

**Breast Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



QUALITY IS OUR IMAGE

May 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. Use of an 11-gauge directional vacuum-assisted biopsy device as compared to a 14-gauge automated core biopsy needle reduces which of the following?

- A. Incidence of bleeding
- B. Incidence of infection
- C. False negative biopsy rate
- D. Needle cost

Key: C

Rationale: A. Incorrect. The incidence of bleeding increases with use of a larger gauge needle. B. Incorrect. The incidence of infection is not changed with the use of a larger needle. C. Correct. The false negative rate is reduced with use of a larger needle, due to increase in the sample size. D. Incorrect. The needle cost is not dependent on the size of the needle.

References: Liberman L., Percutaneous image guided core biopsy. Radiol Clin North Am, 2002; 40:483-500.

2. Which is the MOST important view when evaluating calcifications that are thought to represent milk of calcium?

- A. 90-degree lateral view
- B. Rolled CC view
- C. Medial lateral oblique view
- D. Exaggerated lateral CC view

Key: A

Rationale: A. Correct. When evaluating calcifications for milk of calcium, only the 90-degree lateral view in which the beam is perpendicular to the calcifications, evaluates for layering. This allows the correct diagnosis of milk of calcium to be made. B. Incorrect. The rolled CC view is most useful for determination of whether a finding is a true abnormality or just superimposed breast parenchyma. It does not evaluate for milk of calcium. C. Incorrect. The MLO view will not demonstrate whether a grouping of calcifications layers in a fashion consistent with milk of calcium, since the Xray beam needs to be perpendicular to the calcifications and not oblique. D. Incorrect. The exaggerated lateral CC view is best for evaluating tissue in the far posterior lateral breast and does not add additional information when evaluation calcifications for milk of calcium.

References: Cardenosa G. Breast Imaging Companion, Lippincott Williams and Wilcott. 2004. pp. 157,159, 160.

3. Using ACR accreditation criteria for clinical image evaluation, what is recommended for visualization of the pectoralis muscle on mammography?

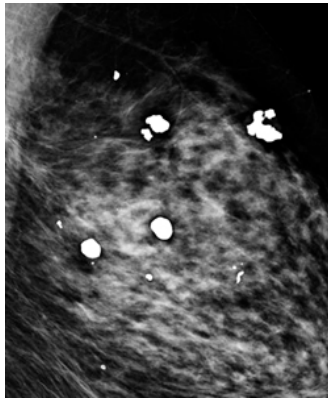
- A. A concave shape on the MLO view
- B. Visible on the CC view
- C. Equal in size on the CC and MLO views
- D. Extends to the level of the posterior nipple line

Key: D

Rationale: A. Incorrect. On a properly positioned MLO view, when the pectoralis muscle is best visualized, it appears as convex, not concave. B. Incorrect. While the pectoralis muscle may occasionally be included on the CC view, it is not required using ACR accreditation criteria. C. Incorrect. The pectoralis muscle tends to not be as well seen on the CC view and is not expected to be equal in size on the CC and MLO views. D. Correct. The pectoralis muscle should extend at least to within 1 cm of the posterior nipple line, according to the ACR accreditation criteria.

References: Cardenosa, Gilda. Breast Imaging Companion, Lippincott Williams and Wilcott. 2004. p. 100-109.

4. You are shown an MLO view of the left breast. What is the MOST likely diagnosis?



- A. Papillomatosis
- B. Fat necrosis
- C. Oil cysts
- D. Fibroadenomas

Key: D

Rationale: A. Incorrect. Although papillomas often calcify, they are usually more fragmented or lava like. B. Incorrect. Fat necrosis tends to appear as rim or lattice like calcifications, and are not as uniform and solid. C. Incorrect. Oil cysts typically demonstrate rim calcifications. D. Correct. The multiple macro or "popcorn" like calcifications are compatible with calcified fibroadenomas.

References: Bassett LW, Jackson VP, et al. Diagnosis of Diseases of the Breast, 2nd Edition, 2005. Pp. 417, 424.

5. What ultrasound finding in a breast lesion is typically associated with malignancy?

- A. Increased through transmission
- B. Height greater than width
- C. Hyperechogenicity
- D. Surrounding hyperechoic halo

Key: B

Rationale: A. Incorrect. Increased through transmission is typically associated with benign simple cysts. B. Correct. Height greater than width is a sonographic feature that is typically associated with malignancy. C. Incorrect. Hyperechogenicity typically is seen with benign fat containing lesions and is not a typical feature of malignancy. D. Incorrect. A surrounding hyperechoic (echogenic) halo is typically associated with benign post traumatic findings.

References: Stavros AT. Breast Ultrasound. Lippincott Williams and Wilkins, 2004. P. 472.

6. For which ONE of the following would a BIRADS 6 classification be MOST appropriate?

- A. Post procedure mammogram for marker placement
- B. Prior treated breast cancer
- C. Recent biopsy proven breast cancer
- D. Suspicious abnormality; needs biopsy

Key: C

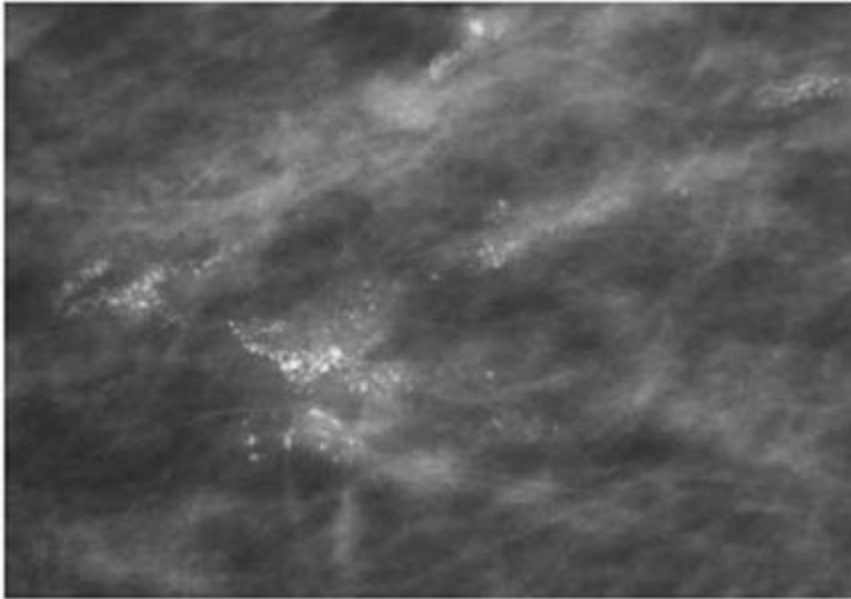
Rationale: A. Incorrect. A Birads category is not given on the post procedure mammogram for marker placement. B. Incorrect. Patients with a history of breast cancer are not assigned a Birads Category 6, which is reserved for patients with known (untreated as yet) malignancy. C. Correct. Birads Category 6 is assigned to patients with a diagnosis of cancer who have not yet been definitively treated. D. Incorrect. Patients with suspicious abnormalities; need biopsy should be coded Birads Category 4. Birads 6 is reserved for patients with a known biopsy proven diagnosis of breast cancer.

References: ACR BIRADS Atlas, 5th Edition, 2013. P. 149-159.

- Key: B**

References: Bassett LW, Jackson VP, et al. Diagnosis of Diseases of the Breast, 2nd Edition, 2005. Pp. 409-439.

8. You are shown a straight lateral (90 degree) magnification view. Which one of the following is the MOST likely diagnosis?



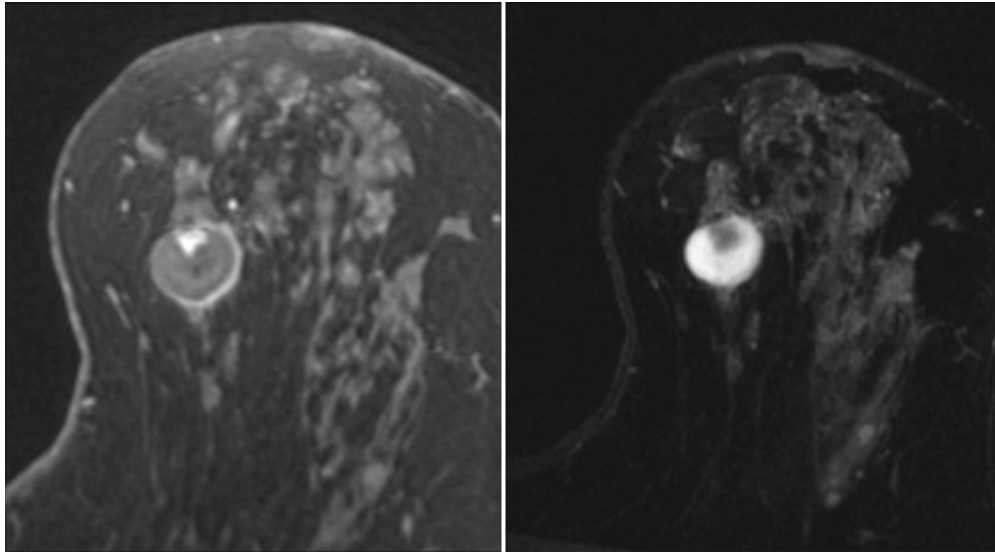
- A. Invasive lobular carcinoma
- B. Ductal carcinoma in situ
- C. Sclerosing adenosis
- D. Milk of calcium

Key: B

Rationale: A. Incorrect. Calcifications are not a hallmark of invasive lobular carcinomas, which tend to present as infiltrative ill-defined masses or asymmetries. B. Correct. DCIS typically presents as calcifications of varying sizes and shapes in a ductal distribution, as shown here. C. Incorrect. Sclerosing adenosis typically presents as diffuse bilateral punctate calcifications. D. Incorrect. On straight lateral view (90 degree) magnification view, layering of the calcifications would be necessary in order to make the diagnosis of benign milk of calcium. The calcifications shown here do not layer and are in a ductal distribution.

References: Basset LW, Jackson VP. Diagnosis of Diseases of the Breast. 2nd ed., 2005. Elsevier Saunders Co., Philadelphia, PA.

