

# COMPREHENSIVE MOCK EXAM 16

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Supplemental to: Ultrasound Physics Board Review 2026-2027

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*ARDMS SPI (Sonography Principles and Instrumentation) Examination, Inteleos -- 110 questions, single-best-answer, four options (A-D), domain-weighted per official ARDMS SPI Content Outline*

## **Board-Review Questions**

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- 1.** Before scanning a bariatric patient on a specialized exam table, confirming the table's weight-limit rating is primarily a matter of:
  - A.** Improving image quality for that patient
  - B.** Meeting billing documentation requirements
  - C.** Patient and staff safety during positioning
  - D.** Increasing the transducer's operating frequency
  
- 2.** A structured fall-risk assessment, completed for certain patients before an exam, differs from a fall-response protocol in that the assessment:
  - A.** Identifies at-risk patients beforehand for prevention
  - B.** Only applies after a fall occurs
  - C.** Is identical to a fall-response protocol
  - D.** Applies only to pediatric patients specifically
  
- 3.** When entering a room under contact isolation precautions, the correct PPE sequence is generally:
  - A.** Whatever order is most convenient that day
  - B.** A defined donning sequence completed before room entry
  - C.** PPE applied only after touching the patient
  - D.** No PPE needed if the visit is brief
  
- 4.** Using a mechanical lift or transfer device for a patient with limited mobility, rather than manually lifting, is primarily intended to:
  - A.** Increase the exam's frame rate
  - B.** Reduce the exam's total scan time
  - C.** Improve image contrast resolution
  - D.** Reduce injury risk to both the patient and staff

5. When a portion of an exam cannot be adequately visualized despite reasonable effort, appropriate practice is to:

- A. Omit any mention of the limitation from the report
- B. Clearly document which structures were not adequately visualized and why
- C. Estimate the missing findings without disclosure
- D. Repeat the entire exam automatically without physician input

6. Restricting ultrasound-suite access to authorized staff via badge/RFID entry control is primarily a measure related to:

- A. Acoustic output safety
- B. Image resolution
- C. Disinfection scheduling
- D. Facility and equipment security

7. Periodically checking the expiration date on an emergency anaphylaxis kit stored in the ultrasound suite is important because expired medications may:

- A. Be less effective or unreliable in an actual emergency
- B. Always remain fully effective indefinitely
- C. Only affect medications used for image contrast
- D. Have no bearing on emergency response effectiveness

8. Storing or transmitting clinical ultrasound images via a personal, non-approved mobile device most directly raises a concern related to:

- A. Overall image resolution quality
- B. Patient confidentiality and data security
- C. Transducer calibration accuracy
- D. Acoustic output monitoring levels

**9.** Scanning a barcode on a patient's wristband to confirm identity before beginning an exam is a technology-assisted form of:

- A.** Disinfection cycle verification
- B.** Patient ID, supplementing standard verification
- C.** Acoustic output level monitoring
- D.** Billing code entry logging

**10.** Using a device or technique outside its labeled/approved indication should generally be disclosed to the patient because:

- A.** It is never permitted under any circumstance
- B.** Disclosure is only required for surgical devices
- C.** It automatically voids the exam's validity
- D.** Patients have a right to know when care involves an off-label use

**11.** A department's periodic self-assessment against accreditation standards, performed before an actual site visit, is intended primarily to:

- A.** Replace the need for the actual site visit
- B.** Satisfy only an internal administrative requirement with no external relevance
- C.** Identify and correct gaps proactively before formal external review
- D.** Determine individual staff bonuses

**12.** At a smooth, specular interface, the law of reflection states that the angle of reflection:

- A.** Equals the angle of incidence, measured from the normal
- B.** Is always exactly 90 degrees regardless of incidence angle
- C.** Depends only on the transducer's frequency
- D.** Is unrelated to the angle of incidence

**13.** Pulse duration, the actual time the transducer is transmitting during one pulse, is distinct from period in that pulse duration:

- A.** Reflects total time for all cycles in one pulse
- B.** Is always identical to a cycle's period
- C.** Has no relation to cycles per pulse
- D.** Is measured only in Doppler mode

**14.** For an unfocused circular transducer with a 10 mm diameter operating at a wavelength of 0.5 mm, the approximate far-zone (Fraunhofer) distance, calculated as diameter squared divided by four times wavelength, is:

- A.** 5 mm
- B.** 20 mm
- C.** 50 mm
- D.** 200 mm

**15.** An acoustic lens focuses an ultrasound beam by exploiting the same basic principle as an optical lens, namely:

- A.** Absorbing all incident energy uniformly
- B.** Bending the wavefront via a curved surface
- C.** Reflecting the beam back to source
- D.** Amplifying the electrical drive signal

**16.** Using the range equation, the round-trip time for a pulse to travel to a reflector at 8 cm depth and return, assuming a propagation speed of 1540 m/s, is closest to:

- A.** 52 microseconds
- B.** 13 microseconds
- C.** 1.3 microseconds

**D. 104 microseconds**

**17.** The strength of reflection at a boundary between two soft tissues with only a small impedance mismatch, such as muscle and fat, is:

**A.** Relatively weak, since reflection strength depends on the size of the impedance mismatch

**B.** Always identical to the reflection at a soft-tissue/air interface

**C.** Unrelated to the impedance difference between the tissues

**D.** Always stronger than at a soft-tissue/bone interface

**18.** A pulse has an average power of 2 mW sustained over a duration of 3 microseconds. The total energy delivered in that pulse, using energy equals average power multiplied by time, is:

**A.** 0.6 mJ

**B.** 1.5 mJ

**C.** 6 nanojoules

**D.** 6 millijoules

**19.** The hertz, the standard unit of frequency, is defined as:

**A.** Meters traveled per second

**B.** Cycles completed per second

**C.** Decibels per centimeter

**D.** Watts per square centimeter

**20.** A wavefront is best defined as:

**A.** The transducer's physical face

**B.** A single reflector in the path

**C.** The boundary between two tissues

**D.** A surface connecting points in the same phase

**21.** A piezoelectric element's natural (resonant) frequency, set by its physical thickness, is distinguished from a 'driven' frequency in that a driven frequency:

- A.** Is always identical to resonant frequency
- B.** Cannot ever differ from resonance
- C.** Refers to the frequency actually driving the element
- D.** Has no relevance to operation

**22.** At a boundary where  $Z1 = 1.5$  and  $Z2 = 1.7$  (in rayls, arbitrary scaled units), the reflection coefficient, calculated as  $[(Z2-Z1)/(Z2+Z1)]^2$ , is closest to:

- A.** 0.13
- B.** 0.004
- C.** 0.5
- D.** 1.2

**23.** A pulse has a spatial pulse length of 0.6 mm. Using axial resolution equals SPL divided by 2, the best possible axial resolution for this pulse is:

