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Question 1

Question Type: **MultipleChoice**

What is the effect of an increased aperture in a linear array transducer?

Options:

A- Deeper focus

B- Improved axial resolution

C- Shorter near-field length

D- Decreased temporal resolution

Answer:

A

Explanation:

The aperture of a transducer is the active area that emits and receives the ultrasound waves. In a linear array transducer, increasing the aperture (using more elements for transmission and reception) results in a deeper focus because the beam is more tightly focused over a longer distance. This improves lateral resolution at greater depths, as the ultrasound beam maintains a narrower width for a longer distance. It allows for better imaging of deeper structures without sacrificing resolution.

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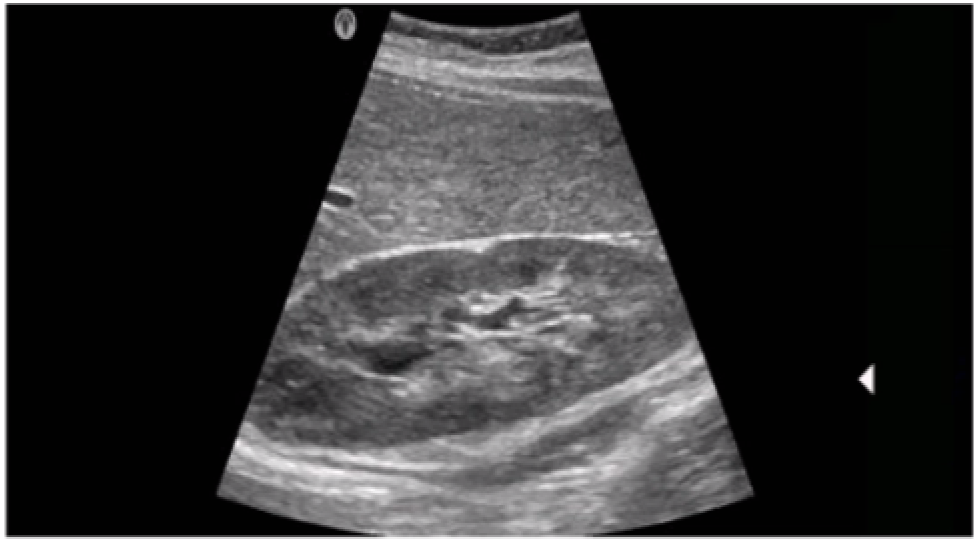
Question 2

Question Type: MultipleChoice

What adjustment is needed to visualize the borders of the anatomical structures in the image below?



Options:

A- Decrease depth

B- Increase sector width

C- Increase dynamic range

D- Lower focal zone

Answer:

C

Explanation:

Dynamic range in ultrasound imaging refers to the range of signal amplitudes that the system can display. Increasing the dynamic range allows the ultrasound system to display a broader range of echo amplitudes, which enhances the contrast resolution and helps to visualize subtle differences in tissue texture and borders of anatomical structures. When the dynamic range is increased, more shades of gray are used, making the image appear softer and less contrasty, which is beneficial for delineating the borders of anatomical structures more clearly.

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Question 3

Question Type: MultipleChoice

Which control determines the amount of amplification occurring in the receiver?

Options:

A- Output power

B- Overall gain

C- Dynamic range

D- Persistence

Answer:

B

Explanation:

Overall gain controls the amplification of all the received ultrasound signals uniformly. This adjustment affects the brightness of the entire image by increasing or decreasing the amplification of the echoes returning from all depths. It is a primary control for adjusting image brightness. The overall gain should be set to an appropriate level to ensure that the ultrasound image is neither too bright (over-gained) nor too dark (under-gained), allowing for optimal visualization of the anatomical structures.

