1. Based upon the post-contrast MRI image of the left breast shown, what is the MOST likely diagnosis?

A. Fibrocystic change
B. Sclerosing adenosis
C. Lobular carcinoma in situ
D. Ductal carcinoma in situ

**Key:** D

**Rationale:**
A. Incorrect. Fibrocystic changes usually are associated with diffuse stippled background enhancement rather than linear non mass clumped enhancement.
B. This benign entity is not usually associated with non mass linear enhancement.
C. LCIS does not typically enhance in a ductal distribution on MRI and does not have a classical enhancement pattern on MRI at all.
D. This pattern of enhancement is classically seen in DCIS where there is clumped non mass enhancement in a ductal distribution.
2. Stereotactic core biopsy of indeterminate calcifications in a 52-year-old woman demonstrated pleomorphic LCIS. What is the most appropriate recommendation?

A. Routine annual mammography
B. Six month follow up mammography
C. Breast MRI
D. Surgical excision

**Key:** D

**Rationale:**
A: While a histologic diagnosis of LCIS increases the patient's risk of developing breast carcinoma in either breast, surgical excision of the biopsy site is suggested due to the concern of undersampling.
B: The presence of LCIS on biopsy requires surgical excision due to the concern of undersampling. Six month follow up mammography would not be appropriate in this setting.
C: The presence of LCIS on core biopsy requires surgical excision due to the concern of undersampling. While these patients may benefit from screening annual MRI due to their overall increase risk of developing breast carcinoma, the next step in management is surgical excision.
D: In the presence of LCIS on core biopsy, surgical excision is the appropriate management due to the concern for undersampling.
3. According to MQSA guidelines, at what interval MUST this study be performed?

A. Daily
B. Weekly
C. Monthly
D. Annually

**Key:** B

**Rationale:**
A: The appropriate use of the phantom is to verify the presence of fibers (1.56 mm, 1.12 mm, 0.89 mm, 0.75 mm diameter), specks (0.54, 0.40, 0.32 mm diameter) and masses (2.0, 1.0, 0.75 mm thick) on a weekly basis.
B: The appropriate use of the phantom is to verify the presence of fibers (1.56 mm, 1.12 mm, 0.89 mm, 0.75 mm diameter), specks (0.54, 0.40, 0.32 mm diameter) and masses (2.0, 1.0, 0.75 mm thick) on a weekly basis.
C: The appropriate use of the phantom is to verify the presence of fibers (1.56 mm, 1.12 mm, 0.89 mm, 0.75 mm diameter), specks (0.54, 0.40, 0.32 mm diameter) and masses (2.0, 1.0, 0.75 mm thick) on a weekly basis.
D: The appropriate use of the phantom is to verify the presence of fibers (1.56 mm, 1.12 mm, 0.89 mm, 0.75 mm diameter), specks (0.54, 0.40, 0.32 mm diameter) and masses (2.0, 1.0, 0.75 mm thick) on a weekly basis.
4. A 76-year-old man presents for diagnostic evaluation of a palpable left breast mass. What is the most likely diagnosis?

A. Invasive ductal carcinoma  
B. Invasive lobular carcinoma  
C. Lipoma  
D. Gynecomastia  

Key: D

**Rationale:**
A: Incorrect. While invasive ductal carcinoma is the most common breast cancer in men (up to 85% of male breast cancer is invasive ductal in origin), the most common etiology of a palpable mass in a man is gynecomastia.
B. Incorrect. Invasive lobular carcinoma is extremely uncommon in men, who do not usually have breast lobules.
C. Incorrect. Lipomas may occur in men but in men who are sent for diagnostic evaluation of a palpable lump, the most common cause is gynecomastia.
D. Correct. The most likely etiology of a palpable breast mass in a male is gynecomastia.

**Reference:**
5. What is the appropriate BIRADS category for this image obtained on technologist performed screening ultrasound?

A.  0
B.  2
C.  3
D.  4

Key:  A

Rationale:
A. Correct. Needs additional imaging evaluation. On technologist performed screening ultrasound, an image such as this one would warrant repeat evaluation to determine if finding is real or artifactual.
B. Incorrect. Finding is not clearly benign. BIRADS 2 would not be appropriate.
C. Incorrect. This sonographic appearance is not probably benign (well circumscribed, uniformly hypoechoic etc.). BIRADS 3 would not be appropriate.
D. Incorrect. While finding may be suspicious, repeat targeted ultrasound is suggested to confirm prior to biopsy recommendation.

Reference:
Thomas Stavros, BREAST Ultrasound, Lippencott Williams and Williams, 2004, Ch 12.
6. This 22 year-old female submits static sonographic images from a study performed at an outside facility where biopsy had been suggested. Based on the submitted image, what is the most appropriate Bi-Rads Category?

A. 0
B. 1
C. 3
D. 4

Key: B

Rationale:
A. Incorrect. The ultrasound image demonstrates a normal rib posterior to the pectoralis muscle. No additional imaging is necessary to make the diagnosis.
B. Correct. BIRADS category 1 is appropriate for this normal structure.
C. Incorrect. Short term follow up (BIRADS 3) is not necessary when this is appropriately recognized as a normal rib.
D. Incorrect. Finding is not suspicious (BIRADS 4) and biopsy should not be recommended.
7. Ultrasound core needle biopsy of the mass shown was performed. Which of the following pathologies would be considered DISCORDANT with the imaging findings?

A. Invasive lobular carcinoma
B. Stromal fibrosis
C. Diabetic mastopathy
D. Pseudoangiomatous stromal hyperplasia (PASH)

**Key:** D

**Rationale:**
A. Incorrect. Invasive lobular carcinoma may appear on ultrasound as a shadowing mass. If pathology yields invasive lobular carcinoma, this is concordant.
B. Incorrect. Stromal fibrosis may appear as a dense shadowing mass on ultrasound.
C. Incorrect. Diabetic mastopathy classically presents as a shadowing mass/region on ultrasound.
D. Incorrect. Pseudoangiomatous stromal hyperplasia can have variable appearances but usually does not present as a dense shadowing mass.

**Reference:**
8. What is the MOST appropriate BIRADS assessment for this single, low density obscured mass seen at baseline screening?

A. 0  
B. 2  
C. 3  
D. 4

Key: A

Rationale:
A. Correct. When an obscured mass is seen on screening mammography, additional views are suggested to further evaluate the margins. BIRADS 0 would be appropriate.
B. Incorrect. A BIRADS 2 would not be appropriate before further work up is done.
C. Incorrect. BIRADS 3 would not be appropriate from a screening study. The patient needs to be called back for additional work up before designating this lesion a BIRADS 3.
D. Incorrect. A BIRADS 4 should not be assigned from screening. Additional work up to include additional mammographic views and ultrasound, as needed, should be performed.
9. This 25 year old patient underwent ultrasound for a palpable breast mass. Which of the following would be an indication for biopsy of this 2 cm mass?

A. Pain associated with the mass
B. Patient is not able to comply with follow up
C. Patient is pregnant
D. Multiple, bilateral similar appearing masses

**Key:** B

**Rationale:**
A. Incorrect. The mass has a probably benign appearance and most likely represents a fibroadenoma. Patients may at times report pain in association with the mass, especially with their menses. Pain alone is not an indication for biopsy.
B. Correct. If patient is unable to comply with follow up, biopsy may be considered. Follow up is necessary for this probably benign mass.
C. Incorrect. Pregnancy is not an indication for biopsy. Often patients present with masses during pregnancy which can then decrease in size following delivery.
D. Incorrect. Multiple bilateral similar appearing masses would indicate a benign process and would not necessitate biopsy.
10. Which kinetic curve enhancement pattern on breast MRI has the highest positive predictive value for carcinoma?
   A. Wash-in
   B. Wash-out
   C. Persistent
   D. Plateau

Key: B

Rationale:
A. Incorrect. Following the administration of contrast, there are 3 possible enhancement curves that can be seen on breast MRI. Wash-in curve is not one of the 3 curves.
B. Correct. Wash out curves have the highest predictive value for carcinoma.
C. Incorrect. Persistent curves typically show a continuous increase in signal intensity over time and only a small percentage of malignant lesions have this pattern.
D. Incorrect. Plateau pattern occurs when initial uptake is followed by the plateau phase over time and while may be concerning for malignancy, do not have the highest predictive value for carcinoma.

Reference:
1. What is the MOST likely diagnosis demonstrated on the provided images?

A. Cardiac myxoma  
B. Cardiac lipoma  
C. Papillary fibroelastoma  
D. Rhabdomyoma

Key: B

Rationale:
A. Incorrect. Myxomas typically have soft tissue attenuation on CT imaging and may be heterogeneous. The most common location for myxoma is the left atrium with attachment of the tumor to the fossa ovale.
B. Correct. Lipoma is the second most common benign tumor of the heart, following myxoma. Common locations include the atrial septum (as in this case), the right atrium and the left ventricle. As elsewhere in the body, they are composed of mature adipose cells, and are encapsulated. Imaging features of lipoma include circumscribed margins, uniform fat-density, and lack of significant enhancing components. Lipomas involving the atrial septum may be confused with lipomatous hypertrophy of the atrial septum, which is not a true neoplasm.
C. Incorrect. Papillary fibroelastomas are benign tumors of the heart, typically involving the valves. They are hypointense on T1 and T2-weighted MRI sequences due to their high fibrous content, however they would not be fat density on CT.
D. Incorrect. Rhabdomyomas are benign cardiac tumors that have an association with tuberous sclerosis. Unlike the angiomyolipomas that affect the kidneys of patients with tuberous sclerosis, cardiac rhabdomyomas do not typically contain fat. Rhabdomyomas typically affect the ventricular myocardium.

Reference:
2. What is the MOST common expected clinical presentation for this patient?

A. Asymptomatic
B. Dysphagia lusoria
C. Hypertension
D. Chest pain

Key: A

Rationale:
A. Correct. The aberrant right subclavian artery, the most common embryologic abnormality of the aortic arch, is usually asymptomatic and found incidentally.
B. Incorrect. In some instances, extrinsic compression of the esophagus by a dilated aberrant subclavian artery may lead to dysphagia. This phenomenon, first reported in 1794 by London physician David Bayford, was originally described as “dysphagia by freak of nature,” and is commonly referred to as dysphagia lusoria.
C. Incorrect. There is no reported association between an aberrant right subclavian artery and systemic hypertension.
D. Incorrect. Aneurysms of the aberrant right subclavian arteries may be symptomatic or clinically silent. Although symptoms may include chest pain, this is not the most common presentation of an aberrant subclavian artery.

Reference:
3. What is the BEST treatment option for the patient whose images are shown?

A. Coronary artery bypass grafting
B. Coronary artery stenting
C. Coronary artery angioplasty
D. Medical management

Key: D

Rationale:
A. Incorrect. The extensive transmural delayed enhancement indicates infarction and so the patient will not benefit from cardiac revascularization. This patient will be managed medically, including anticoagulation given the presence of a left ventricular thrombus.
B. Incorrect. The extensive transmural delayed enhancement indicates infarction and so the patient will not benefit from cardiac revascularization. This patient will be managed medically, including anticoagulation given the presence of a left ventricular thrombus.
C. Incorrect. The extensive transmural delayed enhancement indicates infarction and so the patient will not benefit from cardiac revascularization. This patient will be managed medically, including anticoagulation given the presence of a left ventricular thrombus.
D. Correct. Appropriate medical management is indicated to optimize cardiac function and improve survival while anticoagulation should be initiated in the absence of absolute contraindications to reduce the risk of thrombus progression or embolization.

Reference:
4. Which of the following is MOST closely associated with the abnormality shown on this image?

A. Hypertrophic cardiomyopathy
B. Sudden cardiac death
C. Atrial fibrillation
D. Coronary artery aneurysm

Key: B

Rationale:
A. Incorrect. Hypertrophic cardiomyopathy is not associated with anomalous coronary origin. Causes of left ventricular hypertrophy include systemic hypertension, autosomal dominant mutation, and idiopathic.
B. Correct. Anomalous origin of either the right or left coronary artery from the contralateral sinus of Valsalva with an interarterial course is associated with sudden cardiac death, especially during exercise. The exact mechanism of sudden cardiac death is unclear but may be related to compression of the anomalous artery between the aorta and pulmonary trunk, acute angulation at the vessel origin, or a slit-like ostium.
C. Incorrect. There is no documented association between anomalous origins of coronary arteries and atrial fibrillation.
D. Incorrect. Coronary artery aneurysms are most commonly the sequela of atherosclerosis. Other causes include vasculitis, infection, iatrogenic, and congenital. Anomalous origin of the right coronary artery from the left sinus of Valsalva is not associated with development of an aneurysm.

Reference:
5. Which of the following is present on this image?

A. Right ventricular dilatation
B. Right ventricular hypertrophy
C. Left ventricular hypertrophy
D. Normal anatomy

Key: A

Reference:

Rationale:
A: Correct. The right ventricle is definitely larger than the left, and it should be smaller than, or the same size as, the left ventricle.
B: Incorrect. The right ventricular myocardium is not thickened.
C: Incorrect. The left ventricular myocardium is not thickened.
D: Incorrect. The right ventricle is markedly dilated. Normally, the right ventricle is smaller than, or the same size as, the left ventricle.
6. Three weeks prior to obtaining this radiograph, the patient underwent an ablation procedure for atrial fibrillation. What complication has occurred?

