2 Equipment and Usage of Ultrasound

1. Peripheral nerve stimulation:
   (a) Rely on use of electric current to elicit motor stimulation.
   (b) Depolarisation can result both in contraction of effector muscles and paraesthesias.
   (c) Same principle can be used for percutaneous guidance and epidural catheter placement.
   (d) Rise of high-intensity stimulating current with a short pulse width can prevent uncomfortable motor response to nerve stimulation.
   (e) Limiting energy or current intensity can avoid discomfort.

2. The quality of stimulation of peripheral nerves depend on:
   (a) Polarity of electrode
   (b) Distance between stimulating needle and nerve
   (c) Interaction at the tissue-needle interface
   (d) Type of electrode
   (e) Frequency of stimulus

3. Intensity of nerve stimulation:
   (a) Total charge applied = intensity of applied current × duration of square pulse of current.
   (b) Rheobase is the minimum current density required to repolarise the nerve.
   (c) Chronaxie is the minimum duration of pulse required to depolarise the nerve.
(d) The shorter the fibre, the easier is it to stimulate.
(e) Myelinated fibres require less electrical energy for activation.

4. Stimulation of nerve fibres:
   (a) Rectangular pulses are used.
   (b) Membrane time constant determines properties of the cell.
   (c) Normal membrane time constant is 10 ms.
   (d) Nerve fibres get easily stimulated when anode is applied to them.
   (e) Frequency and pulse duration are the main parameters influencing stimulation of nerves.

5. Coulomb’s law:
   (a) Reflects that stimulation intensity is variable.
   (b) \( E = k(q/r^2) \).
   (c) Values >8 are safe.
   (d) Electrical resistance of human body for wet skin is 10 KΩ.
   (e) Resistance of energy source is not important.

6. Peripheral nerve stimulation:
   (a) Negative electrode is cathode and positive electrode is anode.
   (b) Final intensity of current should be less than 0.3 mA to ensure a high success rate.
   (c) If motor-evoked activity disappears after injecting 1–2 ml, needle repositioning is required.
   (d) PNS technique reduces latency time but prolongs performance time.
   (e) Insulated needles give less satisfactory results than non-insulated ones.
7. Peripheral nerve stimulus:
   (a) Depends on both sensory and motor responses.
   (b) Direct muscle stimulation can give a false stimulating sign.
   (c) Metameric response is seen with stimulation of trunks.
   (d) Median nerve stimulation produces palm flexion and opposition of thumb.
   (e) Radial nerve stimulation causes extension of elbow and wrist.

8. Advantages of peripheral nerve stimulation:
   (a) Increases the success rate of technique
   (b) Decreases the requirements of local anaesthetic
   (c) Helps in developing new approaches
   (d) Easy availability
   (e) Fewer injections required for block

9. Needles for regional anaesthesia:
   (a) Standard shaft length is 8 cm.
   (b) Whitacre needles have large side opening hole.
   (c) Tuohy, Crawford and husted needles are used for spinal anaesthesia.
   (d) The side port in pencil-point needle is designed to prevent intraneural injection.
   (e) Bevel angle is determined by British standards.

10. Ideal characteristics of peripheral nerve stimulator:
    (a) Portable battery operated, with detachable and sterilised needles
    (b) Should have clear markings for attachment to cathode
    (c) Short duration impulse so that sensory nerves are preferentially stimulated
(d) Sensitivity should not be allowed to fall <1 mA
(e) Universal terminal for use with variety of needles

11. Equipment for regional anaesthesia:
   (a) Standard notation for needles is size of external diameter.
   (b) Two factors determining needle diameter are viscosity of fluid and rigidity required for insertion.
   (c) Catheters are usually made of reactive material so that fibrosis consolidates their position.
   (d) Filters should block everything less than 0.22 μm.
   (e) All catheters have single terminal opening.

12. Spinal needle:
   (a) Main consideration in design is a need to minimise PDPH.
   (b) Quincke’s needle has a blunt tip.
   (c) Stillete should be in place while inserting the needle.
   (d) Micro spinal catheters can cause cauda equina syndrome.
   (e) Identification of back flow of CSF is easy with 29 G needle.

