Introduction to Ultrasound

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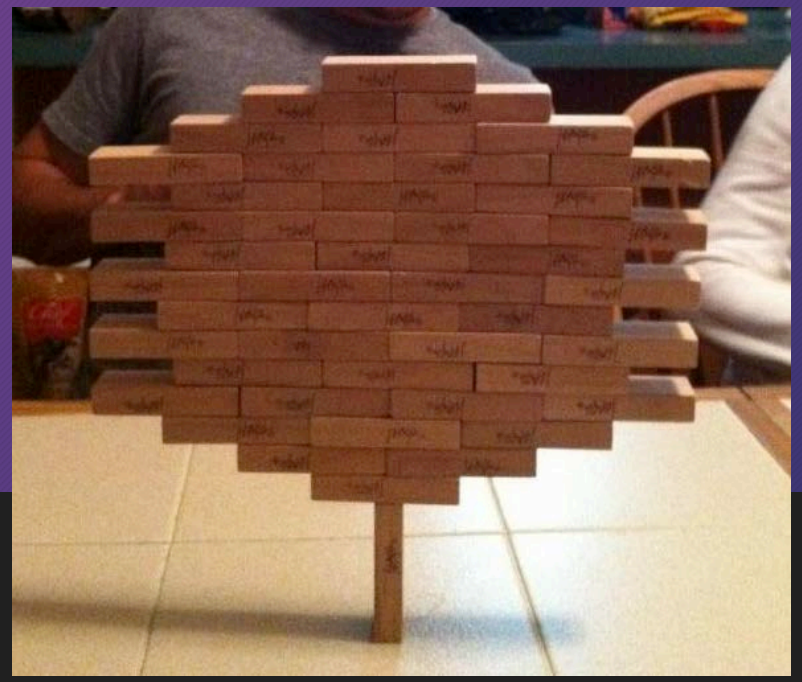
Ultrasound in Medicine

- Point-of-care ultrasound (PoCUS) is a limited exam with a focused question or goal
- Multiple applications across various specialties

Portable bedside ultrasound: the visual stethoscope of the 21st century

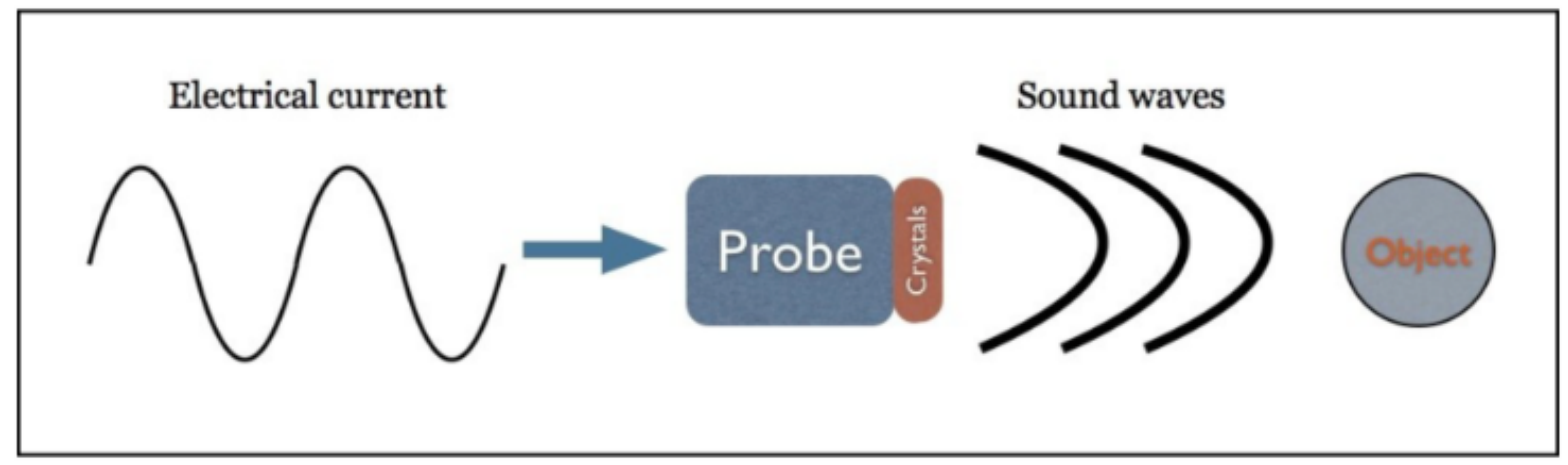
Lawrence M Gillman and Andrew W Kirkpatrick

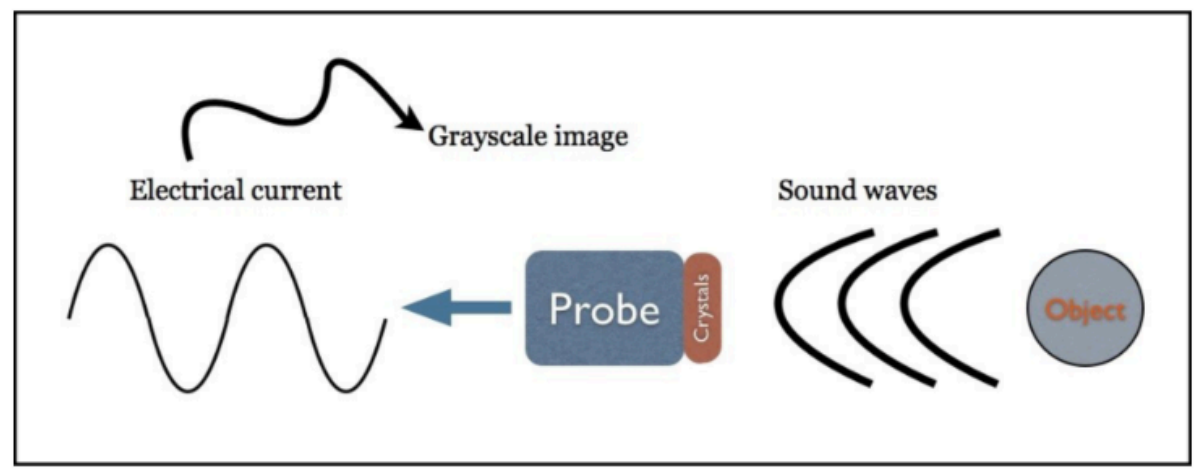
Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2012 20:18 | DOI: 10.1186/1757-7241-20-18



Basic Ultrasound Concepts

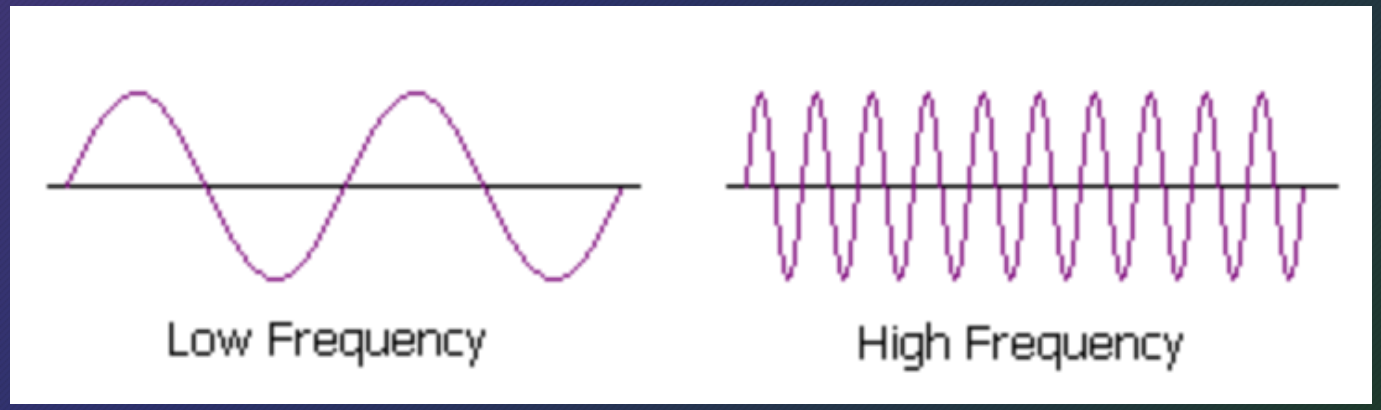
Mechanics of Ultrasound





Frequency: Image Resolution and Depth

- Higher frequency = Greater resolution = Lower penetration and depth
- Lower frequency = Lower resolution = Greater penetration and depth



Terminology

- Echogenic – bright (white) objects

- Hyperechoic – brighter (more white) than nearby structures
  - i.e. Bone, stones
- Isoechoic – same echogenicity as nearby structures
- Hypoechoic – darker (more black) than nearby structures
- Anechoic – dark (black) objects
  - i.e. Fluid filled structures – eye, bladder

