Introduction to Emergency POCUS

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April 2020

Objectives

1. History
2. Understand the basic physics of ultrasound
3. Types of Transducers
4. Ultrasound Imaging Modes
5. Common Artifacts

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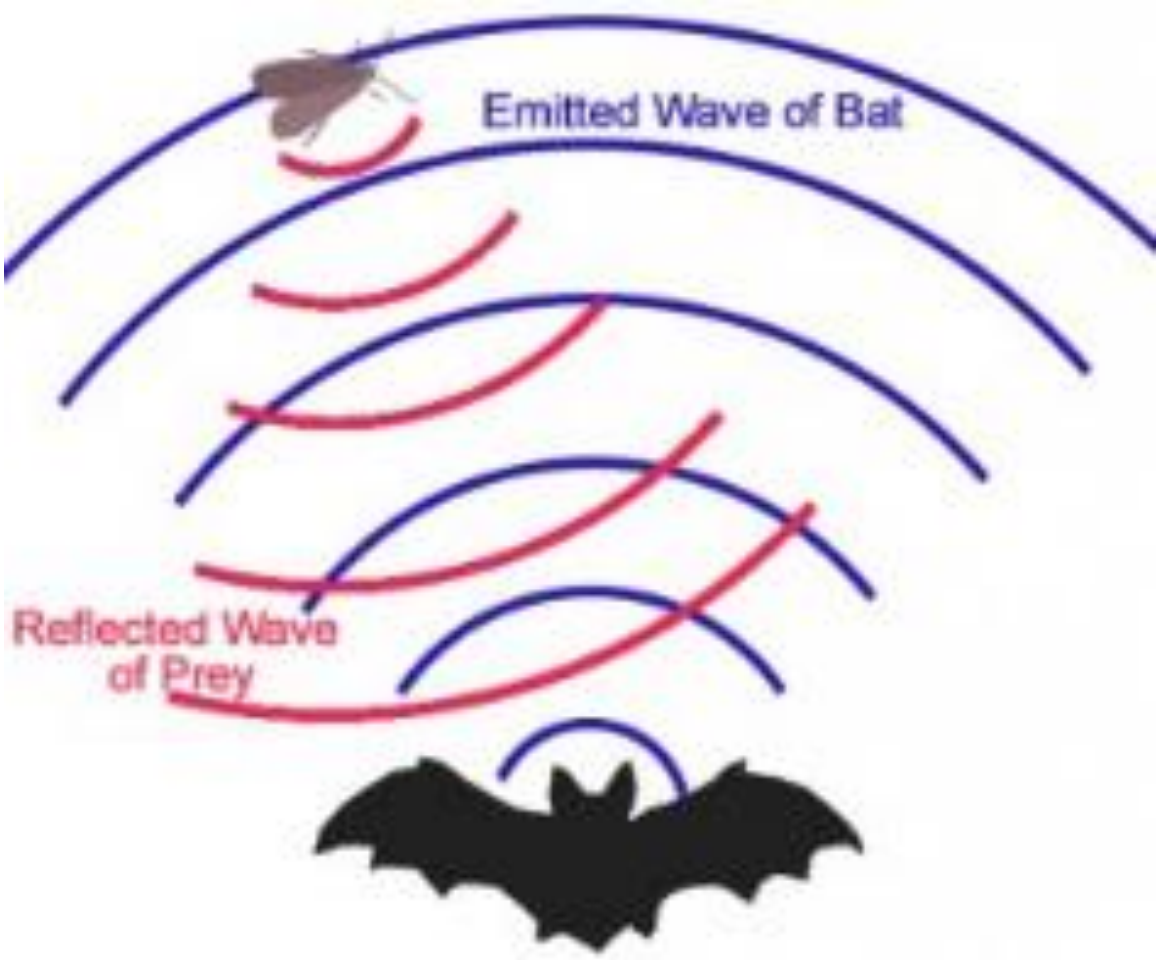
Objectives



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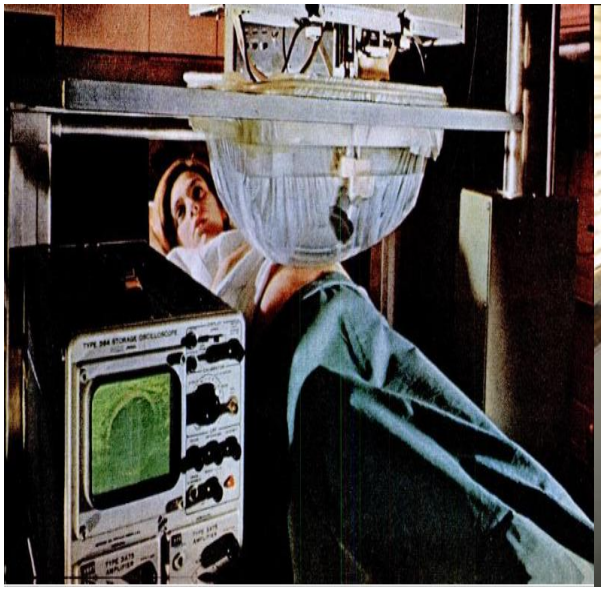
History

Ultrasound

Advancement

1956 **1990** **2018**



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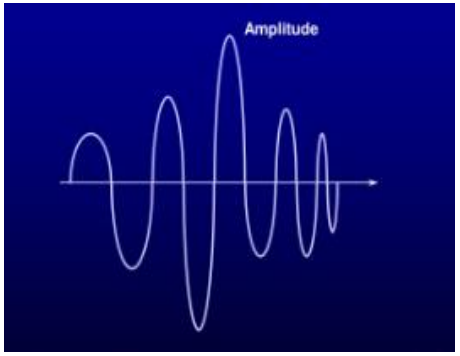
History

Traditional **vs.** **Modern**

Basic Physics



Ultrasound & infrasound

Sound waves with a frequency *too low* for the human ear to hear are called **infrasound**.

Sound waves with a frequency *too high* for the human ear are called **ultrasound**

INFRA SOUND

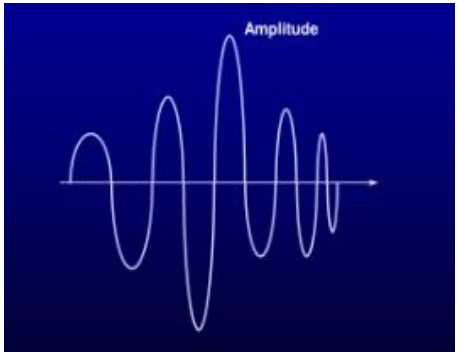
ULTRA SOUND

below 20 Hz | 20 Hz to 20,000 Hz | over 20,000 Hz

Animals such as whales, elephants and hippopotamus use infrasound to communicate over distances.

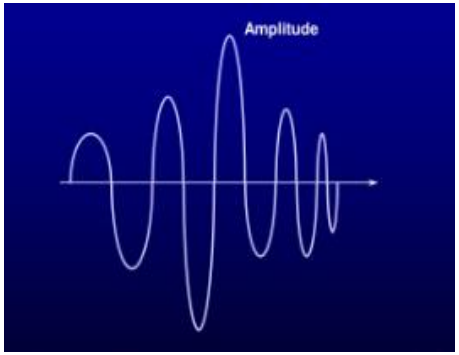
Animals such as dogs, bats, birds and insects can hear ultrasound.