9. You are shown post contrast and T2-weighted MR images of the left breast. What is the MOST LIKELY diagnosis?



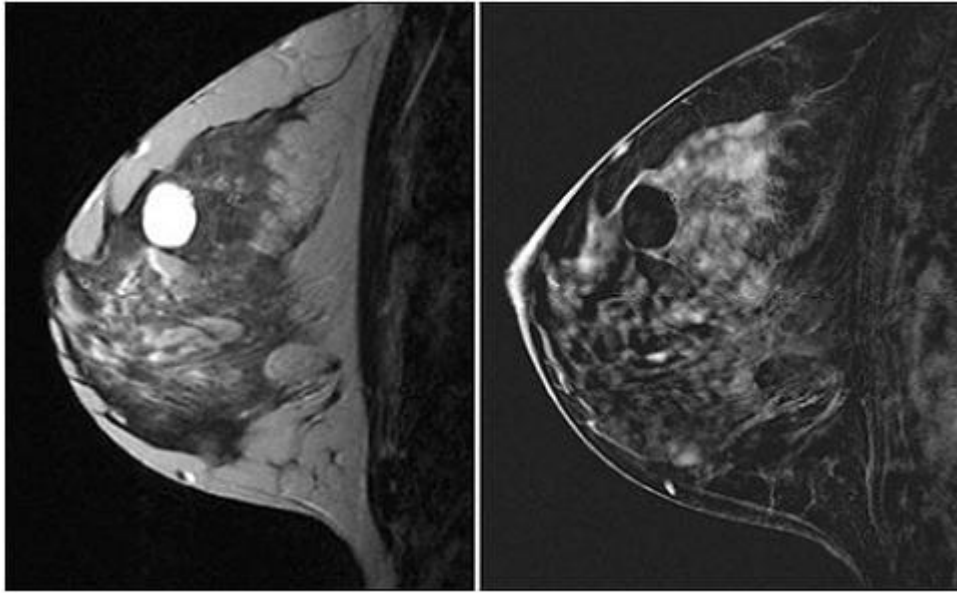
- A. Fibroadenoma
- B. Inflammatory cyst
- C. Intracystic papilloma
- D. Colloid carcinoma

Key: C

Rationale: A. Incorrect. On breast MRI, fibroadenomas tend to have a homogeneous enhancement pattern or non-enhancing internal septations. The mass shown here has an intracystic enhancing focus. B. Incorrect. An inflammatory cyst typically presents as a bright mass on T2 weighted images with rim enhancement post contrast. It should not contain an enhancing nodule. C. Correct. The mass shown here has a typical appearance of an intracystic papilloma. There is an enhancing nodule within a non-enhancing T2 bright cyst. D. Incorrect. Colloid carcinoma is typically T2 bright but enhances post contrast. In this case, only the intracystic nodule is enhancing.

References: Heernandez Rodriguez MC, et al. Intracystic Papillary Carcinoma of the Breast. Radiographics 2010; 30(7). P 2021-2027.

10. Based upon these T2-weighted and T1-weighted post-contrast subtraction MR images of a 45-year-old woman, what is the MOST likely diagnosis?



- A. Fibroadenoma
- B. Lipoma
- C. Lobular carcinoma
- D. Simple cyst

Key: D

Rationale: A. Incorrect. On breast MRI, fibroadenomas tend to have a homogeneous enhancement pattern or non-enhancing internal septations. The mass shown here is high signal intensity on T2 weighed images but does not enhance. B. Incorrect. On breast MRI, lipomas have the same signal intensity as the surrounding fat. C. Incorrect. Lobular carcinomas tend to appear as infiltrative enhancing masses on post contrast images. The mass shown here is well defined and does not enhance on post contrast images. D. Correct. A simple cyst is typically of high signal intensity on T2 weighted imaging but does not enhance, on post contrast imaging, as demonstrated in this example.

References: Jackson VP. The Radiologic Clinics of North America, Breast Imaging. November 1995 Volume 33, Number 6.

**Cardiac Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. What is the MOST common radiographic manifestation of acute papillary muscle rupture?
 - A. Pulmonary edema
 - B. Left atrial enlargement
 - C. Left ventricular enlargement
 - D. Pericardial effusion

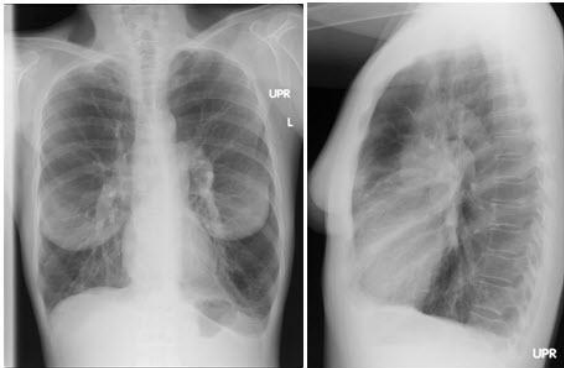
Key: A

References:

Morris MR, Maleszewski JJ, Suri RM, et al. CT and MR Imaging of the Mitral Valve: Radiologic-Pathologic Correlation. *RadioGraph* 2010; 30:1603-1620.

Rationale: A. Correct. The papillary muscles are connected to the mitral valve leaflets by the chordae tendinae. When there is rupture of the chordae tendinae or the papillary muscle itself, the mitral valve is unable to function properly, resulting in mitral regurgitation. Because this is an acute process, accommodation does not occur, resulting in acute pulmonary edema. Edema predominantly affecting the right upper lobe can be seen if the jet of regurgitant blood is directed into the right superior pulmonary vein, which drains the right upper lobe. B. Incorrect. The left atrium will enlarge over time in the setting of mitral valve regurgitation due to the increased volume of blood that is directed into the left atrium during systole. However, this change occurs over time and will not be seen in the setting of acute papillary muscle rupture. C. Incorrect. The left ventricle will enlarge overtime in the setting of mitral valve regurgitation because it receives an increased volume of blood from the left atrium – both the volume of blood returning from the lung as well as the regurgitant volume of blood through the mitral valve. As with left atrial enlargement, left ventricular enlargement will occur over time but will not be seen in the setting of acute papillary muscle rupture. D. Incorrect. Pericardial effusion can occur in the setting of an acute myocardial infarction due to inflammation of the pericardium. Dressler syndrome, thought to be an autoimmune inflammatory response to myocardial neo-antigens, is not an acute process and, when present, occurs several weeks following a myocardial infarction. However, it is not the most common radiographic manifestation of acute papillary muscle rupture.

2. You are shown a posteroanterior (PA) and lateral chest radiograph of a 75-year-old woman. What is the MOST likely diagnosis?



- A. Atrial septal defect
- B. Chronic pulmonary embolism
- C. Pulmonary venous hypertension
- D. Cor pulmonale

Key: D

References:

Mortani Barbosa, Jr. EJ, Gupta NK, Torigian DA, Geffer WB. Current Role of Imaging in the Diagnosis and Management of Pulmonary Hypertension. *Am J Roentgenol* 2012; 198:1320-1331.

Leb JS, Chung MS, Frazier AA, et al. Pulmonary Hypertension: Review of the New WHO Classification. Society of Thoracic Radiology. <http://thoracicrad.org/wp-content/uploads/2016/05/168-Pulmonary-Hypertension-Review-of-the-New-WHO-Classification.pdf> Accessed 5/21/2018.

Rationale: A. Incorrect. The radiograph shows marked enlargement of the central pulmonary arteries with abrupt tapering, or pruning. This finding is consistent with pulmonary arterial hypertension. Although patients with atrial septal defect can develop pulmonary arterial hypertension, in this case, the lungs are markedly hyperinflated consistent with emphysema. In addition, the central pulmonary arteries are typically more markedly enlarged in patients with Eisenmenger physiology. B. Incorrect. Although chronic pulmonary emboli can result in pulmonary arterial hypertension, the lung volume would not be affected. The hyperinflation of the lungs in this case represents emphysema as the cause of the pulmonary arterial hypertension. C. Incorrect. Pulmonary venous hypertension occurs when the left ventricle is unable to pump the volume of blood that it receives. This results in elevated left atrial pressures and pulmonary venous hypertension. On chest radiographs, the findings of pulmonary venous hypertension include cephalization of the vasculature and enlargement of the vessels, interstitial and alveolar edema – findings that are not present in this case. D. Correct. The radiograph shows marked enlargement of the central pulmonary arteries with abrupt tapering, or pruning, consistent with pulmonary arterial hypertension. In addition, there is marked hyperinflation of the lung with diminished lung markings, consistent with emphysema. In severe cases of emphysema, there is obliteration of the capillary bed. If the volume of affected lung is large enough, pulmonary arterial hypertension will occur.

3. You are shown an oblique coronal reformatted image from a contrast-enhanced CT. Which coronary artery is depicted by the arrow?



- A. Diagonal branch
- B. Obtuse marginal branch
- C. Ramus intermedius
- D. Septal branch

Key: C

References:

O'Brien JP, Srichai MB, Hecht EM, et al. Anatomy of the Heart at Multidetector CT: What the Radiologist Needs to Know. *RadioGraph* 2007; 27:1569-1582.

Rationale: A. Incorrect. The diagonal branches arise from the left anterior descending artery. The artery in this case arises at the trifurcation of the left main coronary artery. B. Incorrect. The obtuse marginal branches arise from the circumflex artery. The artery in this case arises at the trifurcation of the left main coronary artery. C. Correct. In this case, the left main coronary artery trifurcates, giving off the left anterior descending artery, the circumflex artery, and between these two, the ramus intermedius. The ramus intermedius supplies the lateral wall of the left ventricle and occurs in approximately 15% of patients. D. Incorrect. Septal branches arise from the left anterior descending artery and immediately enter the interventricular septum. The artery in this case arises at the trifurcation of the left main coronary artery.

4. What does the structure denoted by the white arrow on the second image represent?



- A. Myxoma
- B. Papillary muscle
- C. Crista terminalis
- D. Thrombus

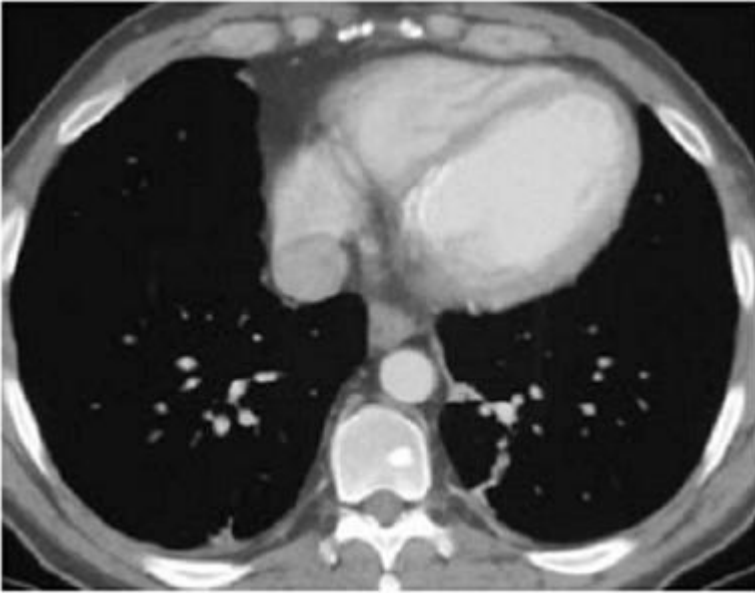
Key: D

References:

Abbara S. Ventricular Thrombus. In, Diagnostic Imaging Cardiovascular. pp. 1-4-10. Amirsys, Salt Lake City 2008.

Rationale: A. Incorrect. Myxomas may occur in the ventricle, however they are much more common in the atria, especially the left atrium. The location of this abnormality adjacent to an area of myocardial infarction makes the diagnosis of thrombus much more likely. B. Incorrect. Papillary muscles are normal “filling defects” within the left ventricle. However the lesion in question is far too large for a papillary muscle and is not in the expected location. Although the right ventricle has a septal papillary muscle, the left ventricle does not. C. Incorrect. The crista terminalis is occasionally mistaken for an intracardiac mass. However, it is located along the posterolateral wall of the right atrium. The crista terminalis represents the residuum of the septum spurium, where the embryologic sinus venosus was incorporated into the right atrial wall. D. Correct. The images show focal thinning and fatty metaplasia of the distal left ventricular septum, consistent with a remote myocardial infarction. This segment of myocardium is likely akinetic or severely hypokinetic, placing the patient at risk for developing intraventricular thrombus, as is shown in this case.