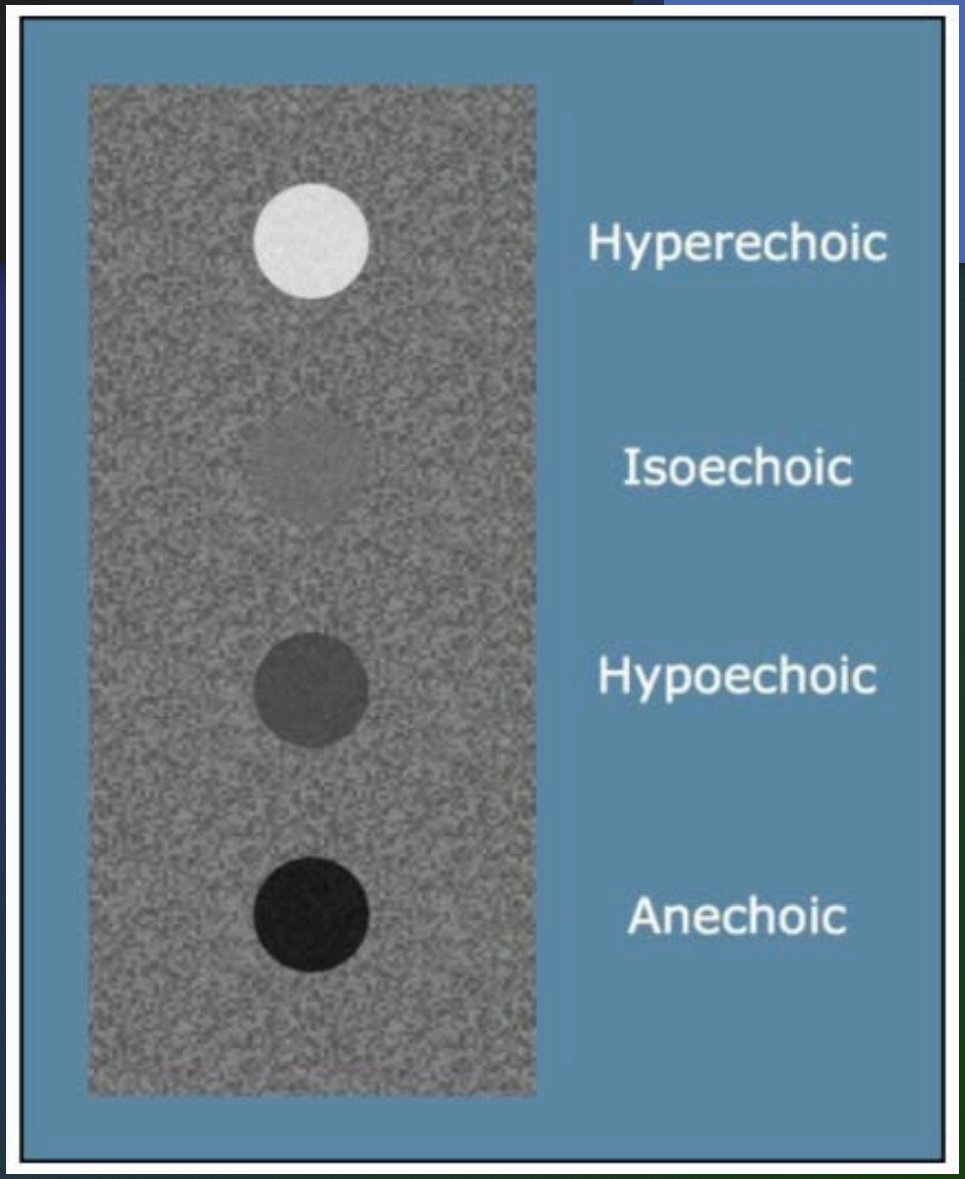
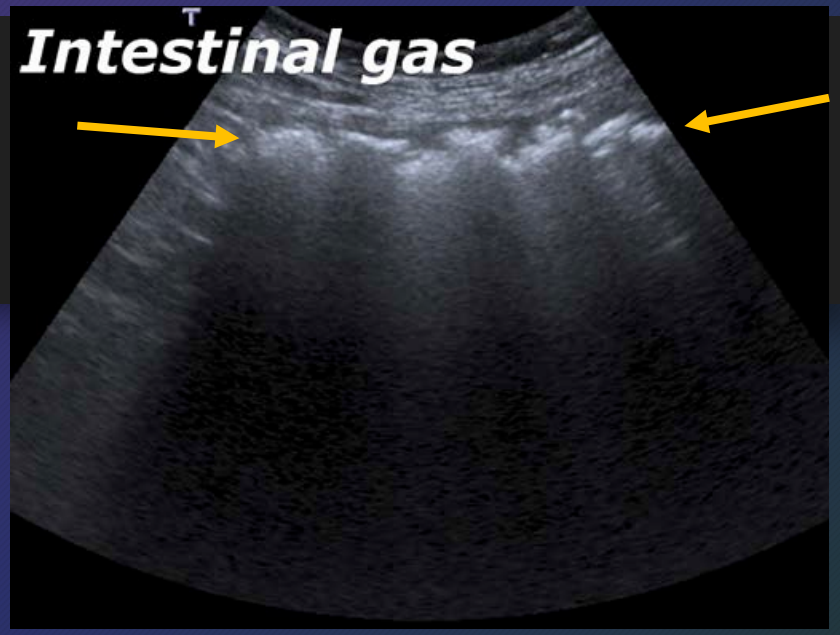
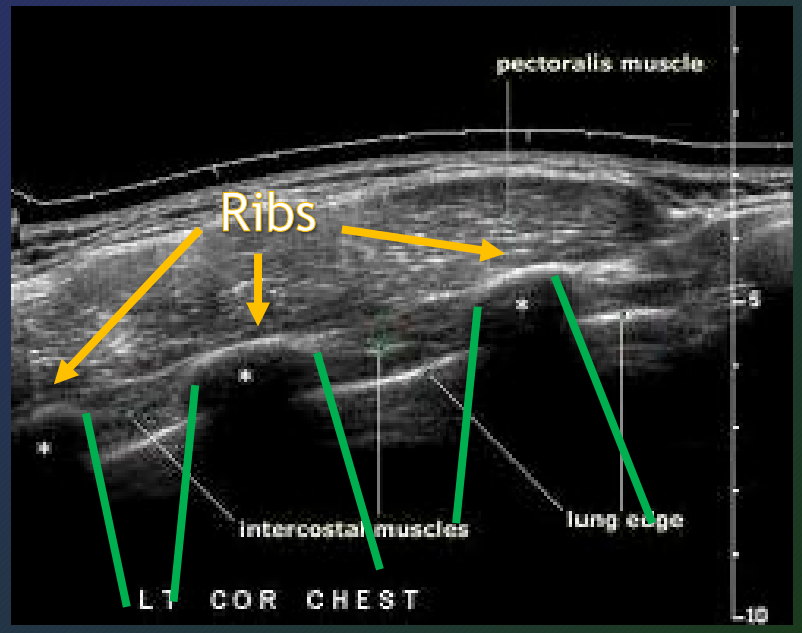


Image Acquisition Pitfalls

- Ultrasound waves do not like:
  - Air
    - Results in scattering of ultrasound beams
  - Bone
    - Results in shadowing behind





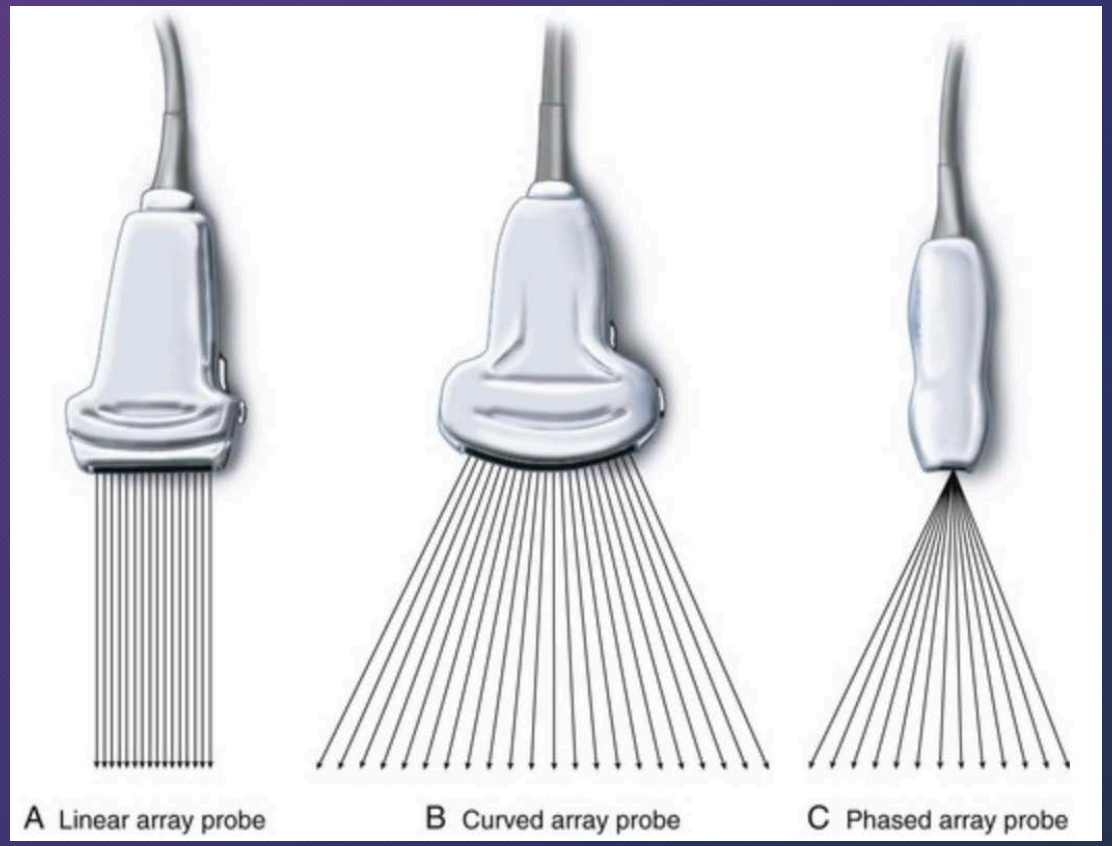
Operating the Machine

On to the Fun Stuff!