13. Following are true about epidural needle:
   (a) Internal diameter should be large enough to allow a suitable-sized catheter.
   (b) External diameter should be as small as possible to allow ease of insertion.
   (c) The catheter should not buckle while insertion.
   (d) 16–18 G can be used for children.
   (e) The Huber tip has an angle of 45°.
14. Epidural catheter markings:
   (a) Double markings at the tip
   (b) Five single markings 1 cm apart
   (c) Double markings at 15 cm
   (d) Quadruple markings at 20 cm
   (e) No markings between 11 and 14 cm

15. Peripheral nerve block needles:
   (a) Short bevelled needles allow user to feel fascial planes more easily.
   (b) Sprotte needle allows passage of catheter parallel to the nerve.
   (c) Tuohy needle with Huber tip can be used for placing catheters.
   (d) Failure rate is decreased by using insulated needles.
   (e) Desirable quality is separate injection port in the side arm.

16. Peripheral nerve block catheters:
   (a) Multiple side-hole catheters are best suited for block.
   (b) Removable wire stiffeners make passage between fascial planes easier.
   (c) Can be made radiopaque.
   (d) Stimulating catheters help reduce the problem of secondary block failure.
   (e) Stimulating catheters have metallic spiral in its wall.

17. Peripheral nerve stimulation:
   (a) Accommodation is best prevented by using a square wave of current with a sharp rising time.
   (b) Anode site is not critical when using a constant current output nerve stimulator.
   (c) The threshold current relation is inverse of square of the distance.
(d) Relation between current intensity and distance is governed by Coulomb’s law.
(e) The most common acceptable current range with a clear motor response is 0.2–0.5 mA.

18. Advantages of ultrasound:
(a) Reveals anatomical details.
(b) Real time imaging guidance during needle advancement.
(c) Local anaesthetic spread is not visible.
(d) Improves quality of sensory block, onset time and success rate compared to nerve stimulation techniques.
(e) Decrease the number of needle attempts.

19. Ultrasound:
(a) Frequency is >20,000 Hz.
(b) Falls within human hearing range.
(c) A wave is generated as electric field is applied to piezoelectric crystal.
(d) Waves of large pulse lengths improve axial resolution.
(e) Pulse radio frequency should be between 1 and 10 KHz.

20. Ultrasound image:
(a) Is due to piezoelectric effect.
(b) Transducer is required to apply high-amplitude voltage to energise the crystals.
(c) Attenuation is due to absorption only.
(d) Bone has a high attenuation coefficient.
(e) Attenuation is independent of frequency.

21. Attenuation seen in imaging:
(a) Water has highest attenuation coefficient.
(b) Gain is the amplification achieved.
(c) Air has lowest acoustic impedance.
(d) The higher the degree of impedance mismatch, the greater the amount of reflection.
(e) Attenuation also results from reflection and scattering.

22. Artefacts of ultrasound:
   (a) Specular reflection occurs at rough surfaces.
   (b) Wavelength of ultrasound wave must be greater than reflective structure to cause specular reflection.
   (c) Scattering is seen in visceral organs.
   (d) Refraction occurs when speed of sound is different on each side of tissue interface.
   (e) Bone causes maximum refraction.

23. Echogenicity:
   (a) Strong specular reflections produce hypoechoic shadows.
   (b) Solid organs are hypoechoic.
   (c) Fluid and blood appears dark.
   (d) Deep structures are hyperechoic.
   (e) Muscles have heterogenous appearance.

24. Tissue echogenicity:
   (a) Vein and arteries both are collapsible.
   (b) Bone has a hyperechoic outline and hypoechoic bony shadow underneath.
   (c) Muscle has highly hyperechoic outline.
   (d) Degree of hypergenicity likely reflects the amount of connective tissue within the nerve.
   (e) There is a change of echogenicity of tissues as a result of transducer angle.
25. Image resolution:
   (a) Is the ability of ultrasound to distinguish two structures that are close together as separate.
   (b) A high-frequency wave with a short pulse length will yield better axial resolution than a low-frequency wave.
   (c) A high-frequency transducer emits a wave with a short wavelength.
   (d) Attenuation decreases with increase in frequency.
   (e) Both axial and lateral resolutions are important.