5. You are shown an axial image from a contrast enhanced CT of a 55-year-old man with cardiac calcification. Which one of the following is the location of the calcification?



- A. Mitral annulus
- B. Coronary artery
- C. Left ventricular wall
- D. Pericardium

Key: C

References:

Nance JW Jr, Crane GM, Halushka MK, et al. Myocardial calcifications: Pathophysiology, etiologies, differential diagnoses, and imaging findings. *J Cardiovasc Comput Tomogr*. 2015; 9:58-67.

Rationale: A. Incorrect. The mitral annulus is located at the atrioventricular groove. The calcification in this case involves the endocardial surface of the left ventricle. B. Incorrect. The coronary arteries are located in the subepicardial fat. The calcification in this case is within the left ventricle. C. Correct. The image shows calcification of the endocardial surface of the left ventricle and represents dystrophic calcification from a prior infarct. D. Incorrect. Pericardial calcification would be located on the outer surface of the heart.

6. Regarding MR imaging in the evaluation of myocardial infarction, which of the following is the MOST important technique?

- A. T2-weighted
- B. First pass perfusion
- C. Velocity-encoded phase-contrast
- D. Delayed-enhancement

Key: D

References:

Ginat DT, Fong MW, Tuttle DJ, et al. Cardiac Imaging: Part I, MR Pulse Sequences, Imaging Planes and Basic Anatomy. Am J Roentgenol 2011; 197:808-815.

Rationale: A. Incorrect. T2-weighted black-blood images are useful for morphologic assessment of the heart. B. Incorrect. First-pass perfusion imaging is helpful in the detection of peri-infarct ischemia. C. Incorrect. Velocity-encoded phase-contrast images are useful for determining regurgitant volumes and fractions and cardiac output. D. Correct. Delayed enhancement is the most important technique as it allows for the diagnosis of nonischemic cardiomyopathies, allows for the quantification of myocardial scarring, and assesses the myocardial viability.

7. Regarding pericardial cysts, what is the MOST common CT appearance?

- A. High attenuation fluid
- B. Low attenuation fluid
- C. Thin wall calcifications
- D. Thin walled septations

Key: B

References:

Abbara S. Pericardial Cyst. In, Diagnostic Imaging Cardiovascular. pp. 3-2-20-23. Amirsys, Salt Lake City 2008.

Restrepo CS, Vargas D, Ocazone D, et al. Primary Pericardial Tumors. RadioGraph 2013; 33:1613-1630.

Rationale: A. Incorrect. Although pericardial cysts may measure higher than water attenuation if there is proteinaceous fluid or prior hemorrhage, the most common appearance is that of a simple cyst. B. Correct. The most common appearance of a pericardial cyst is a fluid attenuation structure with imperceptible walls. C. Incorrect. The wall of a pericardial cyst is typically imperceptible. D. Incorrect. The most common appearance is that of a simple cyst with imperceptible walls. Septations are not a typical feature of pericardial cysts.

8. What is the MOST common primary malignant pericardial neoplasm?

- A. Angiosarcoma
- B. Lymphoma
- C. Mesothelioma
- D. Neuroectodermal tumor

Key: C

References:

Restrepo CS, Vargas D, Ocazone D, et al. Primary Pericardial Tumors. RadioGraph 2013; 33:1613-1630.

Rationale: A. Incorrect. Angiosarcoma is the most common primary malignant cardiac tumor. However, it is not the most common primary malignant pericardial tumor. B. Incorrect. Primary pericardial lymphoma is usually a B-cell lymphoma and is defined as lymphoma involving the pericardium, with no other sites of involvement. It is not the most common primary pericardial malignancy. C. Correct. Primary pericardial neoplasms are rare. Primary pericardial mesothelioma is the most common primary malignant pericardial neoplasm. D. Incorrect. Primary pericardial primitive neuroectodermal tumor is very rare, with only a single case reported in the literature as of 2013.

9. Regarding implantable cardioverter-defibrillator devices, what is the proper anatomic position of the proximal shock coil?

- A. Right ventricle
- B. Superior vena cava
- C. Left ventricle
- D. Inferior vena cava

Key: B

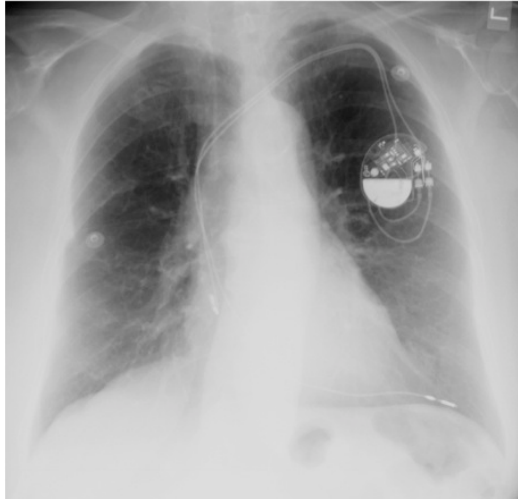
References:

Radiography of Pacemakers and Implantable Cardioverter Defibrillators. Costelloe CM, Murphy, Jr. WA, Gladish GW, Rozner MA. Am J Roentgenol 2012; 199:1252-1258.

Radiography of Cardiac Conduction Devices: A Comprehensive Review. Aguilera AL, Volokhina YV, Fisher KL. RadioGraph 2011; 31:1669-1682.

Rationale: A. Incorrect. The distal coil should be located in the right ventricle. When an abnormal rhythm is detected, the device sends a defibrillation shock. B. Correct. The proximal coil should be placed at the junction of the superior vena cava and brachiocephalic vein. The distal coil should be located in the right ventricle. When an abnormal rhythm is detected, the device sends a defibrillation shock. C. Incorrect. The distal coil should be located in the right ventricle, not the left ventricle. D. Incorrect. The inferior vena cava is not the location for either the proximal or distal coil of an implantable cardioverter-defibrillator device.

10. What is the location of the atrial and ventricular pacemaker lead tips, respectively, in this patient?



- A. Right atrium and right ventricle
- B. Right atrium and extracardiac
- C. Extracardiac and right ventricle
- D. Both leads are extracardiac

Key: B

References:

Radiography of Pacemakers and Implantable Cardioverter Defibrillators. Costelloe CM, Murphy, Jr. WA, Gladish GW, Rozner MA. Am J Roentgenol 2012; 199:1252-1258.

Radiography of Cardiac Conduction Devices: A Comprehensive Review. Aguilera AL, Volokhina YV, Fisher KL. RadioGraph 2011; 31:1669-1682.

Rationale: A. Incorrect. The atrial lead is appropriately positioned in the right atrium. The right ventricular lead tip lies outside of the confines of the heart. If it were placed in the right ventricle, it would overlie the heart. B. Correct. The atrial lead is appropriately positioned in the right atrium. The right ventricular lead tip lies outside of the confines of the heart. C. Incorrect. The atrial lead is appropriately positioned in the right atrium. The right ventricular lead tip lies outside of the confines of the heart. D. Incorrect. The atrial lead is appropriately positioned in the right atrium. The right ventricular lead tip lies outside of the confines of the heart.

**Chest Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



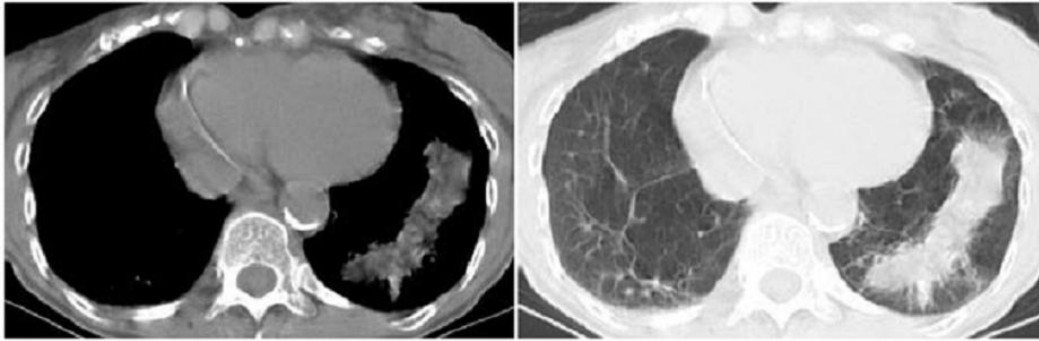
QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. You are shown two axial images from a CT scan of the chest of an 80-year-old woman. What is the MOST likely diagnosis?



- A. Bronchogenic carcinoma
- B. Lipoid pneumonia
- C. Cryptogenic organizing pneumonia
- D. Streptococcus pneumonia

Key: B

References:

Gaerte, SC, Meyer CA, Winer-Muram HT, Tarver RD, Conces DJ. Fat-containing Lesions of the Chest *Radiographics* October 2002 22:suppl 1 S61-S7.

Rationale: A. Incorrect. Bronchogenic cancer is considered in the differential diagnosis of a solitary pulmonary nodule/mass. They can have varying radiographic appearances. They tend to be present in the upper lobes and or centrally either within the airways or perihilar region. They can be lobulated, spiculated or can also cavitate. However, presence of fat in the nodule/mass as in our case suggests an alternative diagnosis. Thus, Bronchogenic cancer is the incorrect answer. B. Correct. Lipoid pneumonia is caused by aspiration of mineral oil. The disease occurs in elderly individuals who frequently use oil for constipation. The radiographic features include air space consolidation with spiculation or linear opacities. These changes are the result of interlobular septal thickening caused by infiltration of lipid laden macrophages and chronic inflammation. The presence of fat in the consolidation strongly favors this diagnosis. These features are present in this case. C. Incorrect. Cryptogenic organizing pneumonia is characterized pathologically as an organizing pneumonia in the alveoli. Radiographically it can manifest as patchy air space opacities, focal consolidation or multiple nodules. However, presence of fat in the nodule/mass as in our case suggests an alternative diagnosis. Thus, cryptogenic organizing pneumonia is the incorrect answer. D. Incorrect. Streptococcus pneumonia can appear as nodule, opacity and or consolidation, however, it will not contain fat within it.

2. Based upon this single axial image from a CT scan of the chest from a 30- year-old woman, which type of nodule is demonstrated?



- A. Centrilobular
- B. Tree-in-bud
- C. Miliary
- D. Perilymphatic

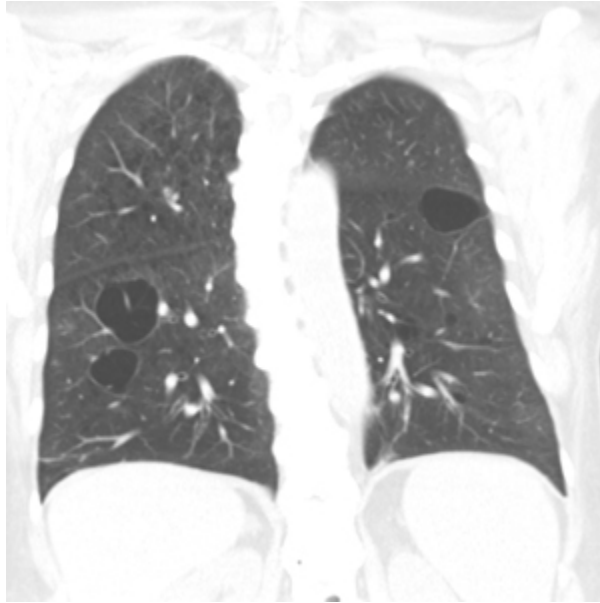
Key: A

References:

Grammatina Boitsios¹, Alexander A. Bankier¹ and Ronald L. Eisenberg. Diffuse Pulmonary Nodules. AJR May 2010, Volume 194, Number 5.

