



Procedural Ultrasound
Chapter 1

NUTS AND BOLTS OF ULTRASOUND-GUIDED PROCEDURES



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Nuts and bolts of ultrasound-guided procedures

MASTERING THE BASIC TECHNIQUES AND MODES

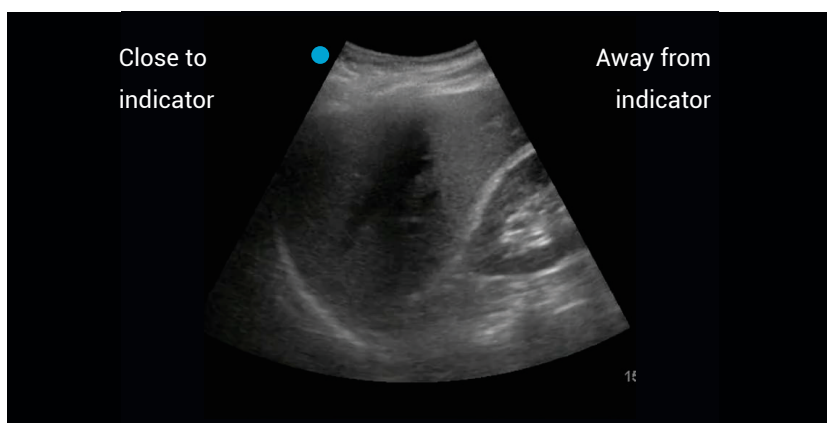


Anchor your hand and the probe. This will give you better control of probe movements, which will lead to more precise imaging.



For basic scanning, hold the probe like a pen with index finger and thumb.

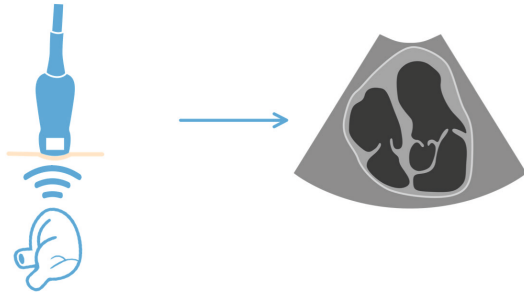
Use your non-dominant hand for scanning during a procedure. This will allow your dominant hand to perform the procedure.



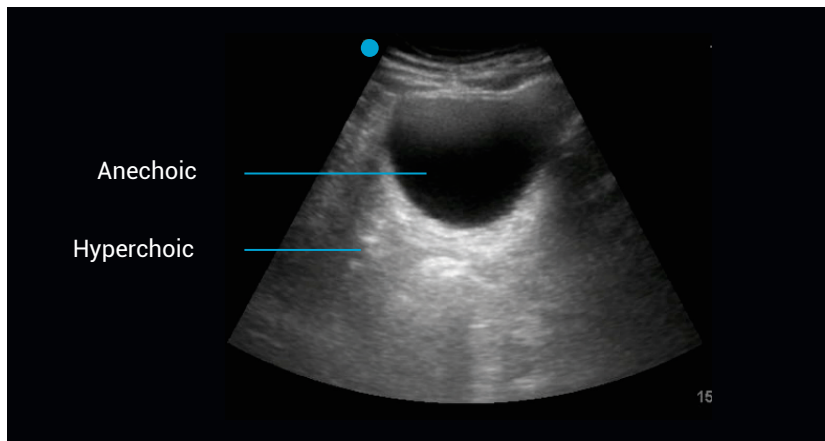
The probe indicator correlates with the dot on the screen.

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INTERPRETING ARTIFACTS



Ultrasound imaging is based on sound waves that travel through the body and then bounce back to the machine, which creates an image from the echoes of the returning waves.