Basic Physics



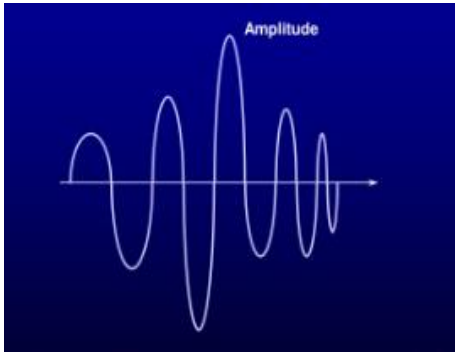
Diagnostic US utilizes sound waves in the range of 1 MHz to 20 MHz

Basic Physics



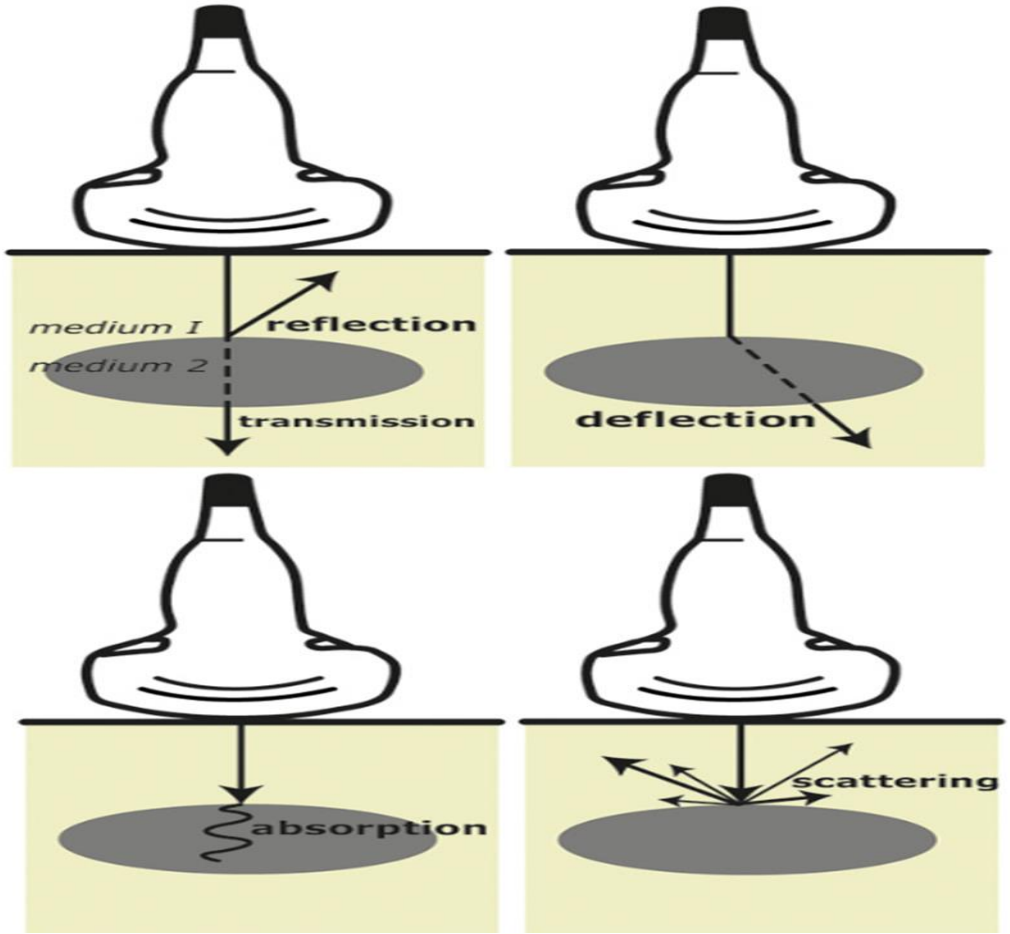
Many factors influence the ultrasound waves transmitted through the human body

Basic Physics

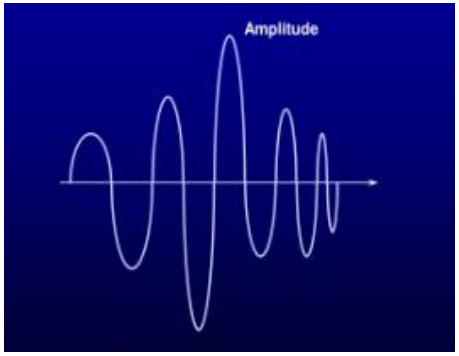


Reflection & Refraction & Scatter

At interfaces between different medium



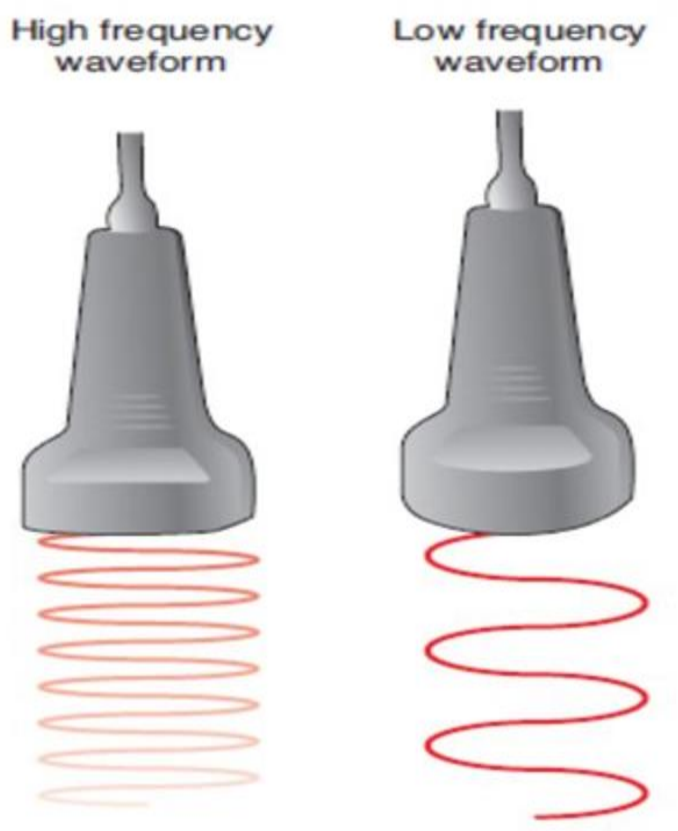
Basic Physics



- High stiffness = high speed
- High density = low speed

Medium	Velocity
Air	331 m/s
Brain	1,541 m/s
Kidney	1,561 m/s
Liver	1,549 m/s
Muscle	1,585 m/s
Fat	1,450 m/s
Soft Tissue (average)	1,540 m/s
Bone (different densities)	3,000 to 5,000 m/s

Transducers



Linear

- High frequency (5-18) MHz
- Flat surface
- High resolution
- Does not allow deep penetration
- Maximum depth (6-8) cm

Curvilinear

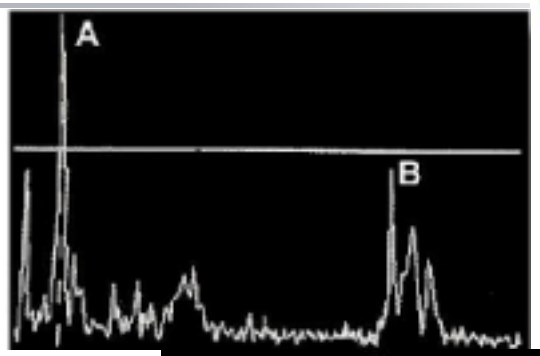
- **Low frequency (1 – 5) MHz**
- **Curved surface**
- **Allow deep penetration into the body.**

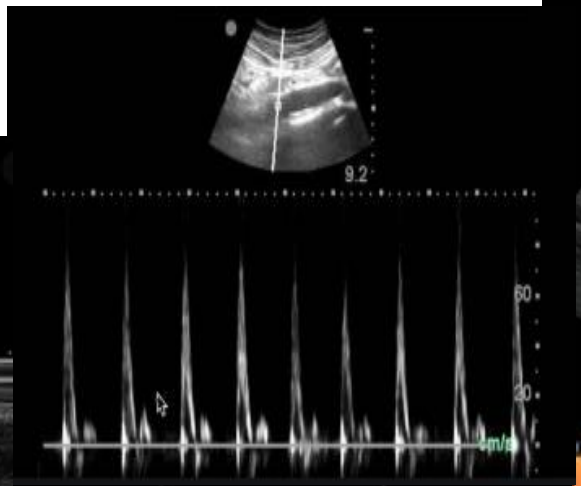
Phased-array

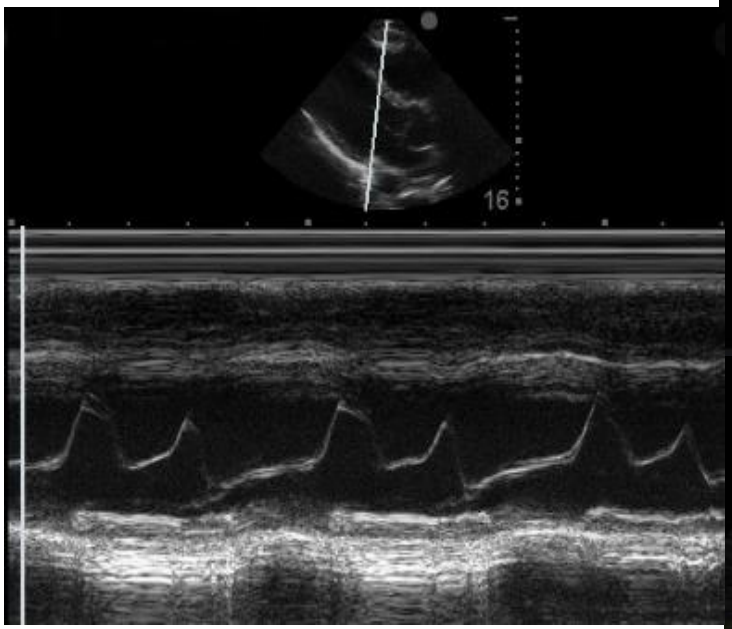
- Low frequency (1 – 5) MHz
- Allow deep penetration into the body.
- Smaller footprint and flat surface.
- Poor resolution in the far field when comparing with curvilinear probe.