A. Pulmonary vein stenosis  
B. Pneumothorax  
C. Esophageal pericardial fistula  
D. Pericarditis

Key: C

Reference:  

Rationale:
A. Incorrect. Although pulmonary vein stenosis is a reported complication following ablation procedures, there are no specific signs on this radiograph to definitively diagnose this condition.
B. Incorrect. There is no evidence of pneumothorax on this radiograph.
C. Correct. The radiograph demonstrates significant pneumopericardium, which occurring after left atrial ablation, is suggestive of a fistula between the pericardium and the esophagus. Esophageal pericardial fistula is a known delayed complication of atrial fibrillation ablation resulting from thermal injury of the anterior esophageal wall, which is in close proximity to the posterior wall of the left atrium. Subsequently, an esophageal ulcer can develop, which is followed by breakdown of the pericardium and fistula formation. When performing CT or MR prior to ablation procedures, it is important to include information regarding the relationship between the esophagus and the left atrium and pulmonary veins in the report.
D. Incorrect. The diagnosis of pericarditis is based on a combination of clinical symptoms, EKG changes, laboratory, echocardiogram and MRI findings. Radiographs alone play very little role in the definitive diagnosis of acute pericarditis.
7. What type of procedure has this patient undergone?

A. Inferior vena cava filter placement
B. Secundum atrial septal defect repair
C. Left atrial ablation
D. Mitral valve replacement

Key: B

Rationale:
A: Incorrect. The radiograph does not demonstrate the presence of an IVC filter.
B: Correct. The radiograph demonstrates a commonly used atrial septal defect (ASD) occluder. Such an occluder is utilized most commonly for small ostium secundum ASDs.
C: Incorrect. The image shows a radiopaque device in the location of the interatrial septum. No intracardiac device is permanently deployed during left atrial ablation procedures.
D: Incorrect. The radiograph does not demonstrate the appearance of a prosthetic mitral valve. Moreover, the location is slightly too cephalad for a mitral valve replacement.

Reference:
8. Phase-contrast MR images focused on the pulmonary valve are provided. Which of the following corrections would eliminate the artifact noted by the white arrowhead?

A. Obtaining more signal averages  
B. Increasing the velocity-encoded value (venc)  
C. Turning on all of the surface coil elements  
D. Changing the direction of the frequency-encoding gradient

Key: B

Rationale:
A. Incorrect. Obtaining more signal averages may increase signal, but will not eliminate aliasing artifact.
B. Correct. The artifact demonstrated in the images is aliasing artifact arising from the use of an inappropriately low velocity-encoded value (venc). The velocity-encoded variable is a value set by the operator during phase contrast imaging for flow evaluation (usually measured in cm/sec). This value is a measurement of the flow-sensitive gradient adjustment needed to achieve a phase shift of 180° in the area of blood flow. This value establishes the highest and lowest velocities that can be measured, with the venc being the upper limit of measurable velocities. If the velocity of flow through the region of interest is higher than the venc, aliasing will occur.
C. Incorrect. Failing to have coil elements turned on would lead to regional loss of signal, which is not demonstrated in the case.
D. Incorrect. Changing the direction of the frequency-encoding gradient would alter chemical shift artifact, but would not eliminate aliasing.

Reference:
9. What is the likely presenting symptom of this patient?

A. Bradycardia  
B. Ventricular tachycardia  
C. Heart failure  
D. Atrial fibrillation

**Key:** A

**Rationale:**
A. Correct. The patient has post-sternotomy changes and a pacemaker. The pacemaker lead wire overlying the left clavicle is fractured, making it non-functional.
B. Incorrect. The patient has post-sternotomy changes and a pacemaker. The pacemaker lead wire overlying the left clavicle is fractured, making it non-functional. The device in this patient is not a cardioverter-defibrillator.
C. Incorrect. There are no signs of pulmonary edema in this patient.
D. Incorrect. The patient has post-sternotomy changes and a pacemaker. The pacemaker lead wire overlying the left clavicle is fractured, making it non-functional. The most likely clinical presentation for this patient is bradycardia.

**Reference:**
10. You are shown 4 MRI images obtained before (A-B), during (C) and 10 minutes after the administration of Gadolinium-DTPA contrast media (D) in a toddler with failure to thrive, cardiac dysrhythmias, and abnormal echocardiography. What is the MOST likely diagnosis?

A. Myxoma
B. Fibroma
C. Papillary fibroelastoma
D. Thrombus

Key: B

Rationale:
A. Incorrect. Myxoma is the most common primary benign cardiac mass in adults. These tumors most often arise in close proximity to the fossa ovalis. Nearly 75-85% originate in the left atrium; up to 25% occur in the right atrium and/or extend through the fossa ovalis and about 5% arise within the ventricles. On HASTE sequences, myxoma is heterogeneous with signal intensity slightly higher than normal myocardium. On T1WI, myxoma is isointense relative to the myocardium and on T2WI the signal intensity is greater than the myocardium. STIR sequences show no fat suppression. SSFP sequences often reveal increased signal (T2/T1 ratio) secondary to the gelatinous composition of the tumor with a high fluid-like content (relative T2-weighting). Perfusion images show no uptake of Gd-DTPA by the tumor but heterogeneous enhancement of the myxoma is possible on delayed Gd-DTPA imaging.

B. Correct. Cardiac fibroma is a rare, benign, tumor of the heart, typically presenting in infancy or early childhood. The tumor is most often located in the ventricular septum or the ventricular wall. Fibroma is isointense relative to muscle on T1WI images and usually homogeneous and hypointense on T2WI images. Fibroma shows no contrast uptake during perfusion imaging and may demonstrate delayed enhancement, often in a heterogeneous fashion, from the periphery to the center.

C. Incorrect. Papillary fibroelastomas typically occur in adults and arise from the endocardium and are most commonly located on a valve leaflet. On MR, they show high signal on T2-weighted sequences, are isointense on T1-weighted sequences and demonstrate contrast enhancement.

D. Incorrect. Intracardiac thrombus is usually located in an atrial appendage. It is often broad-based but may have an irregular contour. On SSFP sequences, the signal intensity is isointense or lower than normal myocardium. Post-Gd-DTPA images show no to mild heterogeneous enhancement. The signal intensity characteristics of thrombus may also vary depending on acuteness or chronicity on the thrombus.

References:
1. You are shown axial CT images of a 65-year-old woman with dyspnea. What is the MOST LIKELY explanation for the findings demonstrated on CT?

A. Mucus  
B. Squamous cell carcinoma  
C. Tracheomalacia  
D. Amyloidosis

Key: B

Rationale:
A. Incorrect.  
B. Correct. Images show an isodense lesion within the trachea. One of the most common endotracheal lesion is squamous cell carcinoma. The image provided is consistent with a tracheal tumor.  
C. Incorrect. Tracheomalacia represents collapse of the trachea on expiration. This finding is not shown in the provided images.  
D. Incorrect. Amyloidosis causes circumferential thickening of the trachea with possible calcification. This finding is not shown in the provided images.
2. You are shown two CT images of a 32-year-old man with a low CD4 count. What is the MOST LIKELY diagnosis?

A. Pneumocystis carinii pneumonia  
B. Wegener granulomatosis  
C. Hypersensitivity pneumonia  
D. Pulmonary alveolar proteinosis

**Key:** A

**Rationale:**
A. Correct. PCP appears as ground glass opacities within both lungs, predominantly in both upper lobes. The finding is typically symmetric in nature. Well defined cysts or pneumatoceles are also present. Given the above findings, PCP is the correct answer.

B. Incorrect. Wegener granulomatosis typically appears as nodules with or without cavitation in the lungs. This finding is not shown in the provided images.

C. Incorrect. HP appears as centrilobular ground glass opacities in both lungs. This finding is not shown in the provided images.

D. Incorrect. PAP appears as ground glass opacities with superimposed intralobular septal thickening. This pattern has been called the crazy-paving pattern. This finding is not shown in the provided images.
3. You are shown two images of a 39-year-old woman. Which of the following can be found in association with this disease?

A. Perilymphatic nodules  
B. Hypercalcemia  
C. Pericardial effusion  
D. Chylothorax

**Key:** D

**Rationale:**
A. Incorrect.  
B. Incorrect.  
C. Incorrect.  
D. Correct. The images show well-defined cysts within both lungs with preservation of the lung architecture. The findings are suggestive of Lymphangioleiomyomatosis (LAM). Chylothorax and recurrent pneumothorax are associated with LAM. The other options are not associated with LAM.
4. Which of the following is the MOST common airway manifestation of Wegener granulomatosis?

A. Subglottic stenosis
B. Nodular calcification of tracheal cartilage
C. Long-segment bronchial stricture
D. Tracheobronchomalacia

**Key:** A

**Rationale:**
A. Correct. Circumferential thickening of the trachea with ulcer formation and tracheal luminal narrowing/stenosis are typical features seen in Wegener granulomatosis when the airway is involved. The other features are not seen.
B. Incorrect.
C. Incorrect.
D. Incorrect.
5. You are shown two images of a 41-year-old man presenting with cough. Staging of this disease is based primarily on which of the following?

A. CT scan of the chest
B. Chest radiography
C. Gallium-67 scan
D. Physical examination

Key: B

Rationale:
A. Incorrect.
B. Correct. The images show bilateral hilar adenopathy in a young individual. The history and radiographic findings suggest diagnosis of sarcoidosis. Staging of sarcoidosis is based on findings noted on the chest radiographs.
C. Incorrect.
D. Incorrect.
6. You are shown CT images of a 51-year-old man with dyspnea and history of lung carcinoma who is status-post erlotinib and radiation therapy. What is the MOST likely diagnosis?

A. Pulmonary hemorrhage  
B. Pulmonary edema  
C. Drug toxicity  
D. Pneumocystis pneumonia

Key: C

Rationale:
A. Incorrect. Hemorrhage may occur as a result of low platelet count, vasculities and drug toxicity. However in this case there is no hemoptysis which makes it less likely.
B. Incorrect. Edema is less likely. Pulmonary edema should be bilateral symmetric and diffuse and often accompanied by pleural effusions. Gravitational component of ground glass opacity is not present.
C. Correct. Ground glass, reticularity, patchy asymmetric distribution is consistent with ARDS, drug toxicity. Biopsy proven.
D. Incorrect. Although PCP pneumonia may have a similar radiographic appearance, there is no report of cough, fever, dyspnea as would be expected if the patient indeed had PCP.
7. What is the MOST common organism isolated from the sputum of a 35 year old woman with the following chest radiographs?

A. Respiratory syncytial virus
B. Coccidiomycosis
C. Escherichia coli
D. Pseudomonas aeruginosa

Key: D

Reference:

Rationale:
A. Incorrect. These infections are not commonly reported in patients with cystic fibrosis.
B. Incorrect. Endemic fungal infections are not commonly reported in Cystic Fibrosis.
C. Incorrect. It is usually not a respiratory pathogen.
D. Correct. Multicenter study showed 61% of patients with cystic fibrosis have infection with this organism.
8. A 24-year-old man with a history of right lower extremity amputation presents with hemoptysis. What is the MOST likely diagnosis?

A. Wegener granulomatosis  
B. Metastasis  
C. Hydatid disease  
D. Histoplasmosis

**Key:** B

**Rationale:**
A. Incorrect. As usually these pulmonary lesions are small nodules that are less than 1 cm in diameter with surrounding inflammatory changes.
B. Correct. Diagnosis based on morphology and particularly the clinical history.
C. Incorrect. Diagnosis as there are no internal septations, fluid contents or calcifications.
D. Incorrect. As the pulmonary lesions usually are small nodules with calcifications and without cavitation.
9. You are shown CT images of a 75-year-old man with shortness of breath. What is the MOST likely diagnosis?

A. Benign pleural effusion
B. Lymphoma
C. Mesothelioma
D. Talcosis

Key: C

Rationale:
A. Incorrect. As there is no homogenous layering water attenuation fluid present in the pleural space.
B. Incorrect. As there is no anterior mediastinal nodal mass. Also, bone destruction is unusual in lymphoma.
C. Correct. Diagnosis as there are classic features of locally advanced stage of mesothelioma in this case.
D. Incorrect. As there are no high attenuation pleural changes
10. You are shown a CT image of a 44 year old man. What is the MOST likely diagnosis?

A. Pneumocystis jiroveci pneumonia
B. Pulmonary alveolar proteinosis
C. Kaposi’s Sarcoma
D. Cryptogenic Organizing Pneumonia

Key: C

References:
Book covering diffuse pulmonary diseases

Rationale:
A. Incorrect. Not typically associated with effusions or lymphadenopathy. Commonly manifests with ground glass and upper-lobe predominant cystic changes.
C. Correct. Features of "flame-shaped" nodules/opacities in peribronchovascular distribution are classic features of Kaposi's sarcoma. Pulmonary involvement rarely develops in patients who do not already have mucocutaneous disease.
D. Incorrect. Rarely associated with pleural effusions.
1. A competent, adult patient is on the CT scanner. You have completed the needed sequences, but decide to try one new experimental sequence you are evaluating. It will only take another 3 minutes to perform the scan. You may do which one of the following?