Anechoic:

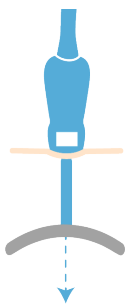
No echoes = black = fluid, blood, urine

Hyperechoic:

Many echoes = bright = dense fibers, bone, metal

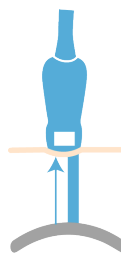
Hypoechoic:

Fewer echoes = gray = most solid organs, like liver and spleen



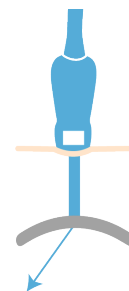
Attenuation:

Beam gets weaker as it travels through certain tissues.



Reflection:

Beam bounces off of a structure.
Mechanism for reverberation and mirror artifacts.



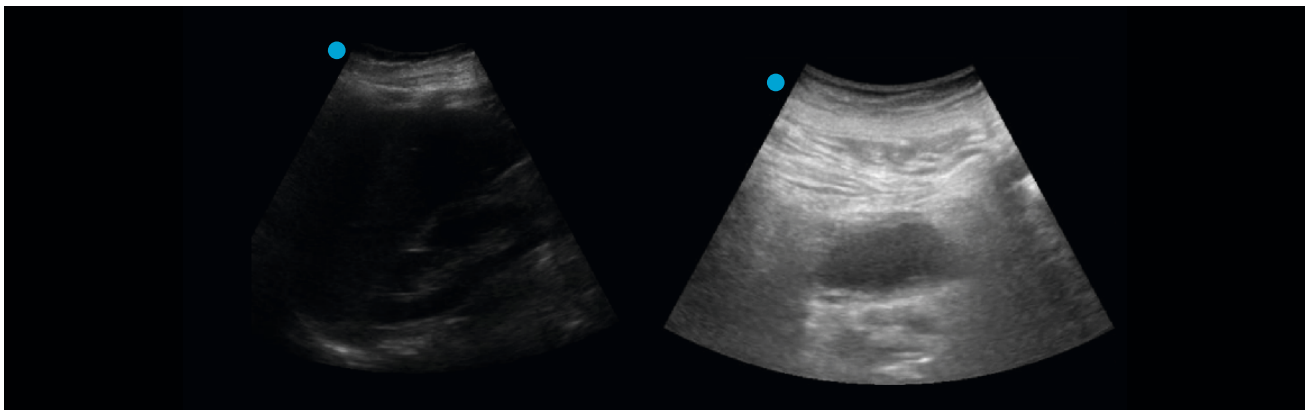
Refraction / Edge:

Beam bounces off at a different angle.

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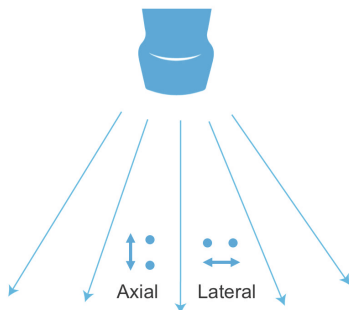
OPTIMIZING ULTRASOUND IMAGES

Attenuation and absorption lead to weakening of the ultrasound beam. Gain brightens your image by amplifying the signal, but can be overdone.



Gain too dark

Gain too bright



Resolution

Axial resolution:

The ability to discern two items along the path of the ultrasound beam. This is a function of the ultrasound probe frequency.

Lateral resolution:

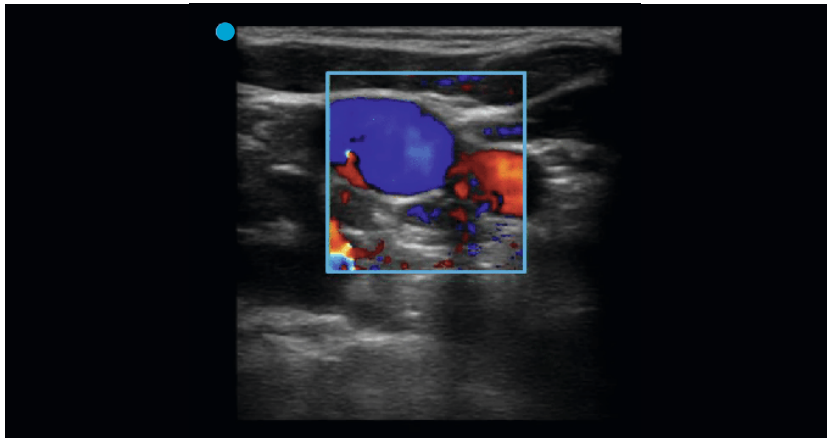
The ability to discern two items perpendicular to the ultrasound beam. You can adjust your focal zone on some ultrasound machine models to improve this.