Gel is Your Friend!

Components of the Ultrasound Machine

Probe = Flashlight



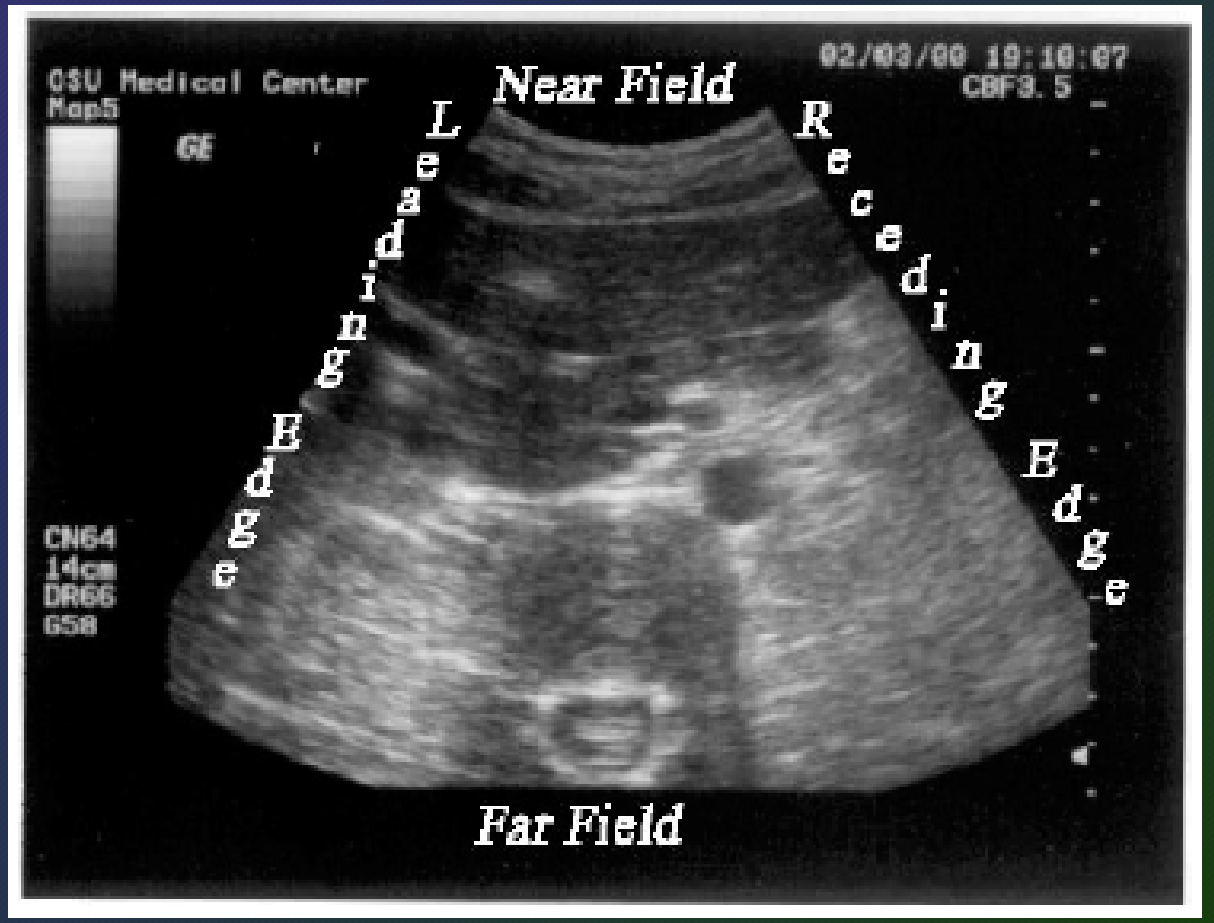
www.aneskey.com

Probe / Transducer Basics – Orientation

- Probe marker
- Leading edge
- Receding edge
- Generally, the probe marker will be oriented towards the **patient's** right or head

Screen Orientation

- Leading edge corresponds to the probe marker
- Near field = Skin surface



Transducer Types

- Curvilinear
- Phased Array
- Endocavitary
- Linear

Curvilinear / Curved Array

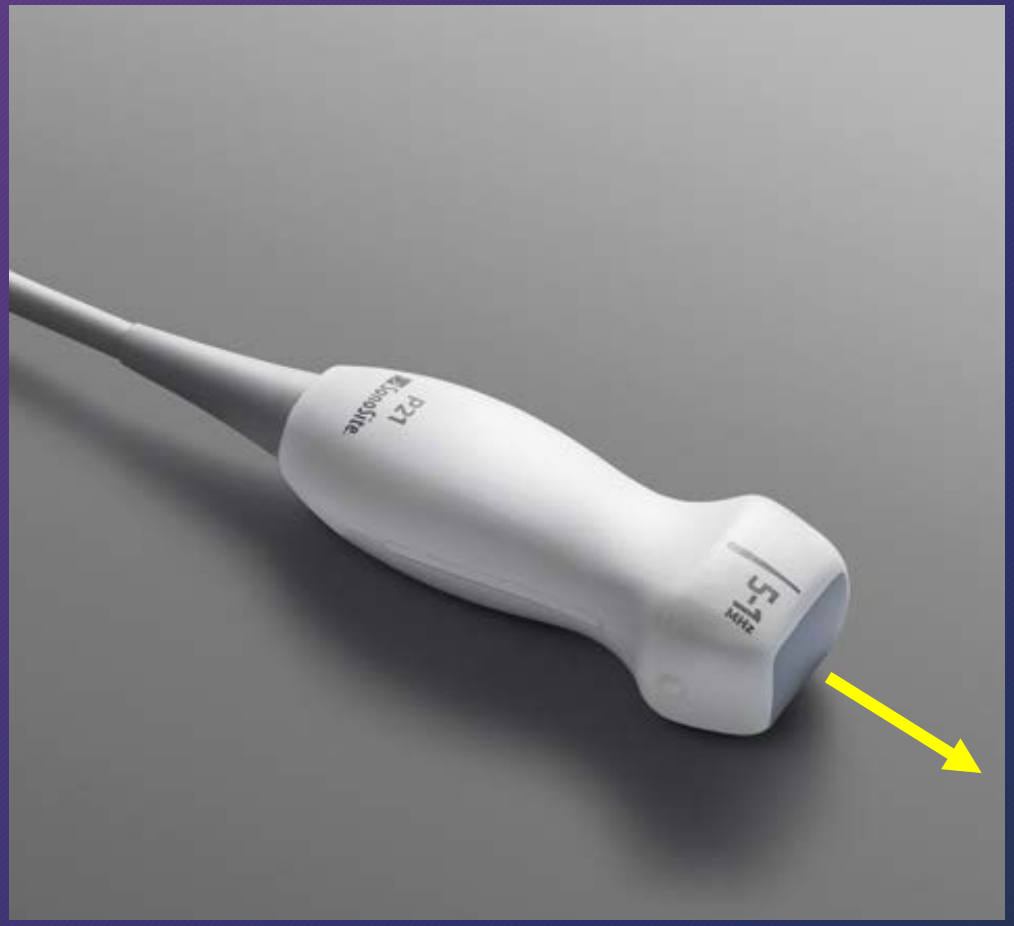
- Low frequency (2-5 MHz)
- Decreased resolution
- Increased depth (scan depth 30 cm)
- Larger footprint
- Uses:
  - Thorax
  - Abdomen
  - Pelvis