A. Perform the added sequence and obtain patient consent following the procedure
B. Obtain the consent from the patient’s spouse, who is in the waiting room
C. Ask the patient for signed informed consent before performing the scan
D. Ask the patient for consent, and have him/her sign the consent form later

Key: C

2. What is a Common Procedural Terminology (CPT) code?

A. Classification developed by AMA describing procedures
B. Technical standard developed by ACR describing how to do a procedure
C. List of potential errors developed by Institute of Medicine by procedure
D. Terms developed by Joint Commission to describe hospital procedures

Key: A

Rationale:
A. AMA developed the CPT descriptions and updates the list annually.
B. ACR did not develop the CPT descriptions.
C. The Institute of Medicine did not develop the CPT descriptions.
D. Joint Commission did not develop the CPT descriptions

Reference:
Thorwarth, From concept to CPT code to compensation: how the payment system works, JACR 2004 1 (1) 48-53.
3. Services for which group of patients are paid under Hospital Outpatient Prospective Payment System (HOPPS)?

A. Medicare  
B. Private insurance  
C. Medicaid  
D. Health savings account  

Key: A

Rationale:  
A. The Hospital Outpatient prospective Payment System (HOPPS) pays hospitals for care provided to outpatients in hospitals.  
B. HOPPS does not cover private insurance care.  
C. HOPPS does not cover Medicaid patients.  
D. HOPPS does not cover health savings account patients.

Reference:  
4. In a pregnant woman with right lower quadrant pain (RLQ), fever, leukocytosis and clinical suspicion for appendicitis, which of the following is the MOST appropriate imaging study?

A. CT of the abdomen and pelvis without contrast
B. MRI of the abdomen and pelvis with contrast
C. Abdominal radiograph
D. Ultrasound of the RLQ

Key: D

Rationale:
A. Incorrect.
B: Incorrect.
C. Incorrect.
D. Correct. Discussion: Within the context of the ACR Appropriateness Criteria (Registered Trademark) for “Right Lower Quadrant Pain – Suspected Appendicitis,” this scenario would fall under the category of Variant 3: “Fever, leukocytosis, pregnant woman.” US (ultrasound) abdomen RLQ (D) received a rating of 8 (9=most appropriate) whereas MRI abdomen and pelvis without contrast (B) received a rating of 7, US pelvis (C) received a rating of 6 and CT abdomen and pelvis without contrast (A) received a rating of 5. Please see the “ACR Appropriateness Criteria (Registered Trademark): Right Lower Quadrant Pain – Suspected Appendicitis” for additional discussion.

Reference:
Right Lower Quadrant Pain – Suspected Appendicitis, ACR Appropriateness Criteria.
5. According to the ACR Appropriateness Criteria, for a child with fever (without any clinically apparent source) and neutropenia, which of the following is the MOST appropriate first imaging procedure?

A. Chest X-ray
B. CT of the sinuses
C. CT of the chest, abdomen and pelvis with contrast
D. MRI of abdomen and pelvis with contrast

Key: A

Rationale:
A. Correct. Discussion: Within the context of the ACR Appropriateness Criteria (Registered Trademark) for “Fever without Source – Child,” this scenario would fall under the category of Variant 5: “Child with fever and neutropenia.” X-ray chest (A) received a rating of 6 (9=most appropriate) whereas CT sinuses chest abdomen without contrast (B) received a rating of 3 and CT sinuses chest abdomen without and with contrast (C) received a rating of 2. Please see the “ACR Appropriateness Criteria (Registered Trademark): Fever without Source – Child” for additional discussion.
B. Incorrect.
C: Incorrect.
D. Incorrect.

6. The Privacy Rule within the Health Insurance Portability and Accountability Act (HIPAA) states that patient information may be released without specific written consent for three purposes only. These include treatment, payment and which of the following?

A. Teaching
B. Healthcare operations
C. Fundraising
D. Research

Key: B

Reference:
http://www.hhs.gov/ocr/privacy/hipaa/understanding/.
7. What does the FIRST character of the ICD-10-PCS code represent?

   A. Body Part
   B. Root Operation
   C. Regions
   D. Section Structure

   Key: D

8. Which division of The Department of Health and Human Services (HHS) is responsible for administering and enforcing HIPAA privacy and security standards?

   A. Centers of Medicare and Medicaid Services (CMS)
   B. Office of Civil Rights (OCR)
   C. Office of Inspector General (OIG)
   D. Office of the National Coordinator for Health Information Technology (ONC)

   Key: B

Reference:
http://www.hhs.gov/ocr/privacy/hipaa/understanding/.
9. To properly code a study, which of the following has the highest priority in determining the proper ICD-10 code?

A. Patient signs and symptoms  
B. Preexisting diagnoses provided from medical staff  
C. New diagnoses resulting from exam  
D. Past surgical history  

**Key:** C  

**Rationale:**  
A. Incorrect.  
B. Incorrect.  
C. Correct. Utilizing the myriad of clinical information appropriately is critical in order to not create fraudulent billing errors, either purposely or inadvertently. The priority one uses to code for ICD-10 is critical to prevent “… investigations of fraud and abuse”. Any new definitive diagnosis from a diagnostic exam takes precedence over the condition of the patient on initial presentation. Only last would preexisting diagnoses be used when appropriate and applicable. Often the new definitive diagnoses would encompass presenting patient data.  
D. Incorrect.  

**Reference:**  

10. When is it permissible for an outside visiting physician to observe multiple patients and examinations?

A. When consent has been obtained from each patient being observed  
B. Anytime, provided the physician cannot access protected health information (PHI)  
C. Whenever the physician has executed an a confidentiality agreement  
D. Anytime, provided the physician has a contractual relationship with the provider or provider's facility  

**Key:** A
1. Which of the following diseases is MOST frequently seen in patients with neutropenia who are undergoing chemotherapy?

A. Ischemic colitis  
B. Typhlitis  
C. Radiation colitis  
D. Graft-versus-host disease

**Key: B**

**Rationale:**
A. Incorrect. Ischemic colitis is typically seen in elderly patients.
B. Correct. Typhlitis is classically seen in neutropenic patients, such as post-transplant patients and those undergoing chemotherapy.
C. Incorrect. Patients with radiation colitis have a history of prior radiation therapy. D. Incorrect. GVHD is seen after stem cell transplants, and may affect any part of the gastrointestinal tract, but is most commonly seen in the small and large bowel.

**Reference:**
2. A 78 year old male presents with severe, acute abdominal pain. Based on the CT image provided, which of the following underlying disorders does the patient MOST likely have?

A. Chemotherapy-induced immunosuppression.
B. Adenomyomatosis
C. Diabetes mellitus
D. Acute cholangitis

**Key:** C

**Rationale:**
A. Incorrect. Chemotherapy is not a known predisposing factor for emphysematous cholecystitis.
B. Incorrect. Adenomyomatosis is not a known predisposing factor for emphysematous cholecystitis.
C. Approximately 30-50% of patients with emphysematous cholecystitis are diabetic.
D. Incorrect. While cholangitis and emphysematous cholecystitis may occur in the same patient, cholangitis is not a known predisposing factor for emphysematous cholecystitis.

**Reference:**
3. An anomalous junction of the common bile duct and pancreatic duct is an etiologic factor in which of the following?

A. Pancreas divisum
B. Choledochal cyst
C. Adenomyomatosis
D. Intraductal papillary mucinous neoplasm

Key: B

Rationale:
A: Incorrect. This is due to abnormal fusion of the dorsal and ventral pancreatic ducts.
B: Correct.
C: Incorrect. There is no association of adenomyomatosis of the gallbladder and duct embryology.
D: Incorrect. IPMNs are neoplastic and not related to abnormal embryology.

Reference:
4. Which of the following diverticula occurs at the Killian dehiscence?

A. Traction
B. Zenker
C. Killian-Jamieson
D. Epiphrenic

**Key:** B

**Rationale:**
A. Incorrect. Traction diverticula are most common at the level of the carina.
B. Correct.
C. Incorrect. They occur laterally, rather than at the midline Killian-Jamieson space.
D. False, these occur in the distal esophagus.

**Reference:**

5. Which one of the following conditions is an autoimmune enteropathy?

A. Mastocytosis
B. Amyloidosis
C. Celiac sprue
D. Whipple Disease

**Key:** C

**Rationale:**
A. Incorrect. Mastocytosis is a disorder characterized by mast cell proliferation and accumulation within various organs.
B. Incorrect. Amyloidosis results from the abnormal deposition of a particular protein, called amyloid, in various tissues of the body.
C. Correct. Patients with this disease have an inappropriate immune response to ingested gluten.
D. Incorrect. Whipple disease is caused by the bacterium Tropheryma whippelii.

**Reference:**
6. Which of the following is the MOST common benign splenic lesion?

A. Lymphangioma
B. Littoral cell angioma
C. Hemangioma
D. Hemangiopericytoma

**Key:** C

**Rationale:**
A. Incorrect. Hemangiomas are more common.
B. Incorrect. These are very rare.
C. Correct.
D. Incorrect. This is a neoplasm of uncertain biologic behavior.

7. What is the expected median survival in patients who undergo successful surgical resection for pancreatic adenocarcinoma?

A. 3 years
B. 2 years
C. 1.5 years
D. 5 months

**Key:** C
8. A Meckel diverticulum arises from persistence of which embryological structure?

A. Splanchno-umbilical duct  
B. Omphalo-mesenteric duct  
C. Paramesonephric duct  
D. Ligamentum venosum  

**Key:** B  

**Rationale:**  
A. Incorrect. It is due to a persistent vitelline or omphalo-mesenteric duct.  
B. Correct.  
C. Incorrect. The paramesonephric duct or Müllerian duct develops into the Fallopian tubes, uterus, cervix and one third of the vagina.  
D. Incorrect. The ligamentum venosum is the fibrous remnant of the ductus venosus of the fetal circulation. Usually, it is attached to the left branch of the portal vein.  

**Reference:**  

9. Which entity is MOST frequently associated with primary sclerosing cholangitis?  

A. Crohn disease  
B. Ulcerative colitis  
C. Retroperitoneal fibrosis  
D. AIDS  

**Key:** B  

**Rationale:**  
A. Incorrect. 13% of patient’s have Crohn's Disease.  
B. Correct. 70% of patients with PSC have UC.  
C. Incorrect. Only a minority of patients with PSC have RP fibrosis.  
D. Incorrect. AIDS cholangitis can produce radiographic findings similar to PSC, but they are not etiologically related.  

**Reference:**  
10. You are shown an abdominal radiograph in a patient who had a recent CT examination with intravenous contrast. Which of the following does the patient have?

A. Cholelithiasis
B. Cholecystitis
C. Cholangiocarcinoma
D. Normal gallbladder

Key: D

Rationale:
A. The film shows biliary excretion of contrast accumulating in a normal appearing gallbladder. The hepatic flexure of the colon is superimposed. There are no filling defects or contour deformities to indicate cholelithiasis.
B. The gallbladder would not fill with excreted contrast from the biliary tree in acute cholecystitis.
C. There are no filling defects or contour deformities to indicate cholelithiasis or cholangiocarcinoma.
D. This is a normal finding after intravenous contrast administration.

Reference:
1. A testicular germ cell tumor is MOST LIKELY to be a concern in which of the following patients?
   A. A patient with an intratesticular simple cyst
   B. A patient with acute onset of unilateral testicular pain
   C. A 25-year-old patient with painless enlargement of one of the testicles
   D. A 70-year-old patient with bilateral testicular enlargement of the testicles

   **Key:** C

   **Rationale:**
   A. Incorrect. Although a complex cystic lesion of the testicle would be concerning for neoplasm, a simple cyst in the testicle is expected to be benign.
   B. Incorrect. A testicular germ cell tumor could present with pain, but would usually be gradual in onset. Acute pain would more commonly be due to processes such as testicular torsion or epidymitis.
   C. Correct. Both the age of the patient and the presentation of unilateral painless enlargement would be typical for testicular germ cell tumor.
   D. Incorrect. An older patient is less likely to have a germ cell tumor, and with bilateral testicular enlargement, other tumors such as lymphoma or leukemia would be more likely.
2. This 29-year-old patient presents with the new onset of right flank pain. What is the MOST likely diagnosis?

A. Pyelonephritis
B. Ureteral mass
C. Vesicoureteral reflux
D. Ureteral calculus

Key: D

Rationale:
A. Incorrect. Reflux can result in pelvicaliectasis and concurrent pyelonephritis; however, an ipsilateral ureteral jet should be visualized as this ureter is not obstructed. Pyelonephritis can develop in the setting of an obstructed collecting system. A ureteral calculus would be a more common presentation of new onset flank pain in a young person.
B. Incorrect. A ureteral mass, such as transitional cell carcinoma, can result in pelvicaliectasis. However, ureteral tumors are less common in a young person than a ureteral calculus.
C. Incorrect. While vesicoureteral reflux can result in pelvicaliectasis, an ipsilateral ureteral jet should be visualized.
D: Correct. A ureteral calculus would be the most common explanation for ureteral obstruction in a young person presenting with new onset flank pain.
3. What is the MOST serious potential complication of a unicornate uterus with a rudimentary horn?
A. Severe dysmenorrhea
B. Spontaneous abortion
C. Rupture with pregnancy
D. Pelvic endometriosis

Key: C

Rationale:
A: Incorrect. While dysmenorrhea can be seen in the setting of unicornate uterus with a rudimentary horn, it is not life-threatening.
B. Incorrect. There is a high spontaneous abortion rate in unicornuate uteri, 37%; however, it does not result in maternal mortality.
C. Correct. It is uncommon for a pregnancy to develop in a noncommunicating rudimentary horn; however, 80-90% of pregnancies within a rudimentary horn result in uterine rupture and there is a 5.1% maternal mortality rate.
D. Incorrect. While endometriosis may be seen in the setting of unicornuate uterus with a rudimentary horn, it is not life-threatening.