Rationale: A. Correct. Centrilobular nodules occur in the center of the secondary lobules, are usually ground glass in nature and are equidistance from each other. These features are present in the provided image. B. Incorrect. Tree-in-bud nodules appear as branching or “Y” shaped tubular opacities. This appearance is not present on the provided image. C. Incorrect. Miliary nodules are usually few mms in size, solid in nature and are randomly distributed in the lungs. These features are not present in the provided image. D. Incorrect. Perilymphatic nodules are present in the subpleural location, on the interlobular septa and along the peribronchovascular bundle. These features are not present in the provided image.

3. You are shown a coronal reformatted image of a 67-year-old woman with collagen vascular disease. What is the MOST likely diagnosis?



- A. Lymphangioleiomyomatosis
- B. Pneumocystis jirovecii pneumonia
- C. Lymphoid interstitial pneumonia
- D. Birt-Hogg-Dubé syndrome

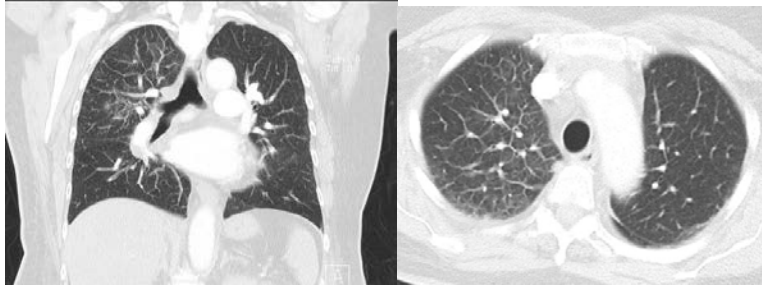
Key: C

References:

Eun A Kim, MD, Kyung Soo Lee, MD, Takeshi Johkoh, MD, PhD, Tae Sung Kim, MD, Gee Young Suh, MD, O Jung Kwon, MD, and Joung-ho Han, MD. Interstitial Lung Diseases Associated with Collagen Vascular Diseases: Radiologic and Histopathologic Findings. *Radiographics*, Oct 2002, Vol. 22: S151-S165.

Rationale: A. Incorrect. Diffuse cystic lung disease, cysts are usually uniform in size. Here, cysts significantly differ in size: upper lobes compare to lower lobes. No definitive association with collagen vascular disorders. B. Incorrect. Cystic form of pneumocystis pneumonia has been reported. Consideration if the patient were immunocompromised. C. Correct. Best answer given the history of collagen vascular disease (scleroderma) and peribronchovascular location of cysts. D. Incorrect. Cysts are basilar predominant but usually subpleural in location.

4. You are shown CT images of a 68-year-old woman with history of acute mitral regurgitation. What is the MOST likely cause of the abnormality demonstrated on the images?



- A. Lymphangitic carcinomatosis
- B. Pulmonary veno-occlusive disease
- C. Pneumonia
- D. Pulmonary edema

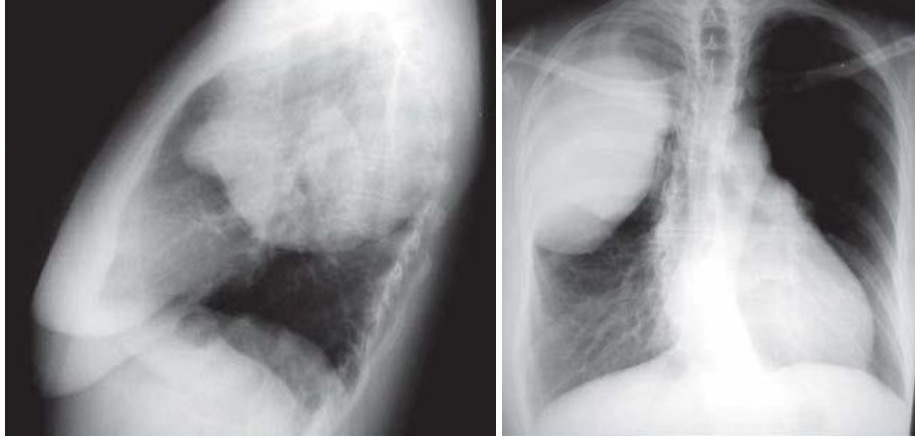
Key: D

References:

Thomas Gluecker, MD , Patrizio Capasso, MD , Pierre Schnyder, MD , François Gudinchet, MD , Marie-Denise Schaller, MD , Jean-Pierre Revelly, MD , René Chiolerio, MD , Peter Vock, MD , and Stéphan Wicky, MD. Clinical and Radiologic Features of Pulmonary Edema. *RadioGraphics*, Nov 1999, Vol. 19: 1507-1531.

Rationale: A. Incorrect. Lymphangitic carcinomatosis appears as thickening of the interlobular septa and peribronchovascular bundle, often with a nodular appearance. These features are not present in the provided images. B. Incorrect. Pulmonary veno occlusive disease demonstrates enlarged pulmonary arteries and thickening of interlobular septa. These features are not present in the provided images. C. Incorrect. Pneumonia appears as nodule, opacity and or consolidation. D. Correct. Pulmonary edema appears as thickening of the interlobular septa which are present in the provided image and thus is the correct answer.

5. You are shown PA and lateral chest radiographs from a 53-year-old woman with mild dyspnea. Which one of the following is the MOST likely diagnosis?



- A. Mesothelioma
- B. Empyema
- C. Bronchogenic carcinoma
- D. Solitary fibrous tumor

Key: D

References:

Ana Giménez, Tomás Franquet, Rosa Prats, Pilar Estrada, Jordi Villalba, Silvia Bagué. Unusual Primary Lung Tumors: A Radiologic-Pathologic Overview. Radiographics. May 2002, Vol. 22: 601-619.

Rationale: A. Incorrect. Mesothelioma appears as a rind of tissue that encircles the hemothorax. This feature is not present in the provided images. B. Incorrect. Empyema demonstrates pleural effusion with air and or thickening of the pleura. These features are not present in the provided images. C. Incorrect. Bronchogenic carcinoma appears as nodule/mass within the lung parenchyma and is often spiculated. These features are not present in the provided images. D. Correct. Solitary fibrous tumor occurs in the pleural space and appears as a mass with smooth borders and incomplete sign which suggests that the finding is extraparenchymal in nature. These features are present in the provided images.

6. You are shown CT image of a 29-year-old woman with shortness of breath. What is the MOST likely diagnosis?



- A. Langerhans cell histiocytosis
- B. Tuberous sclerosis
- C. Emphysema
- D. Lymphangioleiomyomatosis

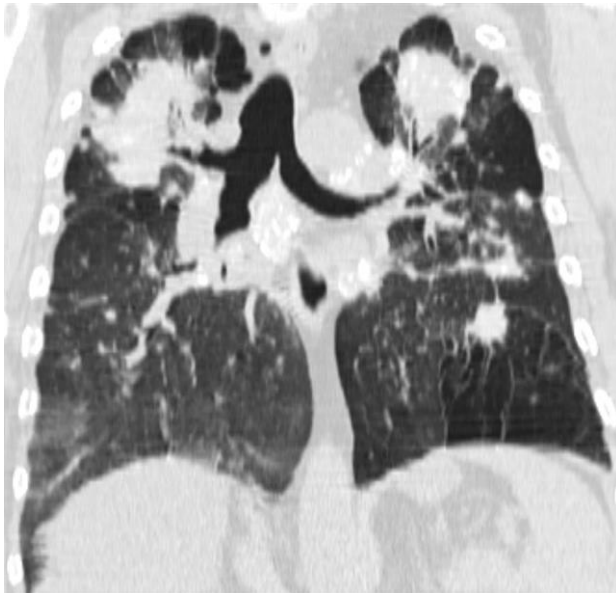
Key: D

References:

Gerald F. Abbott, Melissa L. Rosado-de-Christenson, Aletta Ann Frazier, Teri J. Franks, Robert D. Pugatch, Jeffrey R. Galvin. Lymphangioleiomyomatosis: Radiologic-Pathologic Correlation. Radiographics. May 2005, Vol. 25: 803-828.

Rationale: A. Incorrect. Pulmonary Langerhans Cell Histiocytosis (PLCH) affects typically affects young smokers 20-40 years of age. PLCH involves primarily the mid and upper lung zones, and presents as a combination of reticulonodular pattern, air cysts, and irregular nodules. In this case, there is an absence of associated nodules expected in LCH. B. Incorrect. Tuberous sclerosis can present as a cystic lung disease and typically involves the lung bases (not seen in this case). Additionally, TS has an association with pleural effusions. C. Incorrect. The cysts in this case have well-defined walls, unlike lucent lesions caused by destruction of the alveoli in emphysema. D. Correct. The presence of thin-walled cysts distributed throughout the lung parenchyma in a woman of child-bearing age is typical of LAM. Pneumothorax is a recognized common complication.

7. You are shown a coronal reformatted CT image of a 65-year-old man. What is the most likely diagnosis?



- A. Respiratory bronchiolitis
- B. Pulmonary metastasis
- C. Silicosis
- D. Hypersensitivity pneumonitis

Key: C

References:

Semin Chong, Kyung Soo Lee, Myung Jin Chung, Joung-ho Han, O Jung Kwon, Tae Sung Kim.

Pneumoconiosis: Comparison of Imaging and Pathologic Findings. *Radiographics*. Jan 2006, Vol. 26: 59-77, 10.

Rationale: A. Incorrect. Respiratory bronchiolitis (RB) is a smoking related interstitial lung disease characterized by upper lobe predominant centrilobular nodules in the background of emphysema. The nodules associated with RB tend to be far smaller than those seen in this case. B. Incorrect. Pulmonary metastasis is commonly seen diffusely throughout the lungs, not confined to the upper lobes as was the case in this patient. C. Correct. Complicated silicosis, also known as progressive massive fibrosis (PMF), develops through severe scarring and the expansion and confluence of silicotic nodules, resulting in large mass-like consolidations in the apical and posterior aspects of the upper lobes as depicted in this case. D. Incorrect. Nodules seen in the acute and subacute forms of hypersensitivity pneumonitis (HP) tend to be smaller and more diffuse than those seen in this example. In addition, HP nodules are often spread in a bronchocentric (ie – inhalational) pattern.

8. Which one of the following is the MOST common location of a bronchogenic cyst?
- A. Right cardiophrenic angle
 - B. Left paraspinal region
 - C. Subcarinal space
 - D. Lung parenchyma

Key: C

References:

Jeung M, Gasser B, Gangi A et al. Imaging of Cystic Masses of the Mediastinum. *Radiographics* October 2002 22:suppl 1 S79-S93.