Conduction materials are important to optimize your image.

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USING THE DIFFERENT ULTRASOUND MODES



B-mode = Brightness mode

M-mode = Motion mode

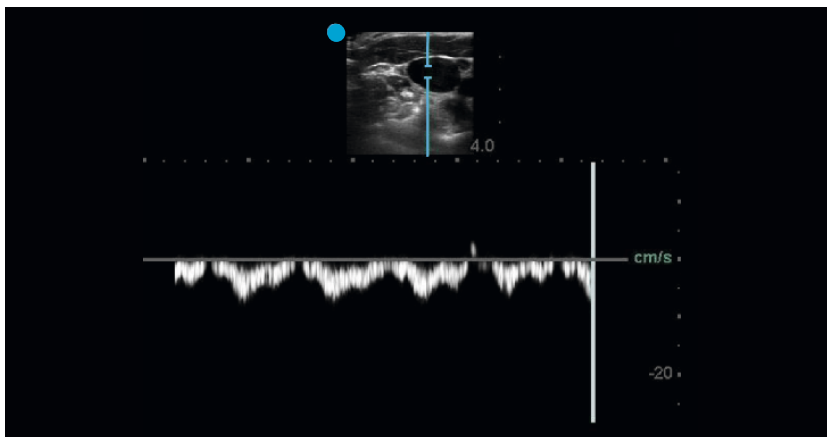
Color Doppler:

Direction of flow

BART:

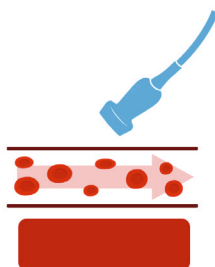
Blue means flow is **A**way from transducer.

Red means flow is **T**owards the transducer.



Spectral Doppler:

Demonstrates flow velocity.



Doppler pearls:

There is a cosine in the Doppler equation, therefore, tilt the probe at a 60-degree angle to the skin to optimize Doppler imaging.

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USING THE DIFFERENT ULTRASOUND MODES

How to place the sterile probe cover without a helper:

Put lots of gel on the probe. Open the sterile probe cover kit before you are sterile. Once gowned and gloved, place your dominant hand into the open end of the probe cover, use your non-dominant hand to pull and unfurl the sterile probe cover over the probe and cord. Use rubber bands to secure the cover and place the probe on your sterile field.

How to place the sterile probe cover with a helper:

Open the sterile probe cover kit. Once sterile, place your dominant hand into the open end of the probe cover, like a sock puppet. Then have your assistant put lots of gel on the probe. The assistant should hold the probe and allow you to grasp it through the sterile cover and pull the cover over the probe and the cord. Use rubber bands to secure the cover and place the probe on your sterile field.

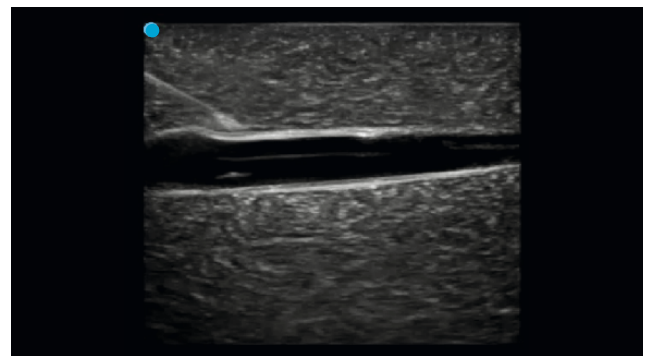
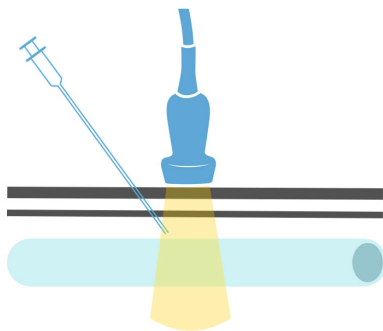