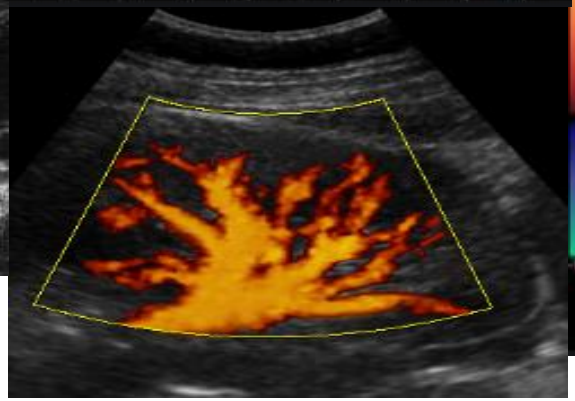
Ultrasound Imaging Modes

- A-Mode = Amplitude
- B-Mode = Brightness
- C-Mode = Color Doppler
- D-Mode = Pulse Wave Doppler
- P-Mode = Power Doppler
- M-Mode = Motion

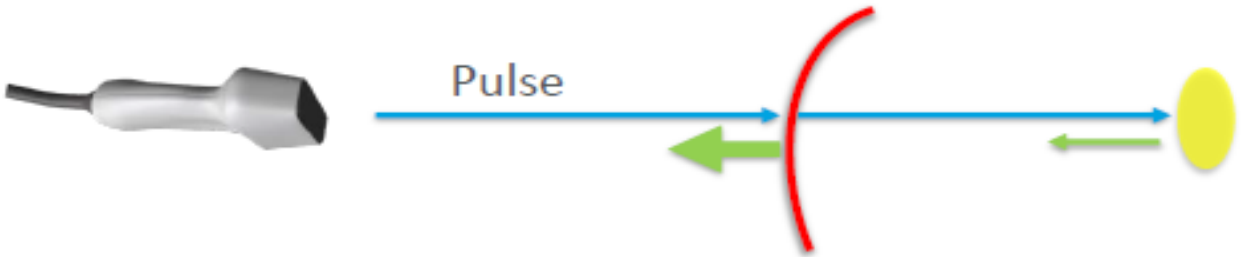








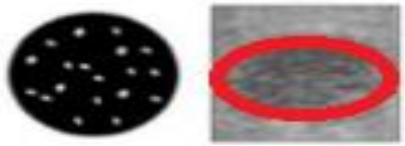
Ultrasound Imaging Modes



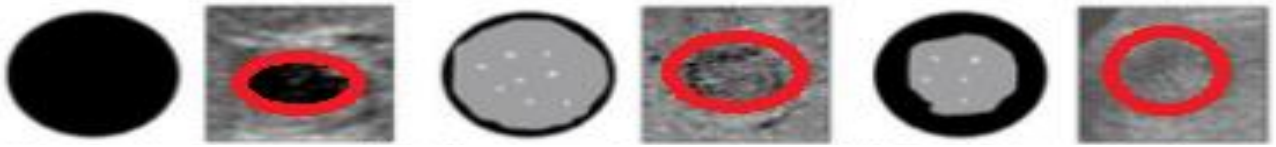
A-mode (Amplitude)

B-Mode (Brightness)