Curvilinear

Phased Array

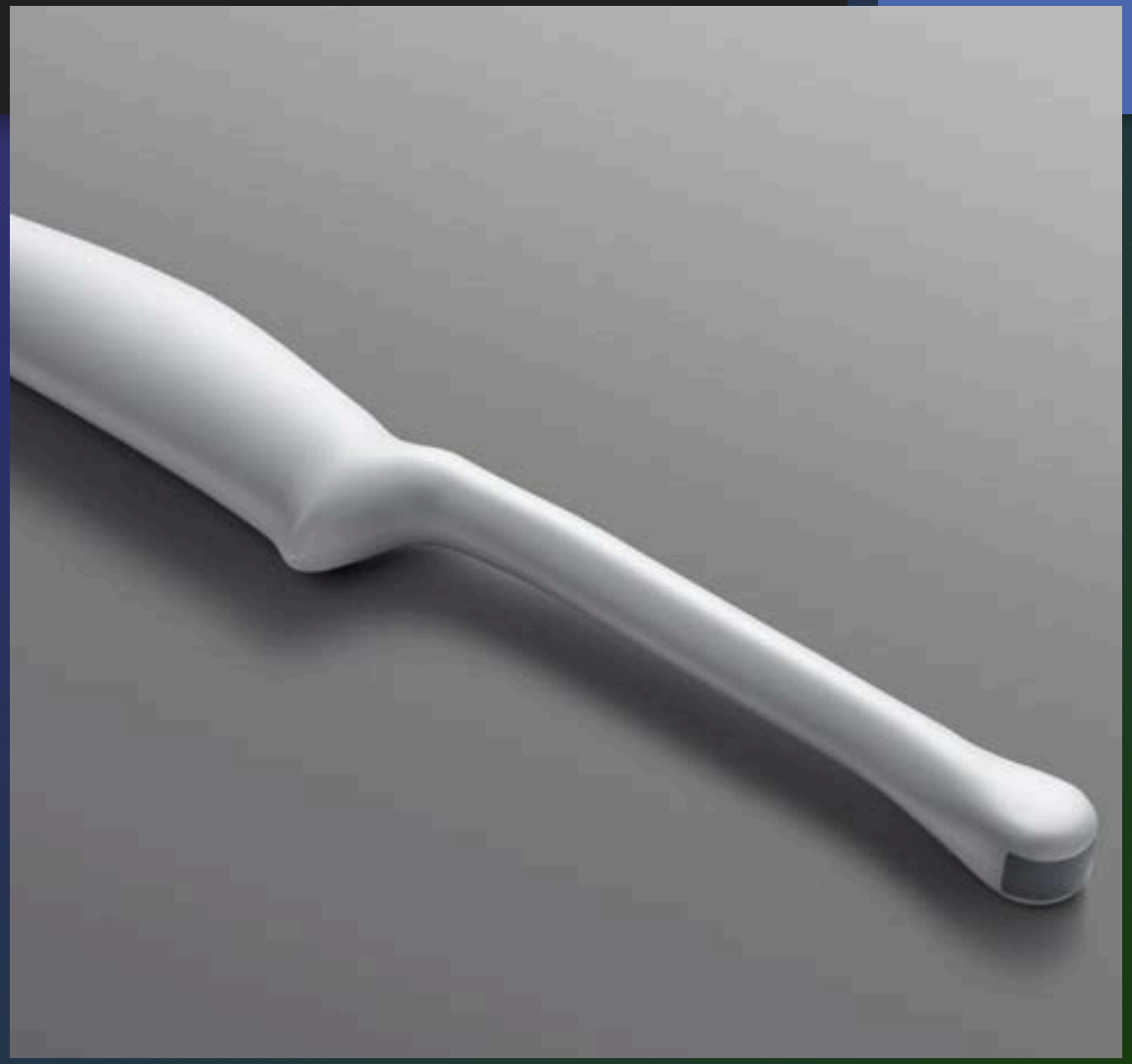
- Low frequency (1-5 MHz)
- Decreased resolution
- Increased depth (scan depth 35 cm)
- Smaller footprint
- Uses:
  - Ideal for cardiac studies (fits between ribs)
  - Thorax
  - Abdomen
  - Pelvis

Phased Array / Cardiac Transducer

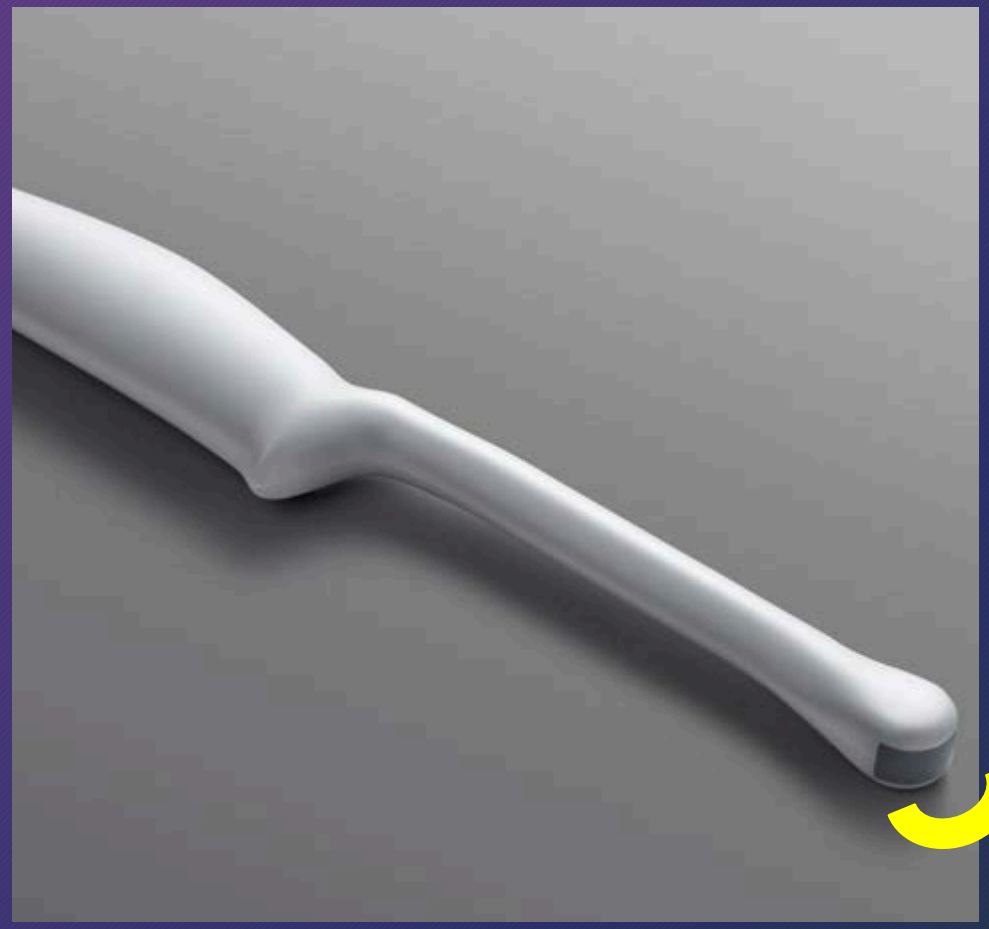


Endocavitary

- Mid to high frequency (8-15 MHz)
- Excellent resolution
- Mid depth (scan depth 13 cm)
- Small footprint
- Uses:
  - OB-gynecologic
  - Oral cavity



