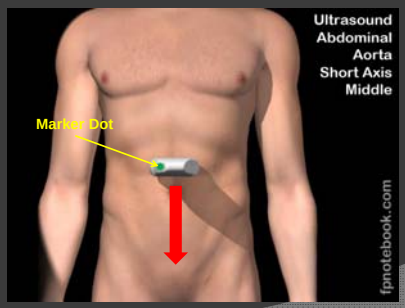
Hyperdynamic

Hypodynamic with abnormal wall motion

Abdominal Aorta

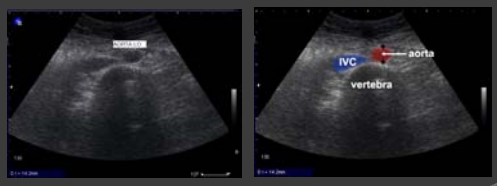


Technique

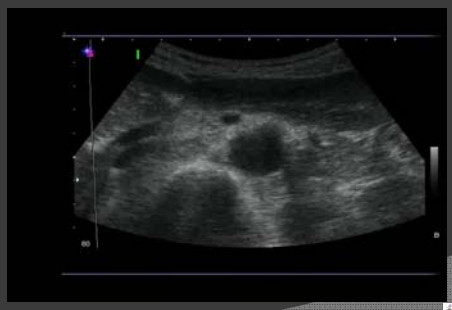


Normal Aorta – Upper

Normal Aorta – Mid to Lower



Normal Scan – Abd Aorta



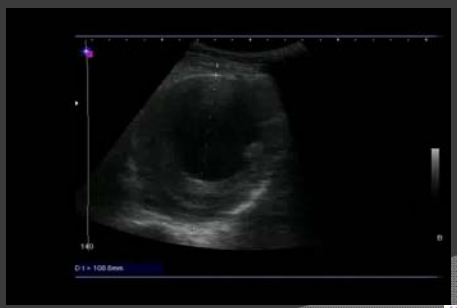
Normal Scan – Abd Aorta

Aortic Aneurysm

Diameter > 3cm

Aneurysm With Thrombus

Aneurysm With Thrombus



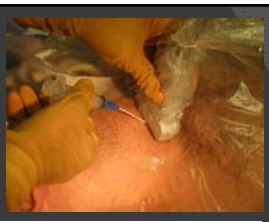
Distal Aneurysm

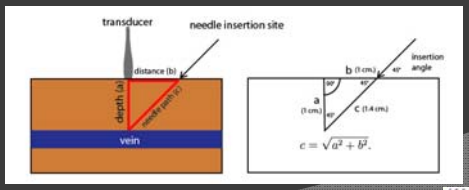
Cardiac Arrest

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

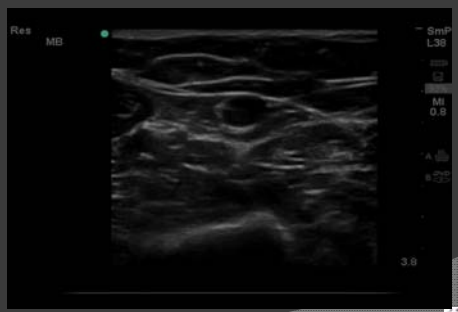
Ultrasound Guided Line Placement

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

Review

- Apply ultrasound to resuscitation of the critically ill patient
- Discussed the benefits of ultrasound guided venous access procedures

References

- Ultrasound Guide for Emergency Physicians
  - http://www.sonoguide.com/
- Paramedic Ultrasound
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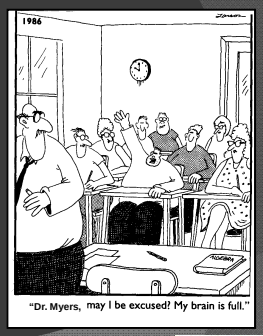
- Jehle D, Heller MB. Ultrasonography in trauma. ACEP, Dallas, TX. 2003
- Perera P, Mailhot T, Riley D, Mandavia D. The RUSH Exam: rapid ultrasound in shock in the evaluation of the critically ill. Emerg Med Clin N Am 2010 28;29-56
- Heegaard W, Hildebrandt D, Spear D, et al. Prehospital ultrasound by paramedics: results of field trial. Acad EM 2010;17(6):624-630
- Nelson BP, Chason K. Use of ultrasound by emergency medical services: a review. International Journal of Emergency Medicine 2008;1(4):253-259
- Smith CA. Ultra-assessment tool: EMS crews begin using portable ultrasound units in the field. JEMS 2003;28(7):46-54

Questions?

Jeff Myers, D.O., Ed.M., NREMTP, FAAEM
Clinical Assistant Professor
Dept. of Emergency Medicine
University at Buffalo, Buffalo, NY

myersj@alum.rpi.edu

http://www.photoemsdoc.com/
716.984.0470



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