

AMSER DIRT Curriculum

Question Bank: 15 Questions Per Module with Explanations

Based on AMSER DIRT Combined Curriculum Videos and Readings

MODULE 1: General Radiology / Introduction to Radiology

1. Which property of tissue primarily determines its appearance (attenuation) on a CT scan?

- A) Water content only
- B) Density (electron density/atomic number)
- C) Temperature
- D) Vascularity

Answer: B — Density

Explanation: CT attenuation (measured in Hounsfield Units) reflects the density of tissue. Denser structures (bone, metal) are hyperattenuating/hyperdense (bright), while less dense structures (fat, air) are hypoattenuating/hypodense (dark). This is the foundational concept from the Introduction to Radiology modules.

2. On a plain radiograph, which of the following appears most radiopaque (brightest)?

- A) Air
- B) Fat
- C) Soft tissue
- D) Cortical bone

Answer: D — Cortical bone

Explanation: Radiographic density follows: Air (black) < Fat < Soft tissue/Water < Bone < Metal (white). Cortical bone appears the brightest natural structure on plain films due to its high calcium content and density.

3. When evaluating whether iodinated IV contrast is appropriate for a patient, which of the following is the most important contraindication to assess?

- A) Mild latex allergy
- B) Shellfish allergy alone
- C) Severe prior contrast reaction or renal insufficiency (elevated creatinine/GFR)
- D) Hypertension

Answer: C — Severe allergy to iodinated contrast or renal insufficiency

Explanation: As covered in Dr. Hartman's 'Issues of Contrast' video, the key contraindications for iodinated contrast include prior severe allergic reactions to contrast and renal insufficiency (risk of contrast-induced nephropathy). Shellfish allergy alone is no longer considered a reliable predictor. Iodine is required for the body's natural production of thyroid hormone, so they are likely allergic to minor fish antigens.

4. Gadolinium-based contrast agents are used with which imaging modality?

- A) CT
- B) MRI
- C) Plain radiograph
- D) Nuclear medicine

Answer: B — MRI

Explanation: Gadolinium is a paramagnetic agent used as MRI contrast. It shortens T1 relaxation times, causing enhancement on T1-weighted sequences. Iodinated agents are used for CT, and barium for fluoroscopy.

5. What does the 'Which Test' feature on the UBC Radiology App help students learn?

- A) How to interpret CXR findings
- B) MRI safety protocols
- C) Appropriate imaging ordering for various clinical scenarios
- D) Radiation dosimetry calculations

Answer: C — Appropriate imaging ordering for clinical scenarios

Explanation: The 'Which Test' module in the Clinical Section of the UBC app is a 70-question quiz designed to teach appropriate imaging utilization — a critical skill for all clinicians.

6. The Hounsfield Unit (HU) scale is central to CT interpretation. Which value correctly pairs a tissue with its approximate HU range?

- A) Air $\approx$ +100 HU
- B) Water $\approx$ 0 HU
- C) Fat $\approx$ +80 HU
- D) Bone $\approx$ -200 HU

Answer: B — Water $\approx$ 0 HU

Explanation: The HU scale is calibrated to water = 0 HU. Air $\approx$ -1000 HU, fat $\approx$ -40 to -100 HU, soft tissue $\approx$ 20–80 HU, and cortical bone $\approx$ +400 to +1000 HU.

7. What is windowing (window level and width) used for in CT interpretation?

- A) Controlling radiation dose
- B) Selecting the slice thickness
- C) Injecting contrast at the right time
- D) Adjusting the display range of HU values to optimize visualization of specific tissues

Answer: D — Adjusting the display range of HU values to optimize visualization of specific tissues

Explanation: Windowing allows the viewer to focus on a specific range of Hounsfield Units. For example, a 'lung window' uses a wide width to see both air and soft tissue, while a 'bone window' emphasizes calcified structures. This concept is covered in the PACS usage video.

8. MRI safety training (ACR Building Blocks) is critical because MRI uses which physical principle that poses unique safety risks?

- A) Ionizing radiation like X-rays
- B) A powerful magnetic field that can attract ferromagnetic objects at high velocity
- C) Radioactive isotopes
- D) Ultrasound waves at high frequency

Answer: B — A powerful magnetic field that can attract ferromagnetic objects

Explanation: MRI uses a strong magnetic field (not ionizing radiation). Ferromagnetic objects become dangerous projectiles ('missile effect') in the MRI environment. Patients with certain implants (pacemakers, cochlear implants) may be contraindicated.

9. Which of the following best describes the difference between ionizing and non-ionizing radiation in the context of medical imaging?

- A) MRI and CT both use ionizing radiation
- B) Ultrasound uses ionizing radiation; MRI does not
- C) X-rays and CT use ionizing radiation; MRI and ultrasound use non-ionizing forms of energy
- D) All medical imaging modalities use ionizing radiation

Answer: C — X-rays and CT use ionizing radiation; MRI and ultrasound do not

Explanation: X-ray, CT, fluoroscopy, and nuclear medicine use ionizing radiation. MRI uses radiofrequency pulses in a magnetic field, and ultrasound uses sound waves — both are non-ionizing and carry no known ionizing radiation risks.

10. When a physician orders imaging, what is the primary principle guiding appropriate utilization?

- A) The cheapest study should always be ordered first
- B) The study must change management or provide diagnostic benefit that outweighs its risks/costs
- C) MRI is always preferred over CT
- D) Patient preference alone determines the study

Answer: B — The imaging study must change management or provide information that outweighs the risk

Explanation: Appropriate use criteria (promoted by the ACR) ensure imaging is indicated, will influence clinical decisions, and the benefit outweighs potential harms (radiation, contrast risk, cost). This is foundational to ordering imaging responsibly.

11. The UBC Radiology App's 'Approach for CXR' module teaches students a systematic method for reading chest X-rays. Why is a systematic approach emphasized?

- A) To make reading faster regardless of thoroughness
- B) To match the radiologist's order of dictation
- C) Because regulations require a specific order
- D) To ensure no finding is missed by reviewing all anatomic regions in a consistent order

Answer: D — To ensure no finding is missed by reviewing all anatomic regions in a consistent order

Explanation: Systematic approaches (e.g., ABCs: Airway, Breathing, Circulation, Soft tissues, or ABCDE for MSK) ensure complete review and reduce errors of omission — a universal principle in radiograph interpretation.

MODULE 2: Chest Radiology

1. On a chest X-ray, which of the following findings most reliably indicates an adequate inspiratory effort?

- A) The clavicles appear horizontal
- B) Visualization of 8–10 posterior ribs above the diaphragm
- C) The trachea is midline
- D) The heart is not enlarged

Answer: B — Visualization of 10 posterior ribs above the diaphragm

Explanation: A properly inspired CXR should show 8–10 posterior rib spaces visible above the hemidiaphragm. Poor inspiration causes apparent cardiomegaly and basilar crowding, mimicking pathology. This is covered in learningradiology.com's 'Recognizing an Adequate Chest X-ray' module.

2. Cardiomegaly on a PA chest X-ray is defined as:

- A) Cardiac silhouette touching both pleural surfaces
- B) Heart diameter greater than 15 cm
- C) Cardiothoracic ratio greater than 0.5 on a PA film
- D) Visible pulmonary arteries beyond the hilum

Answer: C — Cardiothoracic ratio greater than 0.5 on a PA film

Explanation: On a properly performed PA CXR, the cardiac width should not exceed 50% of the thoracic width. A CTR > 0.5 suggests cardiomegaly, which may indicate heart failure, pericardial effusion, or cardiomyopathy. On AP films (e.g., portable), the heart appears magnified due to increased distance between the heart to the X ray detector.

3. A patient presents with acute dyspnea. CXR shows unilateral complete opacification of one hemithorax with contralateral mediastinal shift. What is the most likely diagnosis?

- A) Pneumothorax
- B) Large pleural effusion with mass effect
- C) Lobar pneumonia
- D) Lung collapse (atelectasis)

Answer: B — Large pleural effusion

Explanation: An opacified hemithorax with contralateral mediastinal shift indicates a space-occupying process pushing the mediastinum away — most often a massive pleural effusion. Collapse (atelectasis) would pull the mediastinum toward the opacification. Pneumothorax appears as a lucent area with absent lung markings.

4. Which of the following CXR findings is most characteristic of congestive heart failure (CHF)?

- A) Unilateral consolidation with air bronchograms
- B) Hyperinflation with flattened diaphragms
- C) Pleural-based opacity with meniscus sign (unilateral)
- D) Cardiomegaly, cephalization of pulmonary vessels, Kerley B lines, and bilateral pleural effusions

Answer: D — Cardiomegaly, vascular redistribution (cephalization), Kerley B lines, and bilateral pleural effusions

Explanation: The ABCs of CHF on CXR include: Alveolar edema (bat-wing pattern), B-lines (Kerley B lines), Cardiomegaly, Dilated vessels/vascular redistribution (cephalization), and Effusions (bilateral). This classic pattern reflects elevated pulmonary venous pressure.

5. What distinguishes airspace (alveolar) disease from interstitial disease on a chest X-ray?

- A) Airspace disease is always unilateral; interstitial is bilateral
- B) Only interstitial disease causes pleural effusions
- C) Airspace disease produces fluffy/cotton-ball opacities with air bronchograms; interstitial disease produces reticular, nodular, or reticulonodular patterns
- D) They are indistinguishable on plain film

Answer: C — Airspace disease is fluffy with air bronchograms; interstitial disease shows reticular/nodular patterns

Explanation: Airspace disease replaces air in alveoli with fluid/pus/blood, creating fluffy opacities; air bronchograms (air-filled bronchi outlined by surrounding opacity) are hallmark signs. Interstitial disease thickens the supporting framework, creating linear, reticular, or nodular patterns.

6. A tall, thin 22-year-old male presents with sudden onset right-sided chest pain and dyspnea. CXR shows a thin pleural line with absence of lung markings beyond it. What is the diagnosis?

- A) Spontaneous pneumothorax
- B) Pneumomediastinum
- C) Pulmonary embolism
- D) Rib fracture

Answer: A — Spontaneous pneumothorax

Explanation: A pneumothorax appears as a visible visceral pleural line with absent lung markings lateral to it (the 'lung edge'). Spontaneous pneumothorax classically affects tall, thin young men due to rupture of apical blebs. In a tension PTX, contralateral mediastinal shift and tracheal deviation occur.

7. On a CXR, the right paratracheal stripe, aortopulmonary window, and subcarinal angle are all part of which structure's evaluation?

- A) Pleural space
- B) Lung parenchyma
- C) Mediastinum
- D) Bony thorax

Answer: C — Mediastinum

Explanation: These are landmarks used to evaluate the mediastinum on a CXR. Widening of the mediastinum (>8 cm on PA film) raises concern for aortic dissection, lymphadenopathy, or mediastinal masses.

8. An ICU patient has a CXR obtained after central venous catheter (CVC) placement. The tip of the catheter is projected over the right atrium. What is the appropriate action?

- A) No action needed; the right atrium is ideal
- B) Advance the catheter further
- C) Pull back the catheter — the tip should be in the distal SVC above the cavoatrial junction
- D) Obtain a CT scan immediately

Answer: C — Pull back the catheter — the tip should be in the distal SVC above the cavoatrial junction

Explanation: CVC tips should rest in the distal SVC or cavoatrial junction. Placement in the right atrium risks arrhythmias and myocardial perforation. Reviewing ICU lines/tubes is a key skill covered in the learningradiology.com module.

9. Which CXR finding best represents 'Kerley B lines' in congestive heart failure?

- A) Vertical lines in the lung apex
- B) Short horizontal lines (<2 cm) at the lung periphery perpendicular to the pleural surface
- C) Circular opacities in the lower lobes
- D) Thickening of the major fissures

Answer: B — Short horizontal lines at the lung periphery extending to the pleural surface

Explanation: Kerley B lines are 1–2 cm horizontal lines at the lung bases, perpendicular to and touching the pleural surface. They represent fluid-distended interlobular septa and indicate elevated pulmonary venous pressure (interstitial edema), classically seen in CHF.

11. What is the significance of an 'air bronchogram' sign on CXR?

- A) It indicates pleural effusion
- B) It confirms a tension pneumothorax
- C) It indicates airspace disease surrounding patent, air-filled airways
- D) It is seen only in lung cancer

Answer: C — It indicates airspace (alveolar) disease surrounding patent airways, confirming the opacity is in the lung parenchyma

Explanation: Air bronchograms appear when alveoli fill with fluid (pneumonia, pulmonary edema, hemorrhage) while the bronchi remain air-filled. They exclude pleural effusion and atelectasis from the differential and confirm parenchymal involvement.

