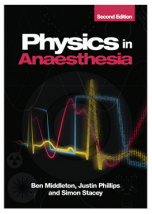
Chapter 23

Ultrasound



Self-assessment questions

These questions and answers, in both MTF and SBA formats, accompany *Physics in Anaesthesia 2e* and link back to the book for guidance.

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Multiple true / false questions

For each of the following questions, mark all answers as either true or false

1. The creation and detection of ultrasound waves by a piezo-electric crystal requires:

a. The temperature to be higher than the Curie temperature
b. An alternating current
c. Compression and rarefaction of sound waves
d. Transduction of energy
e. Long bursts of emission

Reminder

- The piezo-electric crystal in an ultrasound probe acts as a transducer.
- It converts electrical energy into mechanical energy, in the creation of ultrasound waves. It also acts in the reverse manner: converting mechanical energy into electrical energy on the detection of ultrasound waves.
- The Curie temperature is the temperature above which the crystal will lose these characteristics.

Pointer

- For more on transducers see *Section 22.2*.

2. Regarding the diagnostic and therapeutic uses of ultrasound:

a. Lithotripsy takes advantage of acoustic impedance matching
b. 2–5 MHz is the best frequency range for abdominal examinations
c. A bubble echocardiogram takes advantage of acoustic shadowing
d. Trans-thoracic echocardiograms (TTEs) allow for the best views of the mitral valve
e. Ultrasound nebulizers use frequencies in the range of 1–3 MHz

Reminder

- 2–19 MHz are transducer frequencies used in medical ultrasound imaging.
- Due to the acoustic shadowing caused by the rib cage, views of the posterior heart are poor.
- Trans-oesophogeal echocardiograms (TOEs) allow for better views of the mitral valve.

3. Regarding the frequency and energy of ultrasound waves:

a. Lower frequencies allow for the examination of deeper structures for example in the abdomen
b. High energy ultrasound waves can cause acoustic cavitation
c. Higher frequency waves provide better resolution
d. Higher frequency waves are more attenuated
e. In a vacuum, ultrasound waves have longer wavelengths than infrared waves

Reminder

- Remember sound waves, unlike electromagnetic waves, cannot travel in a vacuum.
- Sound waves need a medium, containing molecules, to propagate through.

Single best answer questions

For each of the following questions, select the single best answer – note that more than one answer may be true but only one option represents the best answer

1. What is the benefit of using ultrasound gel between the probe and skin on scanning?

a. It has a greater resistance to ultrasound waves than air and therefore allows for greater reflection
b. It is a great conductor avoiding burning to the skin
c. It has a similar acoustic impedance to the skin so increases the transmission of ultrasound waves to tissue
d. It is sterile so allows for practitioners to use an aseptic technique
e. It has a higher acoustic impedance than air so allows for better transmission of ultrasound waves to tissue

Reminder

- If a medium of dissimilar impedance to the skin was used between the probe and the skin, for example air, the ultrasound waves emitted would be reflected from the skin as opposed to transmitted through.

2. Which of the following processes does not result in the diminution of the energy of an ultrasound wave as it passes through tissue?

a. Absorption
b. Amplification
c. Scattering
d. Reflection
e. Dispersion

Reminder

- Time gain compensation is an amplification technique used to counteract the effects of the attenuation of ultrasound waves in tissue.

3. In ultrasonography, which interface of materials would result in the greatest proportion of the wave being reflected?

a. Air → fat
b. Fat → water
c. Water → blood
d. Air → blood
e. Bone → air

Pointer

- The greater the acoustic impedance mismatch between two materials, the greater degree of reflection of ultrasound waves.
- See *Equation 23.2*.

Did you know?

- The greater the degree of reflection the more difficult it is to gain images beyond that point.
- For example, the interface between the ribs (bone) and the lung (air) is the main barrier to good quality TTE images.

Answers to questions for Chapter 23 – Ultrasound

Multiple true / false questions

The following answers are true:

1. b, c and d

2. b, c and e

3. a, b, c and d

Single best answer questions

The options below represent the single best answer, although other options may also be true:

1. c

2. b

3. e