(1) Hyperechoic

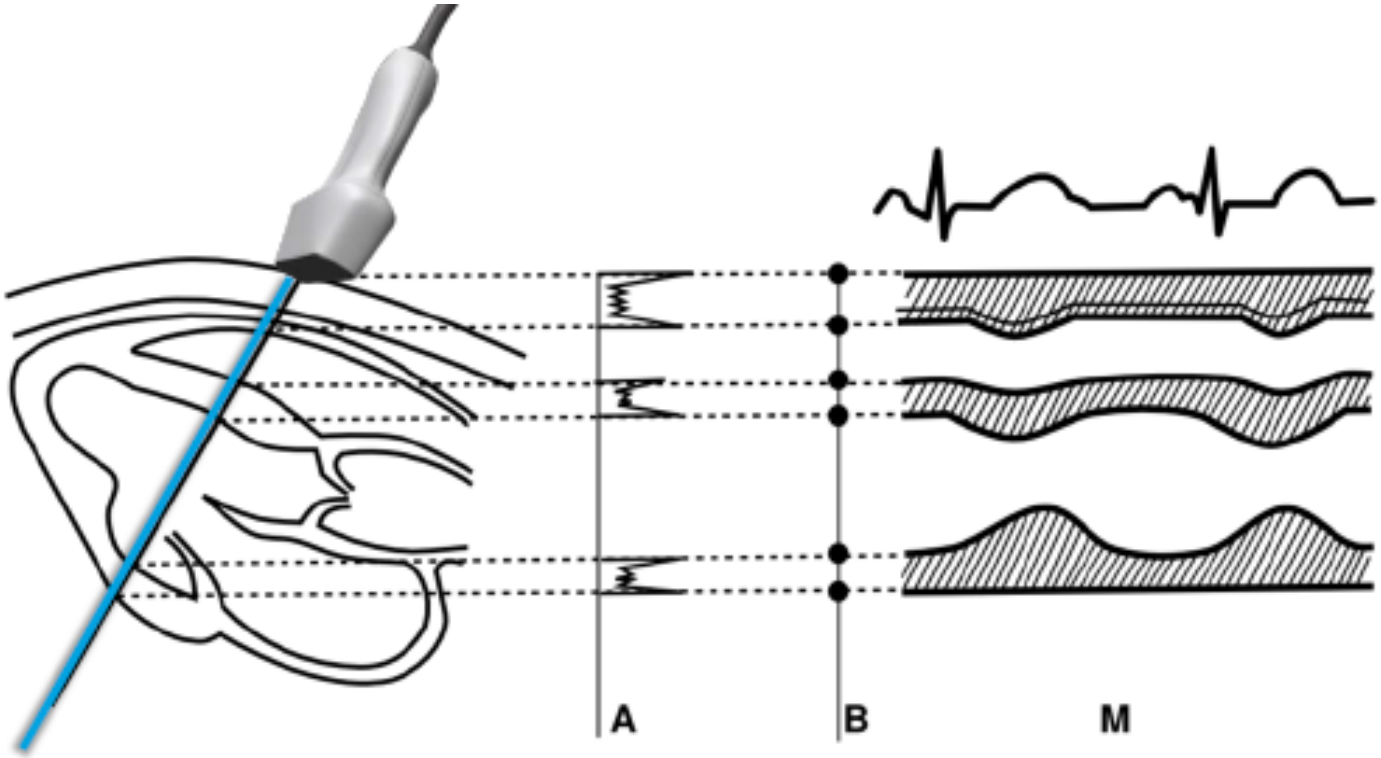


(2) Hypoechoic

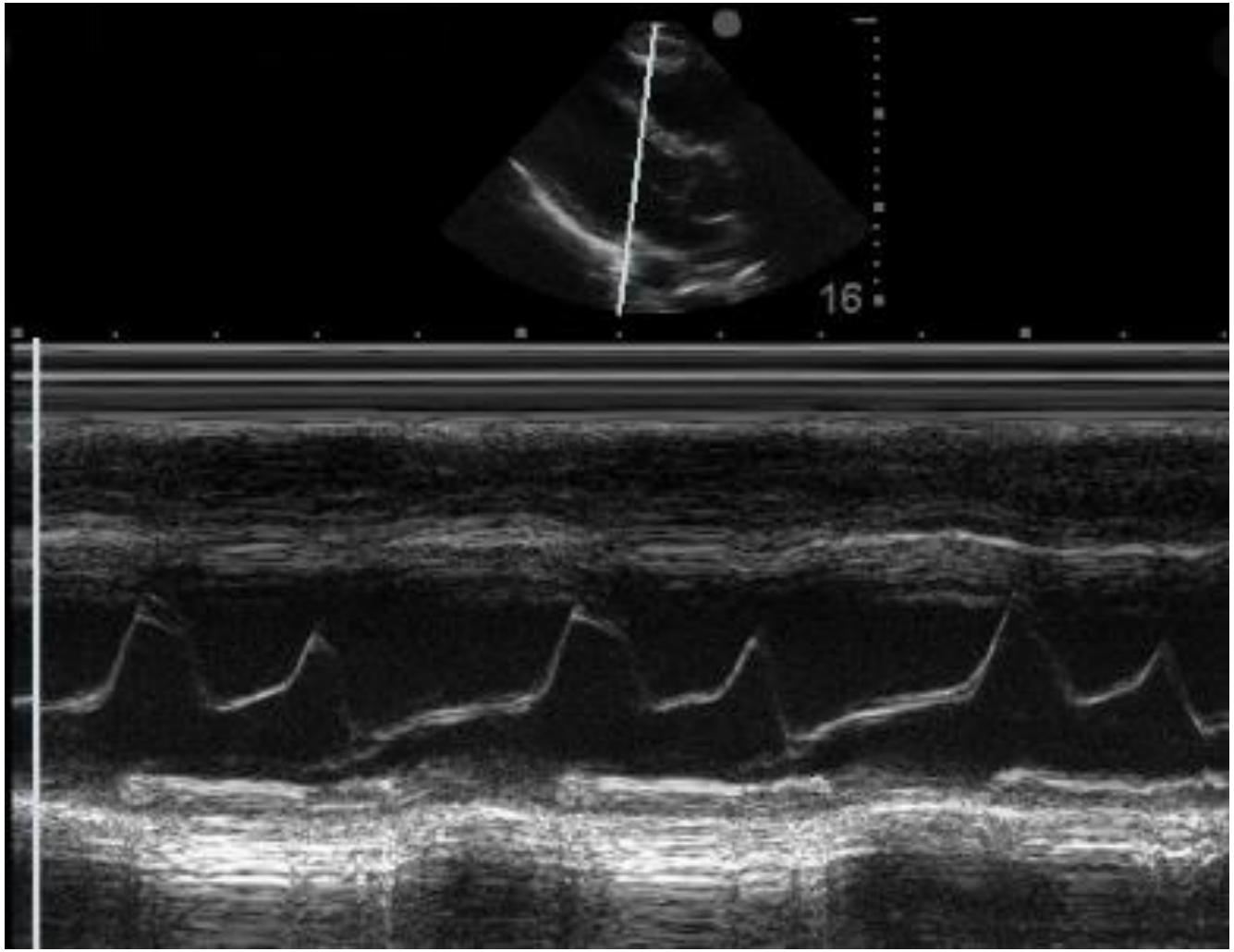


Ultrasound Imaging Modes

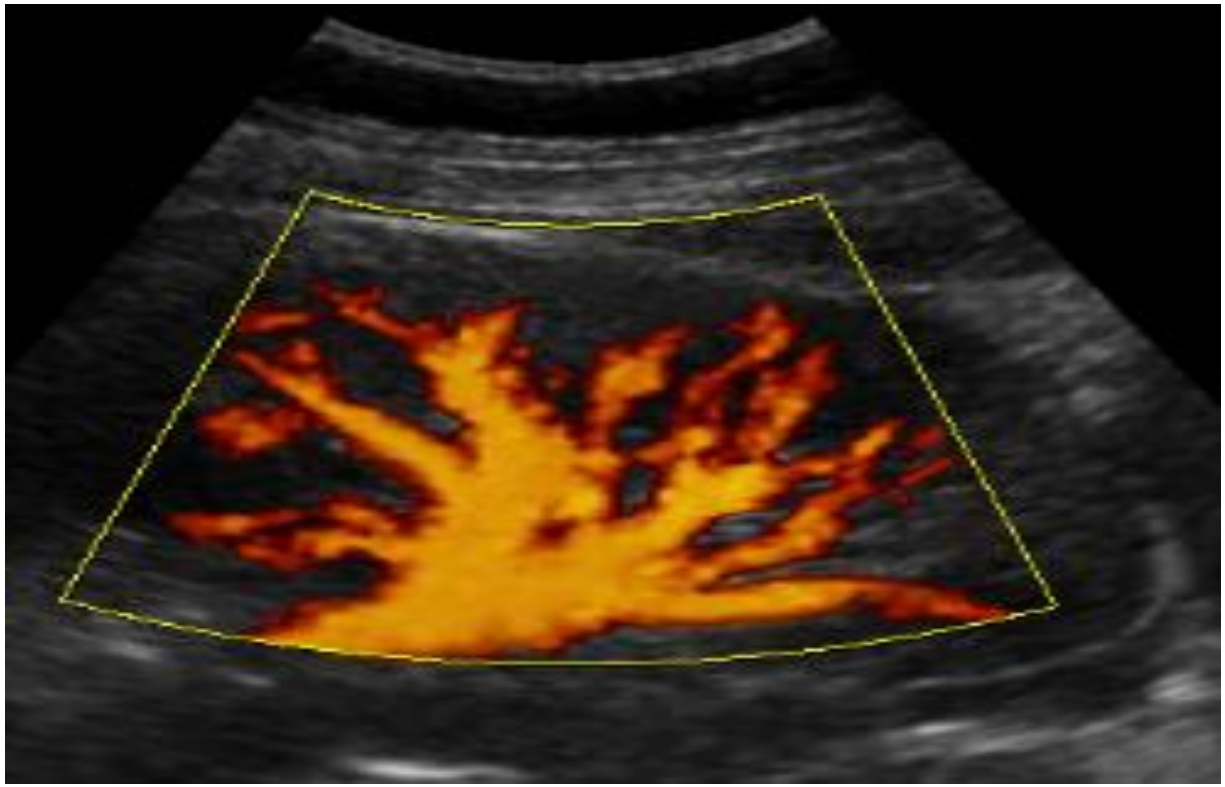
M-Mode



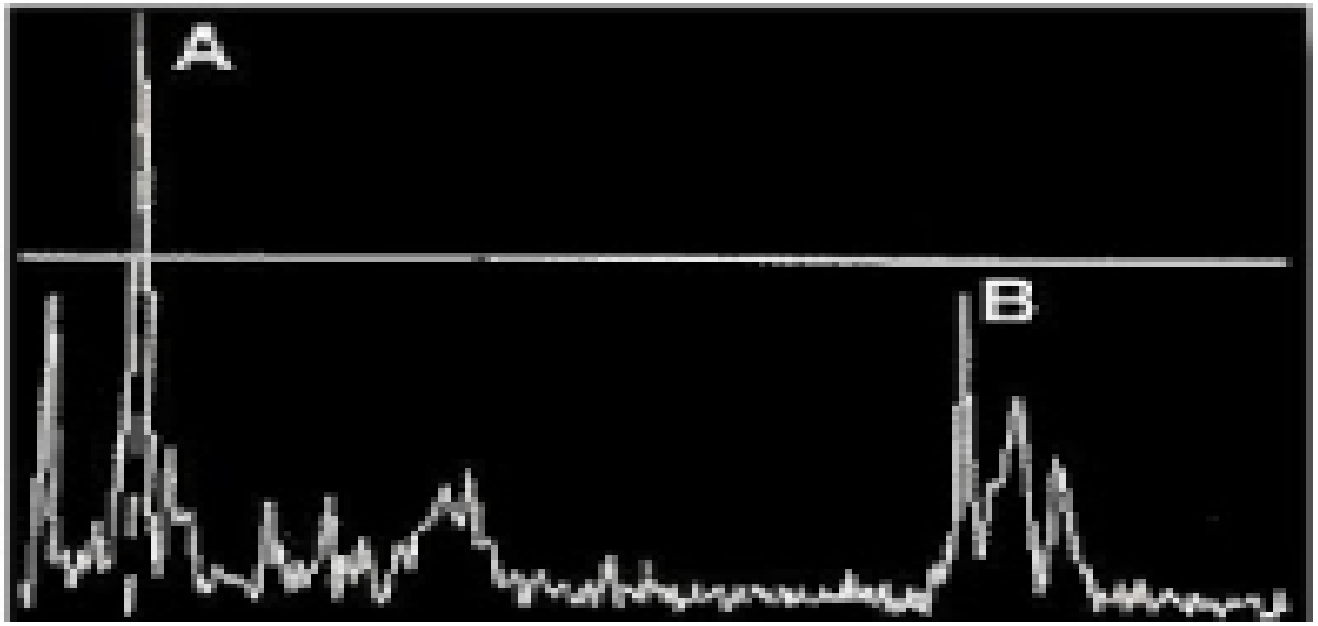