- A.** 0.3 mm
- B.** 1.2 mm
- C.** 0.6 mm
- D.** 0.15 mm

**24.** Comparing the relative influence of stiffness versus density on propagation speed across typical soft tissues, differences in propagation speed are generally driven more strongly by differences in:

- A.** Density variation across tissues
- B.** Transducer frequency setting alone

- C. Transducer bandwidth setting alone
- D. Stiffness, which varies more across tissues

25. When acoustic intensity (rather than pressure amplitude) is used in a decibel calculation, the correct formula uses a multiplying factor of:

- A. 20, the same factor used for pressure/amplitude ratios
- B. 10, since intensity is proportional to amplitude squared
- C. A factor that depends on frequency
- D. No multiplying factor is ever used for intensity

26. A pulse contains 4 cycles at a pulse duration of 2 microseconds. The operating frequency, calculated as cycles divided by pulse duration, is:

- A. 2 MHz
- B. 0.5 MHz
- C. 8 MHz
- D. 4 MHz

27. As a converging beam approaches its focal point and then continues beyond it, the wavefront's curvature:

- A. Remains perfectly flat, never curving
- B. Changes from converging to diverging at focus
- C. Only converges, never diverges
- D. Has no relation to focal geometry

28. A standard curvilinear (convex) array is curved in the azimuthal (scanning) plane, while its elevational plane, unless it is a 1.5D or matrix design, is:

- A. Also curved, identically to the azimuthal plane

- B.** Curved in the opposite direction
- C.** Non-existent, since 1D arrays have no elevational dimension
- D.** Flat, with elevational focusing provided only by a fixed acoustic lens

**29.** Acoustic crosstalk transmitted between adjacent array elements **THROUGH** the shared backing material, distinct from electrical or direct mechanical crosstalk, is reduced primarily by:

- A.** Increasing operating frequency
- B.** Using a thinner matching layer
- C.** Backing that absorbs rather than transmits vibration
- D.** Eliminating the backing material entirely

**30.** The kerf, the narrow physical cut separating adjacent elements in an array, exists primarily to:

- A.** Increase the operating frequency
- B.** Serve as the acoustic matching layer
- C.** House the connector's pins
- D.** Isolate elements mechanically and acoustically

**31.** An element with a very elongated (high) aspect ratio, relative to its thickness, is more prone to:

- A.** Operating at a lower frequency than predicted
- B.** Complete loss of piezoelectric effect
- C.** Spurious vibration modes reducing purity
- D.** Having no measurable bandwidth

**32.** Using two or more matching layers of graduated impedance, rather than a single quarter-wavelength layer, is done primarily to:

- A.** Simplifying manufacturing steps

- B.** Increasing the resonant frequency
- C.** Broadening the effective bandwidth
- D.** Eliminating the backing layer need

**33.** A key function of the backing material is to absorb energy radiated rearward from the element, which primarily prevents that energy from:

- A.** Reflecting back and prolonging the pulse
- B.** Increasing the frequency
- C.** Improving lateral resolution
- D.** Contributing to Doppler sensitivity

**34.** Piezoelectric '33-mode' operation, in which the applied field and resulting strain are along the same axis, is the mode most commonly used in standard diagnostic transducer elements, as opposed to '31-mode,' where:

- A.** No piezoelectric response occurs
- B.** The element cannot be poled
- C.** Strain occurs perpendicular to the field
- D.** Only CW operation is possible

**35.** A patient-safety ground shield within a transducer, distinct from cable shielding used for electromagnetic interference, is intended primarily to:

- A.** Improve the transducer's bandwidth
- B.** Protect the patient from stray electrical leakage current
- C.** Increase the operating frequency range
- D.** Serve as the acoustic matching layer

**36.** A 1.75D array, an intermediate design between a standard 1.5D array and a full 2D matrix, provides:

- A.** Identical capability to a full matrix
- B.** No elevational control, like a 1D array
- C.** Greater elevational control than basic 1.5D
- D.** Only mechanical elevational steering

**37.** Measuring a transducer's far-field beam pattern by scanning a calibrated hydrophone through the beam in a water tank is a technique used primarily for:

- A.** Routine daily bedside clinical QA testing
- B.** Simple disinfection validation testing steps
- C.** Individual patient-specific exam planning
- D.** Specialized manufacturer-level output characterization

**38.** Precise alignment of each element's 'phase center' during array manufacturing is important because misalignment across elements would primarily degrade:

- A.** Disinfection compatibility rating
- B.** Accuracy of electronic steering timing
- C.** Water-ingress rating level
- D.** The connector's pin count

**39.** Allowing a transducer a brief cool-down period after extended high-output scanning, before returning it to a closed storage case, is intended primarily to:

- A.** Avoiding trapped heat against materials
- B.** Increasing operating frequency
- C.** Automatically recalibrating the transducer
- D.** Improving the next frame rate

**40.** For efficient energy transmission at a transducer's center frequency, the total acoustic stack thickness (element plus matching layer) is designed in relation to:

- A.** Body habitus alone
- B.** The frame rate setting
- C.** The disinfection method
- D.** Wavelength design relationships

**41.** Transmit focusing achieved by firing array elements with sequentially timed delays so their wavefronts constructively combine at a chosen depth is functionally distinct from a single, instantaneous firing in that it:

- A.** Allows the operator to select or adjust the transmit focal depth electronically
- B.** Requires a completely different, non-piezoelectric element type
- C.** Eliminates the need for any receive-side processing
- D.** Only works with mechanical, moving-element transducers

**42.** Element pitch, the center-to-center spacing between adjacent elements, is distinct from kerf in that pitch:

- A.** Refers only to the isolating cut width
- B.** Is unrelated to grating lobes
- C.** Cannot be measured directly
- D.** Includes element width plus kerf gap

**43.** Most standard diagnostic transducers cannot tolerate steam autoclave sterilization primarily because the high heat involved risks:

- A.** Exceeding the piezoelectric material's Curie point, causing depoling
- B.** Increasing the transducer's bandwidth beneficially
- C.** Automatically improving image resolution

**D. Having no effect on the element at all**

**44.** Ultrasound transducer beam-forming designs are generally categorized into unfocused, internally (fixed-lens) focused, and electronically focused; a fixed acoustic lens on a standard curvilinear array's elevational plane is an example of:

**A. Unfocused design**

**B. Electronic focusing**

**C. A design with no focusing at all**

**D. Internal (fixed) focusing**

**45.** A transducer connector's keying feature, a specific physical shape that only fits one way, is intended primarily to:

**A. Increase operating frequency**

**B. Serve as cycle counter**

**C. Prevent incorrect-orientation insertion**

**D. Function as matching layer**

**46.** Automated caliper measurement of renal length on a longitudinal image is the primary screening metric used to assess for:

**A. Renal artery stenosis**

**B. Ureteral peristalsis**

**C. Renal vein thrombosis**

**D. Overall kidney size assessment**

**47.** Automated measurement of appendix wall thickness, distinct from overall appendix diameter, is used to help support a diagnosis of:

**A. Appendiceal malignancy specifically here**

**B. Cecal volvulus specifically here**

- C. Meckel diverticulum specifically here
- D. Supporting acute appendicitis diagnosis

**48.** Automated caliper placement measuring the pancreatic head, body, and tail as separate segments, rather than a single overall measurement, allows for:

- A. Automatic pancreatitis diagnosis
- B. Eliminating need for Doppler
- C. Detecting focal segment-specific enlargement
- D. Calculating duct flow velocity

**49.** An AI-guided scan-plane positioning overlay, prompting the operator toward a standard imaging plane, is intended primarily to:

- A. Automatically diagnosing the finding itself
- B. Replacing sonographer judgment entirely
- C. Supporting consistent, reproducible view acquisition
- D. Eliminating the need for training

**50.** Automated measurement of hepatic vein diameter is most directly useful for assessing:

- A. Gallbladder wall thickness
- B. Hepatic venous outflow assessment
- C. Portal vein thrombosis
- D. Pancreatic duct dilation

**51.** A live simultaneous side-by-side display comparing both lung fields during a point-of-care lung ultrasound exam is used primarily to:

- A. Support visual comparison between the two sides
- B. Increase the acquisition frame rate

- C. Automatically calculate B-line count**
- D. Eliminate the systematic lung protocol**

**52.** An automated inferior vena cava collapsibility index calculation, derived from measured maximal and minimal IVC diameters across the respiratory cycle, is used primarily to help assess:

- A. Renal artery stenosis grading**
- B. Gallbladder wall thickness measurement**
- C. Hepatic steatosis grading**
- D. Volume/fluid status assessment**

**53.** An automated lymph node cortex-to-hilum ratio measurement is used, alongside other features, to help assess a node's likelihood of being:

- A. A simple, entirely benign cyst**
- B. A small, entirely benign lipoma**
- C. Reactive versus pathologic node status**
- D. An artifact from adjacent bowel gas**

**54.** A live simultaneous display comparing spectral Doppler waveforms from two different vessels side by side is used primarily to:

- A. Automatically calculate the difference in resistive index**
- B. Support direct visual comparison of waveform morphology between the two vessels**
- C. Eliminate the need for angle correction on either vessel**
- D. Increase the color Doppler frame rate**

**55.** A semi-automated ellipse-fit tool assisting fetal abdominal circumference measurement primarily helps the operator by:

- A. Automatically diagnosing growth restriction**

- B. Eliminating landmark identification need**
- C. Providing a consistent, reproducible trace**
- D. Calculating estimated weight directly**

**56.** A real-time auto-freeze feature that captures a frame when overall image quality metrics peak is intended primarily to:

- A. Replace the sonographer's judgment about which frame to keep**
- B. Assist in capturing a representative, well-optimized frame automatically**
- C. Automatically generate the final report**
- D. Eliminate the need for manual freeze entirely in every case**

**57.** A structured log recording which user made each annotation or measurement on a shared exam, useful in a multi-sonographer or teaching setting, primarily supports:

- A. Accountability for who performed each part**
- B. Automatic image compression**
- C. Increased frame rate**
- D. Eliminating physician review need**

**58.** Automated measurement of gallbladder length, distinct from wall thickness, is most useful for assessing:

- A. Cholecystitis wall inflammation**
- B. Overall gallbladder distension assessment**
- C. Common bile duct diameter**
- D. Pancreatic duct dilation**

**59.** Automated measurement of prostate transition zone volume, distinct from total gland volume, is used primarily to help assess:

- A. Prostatitis diagnosis directly
- B. Benign transition-zone hyperplasia
- C. Testicular torsion assessment
- D. Bladder wall thickness measurement

**60.** A freeze-and-hold countdown timer, prompting the operator to maintain a stable probe position for a standardized number of seconds before capture, is used primarily for exams requiring:

- A. Rapid single-frame acquisition only
- B. No specific positioning requirement
- C. Doppler-only assessment
- D. A sustained, motion-free view

**61.** Automated measurement of carotid bulb diameter, distinct from intima-media thickness or plaque area, is used as one component of assessing:

- A. Doppler wall filter settings
- B. Color gain optimization
- C. Overall vessel geometry assessment
- D. PRF selection choice

**62.** A live, split-screen fetal biometry display auto-plotting each measurement onto a percentile growth chart in real time is intended primarily to:

- A. Automatically diagnosing an abnormality
- B. Giving immediate feedback on the range
- C. Eliminating the anatomic survey need
- D. Replacing formal chart documentation

**63.** A structured measurement-package selection that automatically adjusts which obstetric measurements are offered based on entered gestational age (trimester) is intended primarily to:

- A.** Automatically calculate estimated date of delivery with no other input
- B.** Eliminate the need for entering gestational age at all
- C.** Replace first-trimester dating with third-trimester growth assessment universally
- D.** Present the operator with clinically appropriate measurements for that stage of pregnancy

**64.** An automated splenic-to-renal length ratio, comparing measured spleen length to kidney length, is used as a supplementary metric for assessing:

- A.** Portal vein diameter
- B.** Gallbladder wall thickness
- C.** Hepatic artery resistive index
- D.** Splenomegaly relative to body scale

**65.** Automated measurement of abdominal wall hernia sac depth, distinct from defect width, provides additional information primarily about:

- A.** Bowel wall thickness in the sac
- B.** How far contents protrude, aiding planning
- C.** Doppler flow within the sac
- D.** The defect's location only

**66.** A structured digital-signature acknowledgment step required before a critical finding can be marked as communicated is intended primarily to:

- A.** Notify the patient directly
- B.** Replace verbal physician communication
- C.** Create a verifiable communication record
- D.** Increase the system's frame rate

**67.** Real-time enhancement of the entire visible needle shaft, rather than emphasis on the tip alone, is particularly useful for procedures where:

- A.** Confirming trajectory and depth throughout
- B.** When only tip position matters
- C.** When no needle is used
- D.** When performed entirely out-of-plane

**68.** An automated ovarian follicle size-distribution histogram, plotting the range of follicle sizes detected within an ovary, is used primarily in the context of:

- A.** Suspected ovarian torsion
- B.** Fertility follicle-development monitoring
- C.** Endometrioma characterization
- D.** Ectopic pregnancy localization

**69.** A live elastography color-map legend/scale displayed alongside the image is intended primarily to:

- A.** Calculating stiffness without input
- B.** Replacing region-of-interest placement
- C.** Helping interpret displayed colors correctly
- D.** Increasing acquisition frame rate

**70.** Automated measurement of total thyroid gland volume, distinct from isthmus thickness or a single nodule's risk score, is used primarily to assess for:

- A.** A single nodule's malignancy risk
- B.** Isthmus hypertrophy only
- C.** Overall glandular enlargement, like goiter
- D.** Parathyroid gland size

**71.** A structured exam-completion percentage indicator, updating as required views and measurements are captured, is intended primarily to:

- A.** Help track progress toward completion
- B.** Automatically finalize the report
- C.** Replace documented worksheet need
- D.** Increase the frame rate

**72.** A real-time toggle allowing side-by-side comparison of a standard grayscale image and its inverted-grayscale counterpart is intended primarily to:

- A.** Improving axial resolution
- B.** Changing underlying acquired data
- C.** Helping determine the better presentation
- D.** Increasing the Doppler frame rate

**73.** Automated measurement of cervical length via transvaginal ultrasound in pregnancy is used primarily to screen for risk of:

- A.** Placenta accreta spectrum
- B.** Fetal growth restriction
- C.** Gestational diabetes risk
- D.** Preterm birth risk

**74.** A live display blending a small proportion of fundamental-frequency signal with the dominant harmonic signal is intended primarily to:

- A.** Eliminating the near-field benefit
- B.** Combining complementary signal information
- C.** Calculating tissue stiffness
- D.** Increasing physical bandwidth

**75.** Automated measurement of the epididymal head, distinct from testicular volume itself, is used to help assess for:

- A.** Testicular torsion directly
- B.** Varicocele grading
- C.** Tumor vascularity assessment
- D.** Epididymal enlargement assessment

**76.** A structured worksheet feature that automatically carries forward a patient's prior exam values as reference alongside new measurements is intended primarily to:

- A.** Replace need for new measurements
- B.** Facilitate direct current-vs-prior comparison
- C.** Automatically flag every difference
- D.** Increase the frame rate

**77.** Normal posterior tibial and peroneal artery Doppler waveforms at rest, like other resting peripheral limb arteries, are typically:

- A.** Continuous and monophasic, like a vein
- B.** Absent during systole
- C.** Triphasic, reflecting high resting peripheral resistance
- D.** Reversed in direction compared with the popliteal artery

**78.** A normal radial artery Doppler waveform at the wrist, supplying the hand at rest, is typically:

- A.** Monophasic and continuous, like a vein
- B.** Triphasic, reflecting high resting resistance
- C.** Absent during diastole always
- D.** Reversed compared with the ulnar artery

**79.** A normal ulnar artery Doppler waveform is expected to be similar in character to the radial artery because both:

- A.** Are veins, not arteries
- B.** Supply unrelated territories
- C.** Have opposite flow directions
- D.** Both are resting distal limb arteries

**80.** Markedly elevated superior thyroidal artery peak systolic velocity, in a diffusely hypervascular gland, is a described Doppler pattern (sometimes called 'thyroid inferno') associated with:

- A.** Graves' disease (hyperthyroidism)
- B.** A simple colloid nodule
- C.** A thyroid cyst
- D.** Hypothyroidism from iodine deficiency

**81.** Nutcracker syndrome refers to compression of the left renal vein, most often between the:

- A.** Right renal artery and IVC
- B.** Splenic artery and pancreas
- C.** Superior mesenteric artery and aorta
- D.** Celiac artery and diaphragm

**82.** Normal superior mesenteric vein flow is directed:

- A.** Away from the liver
- B.** A to-and-fro pattern
- C.** Toward the liver, hepatopetal
- D.** Absent under normal conditions

**83.** A normal renal vein Doppler waveform is typically:

- A.** Continuous, low-velocity, non-pulsatile
- B.** Identical to the renal artery
- C.** Absent under normal conditions
- D.** Reversed compared with the IVC

**84.** Increased portal vein pulsatility, rather than the normal gentle respiratory undulation, can be seen in the setting of:

- A.** Normal resting physiology alone
- B.** Mild dehydration alone here
- C.** Elevated right heart pressure transmitted back
- D.** Simple hepatic steatosis alone

**85.** In acute pyelonephritis, color Doppler of the affected kidney may show:

- A.** Uniformly increased perfusion throughout
- B.** Complete absence of all flow
- C.** Identical to a normal kidney
- D.** Patchy wedge-shaped decreased perfusion

**86.** Prominent internal vascularity with low-resistance flow within a solid or complex ovarian mass is considered a finding that:

- A.** Raises concern for malignancy
- B.** Definitively excludes malignancy
- C.** Expected in every simple cyst
- D.** Has no bearing on risk

- 87.** An area of placental infarction typically appears on Doppler as:
- A.** An area of increased vascularity compared with surrounding placenta
  - B.** Identical in vascularity to normal placental tissue
  - C.** An avascular region within the placenta
  - D.** A region of reversed umbilical venous flow
- 88.** Doppler assessment of fetal tricuspid regurgitation during first-trimester screening is used as one marker contributing to risk assessment for:
- A.** Placenta previa risk
  - B.** Aneuploidy risk, with other markers
  - C.** Gestational diabetes risk
  - D.** Maternal preeclampsia directly
- 89.** A true umbilical cord cyst, distinguished from a pseudocyst, would be expected to show on Doppler:
- A.** No internal flow, since a cyst itself is not a vascular structure
  - B.** High-velocity arterial flow within the cyst wall interior
  - C.** Flow identical to the umbilical vein
  - D.** Reversed umbilical artery flow specifically caused by the cyst
- 90.** A traumatic testicular hematoma would be expected to show on color Doppler:
- A.** No internal flow within it
  - B.** Increased internal vascularity
  - C.** A pattern identical to a tumor
  - D.** Reversed testicular artery flow

**91.** Renal transplant vein thrombosis, a less common but serious early complication, is diagnosed by demonstrating:

- A.** A normal venous waveform pattern
- B.** Increased RI with no venous finding
- C.** Absent venous flow, reversed arterial diastole
- D.** A finding identical to simple ATN

**92.** Acute mastitis, an inflammatory breast condition, typically shows on color Doppler:

- A.** Complete absence of flow
- B.** Increased regional hyperemia
- C.** Identical to a simple cyst
- D.** Reversed internal mammary flow

**93.** A well-defined, oval breast mass with mild, peripheral vascularity is a pattern more suggestive of a benign process such as a fibroadenoma, in contrast to a malignant mass, which more often shows:

- A.** Identical, mild peripheral vascularity in every case
- B.** Complete absence of any vascularity
- C.** More disorganized, often increased and penetrating central vascularity
- D.** Flow only detectable with continuous-wave Doppler

**94.** Sialadenitis (inflammation of the parotid gland) typically shows on color Doppler:

- A.** Increased glandular vascularity corresponding to inflammation
- B.** Complete absence of glandular flow
- C.** A pattern identical to a normal, uninflamed gland
- D.** Flow limited exclusively to the facial artery