4. Which uterine anomaly is associated with a horizontal uterine fundus?
A. Bicornuate uterus
B. Uterus didelphys
C. Unicornate uterus
D. Septate uterus

Key: D

Rationale:
A. Incorrect. This has a heart shaped uterine fundus, with indentation on the outer contour of the uterus.
B. Incorrect. In uterus didelphys, there will be a large cleft between the two uterine horns.
C. Incorrect. The outer contour of the uterine fundus in unicorneate uterus is convex.
D. Correct. Septate uterus has an internal septum dividing the uterine cavity, but has a flat, or horizontal, outer contour of the uterine fundus.

Reference:
5. What anatomical structure or space is involved in the pathological process demonstrated on this image?

A. The lacunar space of Smith
B. The tunica albuginea
C. The corpus spongiosum
D. The Dartos layer

**Key:** B

**Rationale:**
A. Incorrect. The lacunar space (Space of Smith) surrounds the tunica albuginea, and is superficial to where the calcification occur in Peyronie disease.
B. Correct. This represents calcified plaques of the penis related to Peyronie disease. Calcification is seen in the tunica albuginea and corpora cavernosa in this case, typical of Peyronie disease. The vast majority of plaques occur on the dorsal surface of the penis, most commonly in the distal penis.
C. Incorrect. Calcification with Peyronie disease occurs in the tunica albuginea or corpus cavernosa, not corpus spongiosum.
D. Incorrect. The Dartos fascia is a layer of connective tissue found in the penile shaft, foreskin, and scrotum. The calcified plaques of Peyronie disease do not occur there.

**Peyronie disease (PD): Abnormal curvature or penis typically with associated plaque, oftentimes causing sexual dysfunction. Plaques often form on tunica albuginea or corpora cavernosa. Fibrosis can also occur in septum and within corpora itself. Fibrosis can also occur in septum and within corpora itself. Vast majority of plaques occur on dorsal surface of penis. Nearly 1/2 of plaques occur in distal 1/3 of penis. Can cause painful erections, shortening of penis, uncertain etiology with possibilities including repetitive microtrauma, collagen vascular disease, and advancing age.**
6. Which of the following abnormalities MOST commonly co-exists with Mullerian duct abnormalities?
A. Horseshoe kidney
B. Duplication of the contralateral collecting system
C. Ipsilateral renal agenesis
D. Cystic renal dysplasia

Key: C

Rationale:
A. Incorrect. Horseshoe kidney is a common congenital renal abnormality, but is not associated with Mullerian duct abnormalities.
B. Incorrect. Duplication of the contralateral collecting system, while not uncommon, is not associated with Mullerian duct abnormalities.
C. Correct. Ipsilateral renal agenesis is the most common congenital abnormality seen with Mullerian duct anomalies.
D. Incorrect. Cystic renal dysplasia is a congenital abnormality of the kidney with lack of function of that kidney. It is not particularly associated with Mullerian duct abnormalities.
7. What is the MOST likely explanation for the filling defect shown in the image?

A. Obstructing stone
B. Crossing vessel
C. Blood clot
D. Urothelial neoplasm

Key: D

Rationale:
A. Incorrect. This image demonstrates a rounded filling defect with dilation of the ureter distal to the filling defect ("goblet sign"). Acute filling defects do not result in dilation of the ureter distal to the filling defect.
B. Incorrect. A crossing vessel would result in a linear, rather than rounded, filling defect. Crossing vessels are usually seen in the region of the uretereopelvic junction.
C: Incorrect. Acute filling defects do not result in dilation of the ureter distal to the filling defect.
D. Correct. This is a classic "goblet sign" which describes ureteral dilation below an intraluminal filling defect. This results from ureteral dilation due to ureteral peristalsis distal to a chronic mechanical obstruction.
8. If the location of the calculus is in question, what would you do before reimaging the pelvis?

A. Administer intravenous contrast  
B. Drain the bladder  
C. Perform a cystogram  
D. Place the patient in the prone position

Key: D

Rationale:
A. Incorrect. Administration of intravenous contrast would be something to consider if a calcification along the course of the ureter was indeterminate for being in the ureter or adjacent to it, although usually unnecessary. In this case, it may or may not help in clarifying whether the stone depicted in the right posterior bladder is within the bladder or within the uretero-vesical junction, and would not be the most simple approach.
B. Incorrect. Draining the bladder may or may not help, and would not be the most straightforward approach.
C. Incorrect. A cystogram would potentially obscure the finding and would not be the most straightforward approach.
D. Correct. Placing the patient prone would clarify whether the stone had already passed into the bladder, in which case it would drop to the anterior aspect of the bladder, or was still within an edematous UVJ, in which case it would not change position when the patient was prone.
9. The MOST appropriate next step in the management of this atraumatic patient is:

A. therapeutic dose anticoagulation and hyperbaric therapy.
B. immediate surgical consultation.
C. intravenous antimicrobial therapy and observation.
D. more frequent patient repositioning and wound checks.

Key: B

Rationale:
A. Incorrect. Gas is seen within the soft tissues of the scrotum, consistent with Fournier’s gangrene. Neither anticoagulation or hyperbaric therapy would be appropriate interventions.
B. Correct. Immediate surgical consultation is the appropriate next step, as Fournier’s gangrene represents a surgical emergency, requiring urgent debridement.
C. Incorrect. Antimicrobial therapy and observation would be inadequate treatment for Fournier’s gangrene.
D. Incorrect. More frequent patient repositioning and wound checks would be appropriate for treating a sacral decubitus ulcer, but would not be appropriate treatment for Fournier’s gangrene.
10. Which of the following is the MOST common uterine anomaly?

A. Septate uterus  
B. Bicornuate uterus  
C. Uterus didelphys  
D. Unicornuate uterus  

Key: A

Rationale:
A. Correct. Septate uterus is the most common uterine anomaly and is associated with an internal septum and outer horizontal fundal contour.  
B. Incorrect. Bicornuate uterus is the second most common uterine anomaly.  
C. Incorrect. Uterus didelphys is a relatively rare uterine anomaly.  
D. Incorrect. Unicornuate uterus is a relatively rare uterine anomaly.

Reference:
Review of uterine anomalies including SAM (self-assessment module).
1. You are shown images of the right and left common carotid arteries. Where was the patient MOST likely examined?

A. Emergency department  
B. Intensive care unit  
C. Vascular ultrasound laboratory  
D. Out-patient facility 

**Key:** B

**Reference:**
2. The median arcuate ligament syndrome affects what vascular structure?

A. Celiac axis  
B. Superior mesenteric artery  
C. Inferior mesenteric artery  
D. Left renal vein

**Key:** A

**Rationale:**
A. Correct. The characteristic finding for this entity is compression of the celiac artery by the median arcuate ligament of the diaphragm.
B. Incorrect.
C. Incorrect.
D. Incorrect. The left renal vein may occasionally be compressed by the superior mesenteric artery, but that is a different syndrome. See the rationale for the correct response.

**Reference:**
3. An infusion port was placed in a patient with cancer of the right lung who previously underwent radiation therapy, but now requires chemotherapy. What is the MOST LIKELY location of the tip of the catheter?

A. Azygous vein
B. Left superior vena cava
C. Descending aorta
D. Left atrium

Key: B

Reference:
4. You are the radiology resident covering the hospital from midnight to 8 am. After viewing this image, what action should you take?

![Image]

A. Call the ER for a pertinent history  
B. Call your back-up at home  
C. Call for a vascular interventionalist  
D. Call the MRI technologist  

Key: C

**Rationale:**
A. Incorrect.  
B. Incorrect. You must have the ability to make this diagnosis with confidence.  
C. Correct. This is a ruptured abdominal aortic aneurysm. Immediate intervention is required to prevent extravasation and death.  
D. Incorrect.

**Reference:**
5. The MOST important measure of cancer treatment effectiveness is:

A. overall response rate.
B. overall survival.
C. progression-free survival.
D. time to progression.

Key: B

Rationale:
A. Incorrect.
B. Correct. Overall survival remains the gold-standard endpoint for cancer research and trials, as well as for the measurement of treatment effectiveness by the US FDA and the European Medicines Agency.
C. Incorrect.
D. Incorrect.

Reference:
6. Uterine artery embolization leads to long-term control of fibroid-related symptoms in approximately what percentage of patients?

A. < 10%
B. 25%
C. 50%
D. 75%

Key: D

Rationale:
A. Incorrect.
B. Incorrect.
C. Incorrect. See rationale for the correct response.
D. Correct. 75% of patients’ symptoms are well controlled at 10 years.

Reference:
7. Vascular closure devices are designed for which of the following purposes?

A. Achieve hemostasis after vascular interventional procedures
B. Close atrial and ventricular septal defects
C. Treat active gastrointestinal hemorrhage
D. Repair aortic aneurysms and dissections

**Key:** A

**Rationale:**
A. Correct. Vascular closure devices are designed to close the arterial puncture wound at the end of the procedure.
B. Incorrect.
C. Incorrect.
D. Incorrect.

**Reference:**

8. The MOST common disease affecting the carotid artery is:

A. arteriovenous malformation.
B. atherosclerosis.
C. dissection.
D. fibromuscular dysplasia.

**Key:** B

**Rationale:**
A. Incorrect.
B. Correct. Atherosclerosis is the most common disease affecting the carotid artery.
C. Incorrect.
D. Incorrect.

**Reference:**
9. You are shown images obtained before and following an intervention performed on a 60-year-old woman presenting with refractory hypertension and a GFR of 45. What is the MOST likely benefit the patient will receive from this procedure?

A. Significantly improved control of hypertension
B. Preservation of renal function
C. Increased patient longevity
D. None

Key: D

Rationale:
A. Incorrect.
B. Incorrect.
C. Incorrect.
D. As eloquently written in the editorial in the NEJM, the answer is no. The only tangible consequence of renal artery stenting is the procedure-related risk of bleeding or vascular complication. The editorial states that beyond a reasonable doubt renal artery stenting is futile for patients with renal artery stenoses of about 75%, poorly controlled hypertension or stage 3 chronic kidney disease. There is no benefit to implanting stents for moderately severe obstructive renal vascular disease compared to medical therapy in preventing death from cardiovascular or renal causes, or preventing myocardial infarction, stroke, CHF, or progressive renal failure.

Reference:
10. A patient with abdominal pain and fever is referred from the emergency department for an abdominal CT scan. Based on this image, what is the MOST appropriate next step in management?

A. Emergency nephrostomy
B. Emergency nephrectomy
C. Renal ultrasound
D. Discharge with referral to a urologist

**Key:** A

**Rationale:**
A. Correct. There is an obstructed infected left kidney. Pus under pressure is dangerous. The kidney should be drained emergently.
B. Incorrect. The patient has emphysematous pyelitis, not emphysematous pyelonephritis. The collecting system is infected, but likely not the renal parenchyma. The kidney needs to be drained, not removed.
C. Incorrect. An obstructed infected kidney should be drained promptly. An ultrasound examination will offer too little new information to be useful.
D. Incorrect. The patient should not be discharged for follow-up care. This kidney should be drained promptly.

**Reference:**
1. You are shown an MR image of the right shoulder of a 29-year-old man. What is the MOST likely diagnosis?

A. Bankhart lesion
B. Deltoid muscle tear
C. Joint bodies
D. Long biceps tendon dislocation

Key: D

Rationale:
A. Incorrect. The visualized glenoid labrum is normal.
B. Incorrect. The visualized deltoid muscle is normal.
C. Incorrect. Although a cartilaginous and/or bony joint body may have a similar appearance, the absence of the long biceps tendon at the bicipital groove and the associated subscapularis tendon tear are features of a dislocated LHBT.
D. Correct. There is a focal, round, low SI lesion at the anterior gleno-humeral joint. There is a tear at the subscapularis tendon insertion. There is no tendon at the bicipital groove.

Reference:
2. In an inversion injury, the first ankle ligament to tear is the:

A. calcaneofibular.
B. anterior talofibular.
C. posterior talofibular.
D. lateral talocalcaneal.

**Key:** B

**Rationale:**
A. Incorrect. This is the second ligament to tear.
B. Correct. This is the weakest of the lateral ankle ligaments, and the first to tear with an inversion injury.
C. Incorrect. The strongest of the lateral complex, the posterior talofibular ligament is rarely injured.
D. Incorrect. This is not considered one of the three components of the lateral collateral ligament complex. It assists in subtalar stability.

3. Dermatomyositis is associated with an increased incidence of which of the following?

A. Malignancy
B. Coronary artery disease
C. COPD
D. Erosive arthritis

**Key:** A

**Rationale:**
Dermatomyositis, one of the inflammatory myopathies, may be associated with malignant neoplasms, including genitourinary, gynecologic, breast, esophageal, GI and lung, as well as melanoma. This is more common with dermatomyositis rather than polymyositis without skin abnormalities and is much more frequent in middle age and older men, the prevalence increasing with age.