Ultrasound Imaging Modes



Ultrasound Imaging Modes



Ultrasound Imaging Modes



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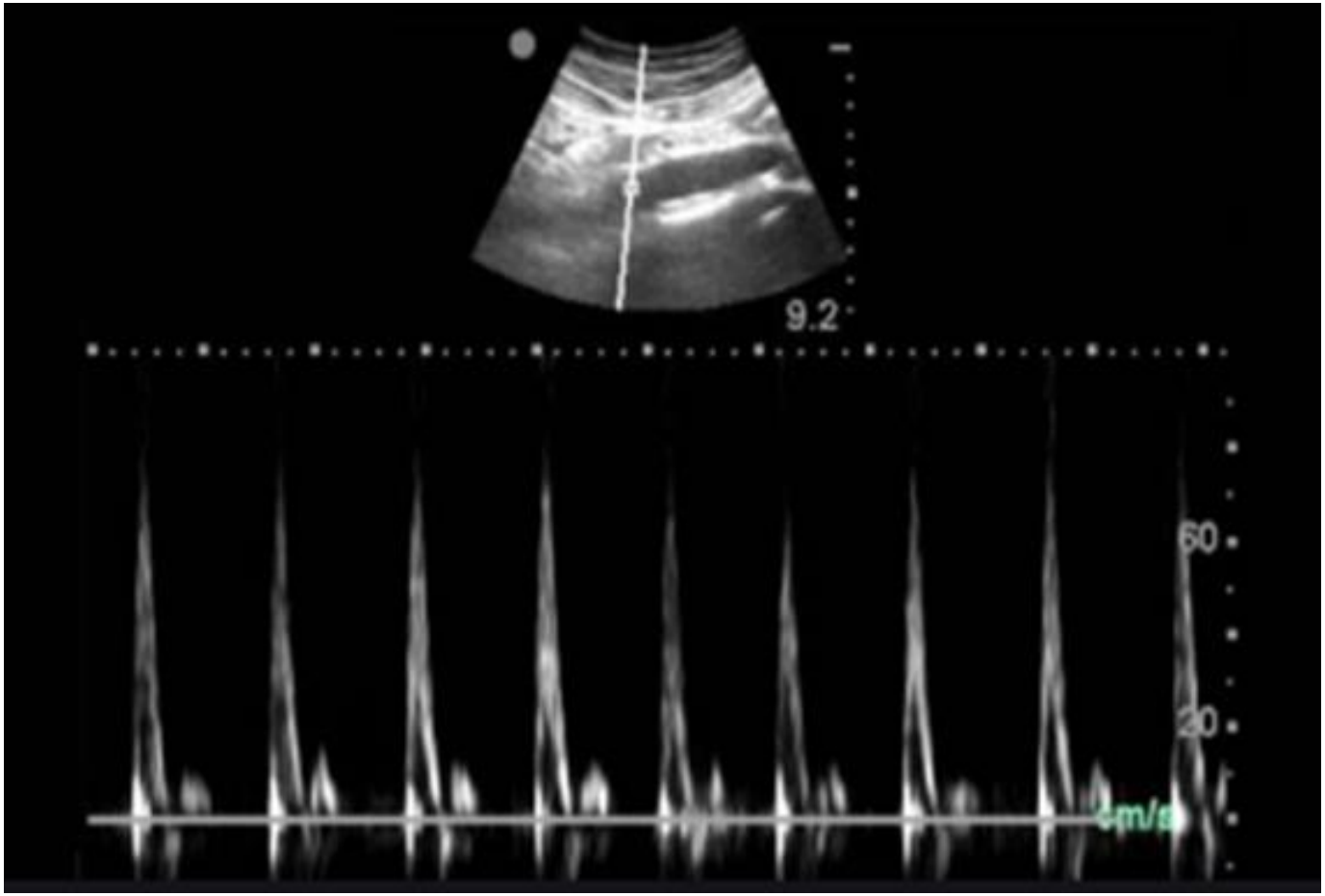
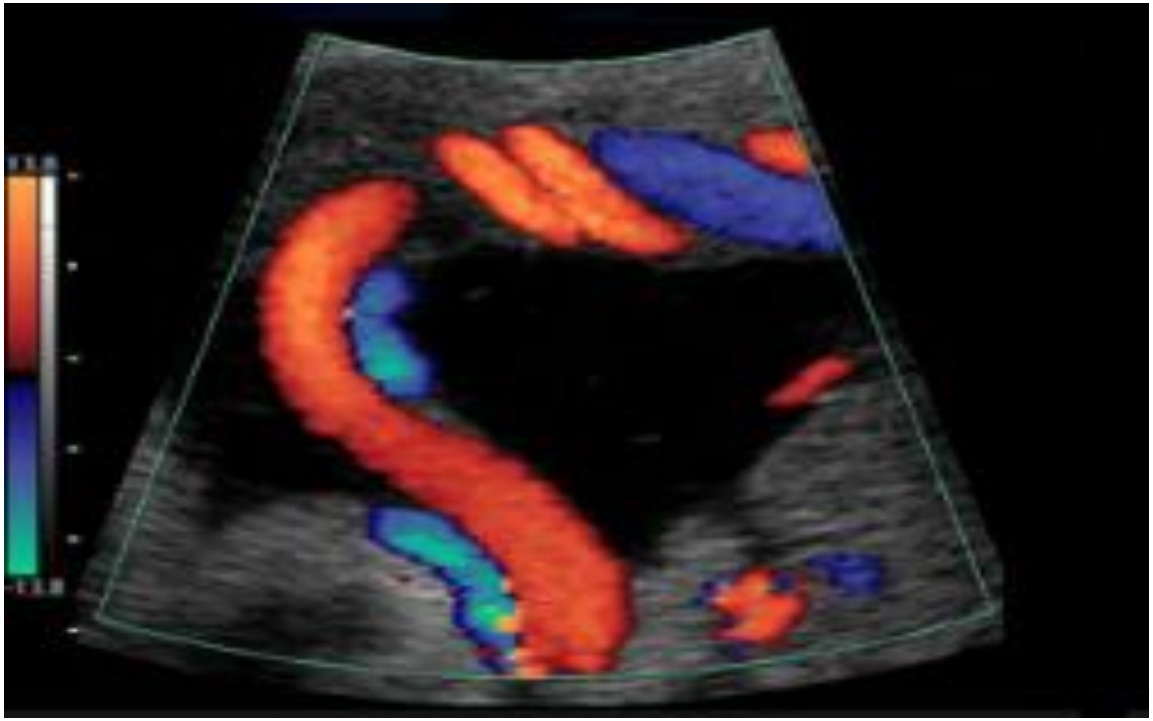