Endocavitary

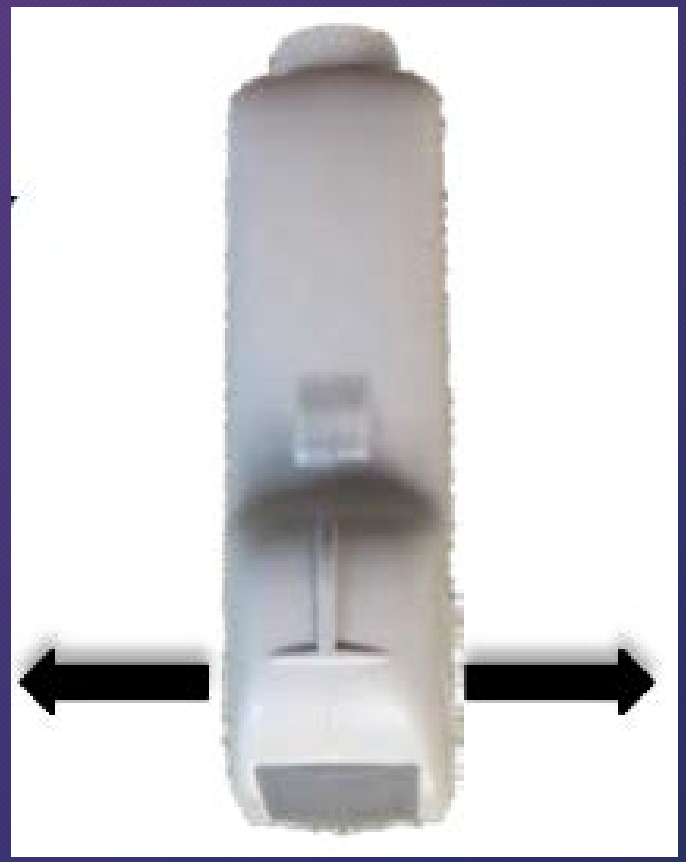


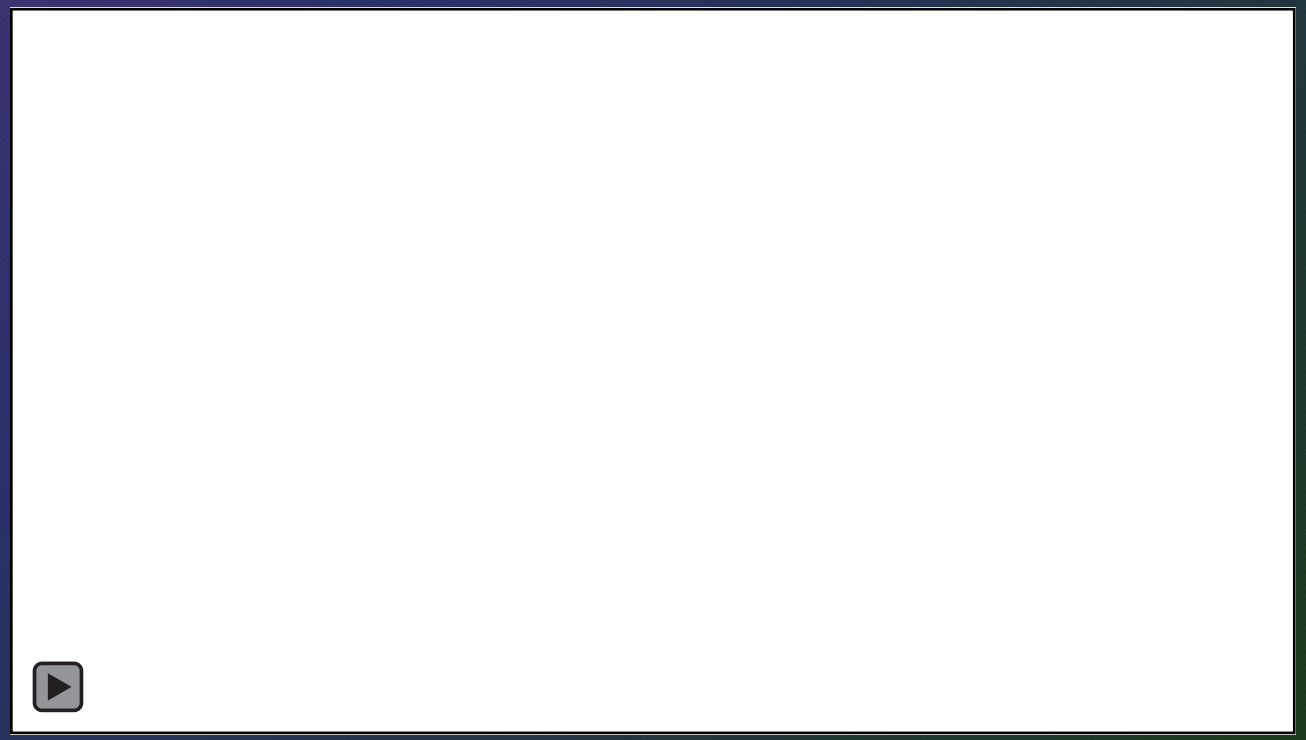
Linear

- Higher frequency (5-16 MHz)
- Higher resolution
- Decreased depth (scan depth 6 cm)
- Scanning area limited to probe size
- Uses:
  - Vascular
  - Musculoskeletal
  - Soft tissue
  - Ocular

Linear

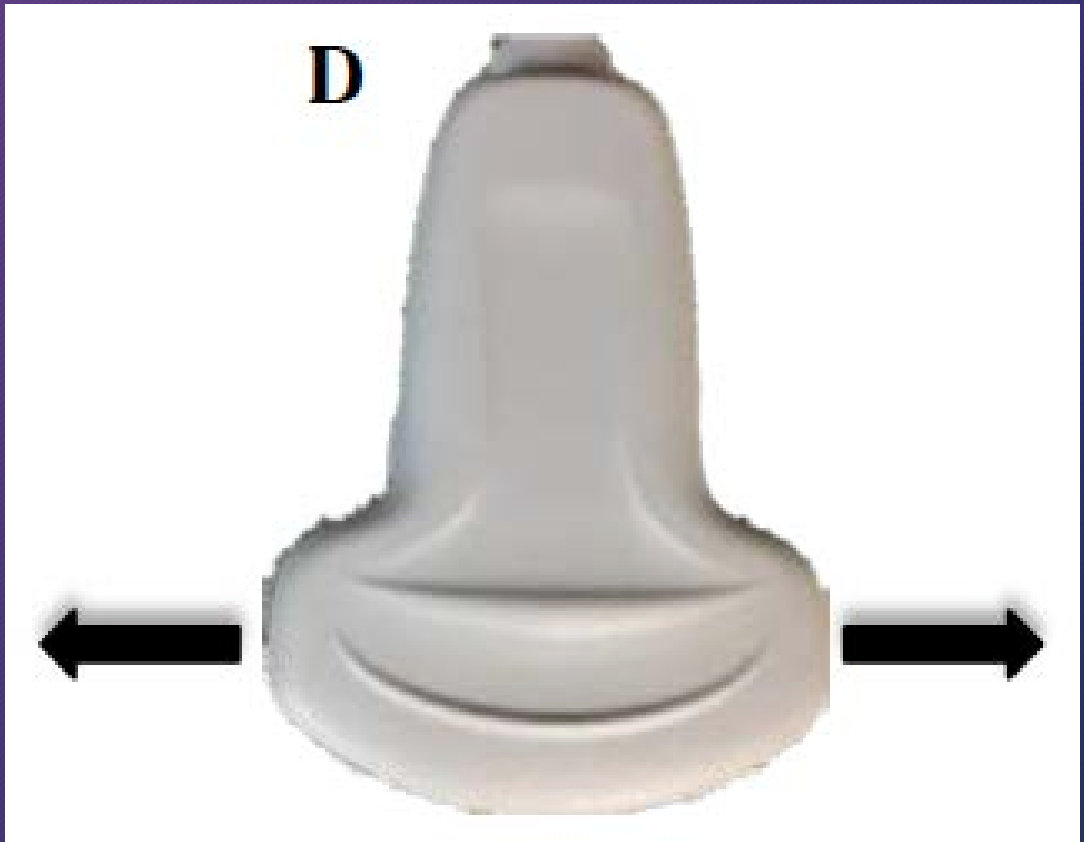
The "ART" of Transducer Movements – Sweep





https://giphy.com

The "ART" of Transducer Movements – Slide



https://giphy.com

The "ART" of Transducer Movements – Rotate

SUSME UItrasound Basics Handout

https://giphy.com

The "ART" of Transducer Movements – Fan

SUSME Ultrasound Basics Handout

https://giphy.com

The "ART" of Transducer Movements – Rock

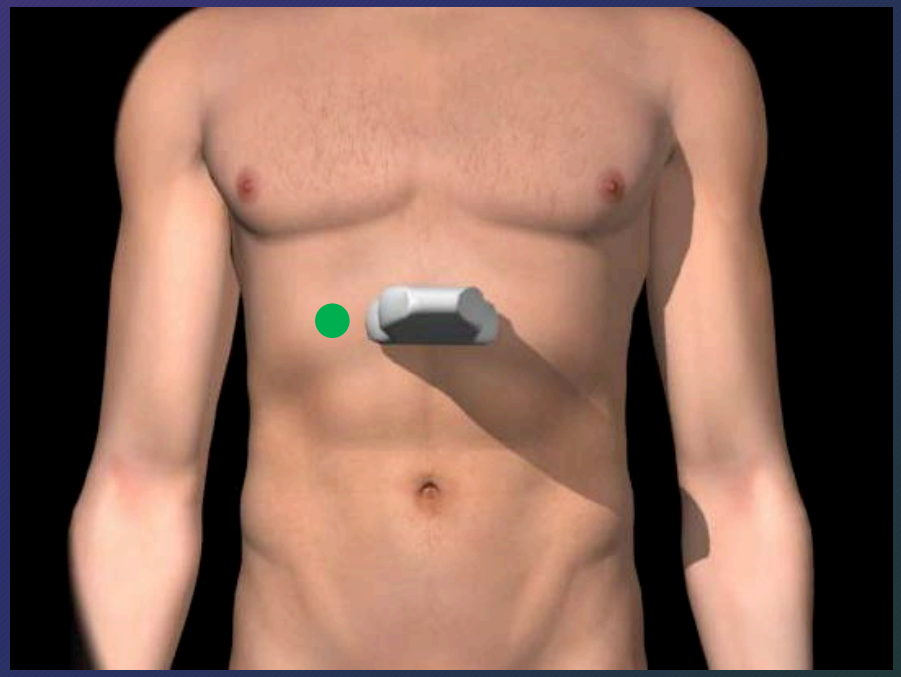
SUSME UItrasound Basics Handout

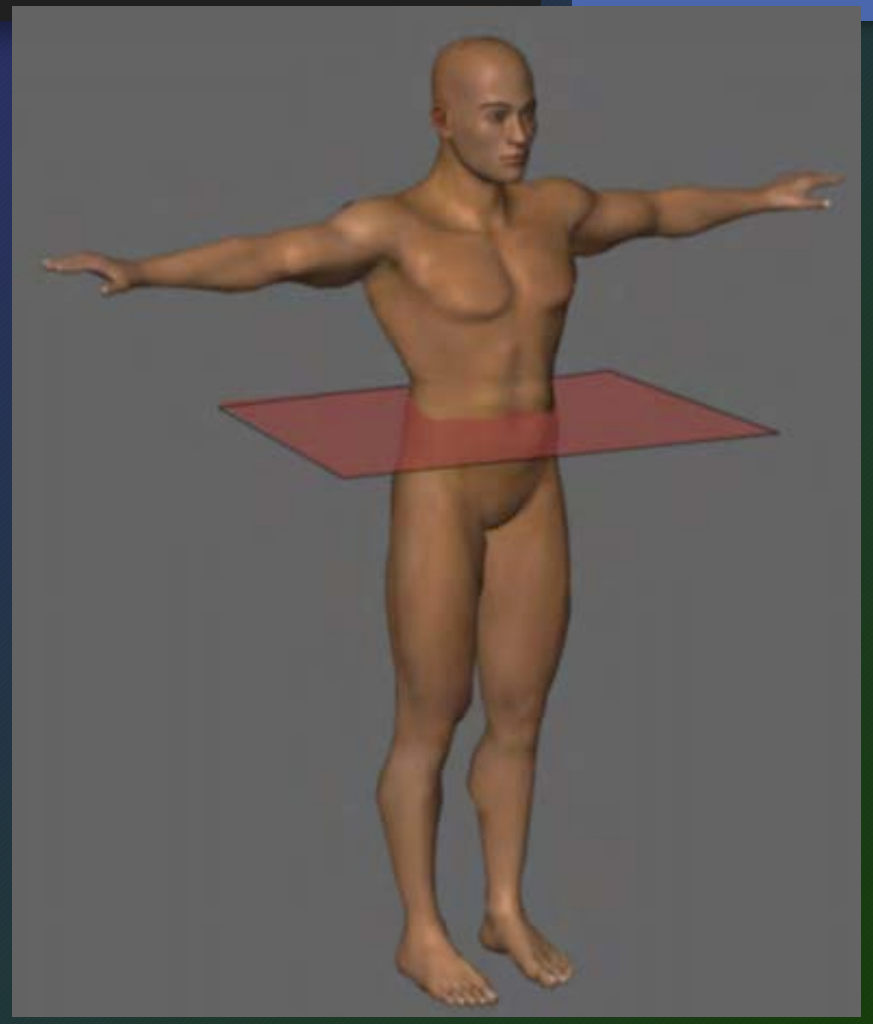
https://giphy.com

Transducer Planes

Transverse Plane (axial or cross section)