26. Doppler:
   (a) A moving source and a stationary listener are required.
   (b) Source moving away from receiver will give red shadow.
   (c) Detection of flow is best when transducer is perpendicular to vessel.
   (d) Colour power Doppler can distinguish vascular from non-vascular structures.
   (e) CPD is more sensitive than colour Doppler in flow direction.

27. Power Doppler:
   (a) Is based on estimating the integrated Doppler power spectrum.
   (b) More sensitive at detecting blood flow.
   (c) The signal is dependent on the angle between the vessel and the transducer beam.
   (d) Artefacts are not seen.
   (e) There are no disadvantages.

28. Image artefacts:
   (a) Acoustic enhancement artefact is seen deep to a fluid-filled structure.
   (b) Tissue reverberation artefact is seen when beam meets bone.
(c) Lung tissue gives specular reflection.
(d) Reverberation artefacts are seen during needle advancement.
(e) Large dropout artefact is seen in air artefact.

29. Needle visibility:
   (a) Main factors determining ultrasonic visibility of needle is insertion angle and gauge of the needle.
   (b) Needle tip visibility is decreased at steep angle.
   (c) Large bore needles are easy to see as they are less likely to bend.
   (d) A dark background enhances tip visibility.
   (e) In-plane techniques prevent vascular punctures.

30. Needle tip visibility:
   (a) Is best seen when beam angles perpendicular to the needle.
   (b) Mean brightness has a linear correlation with angle of incidence.
   (c) Spatial compound imaging improves the needle tip imaging.
   (d) Bevel direction has no effect on tip visualisation.
   (e) Increasing needle diameter improves visualisation of needle tip.

31. Nerve Imaging:
   (a) Cervical nerve roots have mono-fascicular appearance.
   (b) Most peripheral nerves have mono-fascicular appearance.
   (c) Short-axis scanning is better to scan the course of nerve.
   (d) Tendons have similar appearance to nerve.
   (e) Tendons are more anisotropic than nerves.
32. Nerve identification:
   (a) Peripheral nerves have a honeycomb appearance.
   (b) The best way to follow a nerve is by use of linear transducer.
   (c) Long-axis views are the preferred method of nerve visualisation.
   (d) Nerves as small as 1 mm in diameter can be visualised.
   (e) Dynamic ultrasound imaging is best seen with popliteal fossa.

33. Local anaesthetic injection:
   (a) Agitated solutions are best to visualise nerve.
   (b) Bubbles can disperse in tissue and cause acoustic shadowing.
   (c) Bicarbonate-containing solutions of local anaesthetic helps in clarity of image.
   (d) Needle should touch the nerve while injecting solution so as to cause maximum effect.
   (e) Unagitated solution outlines the borders of anaesthetised nerve.

34. Short-axis imaging of nerves:
   (a) Identification of peripheral nerves is easy on short axis.
   (b) Resolution of fascial barriers around nerves is not good.
   (c) Circumferential distribution of local anaesthetic can be seen.
   (d) More mobility of transducer is possible.

35. Ultrasound imaging in tissues:
   (a) Specular reflection is seen with smooth surface.
   (b) Scattering reflection is seen with smooth surface.
   (c) Most neutral images are seen with specular reflection.
   (d) Acoustic impedance of tissue surrounding nerve is not important.
(e) Most neural images are seen with specular reflection.
(f) Best view is seen if needle is parallel to ultrasound beam.

36. Attenuation:
   (a) Progressive loss of acoustic energy as a wave passes through tissue.
   (b) Absorption is the main source of ultrasound attenuation.
   (c) It is measured in dB/mm of tissue.
   (d) Time gain compensation can help in offsetting effects of attenuation.
   (e) The higher the attenuation coefficient, the more attenuated the ultrasound waves.

37. Resolution of ultrasound:
   (a) Ability of ultrasound to distinguish one object from another.
   (b) Axial resolution is the ability to separate two structures lying at different depths.
   (c) Lower frequency produces best axial resolution.
   (d) Lower frequency probes allow for deeper tissue penetration.
   (e) Higher frequency transducer probes effect high axial resolution of superficial structures.