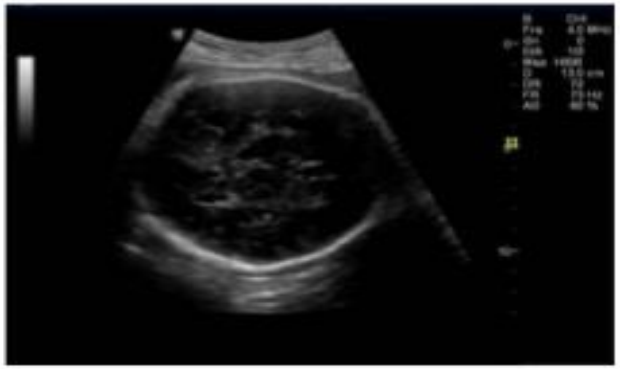
Ultrasound Imaging Modes



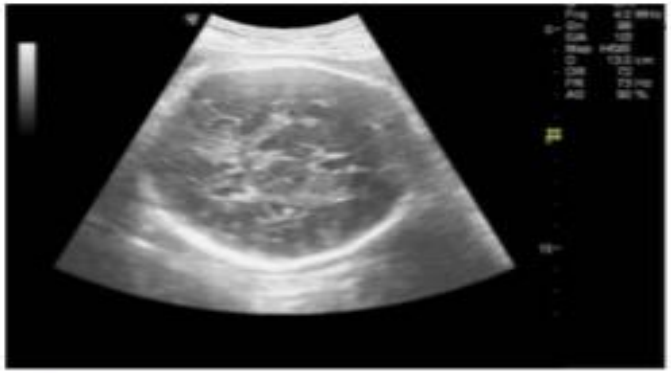
Ultrasound Imaging Modes

Gain

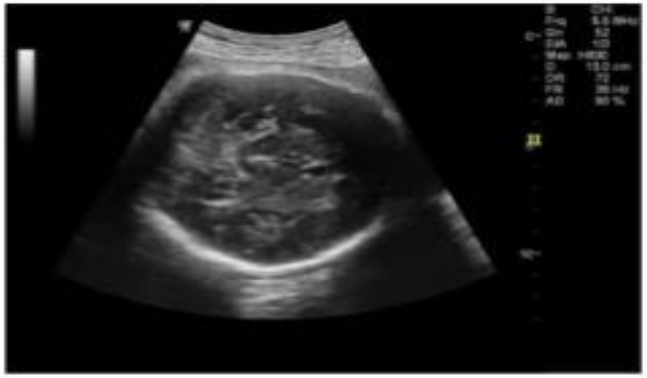
Low



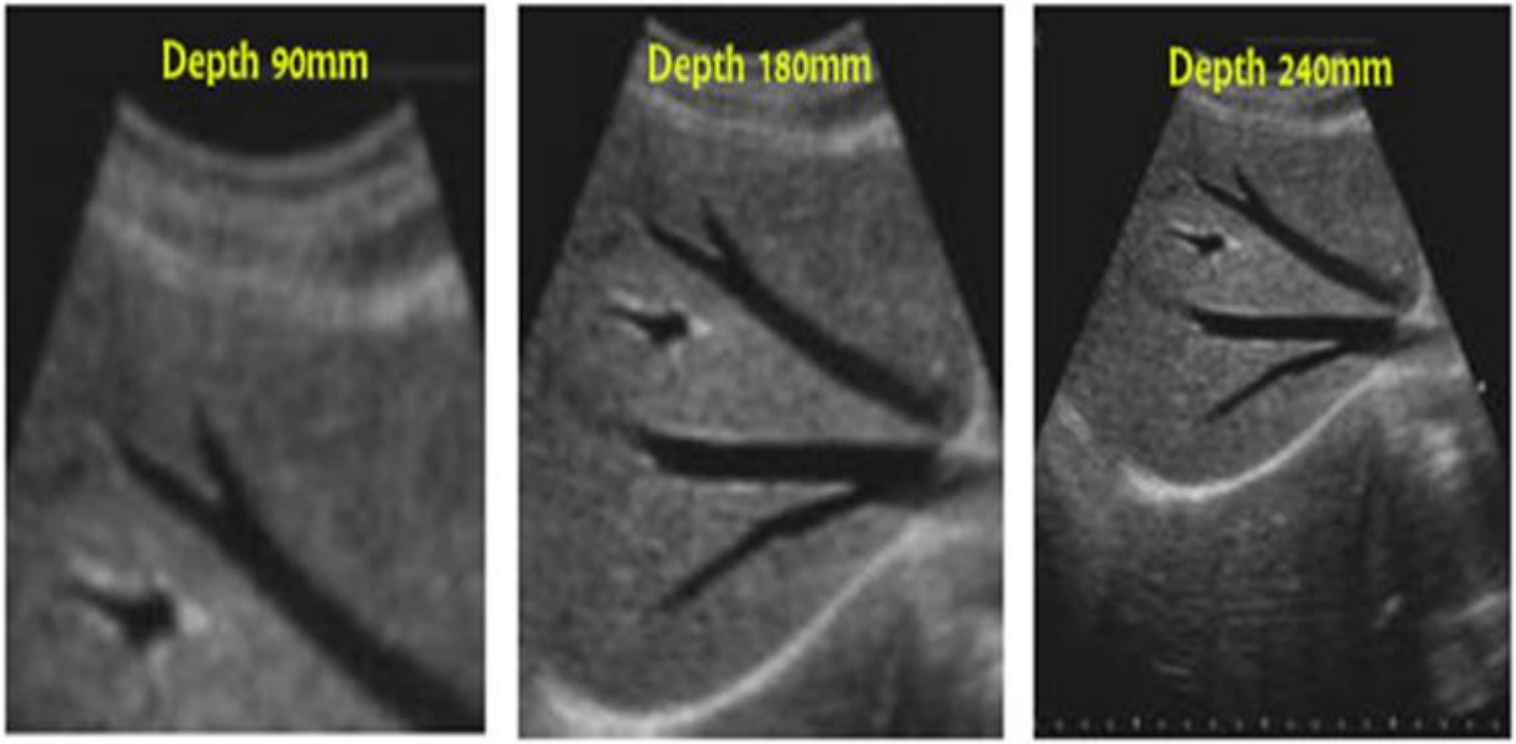
High



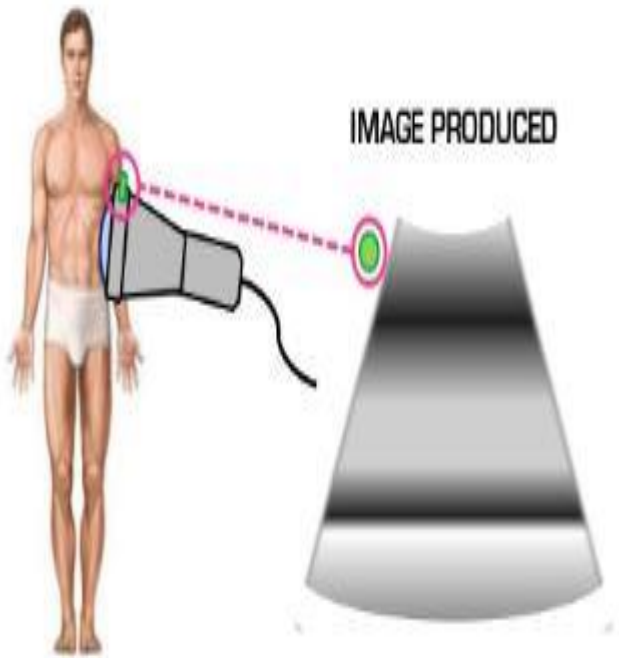