**95.** Rupture of a Baker's cyst, distinct from simply distinguishing an intact cyst from DVT, is suggested when grayscale shows fluid tracking into the surrounding calf soft tissue; Doppler in this setting is used primarily to:

- A.** Diagnose the rupture alone
- B.** Evaluate inflammation or exclude DVT
- C.** Measure pre-rupture cyst volume
- D.** Replace grayscale assessment entirely

**96.** Plantar fasciitis, an inflammatory condition of the plantar fascia, may show on Doppler:

- A.** Increased vascularity from inflammation
- B.** Complete absence of any flow
- C.** Identical to an asymptomatic foot
- D.** Flow limited to one artery only

**97.** Achilles tendinosis, a chronic degenerative tendon condition, is associated on Doppler with:

- A.** Complete absence of flow
- B.** Identical to a healthy tendon
- C.** Neovascularity within the tendon
- D.** Flow limited to the calcaneus

**98.** A Doppler shift of 4000 Hz is measured at a 45-degree angle of insonation, using a 5 MHz transducer (propagation speed 1540 m/s,  $\cos 45$  degrees is approximately 0.71). Using  $v = (\text{shift} \times c) / (2 \times f_0 \times \cos \theta)$ , the calculated velocity is closest to:

- A.** 87 cm/s
- B.** 174 cm/s
- C.** 44 cm/s
- D.** 122 cm/s

**99.** A Doppler waveform has a peak systolic velocity of 90 cm/s and an end diastolic velocity of 10 cm/s. Using  $RI = (PSV - EDV) / PSV$ , the resistive index is closest to:

- A.** 0.11
- B.** 0.90
- C.** 0.89
- D.** 9.0

**100.** A Doppler waveform has a peak systolic velocity of 70 cm/s, an end diastolic velocity of 15 cm/s, and a mean velocity of 35 cm/s. Using  $PI = (PSV - EDV) / \text{mean velocity}$ , the pulsatility index is closest to:

- A.** 1.57
- B.** 0.79
- C.** 4.67
- D.** 2.33

**101.** A stenotic segment shows a peak systolic velocity of 300 cm/s, while the adjacent prestenotic segment shows 75 cm/s. The velocity ratio (stenotic/prestenotic) is:

- A.** A ratio of 0.25
- B.** A ratio of 22,500
- C.** A ratio of 4
- D.** A ratio of 375

**102.** A common carotid artery shows a peak systolic velocity of 120 cm/s and an end diastolic velocity of 30 cm/s. Using  $S/D \text{ ratio} = PSV/EDV$ , the S/D ratio is:

- A.** An S/D ratio of 4
- B.** An S/D ratio of 0.25
- C.** An S/D ratio of 90

**D. An S/D ratio of 150**

**103.** Lymphedema, a condition of impaired lymphatic drainage, is distinguished on Doppler from venous causes of limb swelling primarily because lymphedema typically shows:

- A. Normal flow, since the cause is lymphatic**
- B. Absent venous flow throughout the limb**
- C. Reversed arterial flow throughout**
- D. A finding identical to acute DVT**

**104.** Polycystic kidney disease, as cysts progressively replace normal renal parenchyma, is associated with renal artery Doppler findings that may show:

- A. Normal RI regardless of severity**
- B. Absent diastolic flow always**
- C. Elevated RI with severity**
- D. Reversed systolic flow**

**105.** A scrotal pearl, a small, mobile, calcified free body within the scrotal sac (often within a hydrocele), is expected on Doppler to show:

- A. Increased internal vascularity**
- B. A pattern identical to a tumor**
- C. Flow identical to epididymis**
- D. No internal flow, avascular composition**

**106.** An inguinal hernia containing bowel is assessed with Doppler primarily to help evaluate:

- A. Viability of the herniated bowel**
- B. The defect's exact width**
- C. Overall cardiac output**

**D. Testicular volume assessment**

**107.** An arteriovenous malformation (AVM), in general, is expected on Doppler to show:

- A.** A single simple feeding vessel
- B.** Complete absence of flow
- C.** Indistinguishable from a hemangioma
- D.** High-velocity feeders, arterialized outflow

**108.** Renal angiomyolipoma, a benign fatty renal tumor, is typically:

- A.** Hypervascular but variable in composition
- B.** Always completely avascular here
- C.** Indistinguishable from a simple cyst
- D.** Associated with absent flow always

**109.** Doppler confirmation before and after ultrasound-guided thrombin injection into a pseudoaneurysm is used to:

- A.** Measure original size only
- B.** Calculate blood pressure
- C.** Confirm cessation of sac flow
- D.** Assess an unrelated vessel

**110.** A trauma patient's Doppler exam shows absent flow in a segmental renal artery branch with an adjacent wedge-shaped hypoechoic parenchymal defect, in addition to a separate finding of absent flow in a segmental splenic artery branch with a similar adjacent defect. This combined pattern is most consistent with:

- A.** Isolated chronic renal infarction
- B.** A normal variant in both organs

- C. Multi-organ traumatic vascular injury
- D. Bilateral renal artery stenosis

## Answers

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1. **C.** Exceeding a table's rated weight limit risks equipment failure and injury to the patient or staff during positioning, a safety concern distinct from image quality or billing.
2. **A.** A fall-risk assessment is a proactive, beforehand evaluation intended to identify at-risk patients so preventive measures can be taken, distinct from a fall-response protocol, which addresses what to do after a fall has already occurred.
3. **B.** Contact and other transmission-based precautions specify a defined PPE donning sequence to be completed before entering the room, ensuring the barrier is in place before any patient contact, rather than being applied inconsistently or after the fact.
4. **D.** Mechanical lift/transfer devices reduce the physical strain and injury risk associated with manual patient lifting for both the patient and staff, a safe-patient-handling consideration unrelated to frame rate, scan time, or contrast resolution.
5. **B.** Clearly documenting which structures were inadequately visualized, and why, preserves an accurate record and appropriately informs the interpreting physician and any follow-up decisions, rather than omitting or guessing at the limitation.
6. **D.** Badge or RFID access control restricts physical entry to authorized personnel, a facility and equipment security measure unrelated to acoustic safety, image quality, or disinfection scheduling.
7. **A.** Expired emergency medications may have reduced potency or reliability, which could compromise the response to an actual anaphylactic event, making expiration checks an important part of emergency readiness.
8. **B.** Transmitting or storing clinical images on a personal, unapproved device bypasses institutional security controls protecting patient health information, raising a direct confidentiality and data-security concern.
9. **B.** Barcode wristband scanning is a technology-assisted method of confirming patient identity, supplementing (not replacing) standard verbal/visual identifier verification, distinct from disinfection, output monitoring, or billing functions.
10. **D.** Patients generally have a right to be informed when their care involves a use of a device or technique outside its labeled indication, supporting informed consent, even though off-label use itself may be clinically appropriate in some situations.