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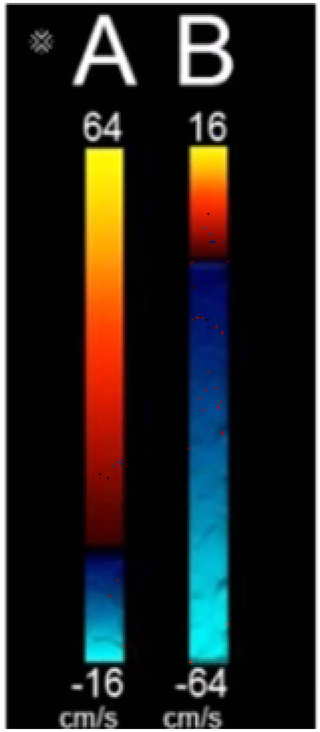
Question 4

Question Type: **MultipleChoice**

Which color control was adjusted in color bar A to produce color bar B?



Options:

A- Baseline

B- Scale

C- Map

D- Invert

Answer:

B

Explanation:

The color bar on a Doppler ultrasound display indicates the range of velocities that the system can detect and display. In color bar A, the scale is set to a higher maximum velocity (64 cm/s), while in color bar B, the scale is set to a lower maximum velocity (16 cm/s). Adjusting the scale (or velocity range) changes the upper and lower limits of the velocities displayed, which affects the sensitivity of the Doppler system to detect flow velocities. Lowering the scale allows for better visualization of lower velocities, but it may also increase the likelihood of aliasing for higher velocities.

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Question 5

Question Type: **MultipleChoice**

Which system control adjusts amplification of signals as a function of depth?

Options:

A- Output power

B- Time gain compensation

C- Transmit focus

D- Reject

Answer:

B

Explanation:

Time Gain Compensation (TGC), also known as Depth Gain Compensation (DGC), is used to adjust the amplification of ultrasound signals based on their depth. As ultrasound waves travel deeper into the tissue, they become weaker due to attenuation. TGC compensates for this attenuation by progressively increasing the gain for deeper echoes, ensuring that structures at different depths appear with similar brightness on the ultrasound image. This function is critical for creating a uniform image and accurately visualizing deeper anatomical structures.

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Question 6

Question Type: MultipleChoice

Penetration can be improved by decreasing which setting?

Options:

A- Output power

B- Frequency

C- Gain

D- Sector width

Answer:

B

Explanation:

In ultrasound imaging, penetration refers to the ability of the ultrasound beam to travel deeper into the tissue. Lower frequency transducers produce sound waves with longer wavelengths, which are less attenuated by the tissues and therefore can penetrate deeper into the body. Conversely, higher frequency transducers produce sound waves with shorter wavelengths that provide better resolution but are more quickly attenuated, resulting in less penetration. Therefore, decreasing the frequency of the transducer improves penetration, allowing for better visualization of deeper structures.

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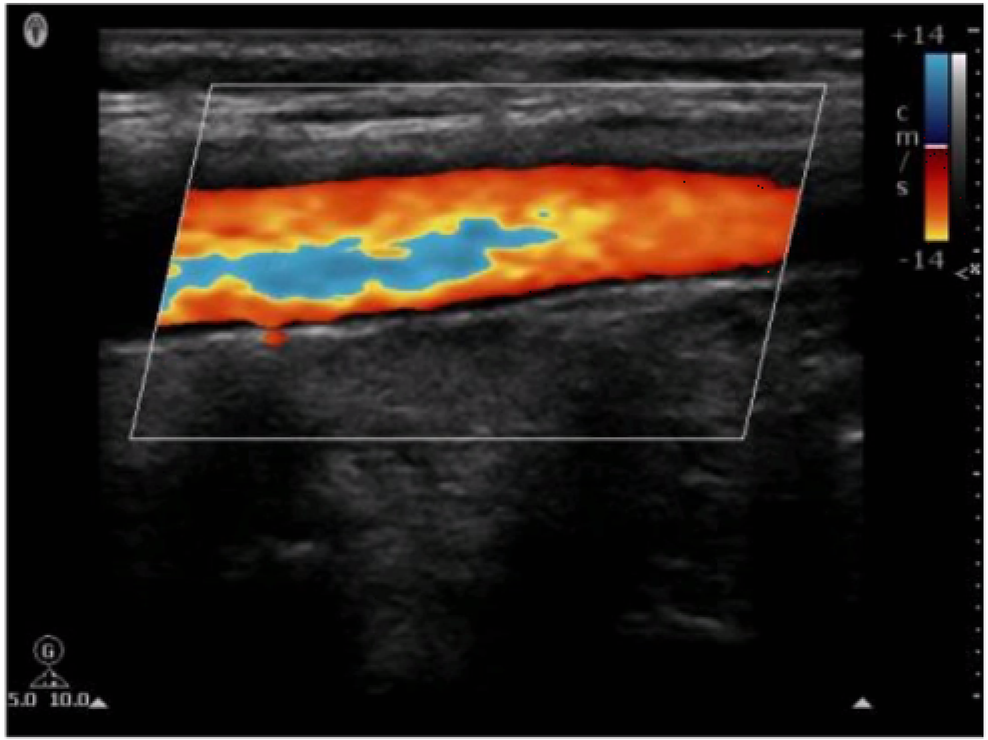
Question 7

