How to Optimize US Images to Increase Diagnostic Confidence

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Optimize US Images to Increase Dx Confidence

Disclosures: New equipment evaluation for Philips US

Ultrasound Today

- We aren’t using US to fullest capability
- Great “bread and butter” examination, but we have to do it well
- US can replace CT/MRI/Angiography in many cases
- Economics will probably force this shift

Ultrasound Today

- We don’t spend enough time optimizing images, to improve diagnostic capability
- Nearly all specialties are using US, often with inadequate training
- OK for procedure guidance

Ultrasound Today

- Not just a screening tool
- Final diagnosis – particularly vascular
- CT/MRI/Angio needed in indeterminate cases

What You Need to Know

- Ultrasound scanner – main focus today
  - All the buttons
- Optimize imaging
  - Gray scale
  - Color Doppler
  - Spectral Doppler
Other Things You Need to Know

• What clinical question is being asked
• Relevant anatomy including waveforms
• What are the diagnostic possibilities given:
  – Clinical question
  – What the images show

Optimize Gray Scale Imaging

• Choose appropriate transducer
  – Highest frequency that will allow adequate penetration
• May need to decrease frequency to get increased gray scale and color Doppler penetration

Optimize Gray Scale Imaging

• If can’t optimize, change transducer
• OK to use multiple transducers for exam
• Arm DVT
  – 15 MHz Hockey stick for arm veins, 9 MHz linear for subclavian veins, +/- baby head probe for central veins

Optimize Gray Scale

• TGC (time gain compensation curve)
  – Some scanners have automatic settings to give you a starting point – use them
• Start with overall image gain in middle
• Focal zone: At or just above, below where you are looking
• Don’t waste pixels!

Optimize Color Imaging

• Color was a revolution
• Need to understand pitfalls
• Optimize gray scale first
• Set red color towards transducer as radiology standard
• Check all cystic structures for flow!
Optimize Color Imaging

- Optimize in normal portion of vessel
- Turn up color gain until see random color pixels, turn down until they just go away
- Decrease color scale (pulse repetition frequency (PRF)) until color only in vessel
- May need to increase wall filter if high velocity flow

Optimize Color Imaging

- Use normal setting as screen – aliasing will be potentially abnormal flow
- Will not see color flow if vessel perpendicular to transducer
  - \( \cos \theta (90^\circ) = 0 \) in Doppler equation
- Need to steer color box to < 60°, or heel-toe probe

How to Maximize Color for Low Flow

- Turn up color gain until see random color pixels, turn down until they just go away
- Decrease color scale (pulse repetition frequency (PRF))
- Decrease wall filter to low flow state

How to Maximize Color for Low Flow

- Decrease frequency of color Doppler
- May need to change to power Doppler
  - Relatively angle independent
  - Displays blood flow amplitude
  - Limited use in areas with significant motion

How to Maximize Color for Low Flow

- Deep abdomen
  - Increase gray scale penetration
  - Decrease frequency
  - Change wall filter
  - Switch to lower frequency transducer
- Superficial vessel or organ
  - Switch to higher frequency transducer

Twinkle Artifact

- Interaction of US beam with rough, highly reflective surfaces
- Generated by intrinsic scanner noise
  - Phase or clock jitter
- Increase color Doppler scale just above visualization of color in normal vessels
- Turn off harmonic imaging and other advanced features
Twinkle Artifact

- Random mix of colors posterior to calcification
- May see when acoustic shadowing from calcification not pronounced
- Improve detection of small renal stones
- Common study now to follow overall stone burden
- No flow will be found at spectral Doppler!

Optimize Spectral Doppler

- Don’t let the waveform get too small - can’t evaluate!
- Adjust scale so waveform fills 2/3 box without aliasing
- Adjust gain so do not have artificial fill-in of spectral waveform (suggests disturbed or turbulent flow)

RAS

- Always evaluate main renal artery and intra-renal waveforms
- Don’t use liver or spleen as a window
- Use flank approach for intra-renal evaluation
  - Improves angle of insonation of segmental arteries to assess for early systolic peak (ESP)

Spectral Doppler Waveform

- Usually evaluate vessels proximal to distal
- Assess waveform – is it normal?
- Is it symmetric bilaterally?

Summary

- Whirlwind tour through vascular US
- Learn all of the buttons (most)
- If you know how to optimize images, image quality will improve
- Sonographers will take pride in images that depict advanced pathology
- Your diagnostic capability & US volume will grow

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