**Reference:**
4. The muscles of the anterior compartment of the leg are responsible for which movements?

A. Knee extension  
B. Ankle dorsiflexion  
C. Ankle plantar flexion  
D. Toe flexion

**Key:** B

**Rationale:**
A. Incorrect. The quadricieps muscles are responsible for knee extension.
B. Correct. The muscles of the anterior compartment of the leg are responsible for ankle dorsiflexion.
C. Incorrect. The soleus, gastrocnemius, posterior tibial and flexor tendons are responsible for ankle plantar flexion.
D. Incorrect. The flexor hallucis and digitorum longus tendons are responsible for toe flexion.

**Reference:**
5. A 75-year-old woman presents with left hip pain. Which of the following is associated with the pathology demonstrated?

A. Bacterial infection  
B. Osteosarcoma  
C. Radiation therapy  
D. Breast Cancer

**Key:** B

**Rationale:**
Cortical thickening and coarsening of the trabeculae are diagnostic of Pagets disease. Of the choices listed, only osteosarcoma is associated with Pagets disease. It is the most common malignancy that arises in Pagetoid bone, although this phenomenon is very rare.

**Reference:**
6. Which one of the following is characteristically associated with unilateral sacroiliitis?

A. Ankylosing spondylitis
B. Adult rheumatoid arthritis
C. Psoriasis
D. Tuberculosis

Key: D

Rationale:
A. Incorrect. AS is characterized by bilateral, symmetric sacroiliitis which is an essential diagnostic criterion.
B. Incorrect. Sacroiliitis is seen in juvenile rheumatoid arthritis, but is not a feature of adult onset RA. There is, however, a strong association with psoriatic arthritis where radiographic evidence has been reported in over 75% of patients.
C. Incorrect. There is a strong association of sacroiliitis with psoriatic arthritis. Radiographic evidence has been reported in over 75% of patients. Involvement is usually bilateral and fairly symmetric although bilateral symmetry is less common than that seen in patients with AS.
D. Correct. Septic sacroiliitis is always more likely to be unilateral.

Reference:
7. Which one of the following radiographic findings is characteristic of neuropathic osteoarthropathy?

A. Periostitis
B. Fracture
C. Osseous erosion
D. Soft tissue calcification

Key: B

Rationale:
A. Incorrect. Periosteal reaction is not characteristic of neuropathic disease.
B. Correct. In addition to malalignment, fracture and fracture fragmentation, in a pattern atypical for acute trauma, are characteristic of neuropathic osteoarthropathy. The term osteoarthropathy is a reminder that both the bone and joint is involved.
C. Incorrect. Bone fractures, fragments and resorbs in cases of neuropathic disease. Osseous erosion is characteristic of osteomyelitis in the diabetic foot.
D. Incorrect. Fracture fragmentation with osseous debris is typical of neuropathic disease. Soft tissue calcification is not.

Reference:
8. Which one of the following is characterized by the absence of calcification?

A. Synovial chondromatosis
B. Soft tissue hemangioma
C. Synovial sarcoma
D. Pigmented villonodular synovitis

Key: D

Rationale:
A. Incorrect. Synovial chondromatosis is a benign, neoplastic proliferative disorder of the synovium characterized by numerous cartilagenous bodies that tend to calcify and/or ossify.
B. Incorrect. A characteristic feature of soft tissue hemangioma is the phlebolith.
C. Incorrect. Approximately one third of synovial sarcomas calcify. This calcification may appear amorphous and randomly distributed throughout the soft tissue mass.
D. Correct. PVNS is a benign neoplastic proliferative disorder of the synovium characterized by the lack of lesional calcification.

Reference:
9. What underlying condition is present?

A. Osteomalacia
B. Hyperparathyroidism
C. Osteoporosis
D. Pagets Disease

Key: C

Rationale:
A. Incorrect. Looser zones are focal, incomplete, linear lucencies with sclerotic margins, perpendicular to the cortex occurring at characteristic sites: axillary margin of the scapula, ribs, pubic rami, dorsal ulna and the inner concave margin of the proximal femur. These "pseudofractures" are often bilateral and symmetric.
B. Incorrect. Hyperparathyroidism results in bone resorption, not focal bone production.
C. Correct. Patients with osteoporosis treated with bisphosphonates, may develop a unique stress reaction and subsequent fracture at the proximal sub-trochanteric femur. Bone marrow edema may be demonstrated with MR imaging early on. Early radiographic findings consist of focal new bone formation with linear lucency within, at the lateral sub-trochanteric cortex.
D. Incorrect. There is no diffuse cortical thickening or coursing of the trabeculae that is characteristic of Pagets disease.

Reference:
10. Which one of the following is MOST commonly associated with the abnormality demonstrated?

A. Ankylosing spondylitis
B. Rheumatoid arthritis
C. DISH (diffuse idiopathic skeletal hyperostosis)
D. Scheuermann disease

Key: C

Findings: There is thick, flowing ossification of the posterior longitudinal ligament of the thoracic spine.

Rationale:
A. Incorrect. Ligamentous, facet and costovertebral joint capsule ossification along with syndesmophyte formation is a characteristic feature of AS. Isolated thick ossification of the posterior longitudinal ligament, however, is not.
B. Incorrect. Rheumatoid arthritis characteristically involves the cranio-cervical junction, sparing the thoracic spine. Bone production is not typical of adult sero + RA. There is no association with OPLL.
C. Correct. DISH is characterized by thick, flowing ossification of the anterior longitudinal ligament with relative preservation of the disc spaces. There is a strong association with OPLL.
D. Incorrect. Scheuermanns disease consists of multiple vertebral body endplate irregularities (Schmorls node formation) and anterior vertebral body wedging with increased kyphotic angulation. There is no association with OPLL.

Reference:
1. Concerning olfactory neuroblastoma, what is the classic imaging and clinical presentation?

A. Involvement of the nasal cavity only in patients between the ages of 30 and 40
B. Cribriform plate, orbital, nasal involvement in patients older than 50
C. Maxillary sinus involvement in a child
D. Sphenoid and clivus involvement in the elderly

Key: B

Rationale:
The data on the epidemiology of olfactory neuroblastomas come from an analysis of 311 cases in the Surveillance, Epidemiology, and End Results (SEER) database over a 30-year period. In this study, the mean age at presentation was 53 years, with most cases occurring in patients between 40 and 70 years. There was a moderate male predominance, with a 55:45 male:female ratio. Nasal obstruction due to the presence of a mass is the most common symptom with olfactory neuroblastoma and is present in the majority of cases. Other manifestations of local disease include epistaxis, nasal discharge, and/or pain. Examples of symptoms due to local extension of tumor include:

- Anosmia caused by tumor extension into the cribriform plate
- Pain, proptosis, diplopia, and excessive lacrimation due to orbital extension
- Ear pain and otitis media because of obstruction of the eustachian tube
- Frontal headache due to involvement of the frontal sinus

Reference:
2. You are shown axial T2-weighted MR image (the first image) and pre-contrast and post-contrast axial T1-weighted MR images (the second and third images) from a 42-year-old man with painless proptosis. What is the MOST likely diagnosis?

A. Optic glioma
B. Hemangioma
C. Meningioma
D. Pseudotumor

Key: B

Rationale:
A. Incorrect. The lesion is intraconal but distinct from the optic nerve from which optic gliomas arise. This is most readily apparent in image three.
B. Correct. Orbital hemangiomas are the most common benign lesion of the orbit in an adult. They are soft tissue signal and enhance avidly.
C. Incorrect. Optic nerve meningiomas encase the optic nerve and present with a “tram track” appearance where the nerve is preserved but encased and surrounded by enhancing neoplasm.
D. Incorrect. Pseudotumor is typically painful at presentation with an inflammatory appearance that includes infiltration of the retroglobar fat.

Reference:
3. Intrauterine CMV infection is MOST often associated with:

A. septooptic dysplasia.
B. subcortical calcifications.
C. subcortical tubers.
D. periventricular calcifications.

Key: D

Rationale:
A. Incorrect. Septooptic dysplasia is associated with various genetic mutations as well as intrauterine cocaine exposure and valproate toxicity. It is not associated with Intrauterine CMV infection.
B. Incorrect. Subcortical calcifications are more commonly seen in congenital Zika virus infection as opposed to periventricular calcifications seen in CMV.
C. Incorrect. Subcortical tubers are seen in tuberous sclerosis, one of the phakomatoses.
D. Periventricular calcifications are seen in association with congenital CMV infection which falls into the group of infections referred to as the “TORCH” group of infections, The original concept of the TORCH perinatal infections was to group five infections with similar presentations, including rash and ocular findings. These five infections are: Toxoplasmosis, Other (syphilis), Rubella, Cytomegalovirus (CMV), Herpes simplex virus (HSV).

Reference:
4. Which of the following is a risk factor for the development of intracranial aneurysms in an adult?

A. Hypertension
B. Alcoholism
C. Male gender
D. Autosomal dominant polycystic kidney disease

Key: D

Rationale:
A. Incorrect: The association between hypertension and aneurysm formation and rupture has been controversial, although the balance of evidence suggests that hypertension is a risk factor. Though this is a possible answer, the proven association with ADPKD is the better answer in this case.
B. Incorrect: Because intracranial aneurysms are the major etiology of SAH, risk factors for SAH may also be risk factors for intracranial aneurysms. Risk factors for SAH include cigarette smoking, and alcohol consumption. Therefore, though alcoholism is a possible answer, ADPKD is the better answer.
C. Incorrect: There is a female preponderance for aneurysms ranging from 54 to 61 percent.
D. Correct: Autosomal dominant polycystic kidney disease (PKD) is associated with a 6.9 times higher risk of intracranial aneurysm.

Reference:
5. Premature closure of the cranial sutures (craniosynostosis) MOST frequently involves which suture?
   A. Coronal
   B. Squamosal
   C. Sagittal
   D. Metopic

**Key:** C

**Rationale:**
Sagittal suture synostosis is most common. Sagittal 60%, coronal 20-30%, metopic 1-2%, lambdoid 1%.

**Reference:**
6. You are shown two unenhanced CT images (bone and brain windows both shown). What is the diagnosis?

A. Aneurysm
B. Meningioma
C. Chondrosarcoma
D. Craniopharyngioma

**Key:** A

**Rationale:**
A. Correct. The most important lesion to exclude in the differential of a parasellar / sellar / suprasellar mass is aneurysm. The peripheral calcifications and location in the cavernous sinus are most concerning for an aneurysm of the cavernous internal carotid artery. This was confirmed by subsequent CTA.
B. Incorrect. 20-25% of meningiomas calcify. Most often the pattern is solid or scattered. The rim pattern of calcification is the least common.
C. Incorrect. Skull base chondrosarcoma has its epicenter typically at the petro-occipital fissure. The chondroid matrix may have rings and arcs, however it is unlikely to have the appearance seen in this case.
D. Incorrect. Although 90% of craniopharyngiomas in the pediatric population will have calcification which may be rim like, this lesion is generally suprasellar (75%) / sellar (4%) / or both (21%) in location. It is not likely to present within the cavernous sinus. Adult craniopharyngiomas are more solid and with a lower incidence of globular calcification.

**Reference:**
7. You are shown three images from a CT study performed on a 23-year-old woman who is 32 weeks pregnant. She reported nausea and vomiting on admission and has now become slightly obtunded. What is the MOST LIKELY etiology of the imaging findings?

A. Trauma
B. Infection
C. Neoplastic
D. Vascular

**Key:** D
8. A patient with prostate carcinoma presents with acute lower extremity weakness and incontinence. Metastatic disease in what space MOST likely results in spinal cord compromise?

A. Epidural  
B. Subdural  
C. Subarachnoid  
D. Intramedullary  

Key: A

Rationale:
A. Correct. The epidural space is the most common location for prostate carcinoma to result in cord compression.  
B. Incorrect. Metastasis to the subdural space is rare. This is a potential space and may be expanded by hematoma or infection, although these are also less common than in the epidural space.  
C. Incorrect. Subarachnoid seeding of metastasis is less common than epidural disease. This type of tumor spread is more commonly seen with medulloblastoma or breast carcinoma.  
D. Incorrect. Intramedullary metastasis is uncommon except in the most advanced stages of disease. Patients will usually present with symptoms due to metastasis in other locations.

Reference:
9. A 35-year-old female presents with 5 months of left hip pain. You are shown STIR and contrast enhanced T1 weighted MRI of the lumbar spine. What is the MOST likely diagnosis?

A. Paraganglioma
B. Schwannoma
C. Meningioma
D. Drop metastasis

Key: A

Rationale:
A. Correct. Extra-adrenal paragangliomas may occur in the spine, most commonly at the cauda equina. They present as smooth, lobulated intradural, extramedullary enhancing masses. Serpentine flow voids are common and represent draining veins. As these are highly vascular masses, a hemosiderin cap or intrathecal blood products may be seen.
B. Incorrect. A schwannoma may present as a smoothly marginated intradural, extramedullary enhancing mass. However they are much less vascular than paragangliomas, so serpentine flow voids would be unlikely. Additionally, hemorrhage is much less likely with a schwannoma.
C. Incorrect. Spinal meningiomas most commonly occur in the thoracic spine and are less common in the cauda equina. They present as smoothly marginated dural based masses often with reactive dural thickening the so-called “tail sign.” Associated hemorrhage is rare.
D. Incorrect. Intrathecal drop metastases may present as smoothly marginated enhancing masses in the cauda equina. They are often multiple and may be associated with nerve root thickening and enhancement or “sugar coating” of the distal cord. These findings are typically seen in advanced cancer cases and history is known.