Rationale: A. Incorrect. B. Incorrect. C. Correct. Bronchogenic cyst are congenital cysts. They are found most commonly in the mediastinum, more so in the subcarinal location. Only a small percentage occurs within the lung parenchyma. D. Incorrect.

9. Which one of the following conditions predisposes to pulmonary aspergilloma?
- A. Cystic fibrosis
 - B. Asthma
 - C. Sarcoidosis
 - D. Chronic lymphocytic leukemia

Key: C

References:

Franquet T, Muller NL, Gimenez A, Guembe P, de la Torre J, Bague S. Spectrum of Pulmonary Aspergillosis: Histologic, Clinical, and Radiologic Findings. *Radiographics* July 2001 21:4 825-837.

Rationale: A. Incorrect. B. Incorrect. C. Correct. Aspergillomas or Mycetomas or fungus balls is a saprophytic infection which occurs in individuals with a pre-existing cyst or cavity. Common causes of pre-existing cavity include Tuberculosis or Sarcoidosis within which mycetomas may occur. Individuals are often asymptomatic, however, hemoptysis may occur. Hemoptysis may range from minor to massive and life threatening. Emergent bronchial artery embolization is required in life threatening cases. D. Incorrect.

10. Which of the following structures is a core component of the secondary pulmonary lobule?

- A. Bronchiole
- B. Pulmonary vein
- C. Lymphatic
- D. Septum

Key: A

References:

W. Richard Webb, MD. Thin-Section CT of the Secondary Pulmonary Lobule: Anatomy and the Image—The 2004 Fleischner Lecture. *Radiology*, May 2006, Vol. 239: 322-338.

Rationale: A. Correct. The bronchiole forms the center of the lobule with its accompanying pulmonary artery. B. Incorrect. The pulmonary vein is located at the peripheral portion of the secondary lobule within the interlobular septum. C. Incorrect. The lymphatics are also located with the vein in the interlobular septum. D. Incorrect. The interlobular septum is a band of fibrous tissue which surrounds the periphery of the secondary lobule.

**General Competency Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. Per the ACR Practice Guidelines and Standards for Performing and Interpreting Diagnostic Ultrasound, physicians performing and/or interpreting diagnostic ultrasound examinations:

- A. Not board certified in radiology or not trained in diagnostic radiology residency program should have completed ACGME approved residency program in specialty practice and completed 200 hours of Category I CME in subspecialty where similar ultrasound reading occurs.
- B. must be eligible for certification in Diagnostic Radiology by the American Board of Radiology with supervision and/or performance, interpretation and reporting of 500 ultrasound examinations within last 36 months.
- C. must have completed an ACGME approved Diagnostic Radiology residency program with supervision and/or performance, interpretation and reporting of 700 ultrasound examination in the past 36 months.
- D. must be board certified in Diagnostic Radiology by the American Board of Radiology or have involvement with supervision and/or performance, interpretation and reporting of 700 ultrasound examinations within the last 36 months.

Key: A

References:

<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/us-perf-interpret.pdf?la=en>

Rationale: A. Correct. The American College of Radiology Practice Guidelines and standards state "Physicians not board certified in radiology or not trained in a diagnostic radiology residency program, and who assume these responsibilities for sonographic imaging exclusively in a specific anatomic area should meet the following criteria: completion of an ACGME approved residency program in specialty practice plus 200 hours of Category I CME in subspecialty where ultrasound reading occurs; and supervision and/or performance, interpretation, and reporting of 500 cases relative to each subspecialty area interpreted (e.g. pelvic, obstetrical, breast, thyroid, vascular, etc.) during the past 36 months in a supervised situation." B. Incorrect. Diagnostic ultrasound state, "Physicians who supervise, perform and/or interpret diagnostic ultrasound examination should be licensed medical practitioners who have a thorough understanding of the indications for ultrasound examinations as well as a familiarity with the basic physical principles and limitations of the technology of ultrasound imaging...Physicians performing and/or interpreting diagnostic ultrasound examinations should meet at least one of the following criteria: Certifications in Radiology or Diagnostic Radiology by the American Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or Le College des Medecins du Quebec, and involvement with the supervision and/or performance, interpretation, and reporting of 300 ultrasound examinations within the last 36 months..." This distractor is incorrect. It states physician performing/interpreting diagnostic ultrasound must be eligible for certification in Diagnostic Radiology by the ABR. Per the above guidelines, physicians not board certified in radiology or not trained in a diagnostic radiology residency programs can perform/interpret diagnostic ultrasound if they complete the above mentioned criteria. In addition, physicians performing and/or interpreting diagnostic ultrasound examinations must be eligible for certification in Diagnostic Radiology by the American Board of Radiology and involvement with supervision and/or performance, interpretation and reporting of 300 not 500 ultrasound examinations within the last 36 months. C. Incorrect. This distractor is incorrect. It states physicians must have completed an Accreditation Council for Graduate Medical Education (ACGME) approved diagnostic radiology residency program with supervision and/or performance, interpretation and reporting of 700 ultrasound examinations in the past 36 months. Per the above guidelines, physicians may complete ACGME approved residency programs in specialties other than radiology. However, they must meet other criteria, including: 200 hours of Category I CME in subspecialty where ultrasound reading occurs; supervision/performance, interpretation and reporting of

500 not 700 cases relative to each subspecialty interpreted. D. Incorrect. This distractor is incorrect. It states Physicians must be board certified in Diagnostic Radiology by the American Board of Radiology or have involvement with the supervision and/or performance, interpretation and reporting of 700 ultrasound examinations within the last 36 months. However, the guidelines state that physician do not have to be board certified in radiology. They may be board eligible or have completed ACGME approved residency program in other specialties and meet additional criteria, as stated above.

2. According to the ACR Practice Guideline for the Performance of Myelography and Cisternography, which of the following is an indication for these procedures?

- A. Radiation therapy planning
- B. Diagnostic MRI studies of the spine or skull base
- C. Correlation of physical findings with MRI studies
- D. The referring physician requests it but provides no specific history or other documentation

Key: A

References:

<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/myelog-cisternog.pdf?la=en>

ACR-ASNR-SPR Practice Parameter For The Performance of Myelography and Cisternography.

Rationale: A. Correct. The ACR-ASNR-SPR Practice Parameter for the Performance of Myelography and Cisternography states numerous indications for myelography and cisternography. Indications include but are not limited to: radiation therapy planning, diagnostic evaluation of spinal or basal cisternal disease, non-diagnostic MRI studies of spine or skull base, poor correlations of physical findings with MRI studies and delineation of congenital anomalies. B. Incorrect. Indications include non-diagnostic MRI studies of the spine or skull base. C. Incorrect. Indications include poor correlation of physical findings with MRI studies. D. Incorrect. Indications do not include referring physician request without specific history or documentation.

3. According to the ACR Practice Guideline for the Performance of Vertebroplasty, which of the following is an absolute (i.e., NOT relative) contraindication for this procedure?

- A. Retropulsion of a fracture fragment causing severe spinal canal compromise
- B. Epidural tumor extension with significant encroachment on the spinal canal
- C. Ongoing systemic infection
- D. Asymptomatic vertebral body compression fractures

Key: D

References:

<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/vertebralaug.pdf?la=en>

Rationale: A. Incorrect. Retropulsion of a fracture fragment causing severe spinal canal compromise is a relative contraindication for vertebroplasty. B. Incorrect. Epidural tumor extension with significant encroachment on the spinal canal is a relative contraindication. C. Incorrect. Ongoing systemic infection is a relative contraindication to vertebroplasty. D. Correct. ACR-ASNR-ASSR-SIR-SNIS Practice Parameter For The Performance of Vertebral Augmentation indicates that absolute contraindications for vertebroplasty include: septicemia, active osteomyelitis of the target vertebra, uncorrectable coagulopathy and allergy to bone cement or opacification agent.

4. Autonomy, beneficence, nonmaleficence and justice are considered to be principles of which of the following parameters of medical practice?

- A. Medical Ethics
- B. Professionalism
- C. Quality
- D. Safety

Key: A

References:

J. Am. Coll. Radiol. J. Am. Coll. Radiol. 2012; 9: 251-255.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1769526/>

AJR. 2017;208 (3): 101-109.

Rationale: A. Correct. The core principles of medical ethics are autonomy, nonmaleficence, beneficence and justice. B. Incorrect. The three fundamental principles of professionalism are: primary of patient welfare, patient autonomy and social justice. C. Incorrect. The principles of quality means “doing the right thing, at the right time, in the right way, for the right person-and have the best possible results” and providing “a timely access to delivery of integrated and appropriate radiological studies and interventions in a safe and responsive facility and a prompt delivery of accurately interpreted reports by capable personnel in an effective and sustainable manner.” D. Incorrect. Safety in health care is based upon “first, do no harm”, which is part of the Hippocratic Oath.

5. Which of the following descriptions BEST describes the desired characteristic of the American College of Radiology's Appropriateness Criteria® (ACR AC®)?

- A. Anachronistic
- B. Anecdotal
- C. Evidence-based
- D. Mandatory

Key: C

References:

<https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria>

<https://www.merriam-webster.com/dictionary/anecdotal>

Rationale: A. Incorrect. Anachronism is defined as chronological misplacing of persons, events, objects or customs in regard to each other. The ACR AC® have been updated several times since its inception, including recently, mitigating against anachronism. B. Incorrect. "The ACR Appropriateness Criteria® are evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition. Presumably the panels that construct the ACR AC® use their own clinical experience, wisdom and common sense in the formulation of individual ACR AC® but in that evidence-based medicine is explicitly (in the description provided) favored, choice "B" does not seem to be the best one. In that the ACR AC® are guidelines (as per the stated description), it would seem logical that they would not typically be mandatory and thus choice "D" does not seem to be the best choice either. C. Correct. The ACR Appropriateness Criteria are evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition." The definition of anecdotal is "based on or consisting of reports or observations of usually unscientific observers". D. Incorrect. The ACR Appropriateness Criteria are guidelines and not mandatory.

6. Which of the following diagnostic imaging examinations is associated with the HIGHEST “relative radiation level (RRL)” according to the American College of Radiology’s Appropriateness Criteria® (ACR AC®)?

- A. Mammography
- B. MRI
- C. Radionuclide bone scintigraphy
- D. Whole-Body PET imaging

Key: D

References:

<https://www.acr.org/-/media/ACR/Files/Radiology-Safety/Radiation-Safety/Dose-Reference-Card.pdf?la=en>

<https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf>

Rationale: A. Incorrect. The ACR Appropriateness Criteria® Radiation Dose Assessment Introduction” from the American College of Radiology has a table which reports effective radiation dose of mammography is 0.4 mSv, which is equivalent to 7 weeks of natural background radiation. Whole Body PET as having a score of 4 “radiation signs,” out of 5 total points and 6 total possible scores (0 is also possible) (reference: <http://www.acr.org/~media/ACR/Documents/AppCriteria/RRLInformation.pdf> accessed 10/9/12). Nuclear Medicine Bone Scan scores 3, Mammography scores 2 and MRI scores 0 in this document (reference:

<http://www.acr.org/~media/ACR/Documents/AppCriteria/RRLInformation.pdf> accessed 10/9/12).