12. On a PA chest X-ray, which side is the diaphragm normally higher, and why?

- A) Right hemidiaphragm, because the liver sits beneath it
- B) Left hemidiaphragm, because the heart is on the left
- C) They are always at the same level
- D) Left hemidiaphragm, because the stomach pushes it up

Answer: A — Right hemidiaphragm, because the liver is below it

Explanation: The right hemidiaphragm is normally 1.5–2.5 cm higher than the left due to the underlying liver. The left side is depressed by the gastric air bubble and cardiac weight. Deviation from this rule may indicate subphrenic pathology, sinus inversus, or phrenic nerve palsy.

13. A patient's CXR shows a unilateral homogeneous opacity in the lower lung zone that obscures the diaphragm with a concave upper border (meniscus sign). What is this most likely?

- A) Lobar pneumonia
- B) Pleural effusion
- C) Pulmonary embolism
- D) Pneumothorax

Answer: B — Pleural effusion

Explanation: The meniscus (or meniscal) sign — a concave upper border of an opacity at the lung base — is the classic appearance of a free pleural effusion. Gravity causes fluid to layer posteriorly and laterally, blunting the costophrenic angle.

14. Which of the following findings on CXR most suggests a right upper lobe pneumonia specifically?

- A) Blunting of the right costophrenic angle
- B) Right lower zone opacity with air bronchograms
- C) Right upper zone consolidation with a sharp lower border at the minor fissure
- D) Left-sided opacity with contralateral tracheal shift

Answer: C — Consolidation in the right upper zone with a sharp lower border at the minor fissure

Explanation: Lobar pneumonias conform to lobar anatomy. RUL pneumonia fills the right upper lobe and is bounded inferiorly by the minor (horizontal) fissure, creating a sharp inferior border. This lobar distribution helps differentiate pneumonia from other causes of consolidation.

15. When reviewing an ICU portable AP CXR, which endotracheal tube (ETT) tip position is considered appropriate?

- A) At the level of the vocal cords
- B) 3–5 cm above the carina, with the neck in neutral position
- C) In the right mainstem bronchus
- D) At the thoracic inlet

Answer: B — 3–5 cm above the carina, with the neck in neutral position

Explanation: The ETT tip should ideally be 3–5 cm above the carina (approximately at the T2–T4 level) to prevent right mainstem intubation or accidental extubation. Neck flexion lowers the tube; extension raises it. Right mainstem placement causes left lung collapse.

MODULE 3: Body Imaging

1. On an abdominal X-ray (KUB), which of the following best distinguishes small bowel obstruction from large bowel obstruction?

- A) Small bowel obstruction shows gas in the rectum; large bowel does not
- B) Small bowel loops are central with thin folds (valvulae conniventes) crossing the full width; large bowel is peripheral with haustra crossing partial width
- C) They are indistinguishable on plain film
- D) Large bowel obstruction causes more severe pain

Answer: B — Small bowel: central loops with valvulae conniventes spanning the full width; large bowel: peripheral with haustra spanning partial width

Explanation: Valvulae conniventes (plicae circulares) are circumferential folds in the small bowel that cross the full lumen width. Haustral folds in the large bowel are thicker and do not cross the full width. In SBO, dilated small bowel (>3 cm) is central; in LBO, dilated colon (>6 cm; cecum >9 cm) is peripheral.

2. Free air (pneumoperitoneum) on an upright CXR appears as:

- A) Lucent (dark) crescents beneath the hemidiaphragms
- B) Air-fluid levels in the bowel
- C) Calcifications in the right upper quadrant
- D) A distended loop of bowel

Answer: A — Lucent crescents beneath the diaphragm

Explanation: Free intraperitoneal air rises to the highest point under the diaphragm on an upright film, appearing as a dark (lucent) crescent beneath the right or left hemidiaphragm. Even a small amount (<1 cc) can be visible. This indicates perforation of a hollow viscus until proven otherwise.

3. On abdominal CT, what does the term 'retroperitoneal' mean, and which organs are retroperitoneal?

- A) Within the peritoneal cavity; includes the liver and stomach
- B) Below the peritoneum; includes the bladder only
- C) Posterior to the peritoneum; includes the kidneys, adrenal glands, aorta, IVC, pancreas, and retroperitoneal duodenum/colon
- D) Anterior to the peritoneum; includes the small bowel mesentery

Answer: C — Behind the peritoneum; kidneys, adrenals, aorta, IVC, pancreas (mostly), and portions of the duodenum/colon

Explanation: Retroperitoneal organs are mnemonic SAD PUCKER: Suprarenal (adrenal) glands, Aorta/IVC, Duodenum (2nd–4th parts), Pancreas, Ureters, Colon (ascending/descending), Kidneys, Esophagus (abdominal), Rectum. These structures do not have a mesentery and are fixed posteriorly.

4. When reviewing a CT of the abdomen/pelvis and windowing to find the appendix, in which of the three standard CT planes might you look for it?

- A) Axial plane only
- B) Sagittal plane only
- C) Coronal plane only
- D) All three: axial, sagittal, and coronal planes

Answer: D — Axial, sagittal, and coronal planes

Explanation: Modern CT workstations display multiplanar reformats (MPR) in axial, sagittal, and coronal planes. The appendix is best localized by tracing the cecum in all three planes, as it can point in any direction. Radiopaedia.org's annotated teaching case demonstrates this three-plane search approach.

5. Which of the following abnormal calcifications on abdominal KUB is considered a normal variant and requires no further workup?

- A) Nephrolithiasis
- B) Phleboliths (small oval pelvic calcifications with a radiolucent center)
- C) Gallstones
- D) Abdominal aortic aneurysm calcification

Answer: B — Phleboliths (small oval calcifications with a lucent center in the pelvis)

Explanation: Phleboliths are calcified thrombi in pelvic veins, common incidental findings. They are distinguished from ureteral stones by their lucent center and pelvic location (not along the ureter course). Nephrolithiasis, gallstones, and aortic calcification are pathologically significant.

6. A patient presents with acute right lower quadrant pain. CT shows a tubular blind-ending structure arising from the cecum measuring 12 mm in diameter with surrounding fat stranding and a calcified appendicolith. What is the diagnosis?

- A) Normal appendix
- B) Crohn's disease
- C) Acute appendicitis
- D) Ovarian cyst

Answer: C — Acute appendicitis

Explanation: CT findings of acute appendicitis include: appendix diameter >6 mm, wall thickening, periappendiceal fat stranding (inflammation), possible appendicolith, and possible perforation (free air/fluid). This is one of the most common emergency abdominal CT indications.

7. On CT of the abdomen, the 'triple-contrast' technique may use oral contrast, IV contrast, and rectal contrast. What is the primary purpose of oral contrast?

- A) To opacify the bowel lumen, distinguishing bowel from lymph nodes, mesentery, and soft tissue masses
- B) To evaluate the liver vascularity
- C) To assess renal function
- D) To prevent artifact from bowel gas

Answer: A — To opacify the bowel lumen and distinguish bowel loops from other structures

Explanation: Oral contrast (positive = barium/iodine, or negative = water) fills the GI lumen, allowing radiologists to distinguish bowel from adjacent structures like lymph nodes, fluid collections, or masses. IV contrast evaluates organ and vascular enhancement.

8. Which of the following is the best initial imaging study for suspected acute appendicitis in a young adult (non-pregnant)?

- A) MRI of the abdomen
- B) Plain abdominal radiograph
- C) CT of the abdomen and pelvis with IV contrast
- D) Upper GI series

Answer: C — CT of the abdomen and pelvis with IV contrast

Explanation: CT is the gold standard for acute appendicitis in adults due to its high sensitivity (>90%) and specificity, speed, and ability to identify complications and alternative diagnoses. MRI is preferred in pregnant women and children to avoid radiation. Ultrasound is used first in children.

9. On an abdominal CT using a standard protocol with IV contrast, the 'portal venous phase' (approximately 70–80 seconds after injection) best evaluates which structures?

- A) Arterial structures and highly vascular tumors (arterial phase)
- B) Liver parenchyma, portal vein, spleen, and most solid abdominal organs
- C) Urinary collecting system (delayed/urographic phase)
- D) Pancreatic duct anatomy

Answer: B — Liver parenchyma, portal vein, and solid abdominal organs

Explanation: The portal venous phase (~70–80s) provides optimal enhancement of the liver (most liver metastases are hypovascular and most visible at this phase), spleen, bowel wall, and other abdominal organs. Arterial phase (~25–35s) is best for hypervascular tumors (HCC, carcinoid) and arteries.

10. What is 'gallstone ileus,' and which CT findings would you expect?

- A) Obstruction of the cystic duct by a gallstone, causing cholecystitis
- B) Paralytic ileus caused by gallstone pancreatitis
- C) Colonic pseudo-obstruction related to cholelithiasis
- D) Mechanical SBO caused by a large gallstone eroding through the gallbladder wall; CT shows Rigler's triad: pneumobilia, SBO, and ectopic gallstone

Answer: D — Mechanical small bowel obstruction caused by a large gallstone that has eroded through the gallbladder wall; CT shows pneumobilia, SBO, and an ectopic gallstone

Explanation: Gallstone ileus (Rigler's triad): air in the biliary tree (pneumobilia from biliary-enteric fistula), small bowel obstruction, and an ectopic gallstone (usually >2.5 cm) lodged in the distal ileum. This was one of the 'Acute GI' cases featured on learnabdominal.com.

11. On CT windowing, which window setting would best evaluate for subtle intrabdominal free air?

- A) Bone window
- B) Lung/air window (wide width, low level, e.g., W:1500, L:-500)
- C) Soft tissue window
- D) Liver window

Answer: B — Lung/air window settings (wide width, low level)

Explanation: Free air has HU near -1000 (similar to air). Soft tissue windows miss small amounts of free air. Using lung window settings dramatically improves sensitivity for pneumoperitoneum by expanding the visible HU range to include air-density structures.

12. A CT scan shows 'fat stranding' adjacent to the pancreas along with a dilated pancreatic duct and peripancreatic fluid. What is the most likely diagnosis?

- A) Pancreatic adenocarcinoma
- B) Splenic infarct
- C) Acute pancreatitis
- D) Hepatocellular carcinoma

Answer: C — Acute pancreatitis

Explanation: Acute pancreatitis on CT: pancreatic enlargement, peripancreatic fat stranding (inflammatory changes in the retroperitoneal fat), and fluid collections. Severe pancreatitis shows pancreatic necrosis (non-enhancing areas). CT severity index correlates with morbidity.

13. Which of the following is the most common cause of small bowel obstruction in adults?

- A) Adhesions from prior abdominal surgery

- B) Crohn's disease
- C) Hernia (without prior surgery)
- D) Gallstone ileus

Answer: A — Adhesions from prior abdominal surgery

Explanation: Post-surgical adhesions account for approximately 60–70% of small bowel obstructions in adults. Hernias are the second most common cause. In patients without prior surgery, hernia should be the leading consideration.

14. Which of the following is an example of a retroperitoneal structure that can present as a 'soft tissue mass' on plain abdominal film?

- A) Sigmoid volvulus
- B) Cholecystitis
- C) Appendicitis
- D) Abdominal aortic aneurysm (AAA)

Answer: D — Abdominal aortic aneurysm (AAA)

Explanation: An AAA may be visible on plain KUB as a soft tissue mass with curvilinear calcification in the aortic wall. However, CT is the definitive diagnostic tool for sizing and surgical planning. Rupture is life-threatening and requires emergency CT angiography.

MODULE 4: Ultrasound

1. Ultrasound uses sound waves to generate images. Which of the following best describes the principle of 'echogenicity'?

- A) The depth of a structure below the skin surface
- B) The relative brightness of a structure based on how much ultrasound it reflects
- C) The frequency of the ultrasound probe
- D) The amount of radiation emitted by the structure

Answer: B — The relative brightness of a structure based on how much sound it reflects back to the transducer

Explanation: Echogenicity refers to the ability of a structure to reflect ultrasound waves. Hyperechoic = brighter than surrounding tissue (e.g., gallstones, fat); hypoechoic = darker; anechoic = no internal echoes (e.g., fluid, simple cysts). This concept is central to the ACR Building Blocks Introduction to Abdominal Ultrasound.