References:
10. The axial T1 fat saturation image of the neck demonstrates a large left tonsillar mass. At what level is the pathologic lymphadenopathy?

A. I 
B. II 
C. III 
D. IV 

Key: B

Rationale:
A. Incorrect. The pathologic lymph nodes are at level 2.
B. Correct. The pathologic lymph nodes are above the hyoid bone consistent with level 2.
C. Incorrect. No. Level 3 would be below the hyoid.
D: Incorrect. No. Level 4 is below the cricoid.

Reference:
Lymph nodes of the neck. P M Som, Published Online: Dec 1 1987https://doi.org/10.1148/radiology.165.3.3317494.
Nuclear Radiology
In-Training Test Questions
for Diagnostic Radiology Residents

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1. Gallium-67 citrate scintigraphy is preferred over In-111 leukocyte scintigraphy in which one of the following entities?

A. Abdominal abscess  
B. Infected joint prosthesis  
C. Disc space infection  
D. Inflammatory bowel disease

**Key:** C

**Rationale:**
A. Incorrect. While both radiopharmaceuticals are efficacious for the detection of abdominal abscesses, Indium-111 leukocyte imaging is often preferred, as the result of the absence of potentially confusing normal bowel activity, as occurs in Gallium-67 scintigraphy. This normal bowel uptake may lead to false positive gallium studies.

B. Incorrect. Indium-111 leukocyte imaging is superior to gallium-67 scintigraphy in the evaluation of suspected infected joint prostheses, in part related to the bone seeking properties of gallium, leading to potential false positive gallium studies due to increased tracer localization secondary to increased bone turnover in the absence of infection.

C. Correct. While sensitive for osteomyelitis, Indium-111 leukocyte scintigraphy has been found to be less sensitive than gallium-67 scintigraphy for the detection of disc space infection.

D. Incorrect. Again, the absence of normal bowel localization makes In-111 leukocyte scintigraphy better suited to the assessment of active inflammatory bowel disease. In gallium-67 scintigraphy, normal bowel uptake, especially in the colon, can be incorrectly attributed to inflammatory bowel disease.

**Reference:**
2. Based upon these static images from a Tc-99m macroaggregated albumin (MAA) pulmonary perfusion scintigram, what is the MOST likely explanation for the image findings?

Findings: There are focal areas of increased tracer uptake noted in the left mid-lung field, near the left major fissure, and also in right middle lobe. There are no significant perfusion defects demonstrated.

A. Tc-99m sulfur colloid was injected instead of Tc-99m MAA.
B. There is significant alumina breakthrough in the radiopharmaceutical.
C. Blood clot was introduced into the syringe during radiopharmaceutical injection.
D. The patient has multiple pulmonary arteriovenous malformations.

Key: C.

Rationale:
A. Incorrect. If sulfur colloid were injected instead of MAA, then the biodistribution of the tracer would follow that of the smaller sulfur colloid particles, resulting in uptake within the liver, spleen and bone marrow, without significant pulmonary uptake. Focal areas of increased activity within the lungs would not result.

B. Incorrect. Alumina breakthrough can result in particle formation in a non-particulate radiopharmaceutical or formation of larger particles in a particulate radiopharmaceutical. For example, excessive alumina breakthrough can result in significant pulmonary uptake on a sulfur colloid liver-spleen scan. However, alumina breakthrough is unlikely to produce particles sizes large enough to result in the focal “hot spot” artifacts noted in this case. The findings in the present case are much more commonly produced via the mechanisms discussed below, namely, aggregation of MAA particles secondary to formation of blood clots in the syringe or from settling of the suspended particles (see C below).

C. Correct. The focal areas of increased tracer uptake demonstrated in the left mid-lung field, near the major fissure, and in the right middle lobe are consistent with focal areas of aggregation of the MAA particles, most likely due either to introduction of blood into the radiopharmaceutical syringe during injection (ie., drawing blood into the syringe) or failure to properly suspend the particles or re-suspend them, if the syringe had been left sitting in the radiopharmacy for a long period of time prior to injection.

D. Incorrect. The findings in this case are consistent with a radiopharmaceutical artifact, as discussed above. Furthermore, pulmonary arteriovenous malformations (AVMs), when large enough to resolve, would present as focal areas of decreased tracer uptake, secondary to shunting of blood via the AVMs from the venous to arterial circulation, bypassing the pulmonary capillary bed, and thus not trapped within it. Therefore, the presence of multiple pulmonary AVMs is not a viable explanation for the findings in this case.

Reference:
3. You are shown maximum intensity projection (MIPS) coronal, transaxial and sagittal F-18-fluorodeoxyglucose (FDG) PET images obtained in an adult patient (Figure 6). What is the MOST LIKELY diagnosis?

A. Bronchogenic carcinoma  
B. Breast carcinoma  
C. Hodgkin’s Disease  
D. Malignant melanoma

Key: D

Findings: There are numerous focal areas of increased tracer uptake noted in the chest, abdomen and pelvis, many of which are clearly located in the subcutaneous tissues of the abdominal wall and chest wall, best seen on the selected transaxial and sagittal images provided.

Rationale:  
A. Incorrect. While several of the lesions demonstrated do project over the lung fields on the MIPS image, the sagittal image demonstrates that at least several are located in the soft tissues of the posterior chest wall, rather than in the lungs. In addition, there is no single dominant lesion that appears to be within a lung. While not excluded, bronchogenic carcinoma is a less likely etiology for these findings than melanoma.
B. Incorrect. As discussed above, the predominance of subcutaneous lesions is less characteristic of metastatic breast carcinoma than of melanoma. There is no lesion demonstrated in the breast, and there is also no evidence of axillary adenopathy or hepatic metastases, which would also commonly occur in metastatic breast carcinoma. Therefore, while not excluded, metastatic breast carcinoma is a less likely etiology for the findings than melanoma.
C. Incorrect. As discussed above, the pattern of subcutaneous lesions is more characteristic of melanoma than lymphoma, particularly in the absence of significant lymph node involvement. While some non-Hodgkin’s lymphomas may primarily involve the skin, this pattern of involvement is not common in Hodgkin’s disease.
D. Correct. Metastatic malignant melanoma is the most likely diagnosis. The pattern of extensive, markedly hypermetabolic lesions in the subcutaneous soft tissues is most characteristic of metastatic malignant melanoma.

Reference:  
4. An exponential pattern of gastric clearance is associated with the gastric emptying of which of the following?

A. Solids only
B. Liquids only
C. Both solids and liquids
D. Neither solids nor liquids

**Key:** B

**Rationale:**
A. Incorrect. Solid-phase gastric emptying studies typically demonstrate an initial lag phase followed by linear gastric emptying in normal subjects.
B. Correct. Liquids follow a monoexponential pattern of gastric emptying normal. Liquid gastric emptying studies are less sensitive than solid-phase studies for the assessment of gastroparesis.
C. Incorrect. As discussed above, the normal patterns of gastric emptying are an initial lag phase followed by linear emptying of solids and a monoexponential emptying of liquids.
D. Incorrect. As discussed above, the normal patterns of gastric emptying are an initial lag phase followed by linear emptying of solids and a monoexponential emptying of liquids.

**Reference:**
5. You are shown multiple 48 hour planar images obtained in a 56 year-old male presenting with recurrent tachycardia after prior right hepatectomy for tumor resection. Which one of the following medications needs to be discontinued prior to this study?

A. Propylthiouracil  
B. Tricyclic antidepressants  
C. Amiodarone  
D. Levothyroxine

**Key:** B

**Rationale:**
A. Incorrect. PTU should be held when performing thyroid scans.  
B. Correct. Tricyclic antidepressants interfere with uptake of I-123 MIBG, which is the exam shown.  
C. Incorrect. Amiodarone can interfere with thyroid function.  
D. Incorrect. Levothyroxine would interfere with a thyroid uptake and scan.

**Reference:**
6. A 43-year-old male patient who is HIV positive presents with fever and back pain, with point tenderness in the thoracic spine on physical examination. Radiographs of the thoracic spine (not shown) are negative. Which of the following is the MOST appropriate scintigraphic workup for suspected osteomyelitis?

A. Indium-111 leukocyte scan  
B. Three-phase Tc-99m MDP bone scan  
C. Gallium-67 citrate scan  
D. Combined Tc-99m MDP and gallium-67 citrate scans

Key: D

Rationale:
A. Incorrect. In-111 leukocyte can be used in infection imaging, but has been shown to have false positive results in discitis osteomyelitis.  
B. Incorrect. Tc-99m MDP by itself is not appropriate as positive findings on a scan are nonspecific. Trauma, tumor, inflammation, etc can be present when bone scans are positive.  
C. Incorrect. Ga-67 citrate is an infection agent but must be correlated with skeletal scintigraphy for greatest specificity.  
D. Correct. The combination of skeletal scintigraphy and Ga-67 citrate is the most appropriate choice to assess discitis osteomyelitis as far as NM exams are concerned. The relative intensity and extent of uptake between the two studies are compared to assess underlying infection.

Reference:  
7. Which of the following malignancies may be treated with yttrium-90 ibritumomab (Zevalin®)?

A. Multiple myeloma
B. Leukemia
C. Non-Hodgkin’s lymphoma
D. Hodgkin’s disease

Key: C

Rationale:
A. Incorrect. Zevalin is not indicated for multiple myeloma.
B. Incorrect. Zevalin is not indicated for leukemia.
C. Correct. Zevalin is indicated for low-grade or follicular B-cell NHL that has relapsed during or after treatment with other anticancer drugs and newly diagnosed follicular NHL following a response to initial anticancer therapy.
D. Incorrect. Zevalin is not indicated for HD.

Reference:
8. Regarding Tc-99m sulfur colloid scintigraphy in focal nodular hyperplasia, which cell line is responsible for radiotracer uptake by this lesion?

A. Hepatocytes
B. Reticuloendothelial cells
C. Bile canaliculi cells
D. Lymphatic duct cells

**Key:** B

**Rationale:**

A. Incorrect. Although the liver does show activity, the tracer does not localize to the hepatocytes.

B. Correct: Tc-99m sulfur colloid localizes to the reticuloendothelial system, therefore the liver, spleen, and bone marrow show activity.

C. Incorrect: Tc-99m is not excreted into the biliary system.

D. Incorrect: Tc-99m is not excreted into the lymphatic system.

**Reference:**
9. Regarding Nuclear Regulatory Commission (NRC) dose limits for occupational exposure, what is the annual whole-body total effective dose equivalent limit?

A. 5 mrem (0.05 mSv)
B. 500 mrem (5 mSv)
C. 5 rem (50 mSv)
D. 15 rem (150 mSv)

Key: C

Rationale:
A. Incorrect. The NRC allows 50 mSv of annual whole body occupational exposure.
B. Incorrect. The NRC allows 50 mSv of annual whole body occupational exposure.
C. Correct. The NRC allows 50 mSv of annual whole body occupational exposure.
D. Incorrect. The NRC allows 50 mSv of annual whole body occupational exposure.

Reference:
10. You are shown serial dynamic static images from a radionuclide hepatobiliary scan performed in a 63-year-old man presenting with abdominal pain and fever. Given the findings demonstrated, which of the following clinical complications is MOST likely present?

A. Acute gangrenous cholecystitis
B. Gallstone pancreatitis
C. Common bile duct obstruction
D. Bile Leak

**Key: A**

**Rationale:**

A: Correct. Hepatobiliary imaging demonstrates non-visualization of the gallbladder and increased pericholecystic hepatic uptake. The latter scintigraphic finding, known as a "rim sign", is often associated with acute gangrenous cholecystitis or otherwise more advanced disease.

B: Incorrect. Hepatobiliary imaging demonstrates non-visualization of the gallbladder and increased pericholecystic hepatic uptake. The latter scintigraphic finding, known as a "rim sign", is often associated with acute gangrenous cholecystitis or otherwise more advanced disease. Gallstone pancreatitis is associated with a choledocholithiasis with concurrent obstruction of the pancreatic duct. There is no evidence of common bile duct obstruction on this exam.

C: Hepatobiliary imaging demonstrates non-visualization of the gallbladder and increased pericholecystic hepatic uptake. The latter scintigraphic finding, known as a "rim sign", is often associated with acute gangrenous cholecystitis or otherwise more advanced disease. There is prompt passage of tracer into the small bowel, without evidence of biliary obstruction on this exam.

D: Incorrect. Hepatobiliary imaging demonstrates non-visualization of the gallbladder and increased pericholecystic hepatic uptake. The latter scintigraphic finding, known as a "rim sign", is often associated with acute gangrenous cholecystitis or otherwise more advanced disease. There is no evidence of biliary leakage on this study.

