Introduction to Ultrasound

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Introduction

• No disclosures
Introduction

• Goals
  – Physics and Artifacts
  – Probe selection
  – Knobology
PHYSICS AND ARTIFACTS
Physics and Artifacts

• Physics is.... fun?
Physics and Artifacts

• Physics is important!
  – Probe selection
  – Image creation and optimization
  – Artifacts
Physics and Artifacts

- Ultrasound machine translates sound into 2-D image

- Piezoelectric effect: the charge which builds up in certain solids in response to applied mechanical strain
Physics and Artifacts

• How does the machine create the picture?
  
  – Depth (position on the screen)
    • Time for sound waves to travel to object and back
  
  – Echogenicity ("brightness")
    • Amplitude of the returning wave (e.g. "intensity")
    • Affected by distance travelled and substances encountered
Physics and Artifacts

• How does the machine create the picture?
  – Echogenicity (brightness)

Hyperechoic = more echogenic than surrounding structures
Hypoechoic = less echogenic than surrounding structures
Isoechoic = same echogenicity as surrounding structures
Anechoic = no internal echoes
PROBE SELECTION
Probe Selection
Probe Selection

• Frequency
  – Resolution (how clear is the picture?)
    • High frequency
  – Penetration (how far can you see?)
    • Low frequency
ARTIFACTS
Artifacts

• Identification of structures
• Avoid misinterpretation
• Diagnosis
Artifacts

• Posterior acoustic enhancement
• Shadowing
• Mirroring
• Edge artifact
• Side lobe artifact
• Reverberation artifact
Artifacts

• Posterior acoustic enhancement
  – Cystic structures transmit sound better
    • Sound is less attenuated, producing a brighter signal
  – Structures posterior appear brighter compared to other structures at a similar depth
Artifacts

• Posterior acoustic enhancement
Artifacts

• Posterior acoustic enhancement
Artifacts

• Shadowing
  – Caused when sound waves can’t pass through media
  – All/most of the waves are reflected
    • Strong reflection = hyperechoic (white) on screen
  – Machine receives no signal from structures posterior
    • No signal = hypoechoic (black) on the screen
Artifacts
Artifacts

• Mirroring
  – Due to reflection
Artifacts

- Mirroring
Artifacts

- Edge Artifact
  - Cause by refraction
  - Sound is bent at the interface of two media
Artifacts
Artifacts

• Side lobe artifact
  – Lower energy “side lobe” beams
  – If reflection strong enough to return to probe, its information is assimilated into the information from the main beam
Artifacts
Artifacts

• Reverberation artifact
  – Ultrasound beams reflecting between two surfaces
Artifacts
Artifacts

- Reverberation artifact
KNOBOLOGY
Knobology

- Probe orientation
Knobology
Knobology

- Gain
Knobology

- Depth
Knobology

- Color
Knobology

- M-mode
  - Motion mode
  - Information over time
Knobology

• Fanning
  – Probe footprint doesn’t move
  – Angle across the long axis of the probe
Knobology

• Rocking
  – Probe footprint doesn’t move
  – Angle across the short axis of the probe
Knobology

- Sliding
  - Probe footprint moves
Knobology

• General tip
  – Move the probe in only one dimension at a time
    • Slide, then fan
    • Rotate, then rock
Closing Thoughts

• Basic understanding of ultrasound physics
  – Acquire images
  – Understand and interpret artifacts

• Choose wisely

• They’re different, and yet the same

• Have fun!