2. Which ultrasound finding is most characteristic of a simple benign cyst?

- A) Internal echoes with irregular thick walls
- B) Hyperechoic with posterior shadowing
- C) Anechoic interior, thin smooth walls, and posterior acoustic enhancement
- D) Heterogeneous echogenicity with calcifications

Answer: C — Anechoic (no internal echoes), thin smooth walls, and posterior acoustic enhancement

Explanation: Simple cysts are anechoic (fluid has no internal echoes), have thin smooth walls, and show posterior acoustic enhancement (increased through-transmission behind the fluid). These features reliably indicate benignity. Complex cysts with internal echoes, septations, or thick walls require further evaluation.

3. On scrotal ultrasound, testicular torsion is a surgical emergency. Which Doppler finding is most consistent with torsion?

- A) Absent or markedly reduced intratesticular blood flow
- B) Increased bilateral blood flow
- C) Normal blood flow with a hypoechoic epididymis
- D) Hyperechoic testis with normal flow

Answer: A — Absent or markedly reduced blood flow to the affected testis on color Doppler

Explanation: Testicular torsion results from twisting of the spermatic cord, compromising arterial inflow. Color Doppler demonstrates absent or decreased blood flow to the affected testis compared to the contralateral side. Epididymo-orchitis, in contrast, shows increased flow. **4. In the evaluation of a female patient with acute pelvic pain, which ultrasound finding is most concerning for ovarian torsion?**

- A) Small ovary with normal Doppler flow
- B) Follicular cyst < 3 cm with normal flow
- C) Free fluid in the pelvis only
- D) Enlarged ovary (>5 cm), peripheral follicles, and absent/diminished Doppler flow

Answer: D — Enlarged ovary (>5 cm) with absent or diminished Doppler flow and peripheral follicles

Explanation: Ovarian torsion classically presents with a large ovary (often due to an underlying mass), peripheral displaced follicles (a 'string of pearls' appearance), and diminished or absent Doppler flow. Normal flow does not exclude torsion (intermittent torsion).

5. Which of the following best describes 'posterior acoustic shadowing' on ultrasound, and when is it seen?

- A) Increased brightness behind a fluid-filled structure
- B) A dark shadow deep to a highly reflective or absorbing object
- C) Echogenic foci within a cystic lesion
- D) Reverberations artifact from bowel gas

Answer: B — A dark shadow deep to a highly reflective or absorbing structure; seen with gallstones, renal calculi, and calcifications

Explanation: Posterior acoustic shadowing occurs when a structure strongly reflects or absorbs ultrasound, preventing transmission to deeper tissues. Classic examples: gallstones (acoustic shadowing + echogenic focus + wall-echo-shadow sign), renal calculi, and calcifications.

6. What is the primary advantage of ultrasound over CT for initial evaluation of the biliary system?

- A) Better soft tissue contrast than CT
- B) Ability to evaluate retroperitoneal structures better
- C) No ionizing radiation, real-time capability, and high sensitivity for gallstones and biliary dilation
- D) Superior evaluation of the pancreatic parenchyma

Answer: C — No ionizing radiation, real-time imaging, and high sensitivity for gallstones and bile duct dilation

Explanation: Ultrasound is the first-line study for suspected biliary disease (cholecystitis, cholelithiasis, biliary obstruction) due to: no radiation, high sensitivity for gallstones (~95%), real-time capability, portability, and low cost. CT is better for complications (perforation, abscess).

7. On a renal ultrasound, which finding suggests hydronephrosis?

- A) An echogenic focus with shadowing in the cortex
- B) Anechoic dilation of the renal pelvis and calyces
- C) Cortical thinning without collecting system changes
- D) Increased echogenicity of the renal cortex

Answer: B — Anechoic (fluid-filled) dilation of the renal collecting system (pelvis and/or calyces)

Explanation: Hydronephrosis appears as anechoic (fluid) distension of the renal pelvis and/or calyces on ultrasound. Grading ranges from mild (only pelvis dilated) to severe (paper-thin cortex). It indicates obstruction (stone, stricture, mass, or external compression) until proven otherwise.

8. Which ultrasound probe type (transducer) is most appropriate for abdominal imaging of the liver, kidneys, and gallbladder?

- A) Curved array (curvilinear) low-frequency probe (2–5 MHz)
- B) High-frequency linear probe (7–15 MHz)
- C) Phased array cardiac probe
- D) Endovaginal high-frequency probe

Answer: A — Curved array (curvilinear) low-frequency probe (2–5 MHz)

Explanation: Low-frequency curved probes (2–5 MHz) penetrate deeply to reach abdominal organs but with lower resolution. High-frequency linear probes (7–15 MHz) have better resolution but limited depth — ideal for superficial structures (thyroid, breast, MSK). Phased array probes are used for echocardiography.

9. In the evaluation of suspected acute cholecystitis on ultrasound, which finding is most diagnostic?

- A) Gallstones alone
- B) Pericholecystic fluid alone
- C) Gallbladder wall thickening alone
- D) Gallstones + gallbladder wall thickening (>3 mm) + pericholecystic fluid + positive sonographic Murphy's sign

Answer: D — Gallstones + gallbladder wall thickening (>3 mm) + pericholecystic fluid + sonographic Murphy's sign

Explanation: Acute cholecystitis on ultrasound: gallstones (in >90%), wall thickening >3 mm, pericholecystic fluid, and the sonographic Murphy's sign (maximum tenderness with probe pressure directly over the visualized gallbladder). This combination has high specificity for acute cholecystitis.

10. Obstetric ultrasound in the first trimester is used for which of the following primary purposes?

- A) Determining fetal sex
- B) Evaluating placenta previa
- C) Confirming intrauterine pregnancy, establishing gestational age, and detecting early complications (ectopic pregnancy, miscarriage)
- D) Assessing fetal lung maturity

Answer: C — Confirming intrauterine pregnancy, establishing gestational age, and detecting early complications (ectopic pregnancy, miscarriage)

Explanation: First-trimester US: confirms IUP (to exclude ectopic), measures crown-rump length (CRL) for gestational age, evaluates fetal number and chorionicity, and screens for aneuploidy (nuchal translucency).

11. On gastrointestinal ultrasound, a 'target sign' (hypoechoic ring with central echogenicity) in a child's abdomen is most suggestive of:

- A) Appendicitis
- B) Intussusception
- C) Pyloric stenosis
- D) Mesenteric adenitis

Answer: B — Intussusception

Explanation: The target sign (also called 'donut sign') on transverse ultrasound represents bowel-within-bowel: the intussusceptum (inner bowel) invaginates into the intussusciens (outer bowel), creating concentric hypo- and hyperechoic rings. Covered in the GI MS Ultrasound Video.

12. The ACR Building Blocks module on Abdominal Ultrasound emphasizes that ultrasound is operator-dependent. What does this mean in clinical practice?

- A) Only radiologists can perform ultrasound
- B) Results vary by machine brand only
- C) Image quality and diagnostic accuracy depend significantly on the operator's skill, technique, and clinical knowledge
- D) Patients must be sedated for adequate studies

Answer: C — Image quality and diagnostic accuracy depend heavily on the skill, technique, and experience of the person performing the scan

Explanation: Unlike CT or MRI where images are standardized, ultrasound quality depends on probe selection, patient positioning, breathing instructions, scanning angle, pressure, and the operator's ability to recognize artifacts vs. pathology in real time.

13. Which of the following is NOT a typical ultrasound finding in cholelithiasis?

- A) Echogenic foci (stones) in the gallbladder lumen
- B) Posterior acoustic shadowing behind the stones
- C) Stone mobility with patient repositioning
- D) Dilated common bile duct (>6 mm)

Answer: D — Dilated common bile duct (>6 mm)

Explanation: Simple cholelithiasis (stones in the gallbladder without obstruction) shows echogenic stones with posterior shadowing that shift with patient position. A dilated CBD (>6 mm) suggests choledocholithiasis (stone in the common duct) or biliary obstruction — a separate, more serious finding.

14. What does 'Doppler ultrasound' add to standard grayscale (B-mode) imaging?

- A) Better depth penetration
- B) Information about blood flow direction and velocity within vessels and organs
- C) Elimination of bowel gas artifact
- D) The ability to measure Hounsfield Units

Answer: B — Information about blood flow direction and velocity

Explanation: Doppler ultrasound detects the frequency shift of sound waves reflected by moving red blood cells. Color Doppler shows flow direction (by convention, red toward/blue away from transducer). Spectral/pulsed Doppler quantifies velocity — critical for evaluating portal hypertension, vascular stenosis, and torsion.

15. Which of the following structures is typically NOT well-visualized on standard transabdominal ultrasound due to bowel gas interference?

- A) Gallbladder
- B) Right kidney
- C) Distal ureters
- D) Liver

Answer: C — Distal ureters and mid-retroperitoneum

Explanation: Bowel gas is a major limitation of abdominal ultrasound — gas reflects all sound waves, creating 'dirty shadowing' that obscures structures behind bowel. This is why the pancreas is often partially obscured, and the retroperitoneum (including distal ureters) is better evaluated by CT.

MODULE 5: Musculoskeletal Radiology

1. The ABCDE approach to musculoskeletal radiograph interpretation stands for which categories?

- A) Anatomy, Breaks, Calcification, Density, Effusion
- B) Alignment, Bone density, Cartilage/joint spaces, Soft tissue Disturbances, Extras
- C) Arteries, Bones, Cortex, Density, Edges
- D) Assessment, Borders, Calcification, Deformity, Enhancement

Answer: B — Alignment, Bone density, Cartilage/joint space, Disturbances (soft tissues), Extras (specific features)

Explanation: The ABCDE mnemonic from Radiopaedia ensures systematic MSK radiograph review: Alignment (fractures, dislocations), Bone density (osteoporosis, sclerosis), Cartilage/joint space (arthritis), soft tissue Disturbances (swelling, calcification), and Extras (specific findings per joint). This prevents errors of omission.

2. On a plain radiograph, which of the following fracture patterns is most consistent with a pathologic fracture (fracture through abnormal bone)?

- A) Transverse fracture of the femur shaft from a high-speed MVA
- B) Greenstick fracture in a child
- C) Fracture with minimal trauma, surrounding lytic/sclerotic lesion, and cortical destruction
- D) Stress fracture with periosteal reaction in an athlete

Answer: C — Fracture with minimal trauma history, surrounding lytic or sclerotic lesion, and cortical destruction

Explanation: A pathologic fracture occurs through bone weakened by underlying disease (metastasis, multiple myeloma, primary bone tumor, Paget's disease). Clues include: minimal or trivial trauma, an associated bone lesion, cortical destruction, and age or clinical context inconsistent with normal fractures.

3. On knee MRI, the anterior cruciate ligament (ACL) normally appears as:

- A) A low signal (dark) band from the posterior lateral femoral condyle to the anterior tibial eminence
- B) A bright (T2 hyperintense) structure in the intercondylar notch
- C) A structure with no visible signal on T1 or T2
- D) A horizontal structure connecting the medial and lateral menisci

Answer: A — A band of low signal intensity (dark) coursing from the posterior lateral femoral condyle to the anterior tibial eminence

Explanation: On MRI, the normal ACL appears as a dark (low-signal) band of tightly packed collagen fibers on both T1 and T2 sequences. ACL tears show: increased T2 signal (edema), disrupted fibers, abnormal orientation, or absence of the ligament. Reviewed in the 'Systematic Interpretation of Knee MRI' video.

4. In osteoporosis, which radiographic finding indicates significant loss of bone density?

- A) Dense sclerotic bone with periosteal reaction
- B) Cortical thinning, accentuated vertical trabeculae, and vertebral compression (wedge or biconcave) fractures
- C) Lytic lesions with a sclerotic rim
- D) Periarticular osteopenia only

Answer: B — Cortical thinning, accentuated vertical trabeculae, and vertebral compression fractures

Explanation: Osteoporosis on radiograph (which requires ~30–40% bone density loss before visible): decreased trabecular pattern with prominent vertically-oriented trabeculae (horizontal trabeculae resorb first), cortical thinning, and ultimately vertebral compression fractures (wedge, biconcave, or 'codfish' vertebrae).

5. Which of the following best describes the radiographic difference between osteoarthritis (OA) and rheumatoid arthritis (RA) on joint radiographs?

- A) OA causes erosions; RA causes osteophytes
- B) They are indistinguishable on plain film
- C) RA preferentially affects the DIP joints; OA affects the MCP joints
- D) OA: asymmetric, large/weight-bearing joints, osteophytes, subchondral sclerosis; RA: symmetric, small joint erosions, periarticular osteopenia

Answer: D — OA: asymmetric, weight-bearing joint involvement, osteophytes, subchondral sclerosis; RA: symmetric, small joint involvement, periarticular erosions, periarticular osteopenia

Explanation: OA is a degenerative 'wear and tear' disease affecting weight-bearing joints (knees, hips, spine) asymmetrically, with joint space narrowing, subchondral sclerosis, and osteophytes. RA is an inflammatory synovitis affecting small joints symmetrically (MCPs, PIPs) with erosions, periarticular osteopenia, and no osteophytes.