38. Contact artefact:
   (a) Seen when there is loss of acoustic coupling between transducer and skin.
   (b) Can be minimised by application of gel.
   (c) Air bubbles trapped in gel can contribute to contact artefact.
   (d) Needle insertion close to transducer helps in avoiding the artefact.
   (e) Firm pressure with transducer is required for optimal block.
39. Anisotropy:
   (a) Amplitude of received echoes varies with angle of insonation.
   (b) With nerves, angle changes as small as 10° from axis can decrease echogenicity.
   (c) Angle changes have no effect on anisotropy on tendons.
   (d) Anisotropy is seen more with tendons than nerves.

40. Needle tip visibility:
   (a) Strong specular reflections occur from beam angle perpendicular to the needle.
   (b) Linear correlation between angle of incidence and mean brightness.
   (c) Beam steering to different angles helps visualise needle tip.
   (d) Needle tip is best visualised when bevel is oriented either directly towards or away from transducer.
   (e) Needle visualisation is better for superficial blocks.

41. Ultrasound image:
   (a) Gain allows operator to change brightness of image.
   (b) Time gain compensation allows operator to adjust the brightness independently at specific depths in the field.
   (c) Temporal resolution is important for visualising moving objects.
   (d) Temporal resolution is improved by adjusting focus.
   (e) Ultrasound beam first converges to a point and then diverges.

42. Acoustic artefacts:
   (a) Both missing structures and degraded images can contribute to this.
   (b) Only overgain is associated with artefacts.
(c) Acoustic shadowing is mostly seen in structures lying deep to bone.
(d) Calcified arterial plaques can cause acoustic shadowing.
(e) Acoustic enhancement is seen in infraclavicular and axillary brachial plexus.

43. Reverberation artefact:
   (a) Occur as a result of ultrasound waves bouncing between two specular reflectors
   (b) Seen more if needle is parallel to ultrasound beam
   (c) Multiple reverberation artefacts can merge to increase image disturbance.
   (d) Needle may actually appear deeper than it is because of the artefact.
   (e) Increase gain can help decrease reverberation artefact.

44. Coulomb’s law:
   (a) $E = K(Q/R^2)$
   (b) Motor response at low amperage means nerve is close to electrode.
   (c) Decrease in amperage leads to increased sensitivity.
   (d) Higher current density is associated with patient discomfort.
   (e) Defibrillation pods have high resistance.

45. Electrical pulse duration:
   (a) Duration of periodic pulse square wave generated by nerve stimulation.
   (b) Typically long pulse durations are used for nerve localisation.
   (c) Increased duration increases severity of localisation.
   (d) Decreased duration increases specificity of localisation.
   (e) Increased pulse duration increases total flow of electrons.
46. Percutaneous electrode stimulation:
   (a) Coupling gel is not required.
   (b) Indentation of skin with stimulation probe facilitates nerve stimulation.
   (c) Pure sensory nerves cannot be localised.
   (d) Normally not possible to stimulate C78T1.
   (e) Stimulation of phrenic nerve means electrode is anterior to plexus.

47. Multiple injection techniques:
   (a) Individual nerves are localised and blocked.
   (b) Evidence shows multiple injections better than single injection.
   (c) Allows reduction in the volume of local anaesthetic solution.
   (d) Only helpful in upper limb injections.
   (e) Multiple injections may delay onset of block.

48. Ultrasound guidance in children:
   (a) 5–10-MHz transducer is used.
   (b) Most reliable way is to insert it transversely.
   (c) Precise location of needle tip on ultrasound image is a prerequisite for effective block.
   (d) Children are more at risk for local anaesthetic toxicity than adults.
   (e) Peripheral nerves are visualised with linear transducers.