Question Type: MultipleChoice

Which pulsed-wave Doppler adjustment would be appropriate to correct the aliasing seen in this image?



Options:

A- Increase the spectral Doppler gain.

B- Decrease the spectral Doppler gain.

C- Increase the Doppler pulse repetition frequency.

D- Decrease the Doppler pulse repetition frequency.

Answer:

C

Explanation:

Aliasing in pulsed-wave Doppler occurs when the sampled Doppler frequency exceeds the Nyquist limit, which is half of the pulse repetition frequency (PRF). This results in an incorrect representation of the blood flow velocities, causing the waveform to wrap around and appear on the opposite side of the baseline. To correct aliasing, the PRF should be increased, which raises the Nyquist limit and allows for accurate measurement of higher velocities without aliasing. Increasing the PRF effectively reduces the likelihood of aliasing artifacts in the Doppler signal.

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Question 8

Question Type: MultipleChoice

What is the benefit of using a wall filter?

Options:

A- Reduces aliasing

B- Increases velocity range

C- Increases signal-to-noise ratio

D- Removes low-frequency signals

Answer:

D

Explanation:

A wall filter in Doppler ultrasound is designed to remove low-frequency signals that are often caused by tissue motion, vessel wall movement, or other forms of motion artifact. These low-frequency signals can clutter the Doppler spectrum, making it difficult to accurately interpret blood flow velocities. By filtering out these unwanted low-frequency signals, the wall filter helps to enhance the clarity of the Doppler signal, allowing for more accurate measurements of blood flow velocities.

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Question 9

Question Type: **MultipleChoice**

Which setting can be increased to correct for clutter artifact when using pulsed-wave Doppler?

Options:

A- Sample volume

B- Doppler gain

C- Wall filter

D- Pulse repetition frequency (PRF)

Answer:

C

Explanation:

The wall filter, also known as the high-pass filter, is used in Doppler ultrasound to remove low-frequency signals, which are typically associated with clutter artifacts. Clutter artifacts can be caused by tissue motion or vessel wall movement, and they appear as low-frequency signals that can obscure the desired blood flow signals. By increasing the wall filter setting, these low-frequency signals are filtered out, thus reducing the clutter artifact and providing a clearer depiction of the blood flow.

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Question 10

Question Type: MultipleChoice

Which is a method to reduce noise?

Options:

A- Increase frequency

B- Decrease beam width

C- Decrease depth

D- Increase persistence

Answer:

D

Explanation:

Persistence is a form of temporal averaging where consecutive frames are averaged to reduce random noise, resulting in a smoother image. Increasing persistence effectively reduces noise by averaging out transient noise artifacts while preserving the true signal. This improves image quality, although it may also reduce the temporal resolution, making it less suitable for rapidly moving structures.

ARDMS Sonography Principles & Instrumentation Guidelines

Hedrick WR, Hykes DL, Starchman DE. Ultrasound Physics and Instrumentation. 4th ed. Philadelphia, PA: Elsevier Saunders; 2005.