6. A Colles' fracture is a common wrist fracture that occurs after a fall on an outstretched hand. Which of the following best describes this fracture?

- A) Fracture of the ulnar styloid only
- B) Fracture of the scaphoid
- C) Transverse distal radius fracture with dorsal angulation/displacement ('dinner fork deformity')
- D) Fracture through the radial neck

Answer: C — Transverse fracture of the distal radius with dorsal (posterior) angulation and displacement

Explanation: A Colles' fracture is a distal radius fracture (within 2 cm of the articular surface) with dorsal tilt and displacement, creating the classic 'dinner fork' deformity on lateral wrist radiograph. It is the most common wrist fracture in older adults. A Smith fracture has volar angulation.

7. On a knee MRI, a meniscal tear is suspected when:

- A) The meniscus appears uniformly dark on all sequences
- B) There is increased T2/PD signal within the meniscus that extends to at least one articular surface
- C) The meniscus has slightly increased signal on T1 but not T2
- D) The meniscus is slightly smaller than the contralateral side

Answer: B — There is increased T2 signal within the meniscus that extends to an articular surface

Explanation: Meniscal tears on MRI (proton density or T2-weighted): Grade 1/2 = increased signal not reaching articular surface (degeneration, not a tear); Grade 3 = signal reaching an articular surface = true tear. Morphologic changes (displaced fragment, abnormal shape) further confirm tears.

8. Which imaging modality is most sensitive for detecting stress fractures, particularly before they are visible on plain radiograph?

- A) Plain radiograph
- B) CT
- C) MRI
- D) Ultrasound

Answer: C — MRI

Explanation: Stress fractures may not be visible on radiograph for 2–3 weeks. MRI detects the bone marrow edema pattern (T2/STIR hyperintensity) and cortical changes days after injury onset. Bone scan is also highly sensitive but less specific. CT shows cortical defects but misses early marrow edema.

9. In the Radiology Masterclass trauma tutorials, the 'Ottawa Ankle Rules' help determine when ankle radiographs are indicated. Which of the following does NOT meet the Ottawa criteria for obtaining ankle X-rays?

- A) Bony tenderness at the posterior tip or inferior 6 cm of the fibula
- B) Bony tenderness at the posterior tip or inferior 6 cm of the tibia
- C) Inability to bear weight both immediately and in the ED (4 steps)
- D) Isolated soft tissue swelling without bony point tenderness and ability to bear weight (4 steps)

Answer: D — Isolated soft tissue swelling with no bony tenderness and ability to bear weight

Explanation: Ottawa Ankle Rules: X-ray is indicated if there is bone tenderness at the posterior fibula or tibia (distal 6 cm) OR inability to bear weight (4 steps) immediately and in the ED. Soft tissue swelling without bony tenderness and retained weight-bearing does NOT require radiographs, reducing unnecessary imaging.

10. Which of the following MSK conditions is most classically associated with a 'lytic lesion with a narrow zone of transition and sclerotic rim' in a young adult?

- A) Osteosarcoma
- B) Non-ossifying fibroma (benign fibrous cortical defect)
- C) Ewing sarcoma
- D) Metastatic carcinoma

Answer: B — Non-ossifying fibroma (benign fibrous cortical defect)

Explanation: Non-ossifying fibromas are common benign incidental lesions in children/adolescents: cortically-based lytic lesion with a well-defined sclerotic ('narrow zone of transition') rim, no periosteal reaction, and no soft tissue mass. Narrow zone of transition = well-defined = favor benign. Wide/permeative = aggressive = malignant.

11. A 72-year-old man presents with back pain. Lumbar spine MRI shows a vertebral body with decreased T1 signal (dark), increased T2/STIR signal (bright), and loss of height compared to adjacent levels. What is the most likely diagnosis?

- A) Disc herniation
- B) Degenerative disc disease
- C) Acute vertebral compression fracture with bone marrow edema
- D) Schmorl's node

Answer: C — Acute vertebral compression fracture with bone marrow edema (likely osteoporotic or pathologic)

Explanation: Acute vertebral fractures on MRI: low T1 signal (edema replaces normal yellow marrow fat), high T2/STIR signal, and loss of vertebral height. Chronic fractures return to normal fat signal. Distinguishing benign (osteoporotic) from malignant fractures requires additional MRI features (convex posterior cortex, pedicle involvement, soft tissue mass = malignant).

12. On MSK radiographs, periosteal reaction (new bone formation along the cortex) has different patterns. Which pattern is most associated with aggressive/malignant processes?

- A) Solid, well-defined periosteal reaction
- B) Undulating periosteal reaction
- C) Parallel periosteal reaction adjacent to a healing fracture

D) Sunburst pattern or interrupted lamellated ('onion skin') periosteal reaction

Answer: D — 'Sunburst' or lamellated/'onion skin' periosteal reaction

Explanation: Solid/dense periosteal reaction = benign, chronic. Sunburst periosteal reaction (spiculated, radiating outward) and aggressive lamellated ('onion skin') patterns with interruption = highly suspicious for malignancy. The Codman triangle (elevated periosteum forming a triangle at tumor margins) also suggests malignancy.

13. During the UBC MSK Clinical Case review (cases 1, 6, 8, 12, etc.), you encounter a hip radiograph in an elderly woman post-fall with shortening and external rotation of the leg. Which fracture location should you specifically evaluate?

- A) Femoral shaft
- B) Femoral neck (intracapsular) or intertrochanteric region
- C) Acetabulum
- D) Tibial plateau

Answer: B — Femoral neck (intracapsular) or intertrochanteric region

Explanation: Hip fractures in elderly patients (typically osteoporotic women) occur at the femoral neck or intertrochanteric region. Clinical signs: shortened, externally rotated leg. Femoral neck fractures risk avascular necrosis of the femoral head. Radiographs (AP and frog-leg lateral) may miss impacted fractures, requiring MRI.

14. The 'Systematic Interpretation of Knee MRI' video emphasizes evaluating all structures in a standard order. Which of the following structures is NOT routinely evaluated on a knee MRI?

- A) ACL and PCL
- B) Medial and lateral menisci
- C) Articular cartilage and subchondral bone
- D) Sciatic nerve

Answer: D — Sciatic nerve

Explanation: A systematic knee MRI review covers: cruciate ligaments (ACL/PCL), collateral ligaments (MCL/LCL), menisci, articular cartilage, subchondral bone, extensor mechanism (patella, patellar tendon, quadriceps), and Baker's cyst. The sciatic nerve is proximal to the knee and not typically evaluated on knee MRI.

15. What does the 'zone of transition' describe on an MSK radiograph, and why is it important?

- A) The border between normal and abnormal bone; narrow = benign; wide/permeative = malignant
- B) The growth plate in a pediatric patient
- C) The interface between cortical and medullary bone
- D) The margin of a joint effusion

Answer: A — The border between normal and abnormal bone; a narrow zone suggests a benign process and a wide/permeative zone suggests malignancy

Explanation: Zone of transition is one of the most important descriptors of bone lesions. Narrow (well-defined, sclerotic rim) = slow-growing, likely benign. Wide (ill-defined, permeative, or moth-eaten) = aggressive growth rate, likely malignant. This concept is covered in the Radiology Masterclass MSK imaging module.

MODULE 6: Neuroradiology

1. On a non-contrast head CT, acute hemorrhage appears as:

- A) Hypoattenuating (dark) relative to brain
- B) Hyperattenuating (bright/white) relative to adjacent brain parenchyma
- C) Isoattenuating to brain with surrounding edema
- D) Air-density (black)

Answer: B — Hyperattenuating (bright/white) relative to adjacent brain parenchyma

Explanation: Acute blood (within hours to ~3 days) has high attenuation (60–90 HU) due to protein content of clot and hemoglobin, appearing bright white on non-contrast CT. Over time (subacute), as hemoglobin degrades, it becomes isodense then hypodense. This is the key concept for interpreting hemorrhagic lesions on head CT.

2. On a non-contrast head CT, a hypodense (dark) region in the distribution of the middle cerebral artery (MCA) territory is most consistent with:

- A) Acute hemorrhage
- B) Calcification
- C) Acute or subacute ischemic infarction
- D) Epidural hematoma

Answer: C — Acute or subacute ischemic infarction

Explanation: Acute ischemic stroke causes cytotoxic edema within hours, which appears as hypodensity (decreased attenuation) on CT in the affected territory. In MCA territory infarcts, look for: loss of gray-white differentiation in the insular ribbon, early sulcal effacement, and hyperdense MCA sign (clot in the artery).

3. Which of the following describes the classic CT appearance of an epidural hematoma (EDH)?

- A) Biconvex (lens-shaped/lenticular) hyperdense collection, usually temporal, often with temporal bone fracture
- B) Crescent-shaped hyperdense collection crossing suture lines
- C) Intraparenchymal hematoma with surrounding edema
- D) Subarachnoid blood filling the sulci and cisterns

Answer: A — Biconvex (lens-shaped) hyperdense extra-axial collection, often associated with temporal bone fracture

Explanation: EDH: biconvex shape (arterial bleeding from the middle meningeal artery cannot cross sutures but can cross the midline). Classic: lucid interval after head trauma, temporal lobe location, associated temporal bone fracture. SDH: crescent-shaped (venous origin), can cross sutures.

4. A 55-year-old presents with the 'worst headache of life.' Head CT shows hyperdense material filling the basal cisterns and sulci. What is the most likely diagnosis and what should be done if CT is negative?

- A) Migraine; discharge with analgesics
- B) Subdural hematoma; neurosurgery consult
- C) Meningitis; broad-spectrum antibiotics
- D) Subarachnoid hemorrhage; if CT is negative, perform lumbar puncture to detect xanthochromia

Answer: D — Subarachnoid hemorrhage; if CT is negative, perform lumbar puncture to detect xanthochromia

Explanation: Subarachnoid hemorrhage (SAH): 'worst headache of life' (thunderclap onset), blood in the subarachnoid space filling cisterns and sulci. Most common cause: ruptured intracranial aneurysm. CT sensitivity ~98% in first 6 hours, decreasing over time. If CT is negative and SAH is suspected, LP is required to detect xanthochromia.

5. In the VINDICATE mnemonic used for brain lesion differential diagnosis, what does the 'V' stand for, and give two examples?

- A) Vascular - stroke, hemorrhage, AVM
- B) Viral - encephalitis, abscess
- C) Volume - hydrocephalus, mass effect
- D) Vertebral - disc herniation, vertebral fracture

Answer: A — Vascular; examples: ischemic stroke, hemorrhage, arteriovenous malformation (AVM), cavernous malformation

Explanation: VINDICATE: Vascular, Infectious, Neoplastic, Degenerative, Iatrogenic/Intoxication, Congenital, Autoimmune/Allergic, Traumatic, Endocrine/Metabolic. Vascular causes of brain pathology include: ischemic stroke, intracranial hemorrhage, AVM, cavernous malformation, and vasculitis.

6. The learningneuroradiology.com module on 'How to Read a Head CT' recommends which systematic approach?

- A) Start with the bone windows, then soft tissue
- B) Review from inferior to superior slice only
- C) Use a systematic mnemonic such as 'Blood Can Be Very Bad' (Blood, Cisterns, Brain parenchyma, Ventricles, Bone)
- D) Begin with the most obvious abnormality and work outward

Answer: C — Blood Can Be Very Bad (Blood, Cisterns, Brain, Ventricles, Bone/soft tissue)

Explanation: A systematic head CT review: Blood (intra/extra-axial hemorrhage), Cisterns (effacement or blood in SAH), Brain parenchyma (symmetry, density, gray-white differentiation), Ventricles (size, shift, blood), Bone/soft tissue (fractures, scalp hematoma). This prevents satisfaction of search errors.

7. Normal pressure hydrocephalus (NPH) presents with the classic triad of symptoms. On head CT or MRI, what is the characteristic imaging finding?

- A. A) Cortical atrophy with ex vacuo ventricular enlargement proportionate to sulcal widening
- B. B) Enlarged ventricles disproportionately large relative to sulcal atrophy; tight high convexity sulci
- C. C) Bilateral basal ganglia calcifications
- D. D) Multiple periventricular white matter lesions

Answer: B — Enlarged ventricles (ventriculomegaly) disproportionate to sulcal atrophy, with tight high convexity sulci

Explanation: NPH triad: Wet (urinary incontinence), Wobbly (gait ataxia), Wacky (dementia). Imaging: ventriculomegaly disproportionate to cortical atrophy, with tight sulci at the high convexity/vertex (DESH pattern). This distinguishes NPH from communicating hydrocephalus due to cerebral atrophy (ex vacuo dilation).