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ORIENTING YOUR PROBE TO VISUALIZE THE NEEDLE

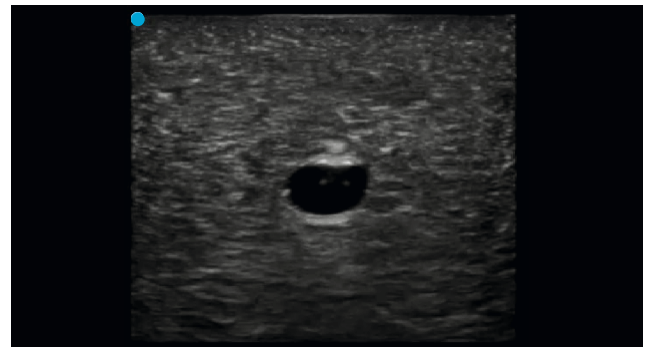
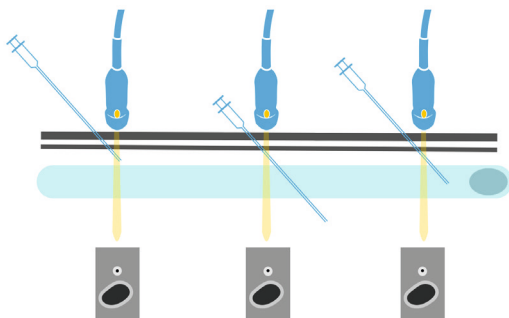
In-plane technique:

Visualize the entire needle path to the target. This is the safest way to use ultrasound to guide a procedure.



Out-of-plane technique:

Visualize only one point of the needle. This can be easier for novice users, but also dangerous in that you cannot fully know where the needle tip is.

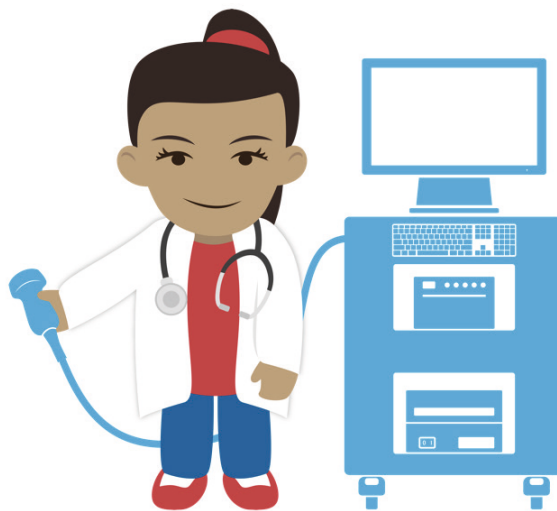


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BENEFITS OF ULTRASOUND GUIDANCE

Ultrasound guidance for procedures has been shown to

- Save time
- Save money
- Improve accuracy and success
- Decrease complications
- Change in management



FURTHER READING

Barrington, MJ, Wong, DM, Slater, B, et al. 2012. Ultrasound-guided regional anesthesia: how much practice do novices require before achieving competency in ultrasound needle visualization using a cadaver model. *RAPM*. **37**: 334–339.

Berk, D, Gurkan, Y, Kus, A, et al. 2013. Ultrasound-guided radial artery cannulation: long axis/in-plane versus short axis/out of plane approaches. *J Clin Monit Comput*. **27**: 319–324.

Noble, VE, Nelson, BP. 2011. *Manual of Emergency and Point of Care Ultrasound*. Cambridge: Cambridge University.
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Sites, BD, Brull, R, Chan, VWS, et al. 2007. Artifacts and pitfall errors associated with ultrasound-guided regional anesthesia. Part i: Understanding the basic principles of ultrasound physics and machine operations. *RAPM*. **32**: 412–418.