Know Your Knob!

A practicum of Ultrasonography

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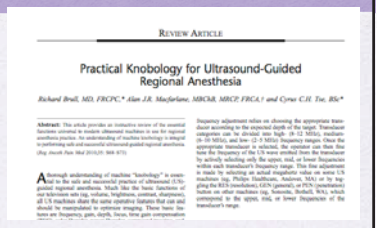
Objectives

- To learn basic ultrasound physics
- To learn the important knobs on the machine
- To improve real time needle guidance skills
- To improve your image and transfer skills across all models of ultrasounds.

Full Disclosure

- This presentation borrows heavily from Brull et al in Regional Anesthesia and Pain Medicine, Vol 35, No.2, Supplement 1, March April 2010.

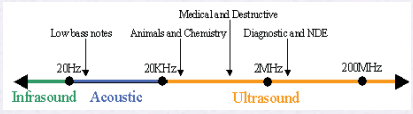


REVIEW ARTICLE

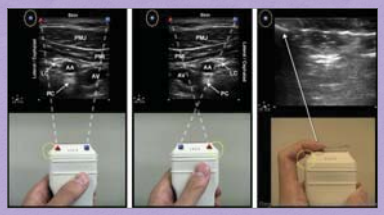
Practical Knobology for Ultrasound-Guided Regional Anesthesia

What is ultrasound?

- Cyclic sound pressure beam which penetrates a medium, and then measures the reflection signature, creating an image



This is what an ultrasound beam looks like



Brull, Richard; Macfarlane, Alan J.R.; Tse, Cyrus C.H. Regional Anesthesia and Pain Medicine. 35(2):S68-S73, March/April 2010.

The dials you need to know

- Power
- Frequency
- Gain
- Time Gain Compensation
- Depth
- Focus

Key Word: Resolution

- Axial resolution: the ability to distinguish between 2 objects at different depths in line with the axis of a beam
- Lateral resolution: the ability to distinguish between 2 objects beside one another at the same depth, perpendicular to the beam
- Temporal resolution: rate at which the images are produced

Higher frequency means less depth

Lower Frequency Means More Depth

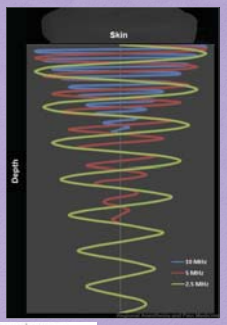


FIGURE 1. Attenuation (energy loss) is directly proportional to the frequency of the sound waves and the distance that the sound waves must travel. Note how the lower-frequency US waves are less attenuated compared with the higher-frequency (10 MHz) wave at any given distance (depth).

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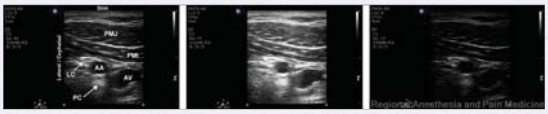
Gain

- Changes amplification of raw returning signal
- Increases brightness
- Increases background noise and artifact



Just Right | Too Much Gain Too Bright | Too Little Gain Too Dull

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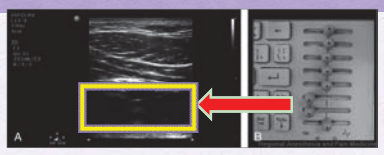
Time Gain Compensation (TGC)

- Allows you to adjust gain and different field depth
- Should help counter attenuation at deeper depth and different tissue densities



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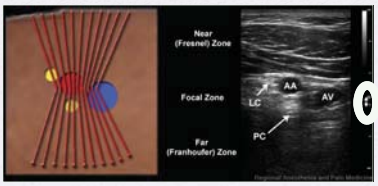
Depth

- Maximizes temporal resolution
- Selects appropriate aspect ratio (ratio of width to height)

Focus

- Sets where the beam converges (Frenzel Zone) to its narrowest point (Focal zone) and then diverges (Fraunhoffer Zone).
- Maximizes lateral resolution



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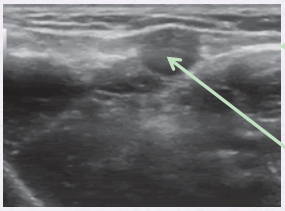
Other Terminology

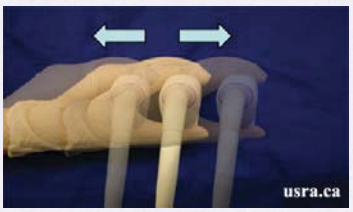
"In Plane" "Out of Plane"

Greg Rutkowski… Fellow..Hand Model

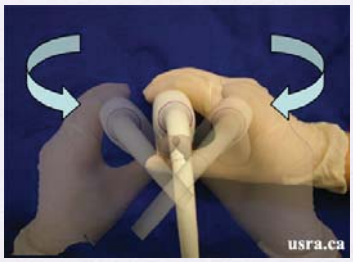
Other Terminology



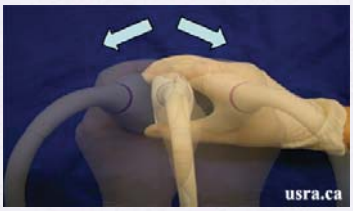
Key Words "Align"



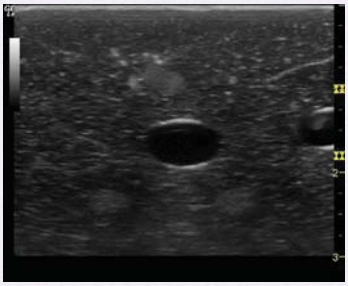
Key Words "Rotate"



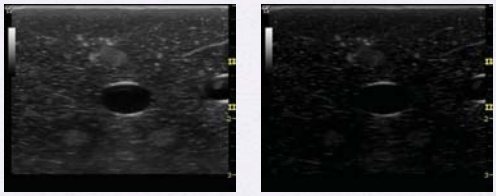
Key Words "Tilt"



OK! Let's Trouble Shoot.

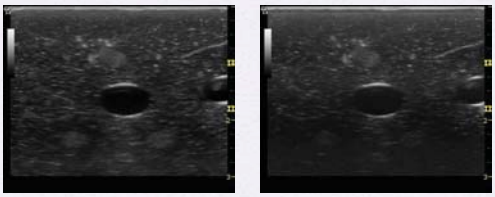


What's Wrong?



Low Gain!

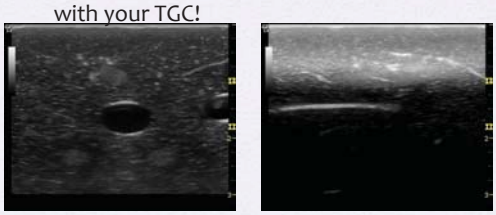
What Wrong?



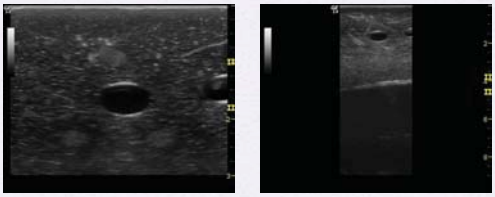
Too high frequency

What's Wrong?

Someone messed with your TGC!

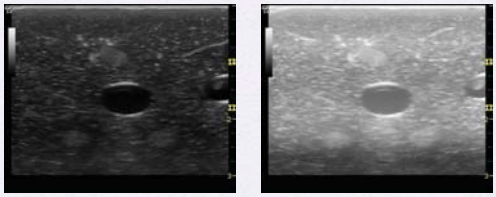


What's Wrong?



In too deep!

What's Wrong?



Gain Too High!