8. On a head CT, which finding is most consistent with a subdural hematoma (SDH)?

- A) Biconvex lenticular hyperdense collection
- B) Round intraparenchymal hematoma with surrounding edema
- C) Crescent-shaped collection following the inner table of the skull, crossing suture lines
- D) Blood in the fourth ventricle

Answer: C — Crescent-shaped extra-axial collection following the inner table of the skull, crossing suture lines

Explanation: SDH: venous bleeding (bridging veins) into the subdural space, which is not limited by sutures. Appears crescent-shaped, conforming to the brain surface. Acute SDH = hyperdense (white); subacute = isodense (same density as brain, easily missed); chronic = hypodense (dark). Often occurs in elderly and alcoholics after trivial trauma.

9. On the Approach to CT Head in the UBC app, 'midline shift' is an important finding. What degree of midline shift is generally considered clinically significant and may indicate need for surgical intervention?

- A) Any shift > 0 mm
- B) Greater than 5 mm
- C) Greater than 15 mm
- D) Only if associated with tonsillar herniation

Answer: B — Greater than 5 mm

Explanation: Midline shift >5 mm is a commonly used threshold for clinical significance in head CT. It indicates mass effect from hematoma, edema, or tumor. Herniation syndromes (uncal, transtentorial, tonsillar) represent the life-threatening endpoint of progressive midline shift.

10. A posterior fossa mass in a child most commonly represents which tumor type?

- A) Medulloblastoma (vermian) or cerebellar pilocytic astrocytoma
- B) Glioblastoma multiforme
- C) Meningioma
- D) Pituitary adenoma

Answer: A — Medulloblastoma (in the vermis) or pilocytic astrocytoma (cerebellar hemisphere)

Explanation: Posterior fossa tumors in children (most common brain tumors in pediatric age): medulloblastoma (PNET, midline vermis, highly malignant, enhances), cerebellar pilocytic astrocytoma (cerebellar hemisphere, cyst with enhancing mural nodule, benign), and brainstem glioma (infiltrating, non-enhancing). Adults prefer supratentorial tumors.

11. On CT, the Hounsfield Unit measurement of a brain lesion at +80 HU, along with surrounding edema and mass effect, is most consistent with:

- A) Calcification
- B) Acute hemorrhage (blood clot)
- C) Air/pneumocephalus
- D) Subacute stroke

Answer: B — Acute hemorrhage

Explanation: HU reference for brain lesions: Blood (acute) = 60–90 HU, Calcification = >100 HU, Air = -1000 HU, Edema/infarct = 20–30 HU (hypodense). A 80 HU lesion with edema and mass effect = acute hemorrhagic process. The Module 6 case report guide explicitly covers these Hounsfield Unit ranges.

12. In evaluating a stroke patient, what is the primary advantage of MRI DWI (diffusion-weighted imaging) over CT in the hyperacute period (0–6 hours)?

- A) MRI is faster than CT
- B) MRI uses less radiation
- C) DWI detects restricted diffusion (cytotoxic edema) within minutes of ischemic onset, long before CT shows hypodensity
- D) MRI is better at detecting hemorrhage

Answer: C — DWI detects cytotoxic edema (restricted diffusion) within minutes of ischemic onset, before CT shows changes

Explanation: DWI detects the early failure of the Na-K ATPase pump causing cytotoxic edema (restricted water diffusion = bright DWI, dark ADC) within minutes of ischemic onset. CT may appear normal for 6–24 hours. The CREATERAD stroke imaging Radtorial covers this concept comprehensively.

14. When describing a brain CT lesion for the Module 6 case report, which term describes a lesion that appears darker (less attenuating) than the surrounding brain?

- A) Hyperattenuating
- B) Hypoattenuating
- C) Isoattenuating
- D) Heterogeneous

Answer: B — Hypoattenuating

Explanation: The Module 6 report guide defines: Hyperattenuating = brighter than brain (blood, calcification, hypercellular tumor), Isoattenuating = same density as brain, Hypoattenuating = darker than brain (edema, infarct, cyst, fat). Accurate use of these terms is essential for structured radiologic reporting.

15. The VINDICATE mnemonic is used in the Module 6 case report. Which category would best classify a brain abscess?

- A) Neoplastic (N)
- B) Infectious (I)
- C) Vascular (V)
- D) Autoimmune (A)

Answer: B — Infectious (I)

Explanation: A brain abscess (bacterial, fungal, or parasitic infection) falls under 'I — Infectious' in the VINDICATE mnemonic. On imaging, abscesses classically appear as ring-enhancing lesions with restricted diffusion on DWI (pus restricts diffusion), surrounded by edema — features that can overlap with high-grade glioma and metastasis.

MODULE 7: Breast Imaging

1. What is the ACR BI-RADS (Breast Imaging Reporting and Data System) category that indicates findings requiring biopsy (highly suggestive of malignancy)?

- A) BI-RADS 0
- B) BI-RADS 2
- C) BI-RADS 3
- D) BI-RADS 5

Answer: D — BI-RADS 5

Explanation: BI-RADS categories: 0 = incomplete (need more imaging), 1 = negative, 2 = benign, 3 = probably benign (>2% but <95% malignancy risk; 6-month follow-up), 4 = suspicious (biopsy recommended), 5 = highly suggestive of malignancy (>95% probability; biopsy), 6 = biopsy-proven malignancy. Covered in the Breast Imaging Overview video.

2. Which of the following mammographic findings is most associated with malignancy?

- A) Round, circumscribed mass with uniform density
- B) Oval, low-density mass with well-defined margins
- C) Irregular, spiculated mass with associated pleomorphic microcalcifications
- D) Bilateral symmetric round densities

Answer: C — Irregular spiculated mass with pleomorphic microcalcifications

Explanation: Suspicious mammographic features: irregular shape, spiculated margins (radiating lines from the mass), associated microcalcifications (especially pleomorphic/fine linear branching), architectural distortion. Circumscribed oval/round masses are typically benign (fibroadenoma, cyst). Covered in 'How to Read a Mammogram' video.

3. What is the primary difference between screening mammography and diagnostic mammography?

- A) Screening uses MRI; diagnostic uses X-ray
- B) Screening is for asymptomatic women; diagnostic evaluates a specific symptom or abnormal screening mammogram finding with additional tailored views
- C) Screening uses lower radiation dose than diagnostic
- D) Diagnostic mammography does not require a radiologist

Answer: B — Screening mammography is performed in asymptomatic women; diagnostic mammography evaluates a specific symptom or abnormal screening mammogram finding with additional targeted views

Explanation: Screening mammography: asymptomatic women, standard 2 views (MLO + CC) per breast, read in batch. Diagnostic mammography: symptomatic women (palpable lump, nipple discharge, focal breast pain) or abnormal screening result — uses additional targeted views (spot compression, magnification, additional projections) and real-time radiologist involvement.

4. Digital breast tomosynthesis (DBT), also called '3D mammography,' improves detection of breast cancer primarily by:

- A) Acquiring multiple low-dose images at different angles to create slices, reducing tissue overlap that can hide cancers
- B) Using higher radiation doses for better image quality
- C) Replacing ultrasound for all breast evaluations
- D) Adding contrast injection for vascular assessment

Answer: A — Acquiring multiple low-dose images at different angles, reducing tissue overlap that can obscure lesions on standard 2D mammography

Explanation: DBT acquires images at multiple angles (typically 15°), reconstructed into thin 1-mm slices. By reducing overlapping tissue, DBT improves cancer detection rates and decreases recall rates compared to 2D mammography alone. The tomosynthesis biopsy video in Module 7 demonstrates guided upright biopsy using DBT.

5. Gynecomastia on a male mammogram is a common finding. How does it appear, and what is the key differentiator from male breast carcinoma?

- A) They are indistinguishable on mammogram
- B) Gynecomastia shows a spiculated mass; carcinoma shows a circumscribed round mass.
- C) Gynecomastia: bilateral/unilateral subareolar fan-shaped tissue, no discrete mass; carcinoma: eccentric irregular spiculated mass
- D) Gynecomastia only occurs after age 70

Answer: C — Gynecomastia: bilateral or unilateral subareolar fan-shaped tissue, symmetric, no mass; carcinoma: eccentric irregular mass with spiculated margins, often unilateral

Explanation: Gynecomastia (glandular breast tissue in males) appears as subareolar fan-shaped or flame-shaped density, centered on the nipple. Male breast carcinoma is typically an eccentric (off-center), irregular, often spiculated mass. Covered in the 'Male Breast Diseases' video.

6. In the 'Emergency Breast Conditions' video, which of the following is a true breast emergency requiring immediate evaluation?

- A) A new stable fibroadenoma
- B) Inflammatory breast cancer (presenting as breast erythema, edema, peau d'orange)
- C) Simple breast cyst
- D) Bilateral nipple discharge (bilateral, clear, non-bloody)

Answer: B — Inflammatory breast cancer (IBC)

Explanation: Inflammatory breast cancer (IBC) is a clinical emergency: rapid onset breast erythema, warmth, edema, and peau d'orange (skin thickening from dermal lymphatic invasion). IBC is highly aggressive (Stage IIIB at diagnosis) and can be mistaken for mastitis. Mammography shows skin thickening, trabecular thickening, and often no discrete mass.

7. A stereotactic core needle biopsy (as shown in the Module 7 video) is performed for which type of mammographic finding?

- A) Palpable masses in young women
- B) Solid masses visible on ultrasound
- C) Suspicious microcalcifications or lesions only visible on mammogram (not detectable by ultrasound)
- D) Simple cysts requiring fluid aspiration

Answer: C — Suspicious microcalcifications not visible by ultrasound

Explanation: Stereotactic biopsy uses mammographic X-ray guidance (triangulation from two angles) to target lesions visible on mammography but not on ultrasound — most commonly suspicious microcalcifications. The prone stereotactic table immobilizes the patient while the biopsy device is localized to the target.

8. What is a 'needle localization' procedure in breast imaging, and when is it used?

- A) Placement of a wire or marker under imaging guidance to mark a non-palpable lesion for the surgeon prior to surgical excision
- B) Aspiration of a breast cyst with a needle
- C) Injection of contrast into the breast ducts

D) Placement of a chemotherapy port

Answer: A — Placement of a wire/marker under imaging guidance to mark a non-palpable mammographic lesion before surgical excision

Explanation: Pre-surgical needle localization (wire localization): a hooked wire is placed under mammographic, ultrasound, or DBT guidance to mark a non-palpable breast lesion for the surgeon, who uses the wire as a roadmap to excise the lesion. The Module 7 video on 'mammography guided needle location' demonstrates this procedure.

9. Breast MRI uses gadolinium contrast. What is the primary clinical indication for breast MRI beyond standard mammography?

- A) Routine screening for all women over 40
- B) Evaluating simple breast cysts
- C) Replacing mammography in all women with dense breasts
- D) High-risk screening (BRCA+ or lifetime risk >20%), extent of disease in newly diagnosed cancer, and problem-solving for equivocal cases

Answer: D — High-risk screening (BRCA mutation carriers), extent of disease evaluation, and problem-solving for equivocal findings

Explanation: Breast MRI is the most sensitive modality for breast cancer detection (~90%+ sensitivity) but has lower specificity. Indications: BRCA mutation carriers or high lifetime risk (>20%), ipsilateral extent of disease in new cancer diagnosis (identifies multifocal/multicentric disease and contralateral cancer), and problem-solving equivocal mammographic findings.

10. In the 'Breast RadPath Conference' video, what is the purpose of correlating radiology findings with pathology results?

- A) To increase the number of biopsies performed
- B) To verify that the biopsy pathology is concordant with the imaging appearance, and if discordant, consider rebiopsy
- C) To replace surgical excision
- D) To teach pathologists how to read mammograms

Answer: B — To ensure the biopsy result (pathology) is concordant with the imaging appearance and guide further management

Explanation: RadPath correlation is critical: if biopsy pathology is concordant with imaging (e.g., benign fibroadenoma matches well-circumscribed mass), 6-month follow-up is appropriate. If discordant (e.g., biopsy shows normal tissue but image was suspicious), repeat biopsy or surgical excision is needed to avoid missing cancer.