**11. C.** A pre-visit internal self-assessment is meant to proactively surface and correct gaps against accreditation standards before the formal external review, improving readiness rather than replacing the actual site visit or serving a purely internal purpose.

**12. A.** The law of reflection states that at a specular interface, the angle of reflection equals the angle of incidence, both measured from the normal (perpendicular) to the surface -- a fixed geometric relationship, not one that varies with frequency or defaults to 90 degrees.

**13. A.** Pulse duration is the total time spanning all the cycles contained within a single pulse, while period is the time for just one cycle; pulse duration therefore generally differs numerically from period whenever a pulse contains more than one cycle.

**14. C.** Far-zone distance =  $\text{diameter}^2 / (4 \times \text{wavelength}) = (10 \text{ mm})^2 / (4 \times 0.5 \text{ mm}) = 100 / 2 = 50 \text{ mm}$ .

**15. B.** An acoustic lens, like an optical lens, uses a curved surface at a boundary where propagation speed differs between the lens material and surrounding medium to bend (refract) the wavefront and bring it to a focus.

**16. D.** Round-trip distance =  $2 \times 8 \text{ cm} = 16 \text{ cm} = 0.16 \text{ m}$ ; time = distance / speed =  $0.16 \text{ m} / 1540 \text{ m/s} =$  approximately 104 microseconds.

**17. A.** Because reflection strength at a boundary depends on the magnitude of the acoustic impedance mismatch, a small mismatch (as between two soft tissues like muscle and fat) produces a relatively weak reflection, far less than at a soft-tissue/air or soft-tissue/bone interface where the mismatch is much larger.

**18. C.** Energy = average power x time =  $2 \text{ mW} \times 3 \text{ microseconds} = 2 \times 10^{-3} \text{ W} \times 3 \times 10^{-6} \text{ s} = 6 \times 10^{-9} \text{ J} = 6 \text{ nanojoules}$ .

**19. B.** The hertz is defined as one cycle completed per second, the standard unit for frequency, distinct from units of speed, attenuation, or intensity.

**20. D.** A wavefront is a surface connecting all points of a wave that share the same phase at a given instant, a fundamental concept in wave propagation distinct from the transducer face, a single reflector, or a tissue boundary.

**21. C.** While a transducer element has a natural resonant frequency set by its thickness, the system's electronics can excite (drive) it at a somewhat different frequency within its bandwidth, which is what 'driven frequency' refers to, distinct from resonance itself.

**22. B.** Reflection coefficient =  $[(1.7-1.5)/(1.7+1.5)]^2 = (0.2/3.2)^2 = (0.0625)^2 =$  approximately 0.004.

**23. A.** Axial resolution =  $\text{SPL} / 2 = 0.6 \text{ mm} / 2 = 0.3 \text{ mm}$ .

- 24. D.** Across typical soft tissues, stiffness (compressibility) varies more substantially than density, making stiffness the dominant factor driving differences in propagation speed between different soft tissue types.
- 25. B.** Because intensity is proportional to the square of amplitude, converting an amplitude-based  $20\log$  formula into an equivalent intensity-based formula requires using a factor of 10 rather than 20, so that squaring the amplitude ratio is properly accounted for.
- 26. A.** Frequency = cycles / pulse duration =  $4 / 2 \text{ microseconds} = 2 \text{ cycles per microsecond} = 2 \text{ MHz}$ .
- 27. B.** A converging (focused) beam narrows toward its focal point and then diverges beyond it; the wavefront's curvature transitions from converging to diverging exactly at the focus, rather than remaining flat or curving in only one direction throughout.
- 28. D.** A standard curvilinear array's curvature exists only in the azimuthal (in-plane, scanning) direction; the elevational plane is flat and relies on a fixed acoustic lens for elevational focusing, unless the design incorporates 1.5D or full matrix elements.
- 29. C.** Vibrational energy can travel laterally through the shared backing material between adjacent elements; backing material engineered to absorb rather than transmit this lateral vibration reduces acoustic crosstalk transmitted through that path.
- 30. D.** The kerf is the physical cut separating individual elements, providing both mechanical and acoustic isolation so each element can vibrate and be driven largely independently of its neighbors.
- 31. C.** An element with a high aspect ratio (elongated relative to its thickness) is more susceptible to unwanted lateral or other spurious vibration modes competing with the intended thickness-mode vibration, degrading the purity of the primary response.
- 32. C.** Multiple matching layers with gradually stepped impedance values provide efficient energy transmission across a wider range of frequencies than a single quarter-wavelength layer, broadening the transducer's effective bandwidth.
- 33. A.** Without adequate backing absorption, energy radiated rearward from the element would reflect off the housing and return to the element, artificially prolonging the pulse through internal reverberation, which the backing material is specifically designed to prevent.
- 34. C.** In 33-mode operation, the electric field and resulting mechanical strain are along the same axis (typically the thickness direction), which is standard for diagnostic imaging elements; in 31-mode, by contrast, the strain occurs perpendicular to the applied field's axis.
- 35. B.** A patient-safety ground shield is specifically intended to protect the patient from stray electrical leakage current that could otherwise reach them through the probe, a distinct safety function from EMI shielding, which protects signal quality rather than the patient directly.

- 36. C.** A 1.75D array adds more elevational control than a basic 1.5D design (which typically has very limited additional rows) while stopping short of the full independent elevational steering and cost of a true 2D matrix array.
- 37. D.** Detailed hydrophone-based beam-pattern mapping in a water tank is a specialized, precise characterization technique used by manufacturers or testing laboratories, well beyond the scope of routine daily clinical QA performed by sonographers.
- 38. B.** Because electronic beam steering and focusing rely on precisely timed firing across many elements, any misalignment in an individual element's phase center introduces timing errors that degrade the accuracy of the resulting beam pattern.
- 39. A.** Allowing residual heat to dissipate before closing a warm transducer into a storage case helps avoid trapping that heat against case materials or the transducer's own components that could be sensitive to prolonged elevated temperature.
- 40. D.** The acoustic stack's layer thicknesses are deliberately designed relative to the operating wavelength (such as quarter-wavelength matching layers) to maximize efficient energy transmission at the transducer's intended center frequency.
- 41. A.** Because the timing delays across elements can be recalculated for different target depths, this timed-firing approach allows the transmit focal depth to be selected or adjusted electronically, unlike a single simultaneous firing, which cannot be focused this way.
- 42. D.** Pitch is the full center-to-center distance between adjacent elements, which by definition includes both the element's own width and the kerf gap separating it from the next element, making pitch a broader measurement than kerf alone.
- 43. A.** Steam autoclave sterilization involves temperatures that can exceed the Curie point of the piezoelectric material, permanently depoling it and destroying its piezoelectric function, which is why most standard probes are not autoclave-compatible.
- 44. D.** A fixed acoustic lens providing elevational focusing on an otherwise electronically-focused array is a physical, unchangeable focusing element, which is the definition of internal (fixed) focusing, distinct from unfocused or fully electronic designs.
- 45. C.** A connector keying feature physically prevents the connector from being inserted incorrectly, protecting both the pins and the electrical connection from damage or misalignment, a mechanical safeguard rather than a frequency, disinfection, or acoustic feature.
- 46. D.** Renal length is the standard screening metric for overall kidney size, used to identify atrophy (small kidney) or compensatory hypertrophy (enlarged kidney), distinct from vascular or ureteral assessments.