- Runs parallel to the ground
- Separates the superior from the inferior, or the head from the feet

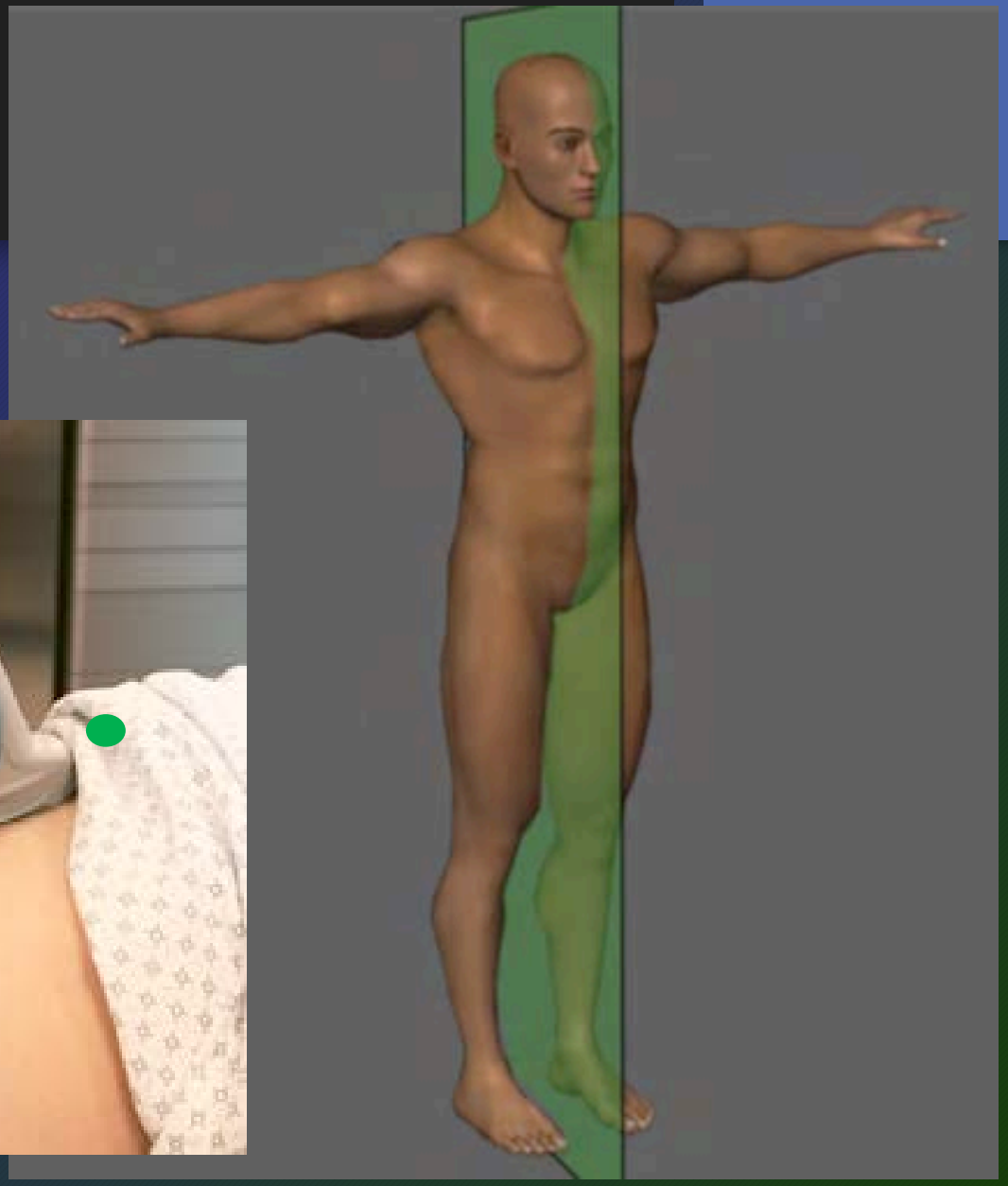




http://www.sonoguide.com/physics.html

Transducer Planes
Sagittal Plane (longitudinal)

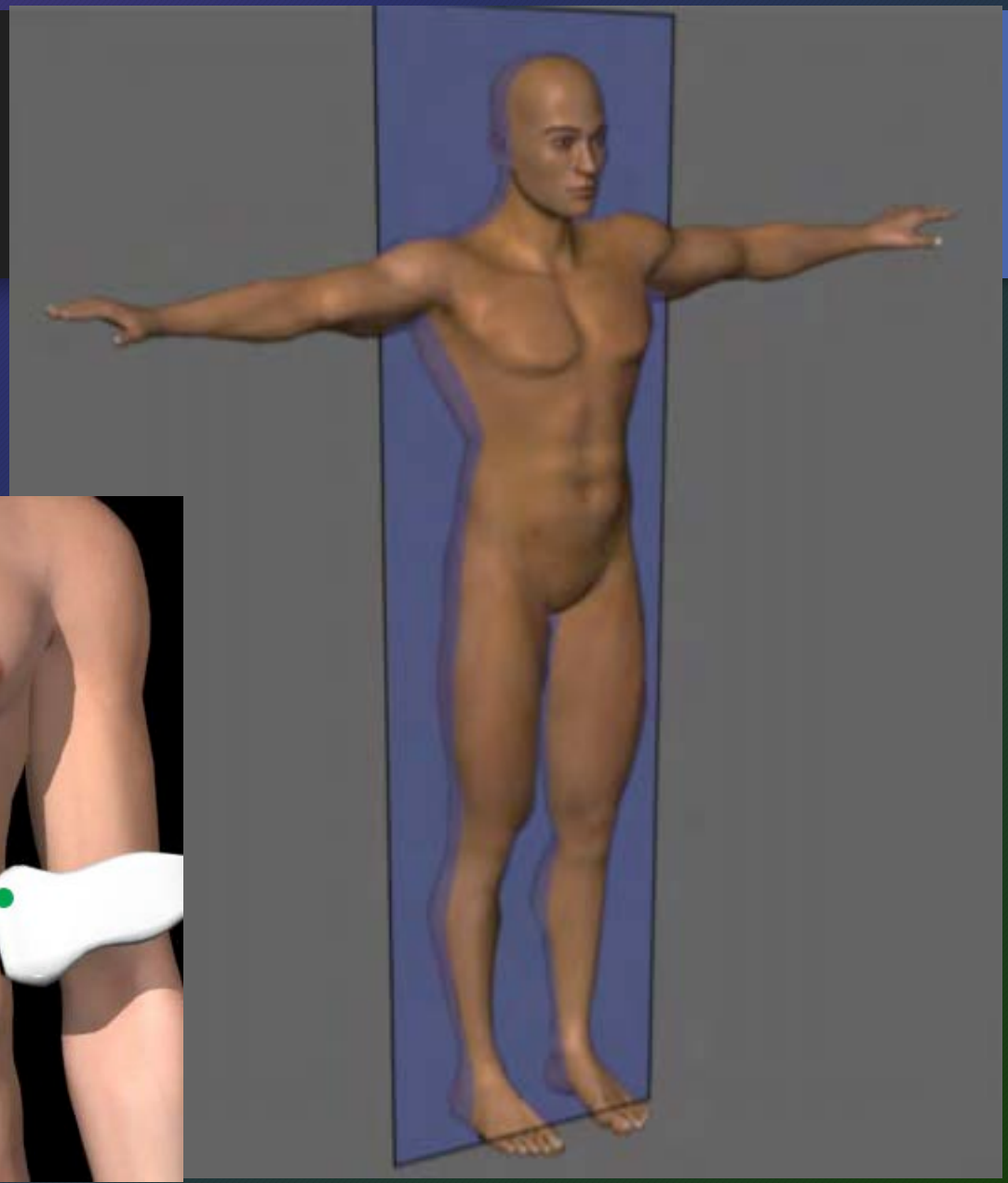
- Oriented perpendicular to the ground, separating left from right