11. Which of the following describes the mammographic appearance of a benign fibroadenoma?

- A) Oval/round, circumscribed mass, possibly with coarse calcifications
- B) Irregular, spiculated mass with pleomorphic calcifications
- C) Linear branching calcifications in a segmental distribution
- D) Architectural distortion with no associated mass

Answer: A — Oval or round, circumscribed mass, possibly with coarse calcifications

Explanation: Fibroadenoma is the most common benign breast tumor in young women. Mammographic features: oval or round, well-circumscribed/lobulated mass. As it ages, it may develop characteristic coarse 'popcorn' calcifications (involuting fibroadenoma). BI-RADS 2 (benign) — no follow-up needed.

12. Current American College of Radiology (ACR)/Society of Breast Imaging (SBI) guidelines recommend annual screening mammography beginning at age __ for average-risk women.

- A) 35
- B) 40
- C) 50
- D) 25

Answer: B — 40

Explanation: The ACR and SBI recommend annual mammography beginning at age 40 for average-risk women. The USPSTF previously recommended starting at 50 (every 2 years), though the 2024 updated USPSTF guidelines moved toward age 40. High-risk women (BRCA+, strong family history) begin earlier with MRI supplemental screening.

13. Nipple discharge is a common breast symptom. Which type of nipple discharge is most worrisome for underlying malignancy?

- A) Bilateral milky discharge in a woman taking antipsychotics
- B) Bilateral multi-duct green/gray discharge
- C) Unilateral, spontaneous, single-duct, bloody or clear (watery) discharge
- D) Bilateral non-spontaneous serous discharge elicited only with squeezing

Answer: C — Unilateral, spontaneous, single-duct, bloody or clear discharge

Explanation: Worrisome nipple discharge: unilateral, spontaneous (not elicited), single duct, bloody or clear (serous/watery) — associated with intraductal papilloma or ductal carcinoma in situ (DCIS). Bilateral, milky, multi-duct discharge is usually physiologic or medication-related (galactorrhea).

14. In breast ultrasound, which features of a breast mass suggest malignancy?

- A) Oval shape, circumscribed margins, posterior enhancement
- B) Well-defined thin capsule with homogeneous echogenicity
- C) Compressible, anechoic, no internal echoes
- D) Non-parallel (Taller-than-wide) orientation, angular margins, posterior acoustic shadowing, and hypoechoic solid mass

Answer: D — Taller-than-wide shape, irregular margins, posterior acoustic shadowing, hypoechoic, and microlobulated borders

Explanation: Suspicious US features (ACR BI-RADS lexicon): non-parallel (taller-than-wide) orientation, irregular shape, not circumscribed margins (angular, microlobulated, spiculated, indistinct), posterior acoustic shadowing, and hypoechoic solid composition. Benign: oval, circumscribed, parallel, posterior enhancement.

15. The Breast RadPath and emergency breast videos emphasize that breast imaging findings must always be interpreted in clinical context. Which scenario would most appropriately result in BI-RADS 3 (probably benign, 6-month follow-up)?

- A) A 65-year-old with a new spiculated mass on mammogram
- B) A oval circumscribed hypoechoic solid mass on ultrasound in a 28-year-old with no risk factors
- C) A new area of architectural distortion in a post-lumpectomy patient
- D) Two similar appearing round circumscribed masses in the left breast and one similar appearing round circumscribed in the right breast on a screening mammogram, for which the masses are nonpalpable.

Answer: B — An oval circumscribed hypoechoic solid mass on ultrasound in a 28-year-old with no risk factors.

Explanation: BI-RADS 3 (probably benign): <2% risk of malignancy, short-interval 6-month follow-up recommended (rather than biopsy). Classic example: a circumscribed oval hypoechoic solid mass (likely fibroadenoma) in a young, low-risk patient. BI-RADS 3 should NOT be used for a new screening finding in a postmenopausal woman or high-risk patient. **Rule of multiplicity:** The presence of at least three oval or round, circumscribed, nonpalpable masses distributed bilaterally (with at least two in one breast and one in the contralateral breast) is considered benign with near certainty.

MODULE 8: Nuclear Medicine

1. A HIDA scan (hepatobiliary iminodiacetic acid scan) evaluates the hepatobiliary system. What radiopharmaceutical is used and how does it work?

- A) I-131
- B) Tc-99m IDA derivative
- C) FDG (fluorodeoxyglucose), D) Gallium-67]

Answer: B — Tc-99m labeled IDA (iminodiacetic acid) derivative, which is taken up by hepatocytes and excreted into bile, allowing visualization of biliary flow

Explanation: HIDA scan uses a Tc-99m labeled IDA derivative (e.g., mebrofenin or disofenin) injected IV. Hepatocytes take it up and excrete it into bile, exactly like bilirubin. Sequential images trace flow: liver → bile ducts → gallbladder → duodenum. Failure to visualize the gallbladder indicates cystic duct obstruction (cholecystitis).

2. On a HIDA scan, what finding indicates acute cholecystitis?

- A) Delayed hepatic uptake and no biliary excretion
- B) Prompt gallbladder visualization within 5 minutes
- C) Non-visualization of the gallbladder at 60 minutes (or 4 hours with morphine augmentation) with normal hepatocyte uptake and ductal excretion
- D) Radiotracer accumulation in the kidneys only

Answer: C — Non-visualization of the gallbladder at 60 minutes, with normal hepatic uptake and biliary excretion into the duodenum

Explanation: In acute cholecystitis, the cystic duct is obstructed (by a stone or edema), preventing radiotracer from entering the gallbladder. HIDA finding: normal hepatic uptake and CBD/duodenum filling, but persistent non-visualization of the gallbladder at 60 min (morphine given to augment filling; if still not seen at 4h = positive for cholecystitis).

3. A bone scan uses Tc-99m MDP (methylene diphosphonate). What does increased uptake ('hot spots') on a bone scan indicate?

- A) Areas of decreased bone density
- B) Areas of increased osteoblastic activity/bone turnover
- C) Areas of bone marrow fat
- D) Purely normal bone remodeling with no pathological significance

Answer: B — Areas of increased bone turnover/osteoblastic activity (metastases, fractures, osteomyelitis, Paget's disease)

Explanation: Tc-99m MDP accumulates at sites of osteoblastic activity (new bone formation). 'Hot spots' on bone scan indicate: metastatic disease (especially from prostate, breast, lung cancer), stress fractures, osteomyelitis, Paget's disease. 'Cold spots' (photopenia) = aggressive metastases (lytic myeloma) or areas of poor blood flow.

4. A tagged red blood cell (tagged RBC) scan is used to detect which clinical condition?

- A) Pulmonary embolism
- B) Renal vascular disease

- C) Active gastrointestinal (GI) bleeding
- D) Hepatocellular carcinoma

Answer: C — Active gastrointestinal bleeding (lower GI or small bowel)

Explanation: Tagged RBC scan: red blood cells are labeled with Tc-99m, reinjected, and serial images are taken. Extravasation of labeled cells into the bowel lumen indicates active GI bleeding. Can detect bleeding rates as low as 0.1 mL/min. Useful for intermittent or slow bleeds when colonoscopy/endoscopy is non-diagnostic.

5. A V/Q (ventilation/perfusion) scan is used to evaluate for pulmonary embolism. Which result pattern is most consistent with PE?

- A) Diffuse decreased ventilation and perfusion
- B) Segmental or lobar perfusion defects with normal ventilation in the same region
- C) Normal perfusion with areas of decreased ventilation
- D) Normal V/Q scan with no defects

Answer: B — Segmental or lobar perfusion defects with normal corresponding ventilation (mismatched defects)

Explanation: PE causes vascular obstruction → decreased perfusion without airway disease → normal ventilation. A 'high probability' V/Q scan shows ≥2 large (segmental) perfusion defects with normal ventilation (mismatched). Matched defects (both V and Q decreased) suggest parenchymal lung disease (pneumonia, COPD), not PE.

6. A myocardial perfusion scan (MPS) using Tc-99m sestamibi evaluates coronary artery disease. What does a 'reversible perfusion defect' indicate?

- A) Stress-induced ischemia in a viable territory (reduced flow with stress, normalizes at rest = ischemia)
- B) Myocardial infarction with no viable tissue
- C) Normal myocardial perfusion
- D) Pericardial effusion

Answer: A — Stress-induced ischemia in a viable myocardial territory that improves at rest

Explanation: MPS: compare stress (exercise or pharmacologic) vs. rest images. Reversible defect: reduced uptake on stress images that normalizes on rest = ischemia (viable myocardium, supply limited during demand). Fixed defect: reduced uptake on both stress and rest = prior MI/scar (non-viable).

7. PET/CT using FDG (fluorodeoxyglucose) exploits which metabolic property of cancer cells?

- A) Increased fat metabolism in tumors
- B) Decreased glucose consumption in malignant cells
- C) Increased glucose uptake and glycolysis (Warburg effect)
- D) Selective uptake of iodine by all tumors

Answer: C — Increased glucose uptake and glycolysis (Warburg effect) in malignant cells

Explanation: FDG (18F-fluorodeoxyglucose) is a glucose analog taken up by cells proportional to metabolic activity. Malignant cells have markedly elevated glucose metabolism (Warburg effect), accumulating high concentrations of FDG. PET detects the emitted positrons as coincident 511 keV gamma ray pairs. **8. A MUGA (Multi-Gated Acquisition) scan is used to assess which cardiac parameter?**

- A) Coronary artery anatomy
- B) Left (and right) ventricular ejection fraction (LVEF)
- C) Valvular regurgitation severity
- D) Pericardial effusion volume

Answer: B — Left ventricular ejection fraction (LVEF)

Explanation: MUGA (equilibrium radionuclide angiography): Tc-99m tagged RBCs label the blood pool gated images over multiple cardiac cycles are averaged to quantify LVEF and wall motion. Highly reproducible and accurate. Used to monitor cardiotoxicity from chemotherapy (e.g., doxorubicin) and in heart failure management.

9. In a patient with choledocholithiasis with CBD obstruction , which HIDA scan finding differentiates CBD obstruction from acute cholecystitis?

- A) Both show identical HIDA patterns
- B) CBD obstruction shows immediate gallbladder filling
- C) Cholecystitis shows no hepatic uptake
- D) CBD obstruction shows no excretion into duodenum OR gallbladder

Answer: D — In CBD obstruction: no radiotracer excretion into the duodenum AND non-visualization of the gallbladder
Explanation: The key distinction: In CBD obstruction, the common bile duct is blocked — radiotracer cannot reach the duodenum or gallbladder. In cholecystitis (cystic duct obstruction), only the cystic duct is blocked — radiotracer reaches the CBD and duodenum normally, but the gallbladder is not visualized. This is the essence of the Module 8 HIDA drawing activity.

10. Bone densitometry (DEXA scan) measures bone mineral density. What T-score defines osteoporosis?

- A) T-score ≥ 0
- B) T-score between -1 and -2.5 (osteopenia)
- C) T-score ≤ -2.5 (osteoporosis)
- D) T-score > -1 (normal)

Answer: C — T-score ≤ -2.5

Explanation: WHO DEXA T-score criteria (compared to young adult peak bone mass): Normal = $T > -1$; Osteopenia = $T -1$ to -2.5 ; Osteoporosis = $T \leq -2.5$; Severe osteoporosis = $T \leq -2.5$ with fragility fracture. Z-score compares to age-matched peers (low Z-score in young adults suggests secondary osteoporosis).

11. The oncologic imaging Radtiorial (CREATERAD) describes how PET/CT is used in cancer staging. What does SUV (Standardized Uptake Value) represent?

- A) The size of a tumor lesion in centimeters
- B) A semi-quantitative measure of FDG uptake normalized to injected dose and body weight, used to assess metabolic activity
- C) The radiation dose received by the patient
- D) The number of positive lymph nodes

Answer: B — A semi-quantitative measure of FDG uptake in a lesion, normalized to the injected dose and patient body weight

Explanation: $SUV = (\text{activity in ROI [MBq/mL]}) / (\text{injected dose [MBq]} / \text{body weight [kg]})$. Higher SUV = higher metabolic activity. Typical thresholds vary by tumor type, but $SUV > 2.5$ in a pulmonary nodule is often used as a threshold for metabolic activity. SUV changes on follow-up PET assess treatment response.

12. Which nuclear medicine study is most appropriate for evaluating a patient with thyroid cancer for metastatic disease?

- A) I-131 (radioiodine) whole body scan
- B) Tc-99m MDP bone scan
- C) FDG PET/CT
- D) V/Q scan

Answer: A — I-131 whole body scan

Explanation: Differentiated thyroid cancer (papillary/follicular) cells retain some iodine uptake capacity. After thyroidectomy and TSH stimulation, I-131 whole body scan detects functioning thyroid remnant and metastatic tissue that takes up iodine. FDG PET is used for less differentiated (iodine-avid to iodine-negative) thyroid cancer ('flip-flop phenomenon').