49. Ultrasound in neuraxial block:
   (a) Is as good as physical examination for identifying the level.
   (b) Ligamentum flavum is hypoechoic on ultrasound.
   (c) Cerebrospinal fluid is hyperechoic.
   (d) Can help in determining the depth of needle penetration.
   (e) Paramedian region is better for ultrasound visualisation.
50. Stimulating catheters:
   (a) The electrically conducting connection extends to proximal 5 cm of catheter only.
   (b) 14-gauge needle is required to insert catheter.
   (c) Once the catheter is in position, saline should be injected to expand space.
   (d) Both sensory and motor stimulation can be achieved with stimulating catheters.
   (e) Long-term infusions require special catheter securing techniques.
Answers

1. (a) T  (b) T  (c) T  (d) F  (e) T
   A weak current is applied to stimulating needle with the help of a current generator (nerve stimulator) to elicit motor stimulation. Low intensity with short pulse width can avoid motor response. Same principal applies for transcutaneous stimulation though longer pulse duration is required.

2. (a) T  (b) T  (c) T  (d) T  (e) T
   Less electrical energy is required if cathode (−ve) is close to the nerve. Anodal stimulation requires a higher current to stimulate the nerve. Distance is governed by Coulomb’s law:
   
   \[ I = K \left( \frac{q}{y^2} \right)^2 \]
   
   \( I = \) current required to stimulate nerve, \( K = \) constant, \( Q = \) minimal current for stimulation and \( V = \) the distance from stimulus to nerve.
   
   If frequency is low, nerve may be penetrated. If frequency is high, painful muscles may be induced.

3. (a) T  (b) F  (c) T  (d) F  (e) T
   Rheobase: It is the minimum current required to depolarise the nerve. Chronaxie: the stimulus duration needed for impulse generation when employing a current strength twice the rheobase. The larger the fibre, the shorter is the chronaxie and easier to stimulate. Similarly, myelinated fibres are much more sensitive and require less energy for stimulation than unmyelinated fibres (chronaxie of \( \alpha \) fibres-50-100; \( \delta \)-170; \( \gamma \)-400).
4. (a) T  (b) T  (c) T  (d) F  (e) T
   A rectangular pulse helps avoid prolonged currents. Membrane time constant represents the time that it takes to change the membrane capacitance. At anode, displacement of positive charge towards exterior of membrane increases the voltage across it. This produces a state of hyperpolarisation that diminishes excitability. Ideal frequency is 1–2 Hz and pulse duration is 1–2 ms.

5. (a) T  (b) T  (c) F  (d) T  (e) F
   Values greater than 8 would require such significant strength stimuli that systemic side effects may result. The resistance between surface electrodes is 25 KΩ, and with penetration of dermis, it comes down to 0.5 KΩ. The internal resistance should always be greater than that of human body (1 KΩ).

6. (a) T  (b) F  (c) F  (d) T  (e) F
   Cathode is attached to machine and anode to patient as neutral return electrode. Insulated needles give more precise location of nerve and require less current.

7. (a) F  (b) T  (c) T  (d) T  (e) T

8. (a) T  (b) T  (c) T  (d) T  (e) T
   Peripheral nerve stimulator helps in developing new approaches like infraclavicular approach to brachial plexus. Less injections are required if PNS is used as in axillary block.

9. (a) T  (b) F  (c) F  (d) T  (e) T
   Needle length variation is 25–100 mm for special needs. Sprotte needle has side opening hole. All three needles used for epidural injections.

10. (a) T  (b) T  (c) F  (d) F  (e) T
11. (a) T  (b) T  (c) F  (d) T  (e) F
   Epidural needles are of 16 G and 18 G to minimise bending. Oil-based agents will pass through large diameter needles. Catheters are usually made of inert material so that they do not produce tissue reaction.

12. (a) T  (b) F  (c) T  (d) T  (e) F
   Quincke’s needle has a sharp cutting edge, while Whitacre and Sprotte have pencil-point and bullet-shaped needles, respectively. Stillete prevents coring of superficial tissue. Repeated exposure of nerve roots with micro spinal catheters can cause cauda equina syndrome.

13. (a) T  (b) T  (c) T  (d) F  (e) F
   19 G is available for children. Huber tip is <20°.

14. (a) F  (b) T  (c) F  (d) T  (e) F
   There is a single marking at the tip. Double markings are at 10 cm.

