Know your Ultrasound Machine (Knobology)

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Objectives

- Outline the commonly used knobs (knobology) of an ultrasound (US) machine and their functions
  - The panel of the Micromaxx (Sonosite) will be used as the template

- Transducer design and terminology

- Illustrate the various modes of US
**Power On/Off**: This control turns the power supply of the ultrasound machine on (off).
Probe Connector

Allows one to connect the desired ultrasound probe to the machine as illustrated
Preset Selection

Allows one to select the appropriate preset for scanning:

- Nerves
- Vascular
- Small parts
Image Optimization Control

Changes the frequency of broadband (multi-frequency) transducer

✓ Res (Resolution) $\rightarrow$ Best resolution, higher frequency

✓ Pen (Penetration) $\rightarrow$ Best penetration, lower frequency

✓ Gen (General) $\rightarrow$ Between Res and Pen
Depth Control

Changes the field of view for the structure being imaged.
Total depth of view is 2.7 cm in this US image.
Gain Control

Gain

- Adjusts the acoustic power of transmitted signals
- Also adjusts the amplification of returning acoustic signals

Near Gain and Far Gain

- Adjust the amplification of returning signals at a specific image depth.
Freeze Control

This Freezes and Unfreezes the image.
**TGC**

- **Time Gain Compensation** controls are arranged in a vertical fashion. Each of the sliders adjusts the amplification of returning 2D mode signals at a specific image depth.

- In Sonosite’s Micromaxx machine (Sonosite), TGC is replaced by near gain and far gain control knobs.
In a linear array of ultrasound crystals, the transducer transmit parallel beams in sequence, creating a field that is as wide as the probe length (footprint). It gives a large footprint and a narrow sector.

Actually it is a curved linear array. This results in a wider field in depth (wide sector), but the lateral resolution is reduced as the scan lines diverge.
A phased array with electronic steering, can generate a beam sweeping at an angle. The footprint is small but still has a wide far field of view. Example - the probe used for echocardiography, the probe is small enough to fit between the ribs, but still has a wide far field of view to image the heart.
Broadband Ultrasound Probes

- **Frequency:** 10-5 MHz
  - **L38e/10-5**: 38-mm broadband linear array
  - Major applications: Small parts, breast, vascular, nerve, IMT, musculoskeletal, superficial

- **Frequency:** 13-6 MHz
  - **HFL38/13-6**: 38-mm broadband linear array
  - Major applications: Breast, small parts, nerve, vascular, IMT, musculoskeletal

- **Frequency:** 5-1 MHz
  - **P17/5-1**: 17-mm broadband phased array
  - Major applications: Cardiac, abdominal, obstetrics

- **Frequency:** 5-2 MHz
  - **C60e/5-2**: 60-mm broadband curved array
  - Major applications: Abdominal, obstetrics, gynecology
Ultrasound Mode Selector
Activates the various modes of ultrasound.
Modes of ultrasound

- B-Mode (2D mode) (Gray-scale)
- M-Mode
- Pulse Wave Doppler
- Colour Doppler
- Power Doppler
B-Mode (2D mode)
Longitudinal scan of the carotid artery
M Mode of Carotid Artery

M-mode displays echo depth and amplitude information with respect to time along a single line of sight.
Pulse Doppler

Angle correction used ($\theta$)

60 degree

Direction of pulse Doppler beam

Assumed direction of the blood vessel

Position of sample volume
To calculate the velocity profile, the angle of the Doppler beam is assumed to be at 60 degrees to the artery.
**Colour Doppler**

Common Carotid Artery (longitudinal View)

- **Left side of the image (cephalad)**
- **Right side of the image (Caudad)**
- **Direction of doppler beam**

**Notes:**
- **RED** → positive doppler shift → blood flow from right to left
Colour Power Doppler (CPD)

Common Carotid Artery (Transverse View)

Colour indicates presence of flow, but **no** directional information.
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