13. Which patient preparation is most critical before a bone scan to reduce background activity and improve image quality?

- A) Fasting for 12 hours
- B) Stopping all medications for 48 hours
- C) Adequate hydration and voiding before imaging to clear renal radiotracer excretion and reduce bladder activity
- D) Administration of Lugol's iodine to protect the thyroid

Answer: C — Adequate hydration and voiding before imaging to clear renal/bladder radiotracer

Explanation: Tc-99m MDP is partially excreted renally. Good hydration promotes renal clearance and reduces soft tissue background. Patients should void immediately before imaging to empty the bladder, which otherwise creates a large hot artifact that can obscure pelvic bones and the sacrum.

14. In oncologic FDG-PET imaging, which normal organ shows high physiologic FDG uptake and could be confused with disease?

- A) Liver only
- B) Skeletal muscle only
- C) Thyroid gland
- D) Brain, myocardium (variable), and urinary tract (FDG excreted renally)

Answer: D — Brain, myocardium, and urinary tract (kidneys, ureters, bladder)

Explanation: Normal high FDG uptake: brain (high glucose metabolism), myocardium (variable, fasting reduces cardiac uptake), urinary tract (renal excretion of FDG), GI tract (variable). These must not be confused with pathologic uptake. Patient preparation (fasting 4–6h, avoid exercise, warm/hydrated to minimize muscle uptake) reduces artifacts.

15. Which of the following best describes the difference between planar scintigraphy and SPECT?

- A) Planar uses CT; SPECT uses MRI for anatomic correlation
- B) Planar scintigraphy produces 2D projection images; SPECT rotates the gamma camera around the patient to create 3D tomographic slices with better lesion contrast and localization
- C) SPECT uses positron emitters; planar uses gamma emitters
- D) They are identical techniques with different names

Answer: B — Planar scintigraphy creates 2D projection images; SPECT uses rotating gamma camera to create 3D tomographic images with better lesion localization and contrast

Explanation: Planar nuclear medicine: gamma camera acquires 2D images (anterior/posterior projections). SPECT (Single Photon Emission CT): gamma camera with multiple projections acquired as the camera rotates 360°, reconstructed into 3D tomographic slices (like CT but using gamma emitters). SPECT improves lesion detection, depth localization, and contrast resolution. SPECT/CT adds anatomic overlay.

MODULE 9: Interventional Radiology

1. Interventional radiology (IR) is broadly categorized into which two major domains based on the vascular system?

- A) Diagnostic radiology and therapeutic radiology
- B) Vascular IR (arterial/venous procedures) and non-vascular IR (biopsies, drainages, biliary, GU interventions)
- C) Oncologic IR and trauma IR
- D) Inpatient IR and outpatient IR

Answer: B — Vascular IR and non-vascular IR

Explanation: Per the CIRSE Medical Student Curriculum, IR is divided into vascular IR (angiography, angioplasty, stenting, embolization, thrombolysis, TIPS) and non-vascular IR (image-guided biopsies, drainage, biliary procedures, nephrostomy, ablation). Understanding this distinction helps categorize procedures encountered during clinical observation.

2. Which of the following best describes the Seldinger technique, the foundation of vascular access in IR?

- A) Direct cut-down surgical access to the artery
- B) Blind insertion of a large-bore catheter
- C) Needle puncture of the vessel → guidewire insertion through needle → needle removal → catheter/sheath advancement over guidewire
- D) Ultrasound-guided direct catheter insertion without a wire

Answer: C — Arterial puncture → guidewire insertion → needle removal → catheter advancement over wire

Explanation: The Seldinger technique (modified): vessel puncture with a needle, passage of a flexible J-tip guidewire through the needle, needle withdrawal, then advancement of a catheter/sheath over the wire. This allows percutaneous vascular access without surgical cutdown and is the basis of nearly all IR procedures.

3. Uterine Fibroid Embolization (UFE) treats symptomatic fibroids by:

- A) Surgically removing the uterus (hysterectomy)
- B) Occluding both uterine arteries with embolic agents, causing fibroid ischemia and infarction while preserving the uterus
- C) Injecting chemotherapy directly into the fibroids
- D) Performing laparoscopic laser ablation of fibroids

Answer: B — Occluding the uterine arteries with embolic material, causing fibroid infarction while preserving the uterus

Explanation: UFE: bilateral uterine artery catheterization via the femoral (or radial) artery, followed by injection of microspheres or PVA particles into both uterine arteries. The fibroids (which receive a disproportionate blood supply) infarct, while the uterus survives via collateral flow. Symptom relief in ~85–90% of patients. Covered in CIRSE curriculum Module 4.

4. Prostate Artery Embolization (PAE) is performed for which condition?

- A) Benign prostatic hyperplasia (BPH) causing symptomatic lower urinary tract symptoms (LUTS)
- B) Prostate cancer with bony metastases
- C) Acute prostatitis
- D) Erectile dysfunction

Answer: A — Benign prostatic hyperplasia (BPH) with lower urinary tract symptoms

Explanation: PAE embolizes the prostatic arteries to reduce prostate volume and improve LUTS from BPH. The procedure selectively embolizes the arterial supply to the enlarged prostate, causing ischemia and volume reduction. An alternative to TURP (transurethral resection) for symptomatic BPH. Covered in CIRSE curriculum Module 4.

5. In image-guided percutaneous biopsy (a non-vascular IR procedure), which imaging modalities are commonly used for guidance?

- A) Plain radiograph only
- B) MRI only (for all biopsies)
- C) PET/CT only
- D) CT, ultrasound, and fluoroscopy — choice depends on lesion location, depth, and visibility on each modality

Answer: D — CT, ultrasound, and fluoroscopy (depending on lesion location and visibility)

Explanation: Percutaneous biopsy guidance: ultrasound (real-time, no radiation, superficial lesions), CT (deep retroperitoneal lesions, lung, bone), fluoroscopy (bone, joint, spine). MRI-guided biopsy is used for lesions only visible on MRI (some breast, liver, prostate lesions). The choice of guidance balances visibility, radiation, access, and real-time capability.

6. A transjugular intrahepatic portosystemic shunt (TIPS) is used to treat which condition?

- A) Hepatic artery thrombosis after liver transplant
- B) Hepatocellular carcinoma
- C) Portal hypertension complications (refractory variceal hemorrhage, refractory ascites, hepatorenal syndrome)
- D) Biliary obstruction

Answer: C — Portal hypertension complications (variceal bleeding, refractory ascites)

Explanation: TIPS creates an intrahepatic communication between the portal vein and hepatic vein using a metallic stent, reducing portal pressure. Indications: refractory variceal hemorrhage (esophageal/gastric varices), refractory ascites, hepatic hydrothorax, and Budd-Chiari syndrome. Complications: encephalopathy, stent stenosis/thrombosis.

7. In interventional oncology, thermal ablation (radiofrequency ablation, microwave ablation, or cryoablation) is used for treating small tumors. What is the general size threshold beyond which ablation is less effective for hepatic tumors?

- A) >1 cm
- B) >3–5 cm (optimal candidates are tumors ≤ 3 cm; effectiveness decreases for larger lesions)
- C) >10 cm
- D) There is no size limitation for ablation

Answer: B — Generally >3–5 cm (tumor control rates decrease significantly above this size)

Explanation: Image-guided tumor ablation is most effective for lesions ≤ 3 cm (local recurrence rates are low). For 3–5 cm, ablation is technically feasible but recurrence risk increases. Beyond 5 cm, combination with TACE or surgery is typically preferred. CIRSE curriculum Module 5 covers ablation indications and techniques.

8. Peripheral arterial disease (PAD) treated by IR typically involves which procedures?

- A) IV thrombolytics only
- B) Surgical bypass only
- C) Percutaneous angioplasty (PTA) $\pm$ stenting of stenotic/occluded peripheral arteries, and catheter-directed thrombolysis for acute occlusions

D) Embolization of peripheral arteries

Answer: C — Angioplasty (balloon dilation) with or without stenting of stenotic peripheral arteries

Explanation: PAD IR: percutaneous transluminal angioplasty (PTA) uses a balloon catheter to dilate stenotic arterial segments; stents maintain patency after angioplasty. Catheter-directed thrombolysis (CDT) dissolves acute thrombus via infusion of tPA through a catheter in the clot. Covered in CIRSE Module 6.

9. Which of the following is a common complication of percutaneous nephrostomy (PCN) placement, a procedure covered in the non-vascular IR module?

- A) Pneumothorax and hemothorax only
- B) Intestinal obstruction
- C) Aortic injury
- D) Hematuria, urinary tract infection/urosepsis, tube dislodgement, and potential injury to adjacent bowel or pleura

Answer: D — Hematuria, infection/urosepsis, tube dislodgement, and adjacent organ injury

Explanation: PCN: ultrasound and fluoroscopy-guided placement of a drainage tube into the renal pelvis for urinary obstruction or infection. Complications: hematuria (most common, usually transient), infection/bacteremia/sepsis, tube dislodgement, pneumothorax (if upper pole access), and rarely injury to adjacent bowel, spleen, or liver.

10. The CIRSE curriculum describes two pathways to becoming an IR physician in the United States. What are they?

- A) Fellowship-only pathway and general surgery residency
- B) Integrated IR (DR/IR) residency (6-year program directly from medical school) and Independent pathway (5-year DR residency + 1-year IR fellowship)
- C) Radiology residency and then cardiology fellowship
- D) IR is only accessible after a surgery residency

Answer: B — Integrated IR residency (directly after medical school, 6-year program) and Independent IR pathway (DR residency + IR fellowship)

Explanation: The ABR offers two pathways: (1) Integrated IR/DR residency: 6 years after medical school, combines diagnostic radiology and IR training, leading to dual board certification; (2) Independent pathway: complete a 5-year DR residency, then apply to an ACGME-accredited IR fellowship. Covered in CIRSE Module 8.

11. During clinical observation of a vascular IR procedure, you witness diagnostic angiography. What does this procedure involve?

- A) CT scan of the blood vessels using oral contrast
- B) MRI evaluation of vessel wall without contrast
- C) Injection of iodinated contrast through a selectively positioned catheter under fluoroscopic guidance to map vascular anatomy
- D) Ultrasound evaluation of vessel diameter

Answer: C — Injection of iodinated contrast through a catheter positioned in a vessel, with X-ray/fluoroscopic imaging to evaluate vascular anatomy and identify stenosis, occlusion, or bleeding

Explanation: Diagnostic angiography: catheter-based arterial/venous access (typically femoral artery), selective catheter positioning, iodinated contrast injection, and fluoroscopic X-ray acquisition. Creates roadmap of vascular anatomy, identifies occlusions, stenoses, aneurysms, and bleeding sites. Prerequisite to therapeutic IR procedures.

12. A patient presents with acute lower GI hemorrhage uncontrolled by endoscopy. Which IR intervention is most appropriate?

- A) TIPS procedure
- B) Mesenteric angiography with super-selective embolization of the bleeding vessel
- C) Inferior vena cava filter placement
- D) Biliary drainage

Answer: B — Mesenteric angiography with catheter-directed embolization of the bleeding vessel

Explanation: For GI bleeding uncontrolled by endoscopy: mesenteric angiography (SMA/IMA) identifies active contrast extravasation; super-selective embolization with microcoils, gelfoam, or microspheres stops hemorrhage. Success rates ~70–90% for active bleed. Risk: bowel ischemia (minimized by super-selective technique).

13. What is a biliary drainage procedure (percutaneous transhepatic cholangiography/PTCD), and when is it indicated?

- A) IV injection of contrast to image the bile ducts
- B) Surgical bypass of the common bile duct
- C) Percutaneous placement of a drainage catheter into the biliary tree to relieve biliary obstruction when ERCP is technically impossible or has failed
- D) Radiofrequency ablation of the bile duct

Answer: C — Percutaneous placement of a catheter into the biliary system to relieve obstruction when ERCP has failed or is not feasible

Explanation: PTCD: fine needle puncture of a peripheral bile duct under fluoroscopy/US guidance, followed by catheter placement for external or internal biliary drainage. Indicated for: malignant biliary obstruction (cholangiocarcinoma, pancreatic head cancer), failed ERCP, altered surgical anatomy, or cholangitis requiring urgent decompression.

15. Inferior vena cava (IVC) filter placement is an IR procedure. What is the primary indication for IVC filter placement?