15. (a) T  (b) T  (c) T  (d) T  (e) T

16. (a) F  (b) T  (c) T  (d) T  (e) T
   One or more holes of the catheter may lie outside the fascial plane in which nerve lies. Wire stiffeners make passage easier but may increase the failure rate. The increased efficacy of stimulating catheters is contentious.

17. (a) T  (b) T  (c) T  (d) T  (e) T
   A prolonged subthreshold stimulus or slowly rising current may reduce nerve excitability by inactivating Na conduction before depolarisation reaches its threshold.

18. (a) T  (b) T  (c) F  (d) T  (e) T
19. (a) T  (b) F  (c) T  (d) F  (e) T
   Ultrasound falls in the frequency range of 20–20,000 Hz. Conversion of electrical to mechanical energy is called converse piezoelectric effect. Wave of short wavelength improves axial resolution. Pulse rate frequency is rate of pulses emitted by the transducer.

20. (a) T  (b) F  (c) F  (d) T  (e) F
   Piezoelectric effect is due to conversion of sound to electric energy. Pulsar is required to apply high-amplitude voltage. Attenuation is due to absorption, reflection and scattering. Attenuation coefficient is measured in db/cm of tissue. Bone has a high attenuation coefficient with absorption greater than 80 %. A high-frequency wave is associated with high attenuation thus limiting tissue penetration, where as a low-frequency wave is associated with low tissue attenuation and deep tissue penetration.

21. (a) F  (b) T  (c) T  (d) T  (e) T
   Waters’ attenuation coefficient is 0.002 and bone’s is 5. Increased gain amplifies the returning signal and not transmitted signal. Attenuation is the resistance of a tissue to passage of ultrasound signal.

22. (a) F  (b) F  (c) T  (d) T  (e) T
   Smooth surface is a flat surface where transmitted wave is reflected in a single direction; seen in fascial planes, diaphragm. Specular reflection is seen when wavelength of ultrasound is less than the reflective structure. Scattering is seen where surface is not smooth.

23. (a) F  (b) T  (c) T  (d) F  (e) T
   Attenuation limits beam transmission to reach the structures. Muscles have hyperechoic outline with hypoechoic background.
24. (a) F (b) T (c) T (d) T (e) T

25. (a) T (b) T (c) T (d) F (e) T

A high-frequency transducer emits a wave with a short wavelength and small width. Lateral resolution is poor when the structures lying side by side are located within the same beam length. Axial resolution is ability to distinguish two structures that lie along long axis whereas lateral resolution is resolution of objects lying side by side.

26. (a) T (b) F (c) F (d) T (e) T

Increased frequency is seen when source moves towards receiver and appears red. The frequency is decreased when the source moves away from receiver and appears blue. Colour flow Doppler does not indicate flow direction.

27. (a) T (b) T (c) F (d) T (e) F

Power Doppler is based on estimating the integrated Doppler power spectrum instead of mean Doppler frequency shift. It is more sensitive at detecting blood flow than velocity imaging. Integrated power Doppler is independent of angle between vessel and transducer beam. Disadvantages are high motion sensitivity and lack of directional information.

28. (a) T (b) F (c) T (d) T (e) T

Image artefacts are display distortions and errors that may adversely affect image interpretation. Acoustic enhancement artefact is seen because of beam penetration through an area of low attenuation coefficient to an area of higher attenuation coefficient. Acoustic shadow artefact is seen when beam meets bone.

29. (a) T (b) F (c) T (d) T (e) T
30. (a) T  (b) T  (c) T  (d) F  (e) T  
Spatial compound imaging is beam steering to different angles to produce overlapping scans that will form a composite image. The needle is best visualised when the bevel is oriented directly towards or away from the transducer.

31. (a) T  (b) T  (c) T  (d) T  (e) F

32. (a) T  (b) T  (c) F  (d) T  (e) T  
Short-axis view gives appearance of honeycomb on peripheral nerves. Transverse scanning using a broad linear transducer is method of choice for following a nerve along its course. Though long-axis views are useful for panoramic views, they are time consuming and difficult to construct. Nerve motion can be revealed by dynamic ultrasound imaging and best seen in popliteal fossa where “seesaw” movement is seen with foot movement.