Thus “D” is the best answer and “A,” “B” and “C” are not. B. Incorrect. MRI does not utilize ionizing radiation. There is no radiation dose from this examination. C. Incorrect. The ACR Appropriateness Criteria Radiation Dose Assessment reports the effective dose from a bone scan is 1-10 mSv.

D. Correct. PET/CT has an effective radiation dose of 25 mSv or 8 years of background radiation.

7. According to the “ACR Practice Guideline for Communication of Diagnostic Imaging Findings,” which is MOST important?

- A. Delivery method
- B. Timeliness
- C. Length
- D. Recipients

Key: B

References:

http://www.acr.org//media/ACR/Documents/PGTS/guidelines/Comm_Diag_Imaging.pdf accessed 10/15/12

<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/communicationdiag.pdf?la=en>

Rationale: A. Incorrect. The parameter states that timely receipt of the report is more important than the method of delivery. B. Correct. The ACR Practice Parameter for Communication of Diagnostic Imaging Findings states “Timely receipt of the report is more important than the method of delivery.” C. Incorrect. Length of the report is not specified. The components of the report and format are describes including: demographics, relevant clinical information, body or report and impression. D. Incorrect. The recipients should include ordering physician or other health care provider. However, timeliness of reporting is states as more important.

8. In setting up a new pediatric MRI service at your healthcare facility, your administrator asks about the purchase of MR coils and crash cart supplies. According to the “ACR-SPR Practice Guideline for the Performance and Interpretation of Pediatric Magnetic Resonance Imaging (MRI),” which of the following is the MOST appropriate course of action?

- A. Purchase a variety of sizes
- B. Purchase adult sizes only
- C. Purchase sizes for small children and adults
- D. Purchase sizes for small children only

Key: A

References:

<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/mr-perf-interpret.pdf?la=en>

Rationale: A. Correct. The ACR Practice Parameter For Performing And Interpreting Magnetic Resonance Imaging states “Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications and should also be appropriate and comprehensive for the range of ages and sizes in the facility’s patient population. Inventory and drug expiration dates must be monitored on a regular basis “. Children vary in size. Therefore, a variety of sizes of coils is necessary to accommodate the needs of all pediatric patients. B. Incorrect. Adult size coils would not be the correct size for many pediatric patients and thus not meet the needs of the patient population. C. Incorrect. A variety of size coils is needed to meet the needs of all patients. Coils for small children and adults would not address the needs of patients, who are larger than a small child, but not the size of an adult. D. Incorrect. The needs of larger children, infants and newborns would not be met by the purchase of coils for small children only.

9. HIPAA specifies that its regulations must be followed by "covered entities." Which of the following constitutes a covered entity?

- A. The patient's spouse
- B. The patient's employer
- C. The patient's health care plan
- D. The patient's religious/spiritual consultant

Key: C

References:

<https://www.hhs.gov/hipaa/for-professionals/covered-entities/index.html>

Rationale: A. Incorrect. A patient's spouse is not a covered entity. B. Incorrect. The patient's employer is not a covered entity. C. Correct. A covered entity includes: health care providers (such as: doctors, clinics, psychologists, dentists, chiropractors, nursing homes and pharmacies), health plans (such as: health insurance companies, HMOs, company health plans and government programs that pay for health care) and health care clearinghouses. The patient's health care plan is a covered entity.

D. Incorrect. The patient's religious/spiritual consultant is not a covered entity.

10. The American College of Radiology practice guideline for skeletal survey in children states:
- A. The only clinical indications for performing skeletal survey are suspected physical abuse in infants and young children and suspected skeletal dysplasias.
 - B. The imaging protocol for skeletal survey is always the same, regardless of the indication for the examination.
 - C. An official interpretation of the examination should be included in the patient's medical record and the radiographic examination must be locked in a designated area of the film library or electronic archive system.
 - D. A physician diagnosing suspected child abuse is often legally required to notify local child protection authorities. The interpreting radiologist may be required to do so, if not done by the attending physician/clinician.

Key: D

References:

<https://www.acr.org/-/media/ACR/Files/Practice-Parameters/skeletal-survey.pdf?la=en>

Rationale: A. Incorrect. The American College of Radiology practice guideline for skeletal survey in children states "Indications for skeletal surveys include, but are not limited to: suspected physical abuse in infants and young children; suspected skeletal dysplasias, syndromes, and metabolic disorders; and suspected neoplasia and related disorders." This distractor does not include syndromes, metabolic disorders and neoplasia and related conditions. B. Incorrect. The American College of Radiology practice guideline for skeletal survey in children states "The imaging protocol for the skeletal survey will depend on the particular clinical indication." The protocol is different for indications of suspected child abuse; skeletal dysplasias, syndromes, and metabolic disorders; and neoplasia and related conditions. C. Incorrect. The American College of Radiology practice guideline for skeletal survey in children states, "An official interpretation (final report) of the examination should be included in the patient's medical record...Retention of the radiographic examination should be consistent both with clinical need and relevant legal and local health care facility requirements." D. Correct. The American College of Radiology practice guideline for skeletal survey in children states, "...A physician diagnosing suspected child abuse is often legally required to notify local child protection authorities. Thus, if the attending physician does not report the case, the radiologist may still be required to do so..."

Gastrointestinal Radiology In-Training Test Questions for Diagnostic Radiology Residents



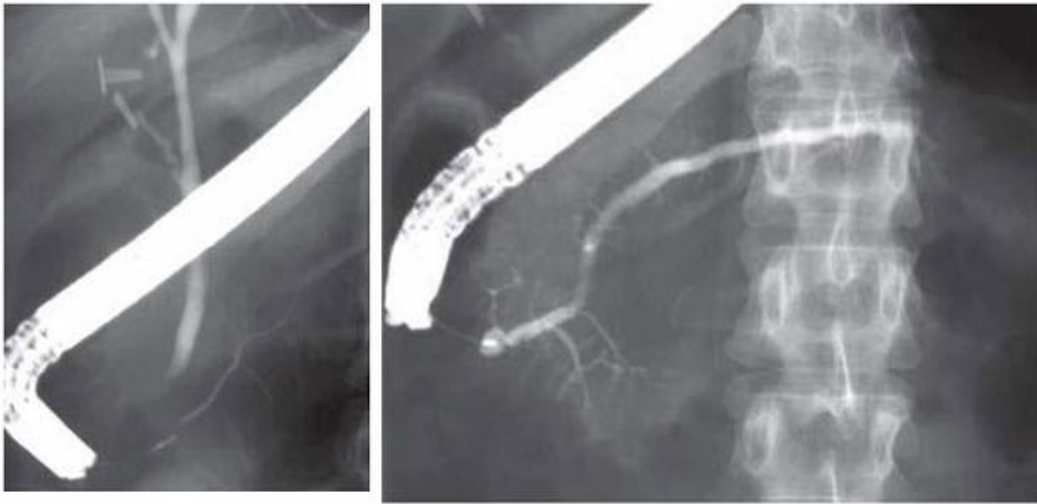
QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. You are shown two films from an ERCP in a 40-year-old woman with abdominal pain. What is the MOST likely diagnosis?



- A. Ductal adenocarcinoma
- B. Double-duct sign
- C. Pancreas divisum
- D. Annular pancreas

Key: C

References:

Borghei P, Sokhandon F, Shirkhoda A, Morgan DE (2013) Anomalies, Anatomic Variants, and Sources of Diagnostic Pitfalls in Pancreatic Imaging. *Radiology* 266 (1):28-36. doi:10.1148/radiol.12112469.

Rationale: A. Incorrect. A double duct sign (dilation of both the common bile duct and main pancreatic duct) is not seen. B. Incorrect. The common bile duct is not dilated. C. Correct. The first image shows injection of the major papilla and opacification of the common bile duct and duct of Wirsung, but no opacification of the main pancreatic duct. The second image shows injection of the minor papilla with opacification of the main pancreatic duct, but no opacification of the common bile duct. This is characteristic of pancreas divisum. D. No opacified pancreatic duct is seen to the right of the duodenum.

2. Concerning hepatic metastatic tumors, which one is typically hypovascular?

- A. Melanoma
- B. Adenocarcinoma
- C. Renal cell carcinoma
- D. Sarcoma

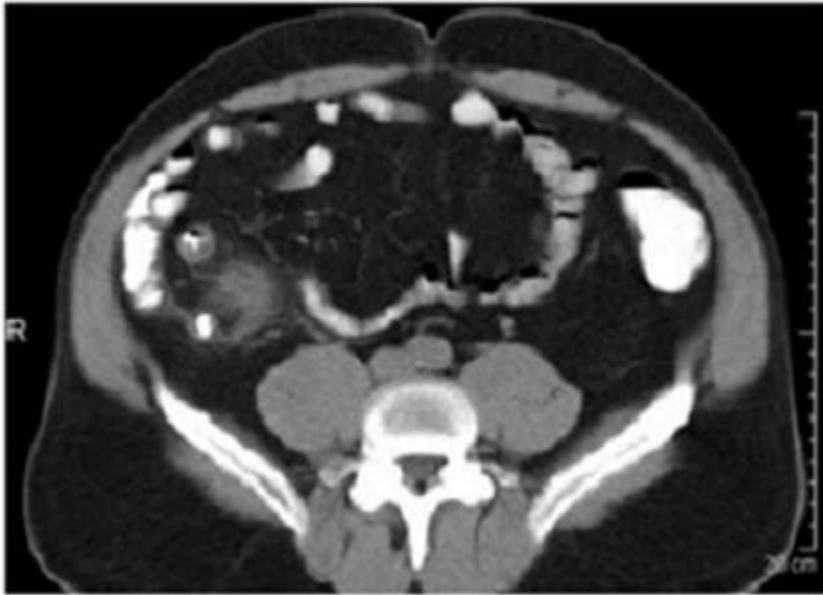
Key: B

References:

IR Kamel, Liapi E, Fishman EK. Liver and Biliary System: Evaluation by Multidetector CT, Radiol Clin North Am, 2005 Nov; 43(6) 977-997.

Rationale: A. Incorrect. Melanoma metastases are typically hypervascular. B. Correct. Most adenocarcinoma metastases are hypovascular. C. Incorrect. Renal cell carcinoma metastases are typically hypervascular. D. Incorrect. Sarcoma metastases are typically hypervascular.

3. You are shown an image (Figure 1) from a contrast enhanced CT of the abdomen and pelvis. What is the MOST LIKELY diagnosis?