Optimal

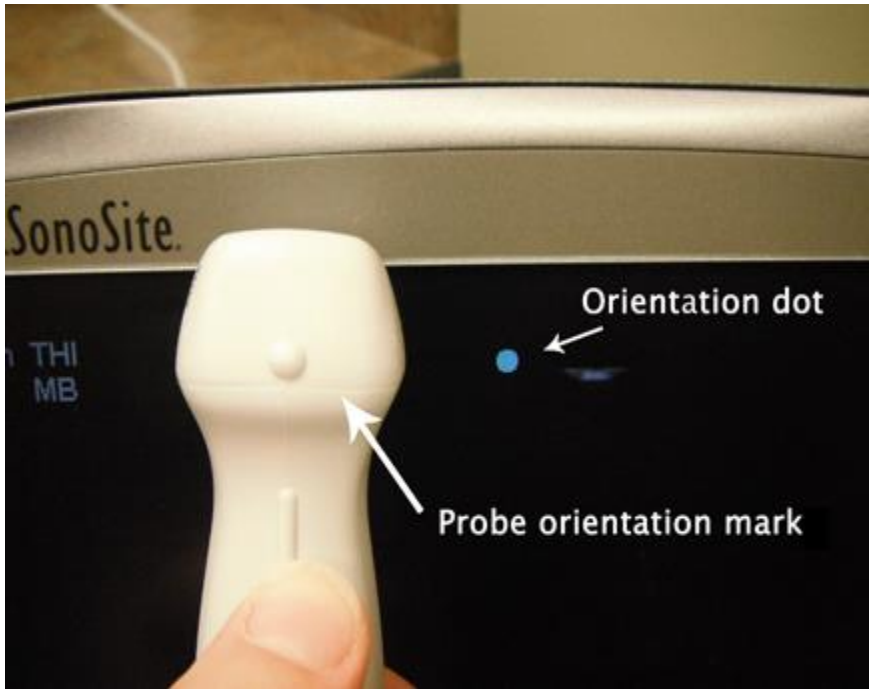


Depth



Probe Orientation

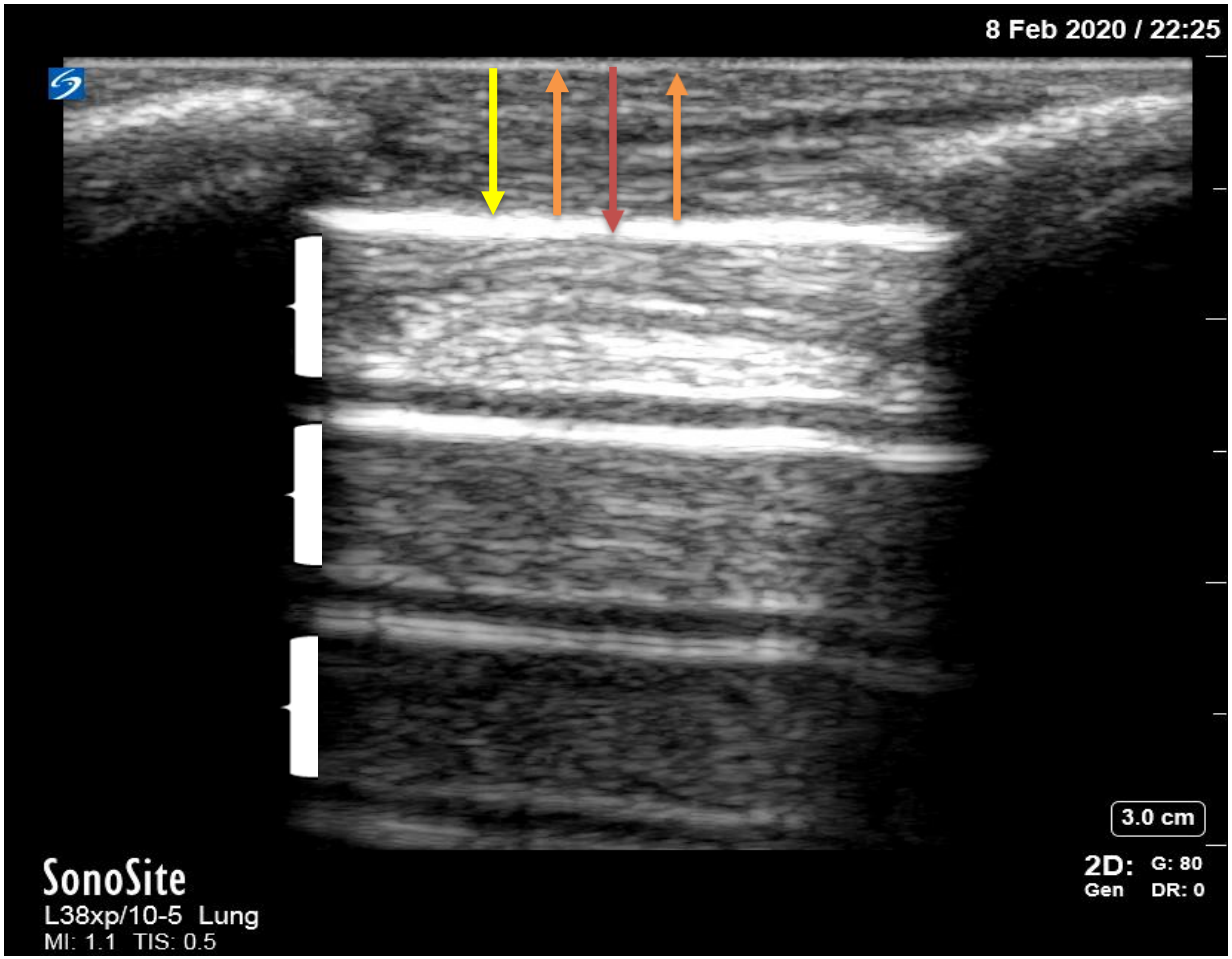




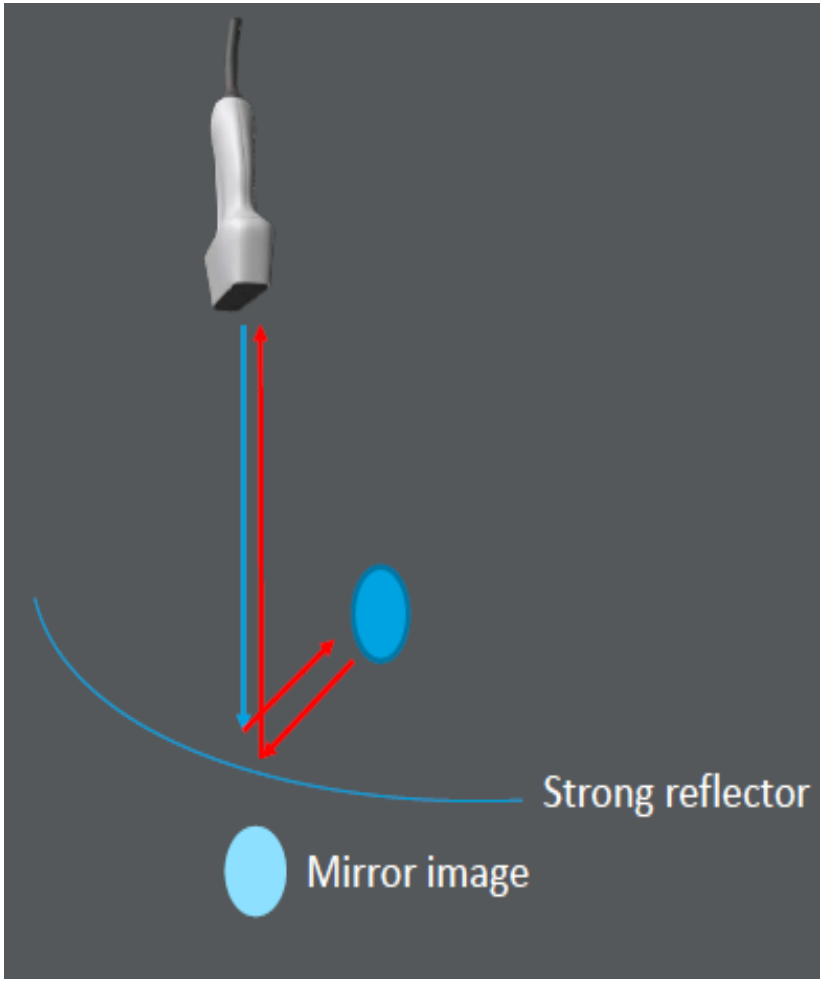
Common Artifacts

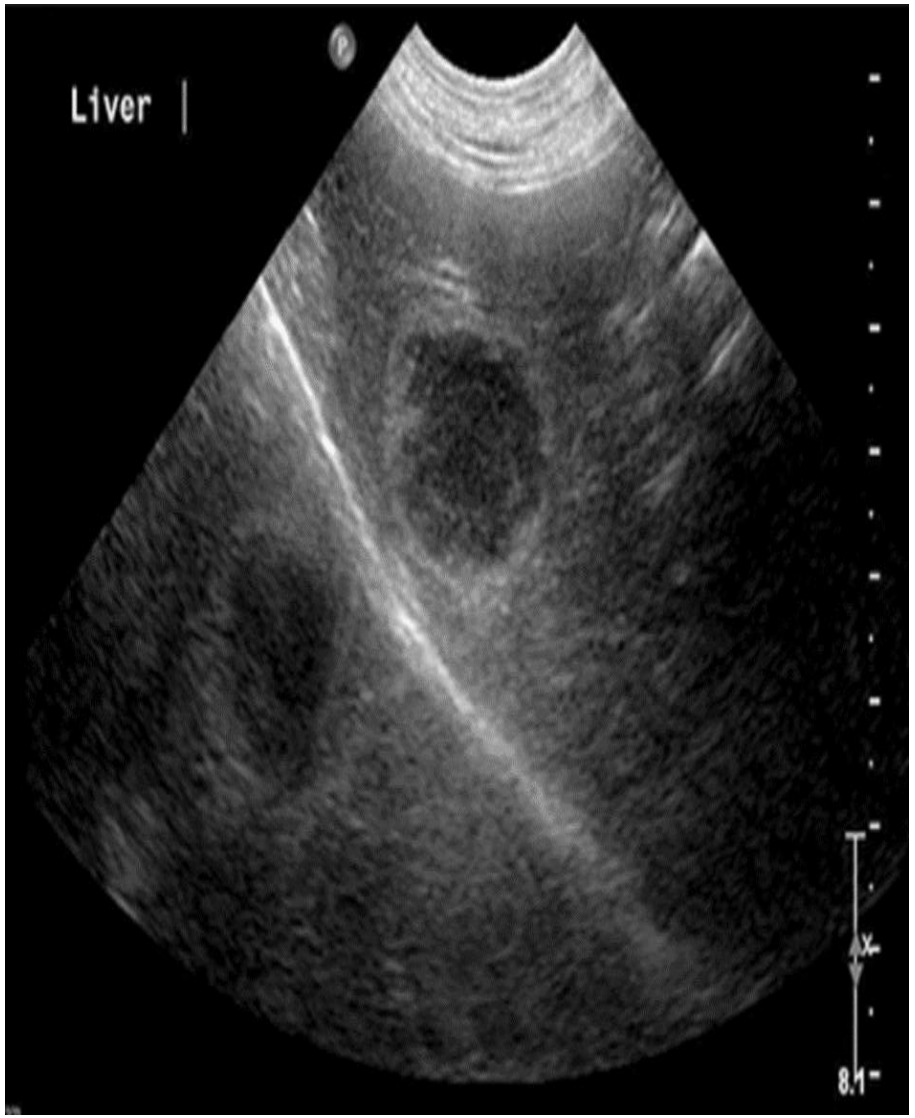
- Reverberation
