Intro to Ultrasound and Knobology

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I have no disclosures
SOUND: Series of pressure waves traveling through a medium

• Physics Words

• WAVELENGTH: Distance traveled in one cycle

• FREQUENCY: number of cycles per sec (Hertz)

“Fancy” Words

• PIEZOELECTRIC EFFECT: crystals vibrate at a given frequency when an alternating current is applied

• PULSE-ECHO MODE: signal generation <1% of pulse cycle
ATTENUATION: Reduction of intensity and amplitude

- **Absorption**: Most common, creates heat
- **Reflection**: “Echo”
- **Scattering**: non-homogeneous surface
- **Refraction**: Different densities

Ultrasound Modes

Brightness Mode: Different shades of gray
Increasing **frequency** improves **resolution** at the expense of penetration.

**Resolution**: Ability to delineate between 2 different objects

**Axial Resolution**: The ability to separate objects linear to the ultrasound beam

**Lateral Resolution**: Ability to separate 2 structures side by side
Transducer basics

Convex Array:
Sector Scanning -
Resolution becomes poorer at greater depths

Phased Array:
Flat Head, crystals fire at variable time
Transducer basics

Echogenicity

- **Hyperechoic**
  - More echogenic than surrounding tissue
  - Object has lots of echo’s, appears brighter

- **Hypoechoic**
  - Less echogenic than surrounding tissue
  - Very few echo’s, appears darker

- **Anechoic / Echolucent**
  - Absence of returning echo’s
  - Area is black
Probe Position and Image Orientation

- In relation to probe dot
- Transverse
- Longitudinal
- Coronal / Sagittal

Button Basics

- **Gain**
  - Strength of returning echoes
  - Amplifier
  - Gain is adjusted differently depending on the machine
Artifacts:
Attenuation Artifacts

- **Shadowing**
  - Partial or total reflection of sound
  - Weak or no transmission posterior

Artifacts:
Attenuation Artifacts

- **Posterior Enhancement**
  - Area behind echo-weak or echo-free structure appears brighter
Artifacts:
Attenuation Artifacts

- **Edge Artifact aka “Side Lobe”**
  - Sound waves are scattered when they encounter cystic wall or curved surface
  - Energy loss

Artifacts:
Propagation Artifacts

- **Reverberation**
  - Sound encounters 2 highly reflective layers
  - Sound is bounced back and forth
  - Probe detects a longer traveling time
Artifacts: Mirror Imaging

- Sound glances off highly reflective surface (diaphragm)
- Returning sound waves have longer travel time
- Misinterpretation of "more liver"

Artifacts: Mirror Image
Artifacts: Mirror Image

Trouble-Shooting

Know your anatomy
Define boundaries
Choose the proper transducer
Learn acoustic windows
Go from wider view and zoom in
Visualize the anatomy in two planes
Maximize system controls - depth/gain/frequency
Image Acquisition Tips

• “I am having a hard time finding _____, do you have any tips?”
  • Use more gel!
  • Transducer movements
    • Fan
    • Angle
    • Rotate
    • Translocate / Try a new location (window)

Only try one movement at a time