- 47. D.** Wall thickness, along with overall diameter and other sonographic features, contributes to the overall impression supporting a diagnosis of acute appendicitis, rather than being specific to malignancy or an unrelated diagnosis.
- 48. C.** Measuring each pancreatic segment separately allows detection of focal enlargement confined to one region (such as the head), which could be diluted or missed if only a single, averaged overall measurement were taken.
- 49. C.** A scan-plane guidance overlay is intended to support the operator in more reliably and consistently acquiring standardized views, complementing rather than replacing sonographer skill and judgment.
- 50. B.** Hepatic vein diameter is relevant to assessing hepatic venous outflow, with dilation potentially reflecting venous congestion (such as from right heart failure), distinct from gallbladder, portal vein, or pancreatic duct assessments.
- 51. A.** A side-by-side dual-lung display allows direct visual comparison of pleural line and B-line findings between the two lung fields at the same point in time, aiding symmetric/asymmetric pattern recognition.
- 52. D.** The IVC collapsibility index, derived from the percent change in IVC diameter across the respiratory cycle, is used as a noninvasive indicator of a patient's volume/intravascular fluid status, distinct from renal, gallbladder, or hepatic assessments.
- 53. C.** A more oval node with a normal cortex-to-hilum ratio is generally reassuring for a reactive/benign node, while an altered ratio (cortical thickening relative to the hilum) raises concern for pathologic involvement, a feature used alongside others in node characterization.
- 54. B.** Displaying two vessels' spectral waveforms simultaneously allows direct visual comparison of their morphology (such as symmetry between paired limb vessels), rather than performing an automatic numeric comparison or altering angle correction settings.
- 55. C.** A semi-automated ellipse-fit tool still depends on the operator confirming correct anatomic landmarks, but once confirmed, it provides a consistent, reproducible trace for the abdominal circumference measurement rather than eliminating the need for correct landmark placement.
- 56. B.** An auto-freeze-on-quality feature is designed to assist the sonographer by capturing a well-optimized frame automatically at an opportune moment, supporting rather than replacing the sonographer's own selection and judgment.
- 57. A.** Logging which user performed each annotation or measurement creates accountability and traceability, particularly useful in multi-sonographer or teaching environments where more than one person may contribute to a single exam.

- 58. B.** Gallbladder length reflects overall distension of the organ, such as from obstruction, distinct from wall thickness (more specific to inflammation) or unrelated structures like the CBD or pancreatic duct.
- 59. B.** Benign prostatic hyperplasia predominantly enlarges the transition zone rather than the whole gland uniformly, making transition zone volume a more targeted metric for BPH assessment than total gland volume alone.
- 60. D.** A countdown timer enforcing a sustained, motion-free probe position is particularly useful for acquisitions that require stability over a period of time, such as certain elastography techniques or 3D/4D volume sweeps, rather than a single instantaneous frame.
- 61. C.** Vessel geometry, including bulb diameter, can influence local flow patterns and factor into how stenosis severity is calculated or interpreted, distinct from Doppler-specific settings like wall filter, color gain, or PRF.
- 62. B.** Real-time percentile plotting gives the operator immediate visual feedback on whether a measurement falls within an expected range for gestational age, supporting timely recognition of a potentially outlying value, without itself diagnosing any specific condition.
- 63. D.** Adjusting which measurements are offered based on gestational age ensures the operator is presented with clinically appropriate options for that stage of pregnancy (such as first-trimester dating versus third-trimester growth parameters), rather than a one-size-fits-all package.
- 64. D.** Comparing spleen length to the patient's own kidney length provides a body-scaled reference that can help contextualize splenomegaly, since normal organ size varies with patient body habitus.
- 65. B.** Sac depth indicates how far hernia contents protrude beyond the abdominal wall defect, information relevant to reducibility and surgical planning, distinct from the width of the defect itself or Doppler flow assessment.
- 66. C.** A required digital-signature acknowledgment step creates a verifiable record confirming that a critical finding was actually communicated to and acknowledged by the appropriate recipient, supporting patient safety and documentation integrity.
- 67. A.** Enhancing the entire visible needle shaft, rather than just the tip, helps confirm the needle's full trajectory and depth throughout an in-plane pass, which is clinically important for procedures where the path matters as much as the final position.
- 68. B.** A follicle size-distribution histogram is used in fertility monitoring to track the range and development of follicles over a treatment cycle, distinct from torsion, endometrioma characterization, or ectopic pregnancy evaluation.
- 69. C.** A displayed color-map legend allows the operator and interpreting physician to correctly interpret what each color on the elastography image represents (such as relative softness versus stiffness), supporting accurate interpretation rather than performing any calculation itself.

- 70. C.** Total gland volume reflects overall glandular enlargement, such as diffuse goiter, distinct from an individual nodule's risk scoring, isolated isthmus hypertrophy, or an unrelated structure like the parathyroid glands.
- 71. A.** A completion-percentage indicator helps the sonographer track progress toward a complete, protocol-adherent exam in real time, supporting workflow awareness rather than automatically finalizing the report or replacing formal worksheet documentation.
- 72. C.** Comparing standard and inverted grayscale side by side helps the operator judge which presentation better displays a particular finding for that specific case, without altering the underlying acquired data or affecting resolution or frame rate.
- 73. D.** Transvaginal cervical length measurement is a well-established screening tool for identifying patients at increased risk of preterm birth, distinct from placental, growth, or metabolic screening purposes.
- 74. B.** Blending fundamental and harmonic signal allows the displayed image to combine complementary information from both signal types into one view, rather than eliminating harmonic benefits or performing an unrelated stiffness calculation.
- 75. D.** Measuring the epididymal head specifically helps assess for epididymal enlargement, such as with epididymitis, a distinct structure and purpose from testicular torsion, varicocele grading, or tumor vascularity assessment.
- 76. B.** Carrying forward prior values alongside new measurements within the same worksheet facilitates direct, convenient comparison between current and prior findings, supporting trend recognition rather than replacing new measurement or auto-flagging every difference.
- 77. C.** Like other resting peripheral limb arteries, the posterior tibial and peroneal arteries normally show a triphasic waveform reflecting the high resistance of resting distal limb musculature.
- 78. B.** As a resting distal limb artery, the radial artery normally shows a triphasic waveform reflecting high downstream resistance, similar in principle to other resting peripheral arteries rather than a continuous venous-type pattern.
- 79. D.** Both the radial and ulnar arteries are resting distal limb arteries supplying the hand's vascular arches, and both normally display the same triphasic, high-resistance waveform pattern characteristic of resting limb arteries.
- 80. A.** The markedly hypervascular, high-velocity pattern sometimes called 'thyroid inferno' is classically described in Graves' disease, reflecting the diffuse hyperfunction and hypervascularity of that autoimmune hyperthyroid condition.