- Mirroring
- Acoustic Enhancement
- Shadowing

Reverberation

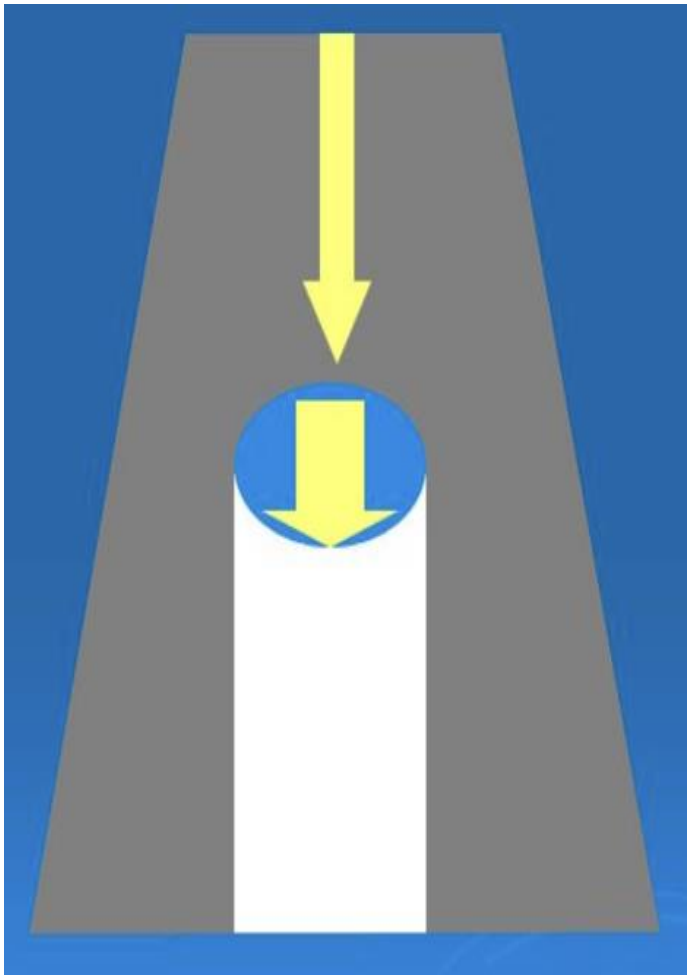


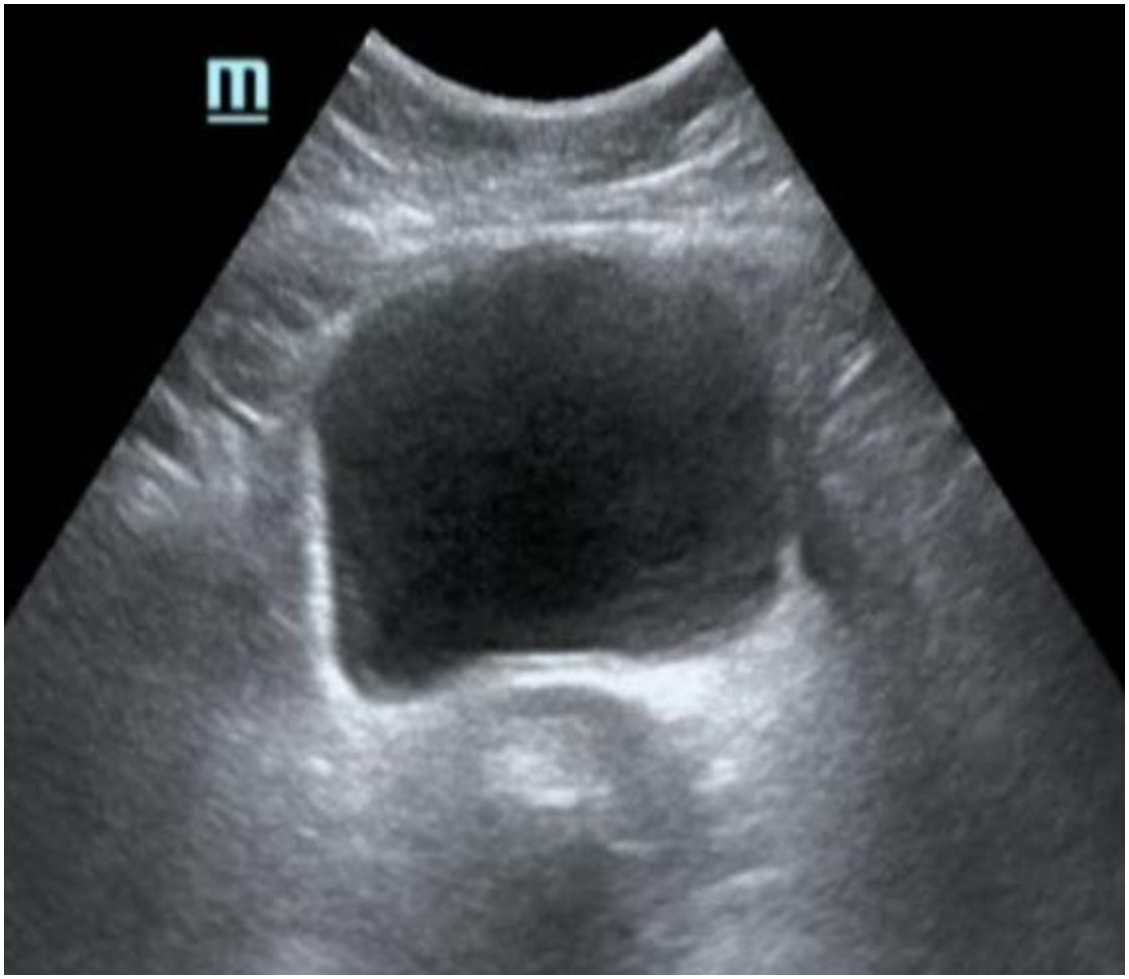
Mirroring





Acoustic Enhancement





Shadowing

Thank You

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