- A. Omental infarct
- B. Epiploic appendagitis
- C. Acute appendicitis
- D. Typhlitis

Key: C

References:

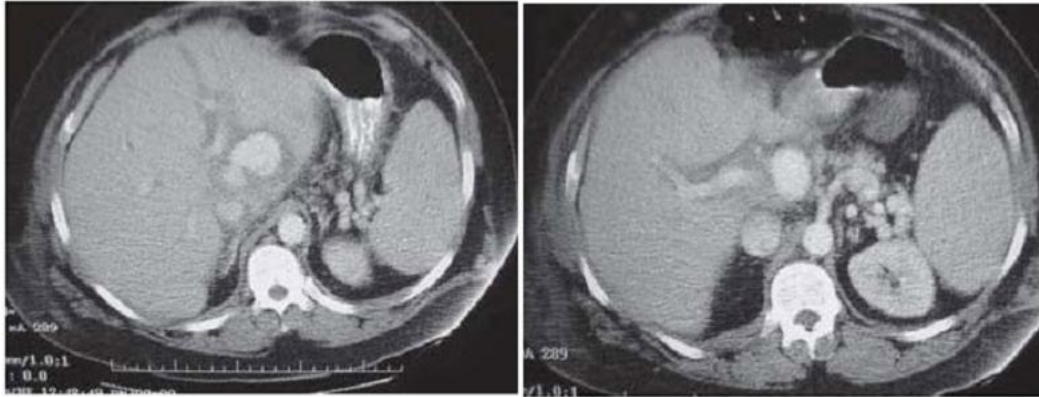
Singh AK, Gervais DA, Hahn PF, et al. Acute epiploic appendagitis and its mimics, Radiographics, 2005; 25:1521-1534.

KM Horton, Corl FM, Fishman EK. CT Evaluation of the colon: Inflammatory disease, Radiographics, 2000; 20:399-418.

Rationale: A. Incorrect. Omental infarct, a manifestation of fat necrosis, typically presents as a large area of fat attenuation and stranding, and most commonly occurs in the right lower quadrant. B. Incorrect. Epiploic appendagitis, another manifestation of fat necrosis, may present anywhere along the length of the colon where epiploic appendages occur. These also appear as a fat attenuation mass with a peripheral rim of soft tissue and often a “central dot” corresponding to the torsed central vessel. C. Correct. There is a tubular structure in the right lower quadrant with surrounding fat stranding corresponding to an inflamed appendix.

D. Incorrect. Typhlitis occurs in immunocompromised patients and manifests as circumferential wall thickening of the cecum and ascending colon.

4. You are shown contrast-enhanced CT images (Figures 4A and 4B) of the abdomen in a 38-year-old man who presents 3 weeks after liver transplantation. What is the MOST likely diagnosis?



- A. Hepatic artery pseudoaneurysm
- B. Intrahepatic biloma
- C. Postoperative hematoma
- D. Posttransplant lymphoproliferative disorder

Key: A

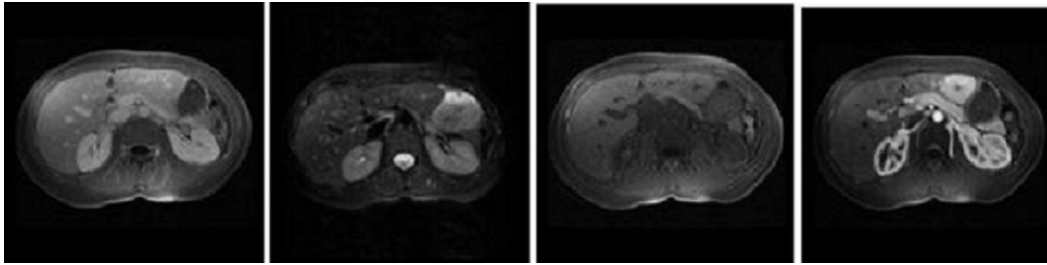
References:

Singh AK, Nachiappan AC, Verma HA, Uppot RN, Blake MA, Saini S, Boland GW (2010) Postoperative Imaging in Liver Transplantation: What Radiologists Should Know. *RadioGraphics* 30 (2):339-351. doi:10.1148/rg.302095124.

Borhani AA, Hosseinzadeh K, Almusa O, Furlan A, Nalesnik M (2009) Imaging of Posttransplantation Lymphoproliferative Disorder after Solid Organ Transplantation. *RadioGraphics* 29 (4):981-1000. doi:10.1148/rg.294095020.

Rationale: A. Correct. There is a hyperattenuating mass near the hepatic hilum which follows the attenuation of the aorta, suggesting a pseudoaneurysm. B. Incorrect. Bilomas are hypoattenuating and are within the liver parenchyma. C. Incorrect. Hematomas typically do not follow blood pool attenuation and are less well defined. D. Incorrect. Post-transplant lymphoproliferative disorder after hepatic transplant may occur in various locations (extranodal, typically the gastrointestinal tract or liver, or nodal). If it occurs within the liver, it typically presents as discrete low attenuation masses or an infiltrative mass at the porta hepatis.

5. You are shown T2-weighted and pre- and post-contrast T1-weighted arterial and portal venous phase MR images (Figures 2A through 2D). Concerning the hepatic lesion, which one is TRUE?



- A. It is the MOST common benign hepatic neoplasm
- B. It may increase in size with use of oral contraceptives
- C. It is associated with cirrhosis and viral hepatitis
- D. Predisposing conditions include primary sclerosing cholangitis

Key: B

References:

Borhani AA, Wiant A, Heller MT (2014) Cystic Hepatic Lesions: A Review and an Algorithmic Approach. American Journal of Roentgenology 203 (6):1192-1204. doi:10.2214/AJR.13.12386.
Anderson SW, Kruskal JB, Kane RA (2009) Benign Hepatic Tumors and Iatrogenic Pseudotumors. RadioGraphics 29 (1):211-229. doi:doi:10.1148/rg.291085099.

Rationale: A. Incorrect. Hemangiomas are the most common hepatic neoplasm. B. Correct. While data is equivocal, there is thought that focal nodular hyperplasia may grow with oral contraceptive use. The relationship between lesion growth and contraceptive use is clearer with hepatic adenomas. C. Incorrect. Cirrhosis is associated with hepatocellular carcinoma. D. Incorrect. PSC has an association with cholangiocarcinoma.

6. 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

References:

Puryrsko AS, Remer EM, Filho HML, Bittencourt LK, Lima RV, Racy DJ (2011) Beyond Appendicitis: Common and Uncommon Gastrointestinal Causes of Right Lower Quadrant Abdominal Pain at Multidetector CT. *RadioGraphics* 31 (4):927-947. doi:10.1148/rg.314105065.

Thoeni RF, Cello JP (2006) CT Imaging of Colitis. *Radiology* 240 (3):623-638. doi:10.1148/radiol.2403050818.

Lubner MG, Menias CO, Agrons M, Alhalabi K, Katabathina VS, Elsayes KM, Pickhardt PJ (2017) Imaging of Abdominal and Pelvic Manifestations of Graft-Versus-Host Disease After Hematopoietic Stem Cell Transplant. *American Journal of Roentgenology* 209 (1):33-45. doi:10.2214/AJR.17.17866.

Rationale: A. Incorrect. Patients with ischemic colitis typically are older (age > 70 years). Imaging appearance depends on the distribution of the area of ischemia. B. Correct. Patients with typhlitis are classically immunocompromised and present have circumferential wall thickening of the cecum and ascending colon on imaging. C. Incorrect. These patients have a history of radiation therapy, and the affected segment of colon corresponds to the radiation field. D. Incorrect. GVHD occurs in patients with a history of stem cell transplant. Common imaging manifestations include mucosal hyper enhancement, wall thickening, and mural stratification of the small and large bowel.

7. What is the MOST common cause of a gastrocolic fistula?

- A. Crohn disease
- B. Chronic NSAID use
- C. Adenocarcinoma of the colon
- D. Ulcerative colitis

Key: B

References:

Levine MS, Kelly MR, Laufer I, Rubesin SE, Herlinger H (1993) Gastrocolic fistulas: the increasing role of aspirin. *Radiology* 187 (2):359-361. doi:10.1148/radiology.187.2.8475272.

Rationale: A. Incorrect. Crohn's disease is a common cause of fistula, but is not the most common cause of gastrocolic fistula. B. Correct. The prevalence of long term aspirin and NSAID use makes this the most common cause of gastrocolic fistula. C. Incorrect. This is an uncommon cause of gastrocolic fistula. D. Incorrect. Ulcerative colitis does not cause transmural inflammation, and is thus an uncommon cause of gastrocolic fistula.

8. Which of the following conditions is associated with anomalous pancreatobiliary duct union?

- A. Pancreas divisum
- B. Chronic calcific pancreatitis
- C. Choledochal cyst
- D. Sclerosing cholangitis

Key: C

References:

Mortelé KJ, Rocha TC, Streeter JL, Taylor AJ (2006) Multimodality Imaging of Pancreatic and Biliary Congenital Anomalies. *RadioGraphics* 26 (3):715-731. doi:10.1148/rg.263055164.

Rationale: A. Incorrect. Pancreas divisum occurs when the dorsal and ventral pancreatic ducts do not fuse. B. Incorrect. While patients with an anomalous pancreaticobiliary duct union can potentially have recurrent pancreatitis due to reflux of bile into the pancreatic duct, there is no definitive association with chronic calcific pancreatitis. C. Correct. A long common channel with reflux of pancreatic secretions up the biliary tree is one of the proposed causes of choledochal cyst formation. D. Incorrect. Sclerosing cholangitis is not associated with an anomalous pancreaticobiliary duct union.

9. What disease is MOST commonly associated with primary sclerosing cholangitis (PSC)?

- A. Crohn colitis
- B. Chronic ulcerative colitis
- C. Cholangiocarcinoma
- D. Hepatocellular carcinoma

Key: B

References:

Seo N, Kim SY, Lee SS, et al. Sclerosing Cholangitis: Clinicopathologic Features, Imaging Spectrum, and Systemic Approach to Differential Diagnosis. *Korean Journal of Radiology*. 2016; 17(1):25-38. doi:10.3348/kjr.2016.17.1.25.

Rationale: A. Incorrect. While PSC may be associated with Crohns disease, it is more commonly seen in the setting of ulcerative colitis. B. Correct. Approximately 60-80% of patients with PSC have inflammatory bowel disease, and of those, the vast majority of these patients have ulcerative colitis. C. Incorrect. While patients with PSC an increased risk of cholangiocarcinoma, the risk of developing cholangiocarcinoma in a PSC patient is approximately 10-15%. D. Incorrect. PSC is associated with cholangiocarcinoma, not hepatocellular carcinoma.

**Genitourinary Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. You are shown an image from a contrast-enhanced CT scan. What is the MOST likely diagnosis?



- A. Adenoma
- B. Adrenal cortical carcinoma
- C. Myelolipoma
- D. Metastasis

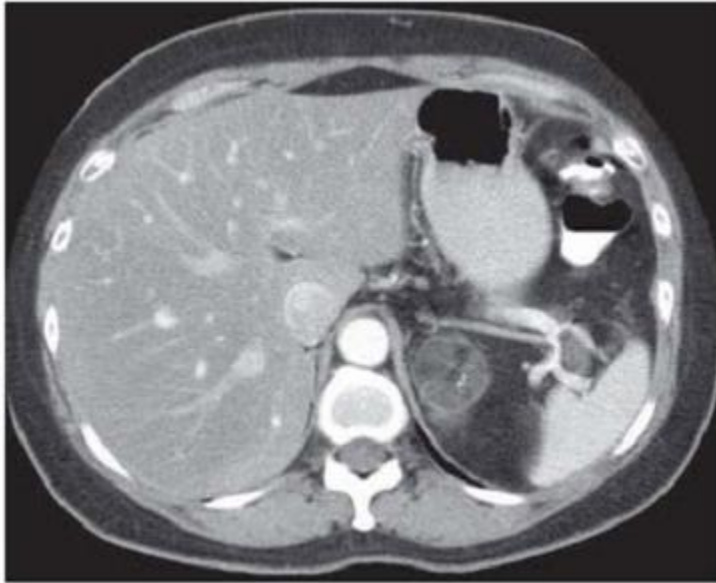
Key: C

References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: A. This lesion is predominantly of soft tissue attenuation, however there are two small foci of gross fat. Although adrenal adenomas may have microscopic fat in them, they would not be expected to have macroscopic fat as in this case. B. Adrenal cortical carcinomas are malignant lesions with aggressive behavior, typically 6 cm or larger, that often invade the adrenal vein. They would not contain fat. C. Correct. Myelolipomas are composed of varying proportions of adipose and bone-marrow like hematopoietic tissue, including megakaryocytes. D. A metastasis to the adrenal gland would not be expected to contain fat (a rare liposarcoma metastasis theoretically could, but would be unlikely to be a small, well-defined lesion such as this).