**Reference:**

Pediatric Radiology
In-Training Test Questions
for Diagnostic Radiology Residents

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1. A 16-month-old male patient presents with difficulty in learning to walk. Based on the imaging findings, what is the MOST likely diagnosis?

A. Moya moya  
B. Medulloblastoma  
C. Carotid dissection  
D. Arteriovenous malformation

Key: A

Rationale:
A. Correct. The findings include occlusion of the distal right internal carotid artery with no visualization of the proximal right middle or anterior cerebral arteries. There are a number of irregular collaterals of the lenticulostriate vessels, which give the traditional angiographic contrast appearance of the "puff of smoke" (moyamoya, in Japanese). Moyamoya is often idiopathic, but can be a result of occlusion in children with sickle cell disease, other vasculitides, and phakomatoses such as neurofibromatosis and tuberous sclerosis.
B. Incorrect. Medulloblastoma is a cellular primitive neuroectodermal tumor of the CNS that primarily affects the posterior fossa in children. This tumor mass would displace the normal posterior fossa vasculature, but would not be expected to cause occlusion of the ICA.
C. Incorrect. Spontaneous or traumatic carotid dissection can occur in children, but involves a more proximal segment than is seen here. Occlusive complications are acute, and would not be expected to result in an appearance of chronic collateralization to the lenticulostriates specifically.
D. Incorrect. While these can occur virtually anywhere in the CNS, they would be expected to show increased, not decreased, vascular flow into affected arteries with enlarged veins.

Reference:
2. Which of the following liver lesions may present with a characteristic central scar with calcification?

A. Hepatoblastoma  
B. Adenoma  
C. Infantile hemangioma  
D. Fibrolamellar carcinoma

**Key:** D

**Rationale:**  
A. Incorrect. A central scar with calcification is not a typical feature of hepatoblastoma.  
B. Incorrect. A central scar is not associated with hepatic adenoma.  
C. Incorrect. A central scar with calcification is not a typical feature of hepatic hemangioma.  
D. Correct. When present, a central scar with calcifications may suggest fibrolamellar hepatocellular carcinoma. When a central scar is present, approximately 35-55% will have central calcifications. Central scars are also seen in focal nodular hyperplasia (FNH), typically not calcified. Differential imaging parameters in most cases include the enhancement of the central scar in FNH, and lack of enhancement in fibrolamellar carcinoma.

**Reference:**  
3. CT angiography of the chest was performed on 15 year old girl with history of wheezing. What is the diagnosis?

A. Anomalous left coronary artery
B. Right arch with aberrant left subclavian
C. Pulmonary artery sling
D. Azygous arch

Key: C

Rationale:
A. Incorrect. The abnormal vessel arises from the single right pulmonary artery and crosses between trachea and esophagus; these are findings diagnostic of pulmonary artery sling; coronary arteries arise from the proximal ascending aorta.
B. Incorrect. The aortic arch is not visualized at this level, but the aorta descends normally on the left. The aberrant vessel arises from the pulmonary artery, not from the aorta, and extends into the lung; it is therefore an abnormal left pulmonary artery, not an aberrant subclavian.
C. Correct. The left pulmonary artery arises from the right pulmonary artery and then crosses to the left hilum between the trachea and the esophagus. This is the definition of pulmonary artery sling. There is associated narrowing of the airway.
D. Incorrect. The azygous vein arch courses anteroposteriorly to the right of the trachea, is located cephalad to the right pulmonary artery, and drains into the superior vena cava. Such is not the case here, where an abnormal vessel arises from the right pulmonary artery, and courses to the left between the trachea and the esophagus, findings indicative of a pulmonary artery sling.

Reference:
4. A chest radiograph is obtained in an acyanotic 13-year-old girl with an abnormal echocardiogram. Based on the chest radiograph, what is the MOST likely diagnosis?

A. Atrial septal defect
B. Truncus arteriosus
C. Hypoplastic left heart syndrome
D. Ebstein anomaly

Key: A

Rationale:
A. Correct. The pulmonary vascularity is increased with prominent, well-defined, and sharply-marginated vessels. This enlargement of the pulmonary arteries is consistent with a left-to-right shunt. Patients with atrial septal defects have shunt vascularity and are acyanotic.
B. Incorrect. Patients with truncus arteriosus have shunt vascularity. However, patients with this diagnosis will be cyanotic. Furthermore, patients with truncus arteriosus would have presented much earlier and would have had surgery by this age. Therefore, truncus arteriosus is not the correct choice.
C. Incorrect. Patients with hypoplastic left heart syndrome present in the neonatal period. They have pulmonary venous congestion rather than shunt vascularity. In addition, patients with this diagnosis do not survive the neonatal period without intervention. This is typically a Norwood.
D. Incorrect. Patients with Ebstein anomaly present at birth with cyanosis, a very large heart, and decreased pulmonary vascularity (right-to-left shunt rather than a left-to-right shunt). Therefore, Ebstein anomaly would not be the correct answer.

Reference:
Allen JD, Shaddy RE, Penny DJ, Feltes TF, Cetta F. Moss and Adams' Heart Disease in Infants, Children and Adolescents, including the Fetus and Young Adult 9th edition 2016 Wolters Kluwer.
5. A chest radiograph is obtained on a 16-year-old girl presenting with a “murmur” on physical examination. Based on the chest radiograph, what is the MOST likely diagnosis?

A. Valvular aortic stenosis  
B. Pulmonic stenosis  
C. Mitral insufficiency  
D. Tricuspid insufficiency

**Key:** B

**Rationale:**

A: Incorrect. Aortic stenosis classically shows enlargement of the proximal ascending aorta, which is not seen here.

B: Correct. In pulmonic stenosis, chest radiographs may reveal post-stenotic dilatation of the main and left pulmonary arteries secondary to the direction of the post-stenotic jet, as is seen here.

C: Incorrect. When there is mitral valvular disease, particularly insufficiency, there is enlargement of the left atrium, which is not seen on these radiographs.

D: Incorrect. Tricuspid insufficiency would classically present as right heart enlargement, including the right atrium, due to volume overload. Although there is likely right ventricular hypertrophy, there is no right cardiac enlargement, and the right atrial outline is normal.

**Reference:**


Allen JD, Shaddy RE, Penny DJ, Feltes TF, Cetta F. Moss and Adams’ Heart Disease in Infants, Children and Adolescents, including the Fetus and Young Adult 9th edition 2016 Wolters Kluwer.
6. A 2-day-old term infant presents with worsening abdominal distension. Based on these images from a contrast enema, what is the MOST likely associated condition?

A. Aganglionic segment of bowel  
B. Cystic fibrosis  
C. Maternal diabetes  
D. Proximal atresia

Key: B

Rationale:
A. Incorrect. The contrast enema shows a microcolon for which the differential diagnosis is meconium ileus or ileal atresia. Filling defects are noted in the small bowel, which represent balls of inspissated meconium, and further filling allows contrast to reflux beyond the obstruction into the dilated proximal bowel, excluding the diagnosis of ileal atresia, which could be associated with proximal atresia. There is no zone of transition to suggest Hirschsprung disease; total colonic aganglionosis is much less frequent than segmental aganglionosis, and most importantly would not cause filling defects in the small bowel.
B. Correct. The contrast enema shows a microcolon for which the differential diagnosis is meconium ileus or ileal atresia. Filling defects are noted in the small bowel, which represent balls of inspissated meconium, and further filling allows contrast to reflux beyond the obstruction into the dilated proximal bowel, excluding the diagnosis of ileal atresia, and establishing the diagnosis of meconium ileus. Virtually all patients with meconium ileus have cystic fibrosis, therefore this is the correct answer.
C. Incorrect. Maternal diabetes is associated with functional immaturity of the colon which does not cause microcolon, and is typically seen as small left colon syndrome. Furthermore, the inspissated meconium in the dilated bowel loops would not be a finding in small left colon syndrome associated with maternal diabetes.
D. Incorrect. Proximal atresia is excluded by the inspissated meconium and dilatation of the distal small bowel.

Reference:
7. Where does an ectopic ureter insert?

   A. Medial and inferior to the orthotopic orifice
   B. Adjacent to the ureterocele
   C. At the urachal remnant
   D. Below the male external sphincter

**Key:** A

**Rationale:**
A. Correct. As per the Meyer-Weigert rule.
B. Incorrect. Ectopic ureters are not always associated with a ureterocele. When a ureterocele is present, it is part of the ectopic ureter itself.
C. Incorrect. The urachal remnant represents the remnant of the allantois, the fetal communication between the bladder and the umbilicus, and is not related to the ectopic ureter.
D. Incorrect. The ectopic ureter follows the course of the mesonephric ducts, which insert at the prostatic urethra, above the external sphincter. This is the reason why ectopic ureters do not present with urinary dripping in males.

**References:**
8. You are shown a PA chest radiograph and posterior image from a Tc-99m MAA perfusion lung scan performed in a 22-month-old previously healthy male presenting with cough. A ventilation study (not shown) was normal. What is the MOST likely diagnosis?

A. Foreign body aspiration  
B. Swyer-James syndrome  
C. Right pulmonary artery agenesis  
D. Mucus plugging

Key: C

Rationale:
A: Incorrect. The right lung is smaller than the left but both lungs are the same density. In foreign body aspiration, the lung with the obstructed bronchus is hyperexpanded, not smaller than the contralateral lung. No absent bronchus sign or radio-opaque foreign body is seen.
B. Incorrect. Ventilation scan would not be normal in a patient with Swyer-James.
C. Correct. The right lung is smaller than the left. The MAA perfusion scan shows no flow from the pulmonary circulation on the right.
D: Incorrect. Mucus plugging would be expected to have findings similar to radiolucent endobronchial foreign body, and would be unlikely to be confined to one lung in a non-intubated, previously healthy child.

Reference:
9. You are shown images from a 7-day-old infant presenting with a right-sided neck mass. What is the MOST likely diagnosis?

A. Rhabdomyosarcoma
B. Plexiform neurofibroma
C. Lymphatic malformation
D. Teratoma

Key: C

Rationale:
A: Incorrect. Rhabdomyosarcoma: usually solid intensely enhancing mass. This diagnosis is inconsistent with the findings.
B: Incorrect. Plexiform neurofibroma: Solid lesion and may have the classic target sign on T2-W sequences, inconsistent with the findings.
C: Correct. The images demonstrate a cystic multiloculated mass, with septal enhancement after Contrast. This is consistent with a lymphatic malformation commonly seen in the head and neck region.
D: Incorrect. Teratoma: often large and infiltrative mass with solid components at this age and location. Variable enhancement and often contain foci of calcification.

Reference:
10. You are shown an AP radiograph of the left elbow obtained after trauma. What type of Salter-Harris fracture is demonstrated?

A. I  
B. II  
C. III  
D. IV  

Key: D

Rationale:
A: Incorrect. The lateral condylar fracture involves epiphysis, epiphyseal plate and metaphysis, and therefore represents a Salter Harris type IV injury.
B: Incorrect. The lateral condylar fracture involves epiphysis, epiphyseal plate and metaphysis, and therefore represents a Salter Harris type IV injury.
C: Incorrect. The lateral condylar fracture involves epiphysis, epiphyseal plate and metaphysis, and therefore represents a Salter Harris type IV injury.
D: Correct. The lateral condylar fracture involves medial metaphysis, epiphyseal plate and epiphysis. Due to incomplete ossification of the epiphysis, the involvement of the epiphysis and epiphyseal plate may not be apparent on a plain radiograph.

Reference:
Physics Radiology
In-Training Test Questions
for Diagnostic Radiology Residents

Released July 2019

Sponsored by:
Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology

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1. What is the principal reason that iodine contrast media causes an increase in the blood’s ability to attenuate x-rays?
A. Higher atomic number of iodine increases photoelectric interactions
B. Higher atomic number of iodine increases the Compton interactions
C. Increasing the blood density increases the photoelectric interactions
D. Increasing the blood density increases the Compton interactions

Key: A

References:

2. A 26 year-old woman undergoes a trauma chest CT following a motor vehicle accident and is later discovered to be pregnant. The radiation exposure to the fetus from this study is primarily derived from which of the following types of radiation?
A. Primary x-ray
B. External scatter
C. Internal scatter
D. Leakage

Key: C

Reference:
3. What technique is used for functional MRI?
A. Arterial Spin Labelling (ASL)
B. Magnetic Resonance Spectroscopy (MRS)
C. Blood Oxygen Level Dependent (BOLD)
D. Phase Contrast Imaging

**Key:** C

**Rationale:**
A. Incorrect. Bold techniques is used for FMRI.
B. Incorrect. FMRI utilized BOLD imaging.
C. Correct. BOLD technique is fundamental to FMRI.
D. Incorrect. BOLD technique is used with FMRI

**Reference:**

4. According to the Mammography Quality Standard Act (MQSA), who has the general responsibility for ensuring that all MQSA quality assurance requirements are met?
A. All interpreting physicians
B. Lead interpreting physician
C. Medical physicist
D. Quality control technologist

**Key:** B

**Rationale:**
MQSA Section 900.12 (d) indicates these must follow facility procedures and participate in the facility’s medical outcomes audit program, but it is the lead interpreting physician who's responsible for ensuring these exist.