33. (a) F  (b) T  (c) F  (d) F  (e) T
Agitated solution is best suited for visualising needle. Injection of small amount of air (0.3–0.5 ml) can be used to identify location of tip. Bicarbonate-containing solutions evolve CO$_2$ obscuring image.

34. (a) T  (b) F  (c) T  (d) T

35. (a) T  (b) F  (c) F  (d) F  (e) F  
Large difference in acoustic impedance leads to more nerve clarity. Best view is seen if needle is perpendicular to ultrasound beam to minimise refraction and maximise reflection. This is the reason out of plane approach is preferred for deep-seated nerves.

36. (a) T  (b) T  (c) F  (d) T  (e) T  
Time gain compensation is the ability of operator to control gain independently at specified depth intervals.
37. (a) T  (b) T  (c) F  (d) T  (e) T
   Axial resolution is seen when two structures lie parallel to the ultrasound beam. High-frequency transducer probes offer high resolution at expense of low tissue penetration.

38. (a) T  (b) T  (c) T  (d) F  (e) T

39. (a) T  (b) T  (c) F  (d) T
   Tendons are more ordered than nerves, and anisotropic effects are seen with angle changes as small as 2°.

40. (a) T  (b) T  (c) T  (d) T  (e) F
   Spatial compound imaging is the steering of beam in different directions to help visualise needle tip. Needle visualisation is better with deeper blocks as back scatter from needle is received by transducer rather than a strong specular reflection.

41. (a) T  (b) T  (c) F  (d) F  (e) T
   Lateral resolution is improved by adjusting focus. Ultrasound beam first converges to a point called as Fresnel zone and then diverges (Fraunhofer zone).

42. (a) T  (b) F  (c) T  (d) T  (e) T
   Both undergain and overgain can contribute to artefact. When a structure has a larger attenuation coefficient than the tissue that lies deep to it, deeper tissue appears less echogenic than normal, e.g. under ribs, under vertebral spines.

43. (a) T  (b) F  (c) T  (d) T  (e) F
   Reverberation artefact is seen when needle is perpendicular and incidence decreases if angle decreases less than 90°. Multiple reverberation artefacts can cause image disturbance leading to
comet-tail sign. Ultrasound waves oscillate back and forth within the lumen of the needle shaft, and needle appears deep because time has elapsed for ultrasound waves to return to the probe. Decreasing gain can darken duplicate image and decrease reverberation artefact.

44. (a) T (b) T (c) F (d) T (e) F
Increase in amperage leads to increase sensitivity. This is useful in cutaneous electrodes for monitoring neuromuscular function.

45. (a) T (b) F (c) T (d) T (e) T
Short pulse impulses are used for nerve localisation (0.05–1 ms).

46. (a) T (b) T (c) F (d) T (e) T
Conduction gel is not required, but conduction is enhanced by cleaning and removing oil. Indentation decreases the distance between nerve and probe and decreases resistance.

47. (a) T (b) T (c) T (d) F (e) F
Both lower and upper limb injections are benefitted. Multiple injections decrease latency of blocks and decrease time of onset.

48. (a) T (b) T (c) F (d) T (e) T
In children, mostly hockey stick probes with surface length of 25 mm are used. Children are more at risk of local anaesthetic toxicity because deficient α1 acid glycoprotein and albumin.

49. (a) F (b) F (c) F (d) T (e) T
Physical examination alone is imprecise in localisation of levels in 70–80 % of patients. Ligamentum flavum and
dura mater appear hyperechoic. Epidural space and cerebrospinal fluid are hypoechoic.

50. (a) F (b) F (c) F (d) F (e) T
The electrically conducting connection extends to tip only. 17- to 20-G needle is required for inserting catheters. Local anaesthetic or saline is injected in non-stimulating technique and is not required with stimulating catheters. Catheter is tunnelled and a skin bridge is made for easy removal for short-term use. For prolonged infusions (>7 days), tunnelling without skin bridge is done to avoid infection.
Multiple Choice Questions in Regional Anaesthesia
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