- A) Prevention of DVT in all post-surgical patients
- B) DVT/PE in patients with contraindication to anticoagulation, or recurrent PE despite therapeutic anticoagulation
- C) Treatment of varicose veins
- D) Management of portal hypertension

Answer: B — Deep vein thrombosis or pulmonary embolism in patients with contraindication to anticoagulation or recurrent PE despite adequate anticoagulation

Explanation: IVC filters catch thromboemboli from the lower extremities before reaching the pulmonary circulation. Primary indications: DVT/PE with contraindication to anticoagulation (recent surgery, hemorrhagic stroke, GI bleeding), failure of anticoagulation (recurrent PE), or massive PE after thromboendarterectomy. Retrievable filters should be removed when anticoagulation can be resumed.

MODULE 10: Pediatric Radiology

1. Which of the following best describes why radiation dose reduction is especially important in pediatric patients?

- A) Children have smaller body habitus, requiring less radiation to obtain images
- B) Pediatric X-ray units use higher kV than adult units
- C) Children have rapidly dividing cells, higher radiosensitivity, and longer life expectancy — the same dose confers greater lifetime cancer risk than in adults
- D) Children receive the same dose as adults on all studies

Answer: C — Children have more rapidly dividing cells, longer remaining life expectancy, and higher radiosensitivity, leading to greater lifetime cancer risk per unit dose

Explanation: ALARA is especially critical in pediatrics: (1) Radiosensitivity — growing tissues and rapidly dividing cells are more susceptible to radiation-induced DNA damage; (2) Life expectancy — more years to develop radiation-induced malignancy; (3) Smaller body = greater dose per unit area. Pediatric protocols (ALARA, Image Gently campaign) use age/weight-based dose reduction.

2. The 'Game of Unknowns: Pediatric Edition' activity on the curriculum covers common pediatric diagnoses. Which of the following pediatric conditions classically presents with a 'double bubble sign' on abdominal X-ray?

- A) Hypertrophic pyloric stenosis
- B) Duodenal atresia
- C) Malrotation with midgut volvulus
- D) Intussusception

Answer: B — Duodenal atresia

Explanation: The double bubble sign: two gas-filled structures (stomach + first part of duodenum) separated by the pylorus, with no distal bowel gas. This pattern is pathognomonic for duodenal atresia (or duodenal stenosis). Associated with Down syndrome in ~30% of cases. Diagnosed on prenatal ultrasound or neonatal X-ray.

3. A 3-week-old male infant presents with projectile vomiting after feeds. Ultrasound shows a pyloric muscle thickness >4 mm and pyloric channel length >17 mm. What is the diagnosis?

- A) Hypertrophic pyloric stenosis (HPS)
- B) Gastroesophageal reflux
- C) Duodenal atresia
- D) Intussusception

Answer: A — Hypertrophic pyloric stenosis (HPS)

Explanation: HPS: hypertrophy of the pyloric muscle causing gastric outlet obstruction. Classic: firstborn male, 3–6 weeks old, non-bilious projectile vomiting. Ultrasound diagnosis: pyloric muscle thickness ≥ 4 mm (most important criterion), channel length ≥ 17 mm, pyloric diameter > 13 mm. Treatment: pyloromyotomy (Ramstedt procedure).

4. Non-accidental trauma (NAT) / child abuse imaging follows specific ACR guidelines. Which skeletal survey finding is considered 'high specificity' for child abuse?

- A) Clavicle fracture in a newborn
- B) Toddler's fracture of the tibia in a walking child
- C) Greenstick fracture of the radius

D) Classic metaphyseal lesion (bucket-handle or corner fracture) in an infant, posterior rib fractures, and complex skull fractures

Answer: D — Classic metaphyseal lesion (bucket-handle or corner fracture) in a young infant

Explanation: High-specificity NAT fractures: classic metaphyseal lesions (CMLs/bucket-handle fractures — due to shaking/yanking), posterior rib fractures (due to squeezing/hugging), complex/bilateral/diastatic skull fractures, spinous process fractures. Covered in the ACR Building Blocks Pediatric Non-Accidental Trauma module.

5. A child presents with sudden onset colicky abdominal pain, vomiting, and 'currant jelly' stool. Ultrasound shows a target sign. What is the diagnosis and first-line treatment?

- A) Appendicitis; emergent appendectomy
- B) Malrotation; emergent Ladd procedure
- C) Intussusception; pneumatic (air) or hydrostatic (contrast) enema reduction under fluoroscopic guidance
- D) Meckel's diverticulum; Tc-99m pertechnetate scan

Answer: C — Intussusception; air or contrast enema reduction under fluoroscopic guidance

Explanation: Ileocolic intussusception: most common cause of bowel obstruction in children 6 months–3 years. 'Currant jelly' stool (blood/mucus). Target/donut sign on US. Treatment: pneumatic or hydrostatic enema reduction (success rate ~80–90%) under fluoroscopy. Surgery if enema fails or peritonitis present.

6. The Cleveland Clinic Pediatric Radiology online modules include various topics. Which pediatric lung pathology is characterized by diffuse bilateral granular opacities and air bronchograms in a premature infant?

- A) Transient tachypnea of the newborn (TTN)
- B) Respiratory distress syndrome (RDS) / Hyaline membrane disease due to surfactant deficiency
- C) Meconium aspiration syndrome
- D) Neonatal pneumonia

Answer: B — Respiratory distress syndrome (RDS) / Hyaline membrane disease

Explanation: RDS (hyaline membrane disease): surfactant deficiency in premature infants causes alveolar collapse. CXR: diffuse bilateral granular 'ground glass' opacification, air bronchograms, and low lung volumes (lung volume matches severity). Treatment: exogenous surfactant, CPAP/ventilation.

7. ACR Building Blocks 'Special Considerations when Imaging Children' emphasizes that children are not 'small adults.' Which approach minimizes radiation in pediatric CT?

- A) Using adult protocols but with smaller image fields of view
- B) Performing CT without IV contrast in all children
- C) Replacing CT entirely with plain radiographs for all pediatric conditions
- D) Using weight/size-adjusted protocols with reduced kV, mAs, noise index adjustments, and iterative reconstruction (ALARA/Image Gently principles)

Answer: D — Using weight-based or size-based protocols (ALARA), including reduced kV, mAs, and iterative reconstruction

Explanation: Pediatric CT dose reduction: weight-based kV selection (lower kV for smaller patients = less radiation, better iodine contrast), mAs reduction with noise-index-based protocols, iterative reconstruction algorithms (reduce noise from low-dose acquisitions), and limiting coverage to the area of interest. Image Gently campaign promotes these practices.

8. A 2-year-old presents with an abdominal mass. Ultrasound shows a large heterogeneous intrarenal mass. What is the most likely diagnosis?

- A) Wilms' tumor (nephroblastoma)
- B) Neuroblastoma
- C) Hepatoblastoma
- D) Rhabdomyosarcoma

Answer: A — Wilms' tumor (nephroblastoma)

Explanation: Wilms' tumor (nephroblastoma): most common pediatric renal malignancy, peak age 3–4 years. Presents as a large abdominal mass, often incidentally discovered. US/CT: intrarenal, heterogeneous mass ± cysts, necrosis, calcification. Bilateral in 5–10%. Excellent prognosis with surgery ± chemo/radiation. Neuroblastoma arises from the adrenal/retroperitoneum and crosses the midline.

9. Transient tachypnea of the newborn (TTN) is a common neonatal respiratory condition. What is its characteristic chest X-ray appearance, and how does it differ from RDS?

- A) They are identical on CXR
- B) TTN shows pneumothorax; RDS shows consolidation
- C) TTN: perihilar streaky densities, fluid in fissures, mild cardiomegaly, normal or high lung volumes, resolves in 24–48h; RDS: diffuse granular opacification with air bronchograms and low lung volumes
- D) TTN affects premature infants; RDS affects term infants

Answer: C — TTN: perihilar streaky opacities, fluid in fissures, cardiomegaly — clears within 24–48 hours; RDS: granular diffuse opacification, air bronchograms, low volumes

Explanation: TTN (wet lung): delayed absorption of fetal lung fluid, seen in term or near-term infants, especially C-section births. CXR: retained fluid (perihilar streaks, fissural fluid, pleural effusions), normal-to-high lung volumes. Clears rapidly (12–48h) with supportive care. RDS: surfactant deficiency in premature infants — diffuse granular (ground-glass) opacification, low volumes, air bronchograms.

10. The Radiopaedia pediatric radiology playlist includes a case of a child with an elbow injury. The CRITOE mnemonic helps remember the sequence of elbow ossification centers. What does CRITOE stand for?

- A) Coronoid, Radial, Intercondylar, Trochlear, Olecranon, Epicondyle
- B) Capitellum, Radial head, Internal (medial) epicondyle, Trochlea, Olecranon, External (lateral) epicondyle — in order of ossification
- C) Cortex, Radial shaft, Interosseous, Trochlear groove, Olecranon fossa, Epicondyles
- D) Cuboid, Radius, Insertion, Tendon, Ossification, Epiphysis

Answer: B — Capitellum, Radial head, Internal (medial) epicondyle, Trochlea, Olecranon, External (lateral) epicondyle

Explanation: CRITOE: the order of appearance of elbow ossification centers (approximate ages in years: C-1, R-3, I-5, T-7, O-9, E-11). An ossification center appearing 'out of order' or in an unexpected location suggests an avulsion fracture — the displaced fragment may be the medial epicondyle (most common pediatric elbow pitfall).

11. In suspected pediatric non-accidental trauma (NAT), what is a skeletal survey, and why is it performed?

- A) A single X-ray of the most injured area only
- B) A standardized series of 20+ views covering all skeletal regions to identify occult fractures, especially those in multiple stages of healing
- C) MRI of the entire body without radiation
- D) CT of the chest and abdomen only

Answer: B — A standardized series of radiographs of all skeletal regions (skull, spine, chest, extremities) to detect occult fractures in multiple stages of healing

Explanation: Skeletal survey in NAT: standardized views of skull (AP/lateral), spine (AP/lateral), chest (AP + dedicated rib views), pelvis, long bones (AP bilateral), hands, and feet. Multiple fractures at different stages of healing (acute + healing/callus) are highly suspicious for repeated abuse. ACR guidelines mandate specific views for completeness.

12. A child with cystic fibrosis presents with worsening respiratory symptoms. Which of the following CXR findings is most expected in advanced cystic fibrosis lung disease?

- A) Normal CXR
- B) Unilateral pleural effusion
- C) Hyperinflation, bronchiectasis (ring shadows and tramline opacities), peribronchial thickening, mucus plugging, upper lobe predominance
- D) Bilateral hilar adenopathy with no parenchymal changes

Answer: C — Hyperinflation, bronchiectasis (ring shadows/tramlines), peribronchial thickening, and upper lobe predominant involvement

Explanation: Cystic fibrosis CXR progression: early = hyperinflation (air trapping), peribronchial cuffing; advanced = bronchiectasis (ring shadows/tramlines = dilated thick-walled airways seen en face and in profile), mucus plugging, recurrent pneumonias, upper lobe predominance. CT shows bronchiectasis earlier and more definitively.

13. The ACR Approach to Pediatric Radiology Building Blocks module emphasizes which unique consideration when using iodinated IV contrast in neonates?

- A) Neonates require double the adult contrast dose per kilogram
- B) Neonatal thyroid is sensitive to iodine load from contrast, risking transient hypothyroidism — thyroid function should be monitored after contrast administration
- C) Iodinated contrast is absolutely contraindicated in all neonates
- D) Neonates never develop contrast-induced nephropathy

Answer: B — Risk of transient hypothyroidism due to iodine load, requiring thyroid function monitoring

Explanation: Neonatal considerations for iodinated contrast: the immature thyroid preferentially concentrates iodine and can be suppressed by large iodine loads (Wolff-Chaikoff effect), causing transient hypothyroidism. Guidelines recommend monitoring thyroid function in neonates and very young infants who receive IV contrast, particularly for cardiac catheterization. Weight-based dosing minimizes risk.

14. In pediatric radiology, the 'football sign' on an abdominal radiograph is associated with which condition?

- A) Massive pneumoperitoneum —
- B) Intussusception
- C) Meconium ileus
- D) Duodenal atresia

Answer: A — Massive pneumoperitoneum (free air outlining the entire peritoneal cavity, giving an American football shape)

Explanation: The football sign (also 'oval sign') appears on a supine abdominal radiograph when massive free intraperitoneal air outlines the entire peritoneal cavity in an elliptical shape, with falciform ligament visible centrally as a dark linear structure. Seen in neonates with bowel perforation (NEC, spontaneous perforation). The overlapping falciform ligament is called the 'Duke's sign.'