**Reference:**
Mammography Quality Standards Act MQSA, Section 900.12 (d), Section 900.12 (d).
5. What interaction is the primary source of scattered radiation in diagnostic radiography?
A. Compton
B. Coherent/Rayleigh
C. Annihilation
D. Photoelectric

Key: A

Rationale:
A. Correct. Most scatter is due to Compton interactions in the diagnostic energy range. It is the dominant interaction in soft tissue above 26 keV.
B. In the diagnostic energy range, Rayleigh scatter contributes only a small percentage to overall interactions, less than 5% in soft tissue at 70 keV. Rayleigh scattering occurs mainly with low energy photons, such as those used in mammography.
C. Is not a scatter interaction.
D. Is not a scatter interaction.

Reference:
6. Which of the following will increase the entrance skin dose to the patient during a fluoroscopically guided procedure?
A. Using lower frame rate pulsed fluoroscopy
B. Increasing the skin to image receptor distance
C. Increasing the amount of Copper (Cu) filtration in the beam
D. Increasing the source to patient distance (SOD)

**Key:** B

**Rationale:**
A. Incorrect, this will reduce entrance skin exposure to the patient.
B. Correct. Increasing the distance from the skin to the image receptor, with source to skin distance unchanged, will require the Automatic Exposure Rate Control (AERC) to increase the radiation output of the x ray tube to maintain a constant exposure to the image receptor, in order to maintain image quality. This will increase the patient’s entrance skin exposure.
C. Incorrect, this will reduce the entrance skin exposure to the patient be removing low energy photons that will not contribute to the image.
D. Incorrect, increasing the distance between the x ray tube and the patient's skin will reduce entrance skin exposure.

**Reference:**
7. Which physical property allows contrast media to provide enhanced contrast at certain x-ray energies?
   A. K-absorption edge
   B. Half-value layer
   C. Compton scattering
   D. Kerma

Key: A

Rationale:
A. Correct. The K-edge of the material provides preferential absorption of the x-rays for energies near the K shell energy. The preferential absorption near and above this energy value provides increased contrast where the media is located.
B. Incorrect. The half-value layer describes the beam average energy by providing the amount of attenuator (generally in mmAl) to drop the exposure of the filtered beam to 0.5 of the unfiltered levels.
C. Incorrect. Compton scattering is an interaction of a photon with an atom that produces a scattered photon, and does not contribute to increased contrast. Scattered photons degrade image quality.
D. Incorrect. Kerma is the kinetic energy deposited in matter and is used to describe a dose to air or other materials.

Reference:
8. What does an AUC (Area Under the Curve) value from a ROC (Receiver Operator Characteristic) curve of 0.5 indicate?
A. The inputs are random guesses
B. The inputs have perfect sensitivity and no specificity
C. The inputs have an 80% sensitivity for all specificities
D. The inputs have perfect sensitivity for all specificities

**Key:** A

**Rationale:**
A. Correct. A value of 0.5 indicates the system behaves in a statistically random manner or that the inputs are random guesses.
B. Incorrect. This situation would provide a line on the y-axis and produce and AUC of 0.
C. Incorrect. This would produce a rectangular region on the ROC plot with an AUC=0.8.
D. Incorrect. This would produce a perfect square on the ROC with an AUC=1.

**Reference:**

9. What is the minimum inherent threshold energy required for the positron emission decay process to occur?
A. 140 KeV
B. 311 KeV
C. 511 KeV
D. 1.022 MeV

**Key:** D

**Reference:**
10. What is the typical uptake time for a patient undergoing an oncology F-18 FDG PET-CT whole body scan?
A. 15 minutes
B. 30 minutes
C. 60 minutes
D. 120 minutes

Key: C

Reference:
Ultrasound Radiology
In-Training Test Questions
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1. What is a characteristic ultrasound finding of an endometrioma?

A. Cystic mass with homogeneous low level internal echoes
B. Complex cyst with reticular pattern of internal echoes and septations
C. Highly echogenic and attenuating mass
D. Hypoechoic mass with posterior attenuation of the sound beam

Key: A

Rationale:
A. Correct. The typical ultrasound appearance of an endometrioma is a cystic mass with diffuse, homogeneous low-level internal echoes.
B. Incorrect. A complex cyst with a reticular pattern of internal echoes and septations is characteristic of a hemorrhagic cyst.
C. Incorrect. Ovarian dermoids have a focal or diffuse highly echogenic components with areas of shadowing secondary to attenuation of the sound beam.
D. Incorrect. Fibrous ovarian tumors such as thecomas are typically hypoechoic with posterior acoustic attenuation.

Reference:
2. Which of the following is the MOST common location of an ectopic pregnancy?

A. Intramural portion of the fallopian tube
B. Cervical scar
C. Ampullary region of the fallopian tube
D. Intraovarian

**Key:** C

**Rationale:**
A. Incorrect. The fallopian tube is the most common site of ectopic pregnancy, however the majority are located within the ampullary segment of the tube. The intramural segment of the fallopian tube is the second most common site, involved in about 12% of tubal ectopic pregnancies.
B. Incorrect. Cervical scar ectopic pregnancies are rare and estimated to occur in <1% of all pregnancies.
C. Correct. Ectopic pregnancies are most commonly located in the fallopian tubes (95%). The majority of tubal ectopic pregnancies are located within the ampullary portion of the tube (70%).
D. Incorrect. Intraovarian ectopic pregnancies are rare and estimated to occur in 3% of cases.

**Reference:**
3. Based upon these two images from a carotid ultrasound in a 65-year-old man, what is the most likely etiology of this waveform in the carotid arteries?

A. Proximal carotid stenosis
B. Aortic regurgitation
C. Aortic stenosis
D. Cardiac arrhythmia

**Key:** B

**Rationale:**
A. Incorrect. Proximal carotid stenosis would cause a parvus tardus waveform in the ipsilateral carotid, beyond the stenosis.
B. Correct. Reversed diastolic flow is identified in the internal iliac arteries bilaterally. This can be seen in the setting of aortic regurgitation.
C. Incorrect. Aortic stenosis could cause parvus tardus waveforms in the internal iliac arteries bilaterally.
D. Incorrect. Cardiac arrhythmias can cause irregular spectral waveforms.

**Reference:**
Rohren EM, Kliwer MA, Carroll BA and Hertzberg B. A spectrum of Doppler waveforms in the carotid and vertebral arteries. AJR 2003; 181(6).
4. What ultrasound criterion is used to predict the degree of renal artery stenosis?

A. Presence of post-stenotic flow turbulence
B. Elevated velocity in the stenotic portion of the vessel
C. Tardus parvus waveform in the main renal artery
D. Tardus parvus waveforms in the segmental or interlobar arteries

Key: B

Rationale:
A. Incorrect. Post-stenotic flow turbulence is commonly identified after a significant stenosis but does not predict degree of stenosis.
B. Correct. Elevated peak systolic velocity correlates with the degree of stenosis on angiography.
C. Incorrect. A tardus-parvus waveform may be seen distal to a significant arterial stenosis but it does not predict the degree of stenosis.
D. Incorrect. Tardus-parvus waveforms are typically identified in the segmental or interlobar arteries distal to a significant arterial stenosis but do not predict the degree of stenosis.
5. A 49 year-old woman presents with upper abdominal pain. Based on the two transverse images of the pancreas, what is the MOST likely etiology of the measured structure?

A. Pseudocyst
B. Serous cystadenoma
C. Lymphoma
D. Adenocarcinoma

Key: A

Rationale:
A. Correct. The first image shows multiple coarse calcifications in the head of the pancreas compatible with chronic pancreatitis. The second image shows a complex peripancreatic cystic lesion. In the background of chronic pancreatitis, pseudocyst is the most likely diagnosis. Pancreatic pseudocysts occur in 25 to 40% of patients with chronic pancreatitis.
B. Incorrect. Serous cystadenomas are pancreatic tumors that most commonly occur in women older than 60. On imaging the lesions are composed of multiple small cysts varying in size from 1mm to 2cm. Calcifications may be present in the central scar, which is seen in up to 20% of lesions. Serous cystadenomas of the pancreas are not associated with chronic pancreatitis.
C. Incorrect. While lymphoma can appear quite hypoechoic on ultrasound, it is solid. This lesion clearly cystic with posterior acoustic enhancement.
D. Incorrect. Adenocarcinoma of the pancreas appears as a solid hypoechoic mass, often with ill-defined borders. It tends to cause vascular encasement and venous occlusion as the tumor infiltrates the surrounding structures. The main pancreatic duct and common bile duct may be obstructed by the tumor.

Reference:
6. A patient presents to the Emergency Department with vaginal bleeding and a positive serum beta hCG (human chorionic gonadotropin). An intrauterine pregnancy is not identified by sonography. Which of the following statements is MOST appropriate to be communicated to the referring physician?

A. Spontaneous abortion is likely
B. A molar pregnancy is possible
C. The pregnancy test was probably in error
D. Ectopic pregnancy cannot be excluded

Key: D

Rationale:
A. Incorrect. While a spontaneous abortion is possible in this setting, both a normal early pregnancy and ectopic pregnancy can have a similar appearance and clinical presentation.
B. Incorrect. Molar pregnancies may present with a positive pregnancy test and bleeding, however there are usually multiple cysts within the endometrial cavity.
C. Incorrect. Serum beta hCG is very sensitive and specific to pregnancy. Therefore, it is unlikely that the pregnancy test was in error.
D. Correct. Up to 35% of ectopic pregnancies will have a negative pelvic ultrasound. Therefore, in the setting of a positive serum beta hCG, a normal pelvic ultrasound does not exclude an ectopic pregnancy.
7. You are shown 3 images from an ultrasound guided renal biopsy. Which of the following is the MOST likely etiology for the measured abnormality in image B?

A. Perinephric hematoma  
B. Urinoma  
C. Lymphocele  
D. Renal infarct  

**Key:** A

**Rationale:**
A. Correct. Image b shows an echogenic perinephric fluid collection with absent vascular flow on color Doppler image (c). Given onset after biopsy, the collection is compatible with a perinephric hematoma. Small hematomas usually resolve spontaneously without intervention or treatment.

B. Incorrect. A urinoma is an encapsulated collection of extravasated urine which can be spontaneous or secondary to trauma. Urinoma occurrence as a result of renal biopsy is rare. Sonographic appearance of an acute urinoma is an anechoic fluid collection, without internal vascularity. If a urinoma becomes infected it will have a more complex appearance on ultrasound, with internal debris, septations, and peripheral hyperemia.

C. Incorrect. Lymphocele after renal biopsy is practically unknown. Lymphoceles are a common complication after renal transplantation adjacent to the renal allograft. Lymphoceles result from disruption of lymphatic channels during the perivascular dissection or disrupted hilar lymphatics. Lymphoceles are anechoic on ultrasound and may have internal septations. Infected lymphoceles may have internal debris with peripheral hyperemia.

D. Incorrect. Renal infarct is an unusual and uncommon complication after renal biopsy. Renal infarct occurs as a result of occlusion of the renal vessels, which is unlikely during or after a renal biopsy. Sonographically, renal infarct appears as a wedge-shaped hypoechoic area within the peripheral renal parenchyma without internal vascularity. In a chronic infarct, there may be evidence of overlying capsular retraction.
8. In acoustic radiation force impulse (ARFI) imaging of the liver, hepatic fibrosis or stiffness is estimated by what

A. Speed of the shear wave  
B. Amplitude of shear wave  
C. Speed of the returning echo.  
D. Amplitude of returning echo  

Key: A  

Rationale:
A. Correct. In acoustic radiation force impulse (ARFI) imaging of the liver, hepatic fibrosis or stiffness is estimated by the velocity of the shear wave.  
B. Incorrect. Amplitude of the shear wave is not factored into the assessment of liver stiffness in ARFI imaging.  
C. Incorrect. It is the speed of the detected shear wave that is used to estimate the stiffness of the liver.  
D. Incorrect. Amplitude of the returning echo is not factored into the assessment of liver stiffness in ARFI imaging.  

Reference:
9. A 23-year-old male patient with a palpable left testicular lump underwent ultrasound imaging of his scrotum. Based on the image shown, what is the next best step in management?

A. PET CT
B. Orchiectomy
C. Enucleation
D. Further characterization with MRI

Key: C

Rationale:
A. Incorrect. The lesion is a well-defined intratesticular mass with concentric echogenic and hypoechoic rings which give it an onion skin appearance. Although the imaging features are characteristic of a benign epidermoid cyst, there is some overlap in the imaging appearance of these lesions and germ cell tumors. PET CT would not help further characterize this lesion. PET CT is also not indicated to stage this lesion as it is most likely benign.
B. Incorrect. The lesion is a well-defined intratesticular mass with concentric echogenic and hypoechoic rings which give it an onion skin appearance. Although the imaging features are characteristic of a benign epidermoid cyst, there is some overlap in the imaging appearance of these lesions and germ cell tumors. When the diagnosis of epidermoid cyst is suspected by imaging, the lesions can be treated by enucleation rather than orchiectomy.
C. Correct. Imaging features are strongly suggestive of a benign epidermoid cyst. While there is overlap in the imaging appearance of some epidermoid cysts and germ cell neoplasms in cases which characteristic imaging findings such as this, patients are typically offered tissue sparing surgery.
D. Incorrect. MR imaging has not been shown to be of value in further characterizing lesions with ultrasound imaging features characteristic of epidermoid cyst.