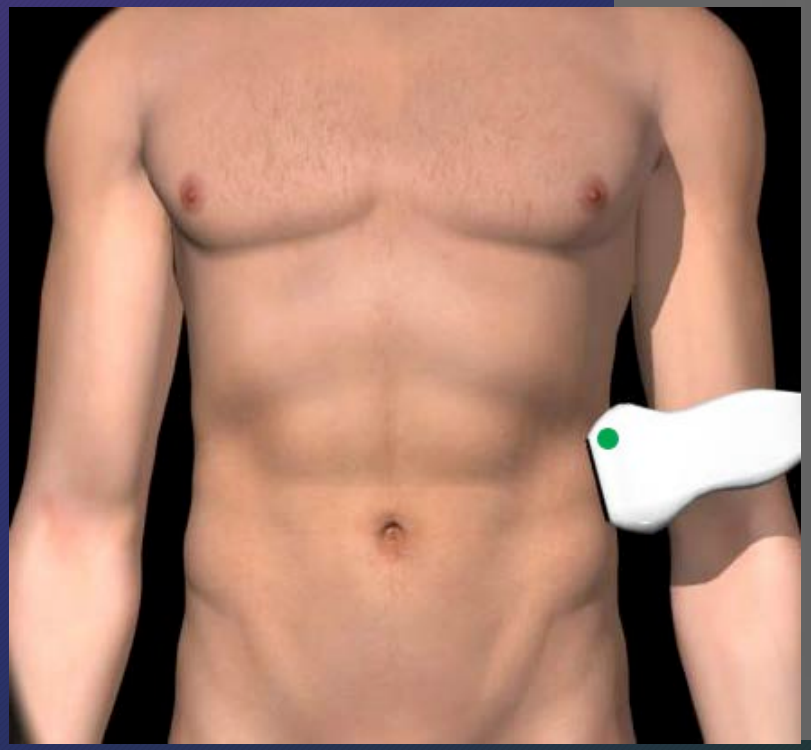


http://www.sonoguide.com/physics.html

Transducer Planes
Coronal Plane

- Separates the anterior from the posterior, or the front from the back.





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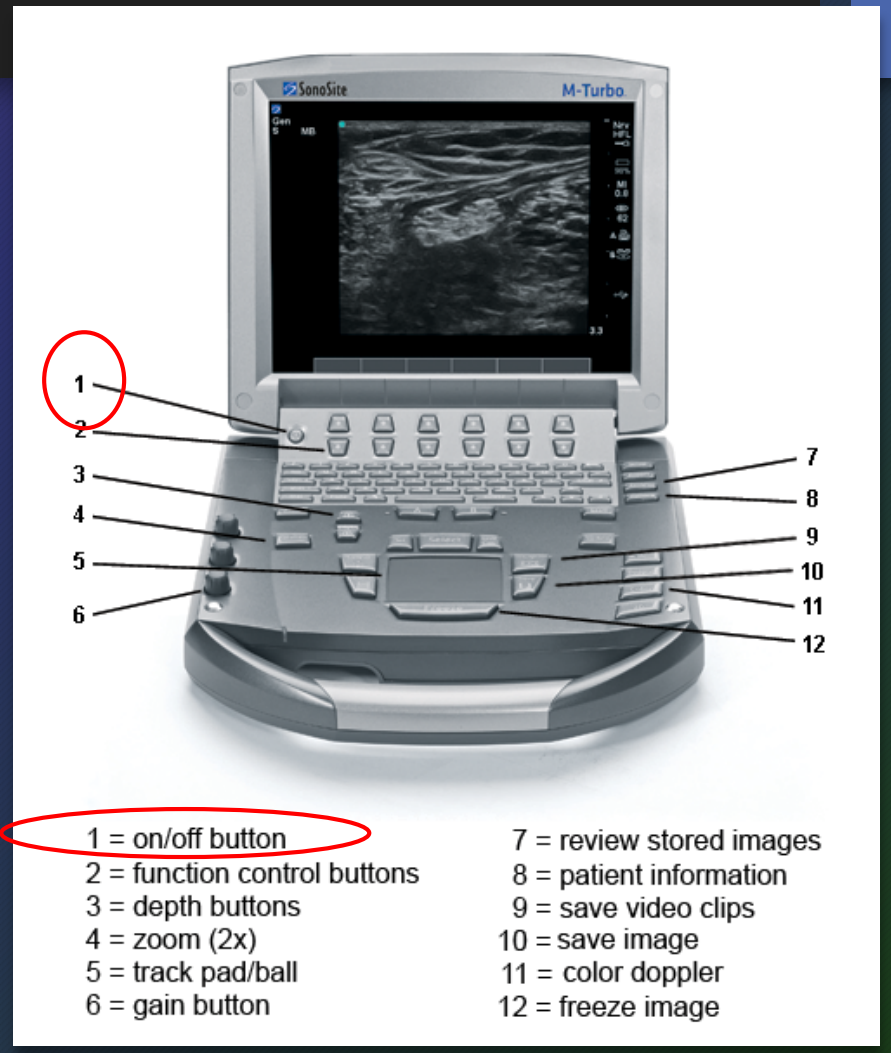
Getting Started – Turning on the Machine

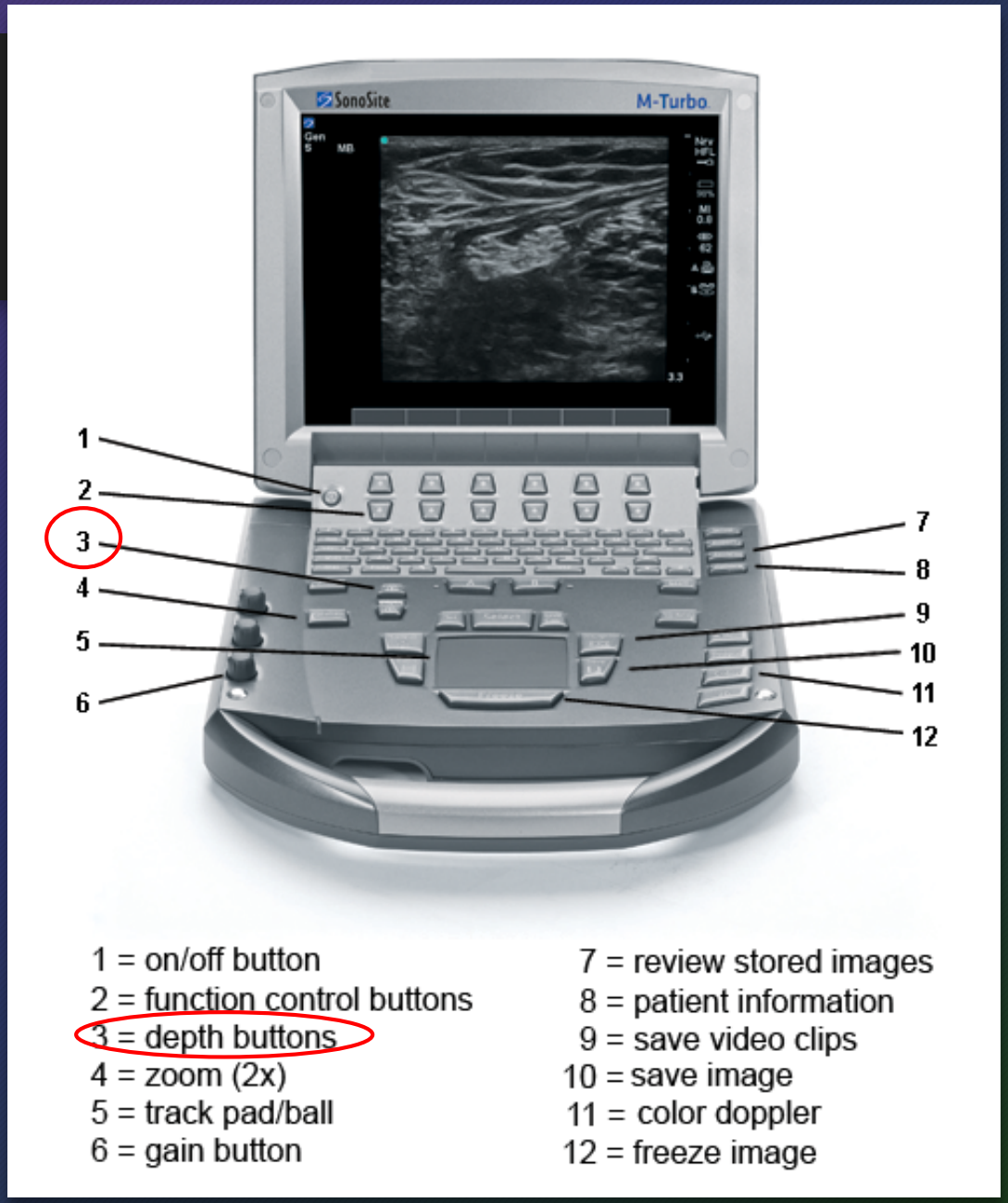
1. Find and press On/Off button (#1)



Adjusting Depth (#3)

Depth:

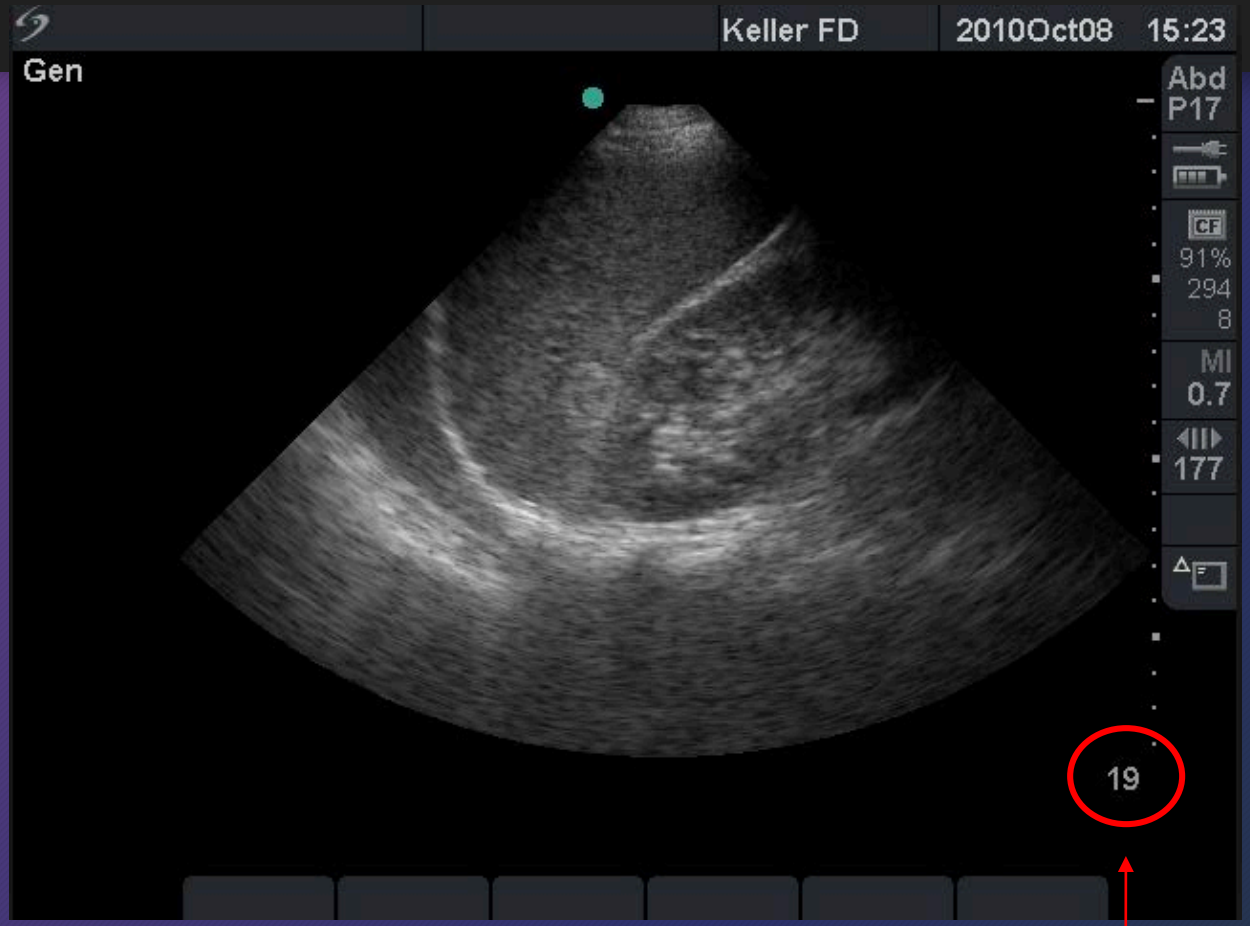
- How deep or shallow you are viewing the structures on the screen



Depth

Goal is to have your target image in the center of the screen.

Depth Markers

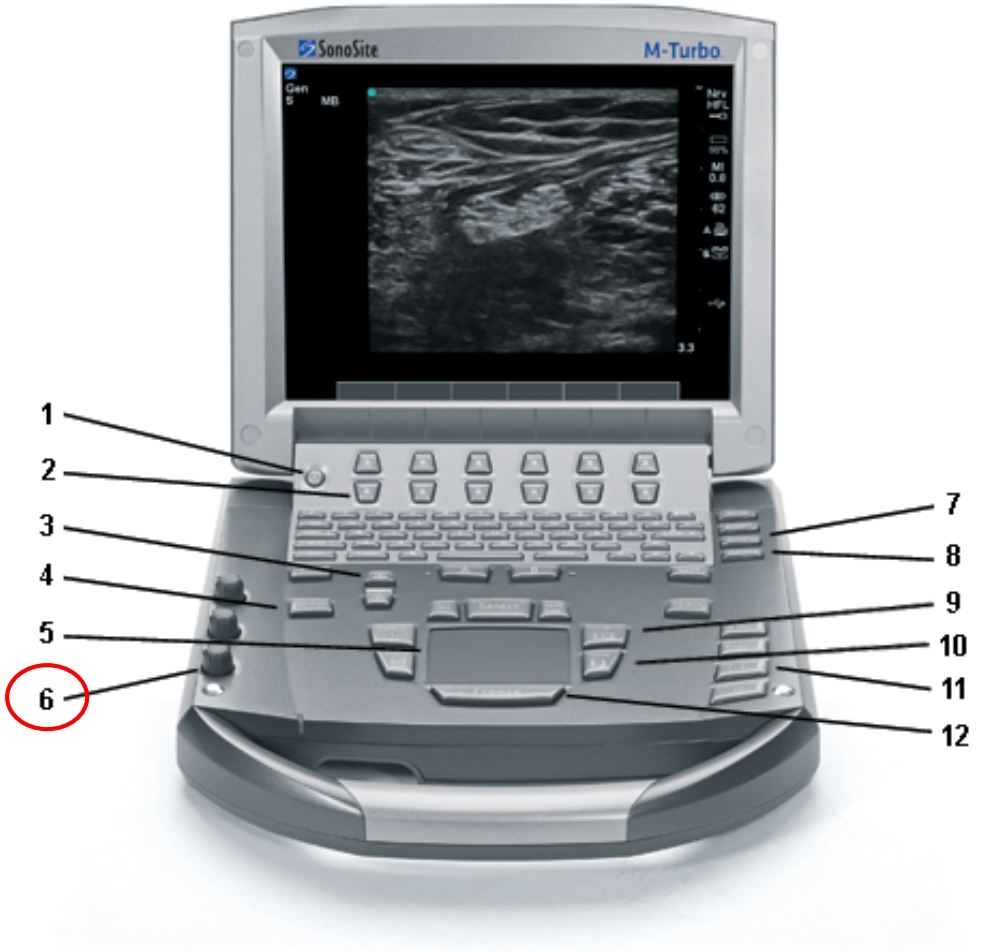


(In cm)

Adjusting Gain (#6)

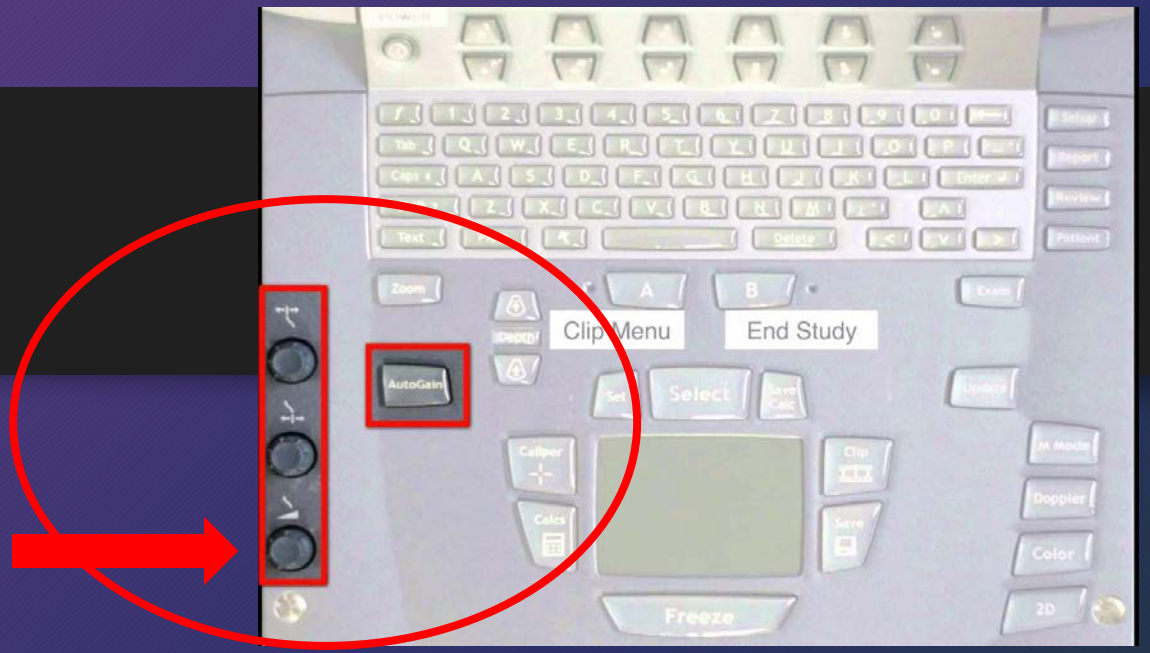
Gain:

- Overall brightness of the image
- Similar to brightness control on a computer monitor



1 = on/off button
2 = function control buttons
3 = depth buttons
4 = zoom (2x)
5 = track pad/ball
6 = gain button
7 = review stored images
8 = patient information
9 = save video clips
10 = save image
11 = color doppler
12 = freeze image

Gain



Too Little!

Just Right!

Too Much!

Ultrasound Etiquette

- Introduce yourself to your patient and ask permission to scan
- Only expose the area of the body being scanned
- Wipe the patient off after the exam is completed
- Clean off the probe and cord
  - Soap and water
  - Alcohol wipes
  - Damp wash cloth or gauze pad
  - DO **NOT** use bleach containing germicidal wipes!
- Do not drop the probes
- Be aware of the cord – no stepping on or running over with wheels
- Plug in or place in charger when not in use