- 81. C.** Nutcracker syndrome results from compression of the left renal vein as it passes between the superior mesenteric artery and the aorta, the anatomic 'nutcracker' responsible for the venous compression and associated symptoms.
- 82. C.** As a tributary of the portal venous system, the superior mesenteric vein normally carries flow toward the portal confluence and then the liver (hepatopetal direction), consistent with normal portal system physiology.
- 83. A.** The renal vein normally shows continuous, relatively low-velocity flow without the pulsatile triphasic character of the adjacent renal artery, reflecting the fundamentally different hemodynamics of venous versus arterial flow at this location.
- 84. C.** Elevated right-sided cardiac pressures, such as from tricuspid regurgitation or right heart failure, can be transmitted backward through the venous system and increase portal vein pulsatility beyond its normal gentle respiratory variation.
- 85. D.** Acute pyelonephritis produces localized inflammation that can appear as patchy, wedge-shaped areas of decreased perfusion on color Doppler, corresponding to the inflamed regions of the kidney, rather than uniform or entirely normal/absent perfusion.
- 86. A.** Prominent, low-resistance internal vascularity within a solid or complex ovarian mass is one of several features that, considered together with morphology and other findings, raises concern for malignancy, though it is not diagnostic in isolation.
- 87. C.** An infarcted area of placenta has lost its blood supply and therefore appears as an avascular region on Doppler, distinct from the surrounding vascularized, functioning placental tissue.
- 88. B.** Fetal tricuspid regurgitation is one of several first-trimester ultrasound markers, used alongside nuchal translucency and other findings, that contribute to overall risk assessment for aneuploidy.
- 89. A.** A true umbilical cord cyst is a fluid-filled structure, not a vascular one, so it is expected to show no internal Doppler flow, distinguishing it from a vascular structure or an artifact that might mimic a cystic appearance.
- 90. A.** A hematoma is a collection of clotted blood without its own blood supply, so it characteristically shows no internal Doppler flow, distinguishing it from vascularized normal testicular tissue or a vascular tumor.
- 91. C.** Renal transplant vein thrombosis is diagnosed by demonstrating absent or markedly abnormal venous flow, often accompanied by a distinctive reversed diastolic arterial flow pattern reflecting the outflow obstruction, a combined venous-and-arterial finding.
- 92. B.** Inflammatory conditions like acute mastitis typically produce increased regional vascularity (hyperemia) on color Doppler corresponding to the area of active inflammation, similar to inflammatory responses seen elsewhere in the body.

- 93. C.** While benign masses like fibroadenomas often show mild, orderly peripheral vascularity, malignant breast masses more frequently show disorganized, often increased vascularity that penetrates into the central portion of the mass, a pattern feature used alongside grayscale characteristics.
- 94. A.** Inflammation of the parotid gland in sialadenitis is typically accompanied by increased glandular vascularity on color Doppler, reflecting the inflammatory hyperemic response, similar to inflammatory patterns seen in other glandular or soft-tissue infections.
- 95. B.** Once rupture is suspected from grayscale findings of fluid tracking into the calf, Doppler is used to help characterize any associated inflammatory hyperemia and, importantly, to exclude a coexisting DVT, which can produce a similar clinical presentation.
- 96. A.** Active inflammation in plantar fasciitis is associated with increased vascularity around the thickened, abnormal plantar fascia on Doppler, a pattern reflecting the inflammatory process rather than absent or unchanged flow.
- 97. C.** Achilles tendinosis is characterized by neovascularity, the ingrowth of new small vessels into the abnormal, thickened tendon substance, a Doppler finding associated with symptomatic chronic tendinopathy rather than a normal, healthy tendon.
- 98. A.** Solving  $v = (\text{shift} \times c) / (2 \times f_0 \times \cos \theta) = (4000 \text{ Hz} \times 1540 \text{ m/s}) / (2 \times 5,000,000 \text{ Hz} \times 0.71) = 6,160,000 / 7,100,000 = \text{approximately } 0.868 \text{ m/s, or about } 87 \text{ cm/s}.$
- 99. C.**  $RI = (PSV - EDV) / PSV = (90 - 10) / 90 = 80/90 = \text{approximately } 0.89.$
- 100. A.**  $PI = (PSV - EDV) / \text{mean velocity} = (70 - 15) / 35 = 55/35 = \text{approximately } 1.57.$
- 101. C.**  $\text{Velocity ratio} = \text{stenotic PSV} / \text{prestenotic PSV} = 300 / 75 = 4.$
- 102. A.**  $S/D \text{ ratio} = PSV / EDV = 120 / 30 = 4.$
- 103. A.** Because lymphedema results from impaired lymphatic drainage rather than a vascular abnormality, venous and arterial Doppler studies in affected limbs are typically normal, which helps distinguish it from venous causes of limb swelling such as DVT or chronic venous insufficiency.
- 104. C.** As polycystic kidney disease progresses and cysts increasingly compress and replace normal renal parenchyma, renal artery resistive index tends to rise, reflecting worsening intrarenal vascular resistance associated with disease severity.
- 105. D.** A scrotal pearl is a small calcified body, essentially avascular calcified tissue, and as such shows no internal Doppler flow, distinguishing it from vascularized structures like the epididymis or a testicular tumor.

**106. A.** Doppler assessment of herniated bowel is used to evaluate for viability; absent flow within the herniated segment raises concern for vascular compromise (strangulation), a more urgent finding than the hernia defect's dimensions alone.

**107. D.** An AVM is characterized by an abnormal tangle of vessels directly connecting arteries to veins without an intervening capillary bed, producing high-velocity, low-resistance arterial feeding vessels and arterialized (pulsatile, higher-velocity) venous outflow, a distinctive combined pattern.

**108. A.** Renal angiomyolipoma is generally hypervascular but its Doppler appearance can vary depending on the relative proportion of fat, smooth muscle, and vascular elements within the tumor, rather than showing one fixed, uniform pattern or being avascular.

**109. C.** Confirming absence of flow within the pseudoaneurysm sac after thrombin injection verifies that the treatment successfully induced clotting and closed the abnormal communication, the key procedural endpoint being assessed.

**110. C.** Segmental devascularization patterns in two separate solid organs in a trauma patient, each with a corresponding parenchymal defect, are most consistent with multi-organ traumatic vascular injury rather than an incidental chronic finding, a normal variant, or an unrelated bilateral stenotic process.