2. Based upon this abdominal CT image from a 39-year-old woman, what is the MOST likely diagnosis?



- A. Adenoma
- B. Lymphangioma
- C. Metastasis
- D. Myelolipoma

Key: D

References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: Findings: Left adrenal mass containing gross fat and a small amount of coarse calcium.

A. Incorrect. Adenomas rarely calcify. Although 80% do contain fat, it is intracytoplasmic -- and thus detectable as low density (< 10 H.U.) on CT, or drop in signal intensity on opposed phase as compared to in-phase on gradient echo MR -- and is usually not grossly fatty as in this case. B. Incorrect.

Lymphangiomas are malformations of the lymphatic system characterized by lesions that are thin-walled cysts; these cysts can be macroscopic or microscopic; they should be mostly water density and not fatty. C. Incorrect. The adrenal glands are a common site of metastatic disease, but adrenal metastases are typically soft tissue density. Larger metastases to the adrenals may have central necrosis or areas of hemorrhage, but would not have a fatty component (a rare liposarcoma metastasis theoretically could, but would be unlikely to be a small, well-defined lesion such as this).

D. Correct. Myelolipomas are uncommon benign tumors of the adrenal gland comprised of mature adipose cells and hematopoietic tissue. They are functionally inactive and usually are detected as incidental findings. A grossly fatty adrenal mass is virtually diagnostic of a myelolipoma.

3. What is the MOST likely diagnosis for this 25-year-old man with sickle cell trait?



- A. Non-Hodgkin lymphoma
- B. Angiomyolipoma
- C. Renal medullary carcinoma
- D. Transitional cell carcinoma

Key: C

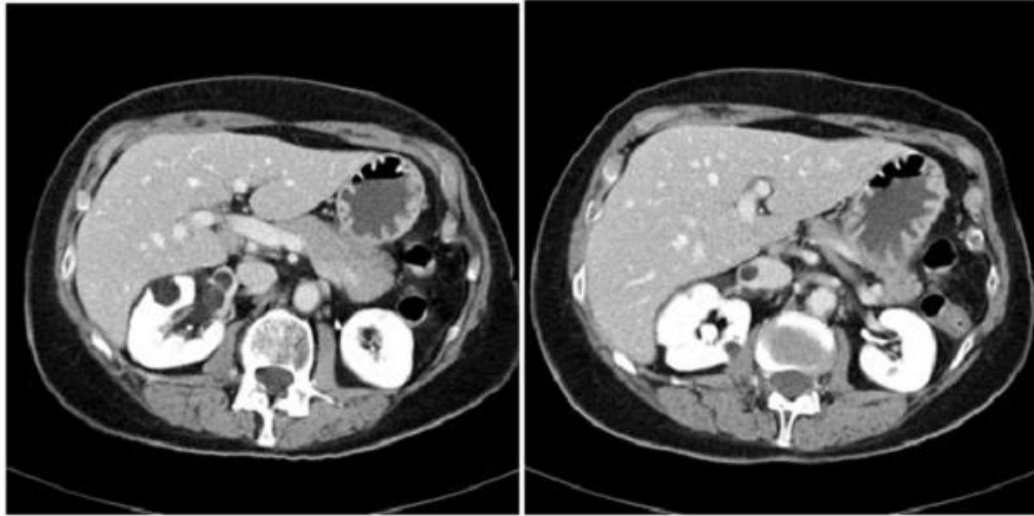
References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Lowe LH et al. Radiographics 2000; 20: 1585-1603.

Rationale: Findings: A large infiltrative mass is present in the right kidney with extension of mass into the renal pelvic fat, the right renal vein and IVC. There is also retroperitoneal lymphadenopathy and splenomegaly. A. Incorrect: Non-Hodgkin's lymphoma can involve the kidney but is seen on presentation in only 5.8% of cases. Although it can involve the kidney as a single mass, renal lymphoma most commonly presents as multiple lymphomatous masses. Additionally, renal vein and IVC invasion would be distinctly unusual for lymphoma. B. Incorrect: Angiomyolipoma is a benign tumor of the kidney that is characterized by regions of macroscopic fat (seen in 95% of cases). No areas of fat density are seen in the images provided with this case. Additionally, renal vein and IVC invasion and lymphadenopathy would not be a characteristic of this benign tumor. C. Correct: Renal medullary carcinoma is an unusual tumor that almost always occurs in young patients with sickle cell trait. No cases have been reported in patients with sickle cell disease. The tumor arises from the calyceal epithelium and grows in an infiltrative pattern. It is a very aggressive tumor with early metastases to lymph nodes and vascular invasion. D. Incorrect: Transitional cell carcinoma can fill the renal pelvis and diffusely infiltrate the kidney as in this case. However, transitional cell carcinomas typically affect older individuals and would be rare to affect someone of this age. Also, transitional cell carcinomas would not demonstrate vascular invasion as in this case.

4. You are shown two images from a contrast-enhanced CT scan of the abdomen (Figures 2A and 2B). What is the MOST LIKELY diagnosis?



- A. Angiomyolipoma
- B. Renal cell carcinoma
- C. Oncocytoma
- D. Multilocular cystic nephroma

Key: A

References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: A. Correct. The mass is nearly completely fat density when compared to subcutaneous fat. B. Incorrect. Although renal cell carcinoma more commonly extends into the IVC and can contain a small amount of fat, this mass has no significant soft tissue component. C. Incorrect. Oncocytomas are not predominantly fat density and can have a central scar. D. Incorrect. These masses are cystic and commonly extend into the renal pelvis and not the IVC.

5. You are shown a CT image of the pelvis in a patient with vaginal carcinoma (Figure 1). What is the MOST LIKELY diagnosis for the bladder finding?



- A. Simple ureterocele
- B. Ectopic ureterocele
- C. Pseudoureterocele
- D. Fungus ball

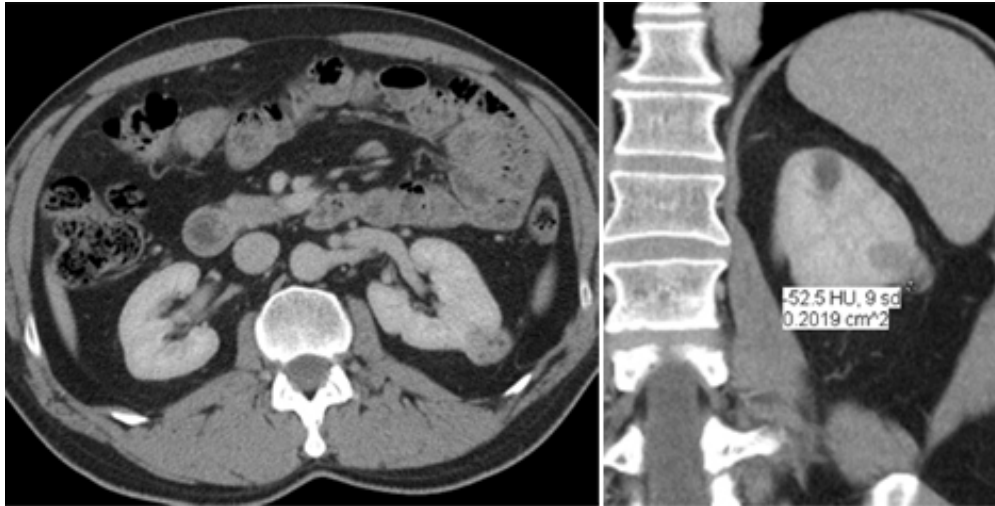
Key: C

References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: A. Incorrect. The mass invades from the vagina through the posterior bladder. A simple ureterocele is a nonmalignant focal dilatation of the submucosal distal ureter. B. Incorrect. The mass invades from the vagina through the posterior bladder. An ectopic ureterocele is a nonmalignant focal dilatation of the submucosal distal Ectopic ureter. C. Correct. Looks like a ureterocele, but in this case is the result of a malignancy invading the bladder trigone. D. Incorrect. Fungus ball would appear as mobile, often multiple, laminated, gas-containing filling defects within the bladder.

6. Which of the following is the MOST LIKELY diagnosis, based on the images shown?



- A. Renal cell carcinoma
- B. Angiomyolipoma
- C. Oncocytoma
- D. Perirenal liposarcoma

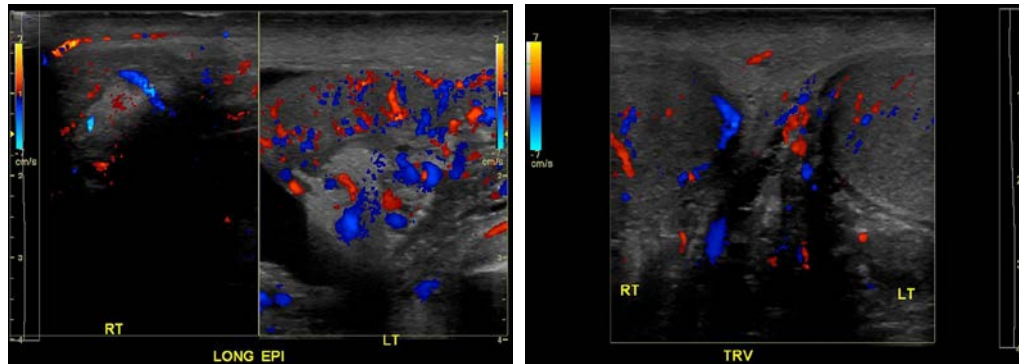
Key: B

References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: Findings: Exophytic left renal mass containing a small amount of gross fat (density -52.5 HU). A. Incorrect. Renal cell cancer can rarely contain fat, but generally as a large very heterogeneous mass. Adenomas rarely calcify. Clear cell renal cell can have microscopic fat, and drop in signal on opposed phase compared as compared to in-phase on gradient echo MR, but not gross fat on CT. Although 80% do contain fat, it is intracytoplasmic -- and thus detectably as low density (< 10 H.U.) on CT, or drop in signal intensity on opposed phase -- and is usually not grossly fatty as in this case. B. Correct. Angiomyelolipomas contain fat. C. Incorrect. Oncocytoma is a benign tumor of the kidney which does not contain fat. D. Incorrect. Perirenal liposarcoma may contain fat, but would typically be larger and more complex in appearance.

7. What is the MOST likely diagnosis?



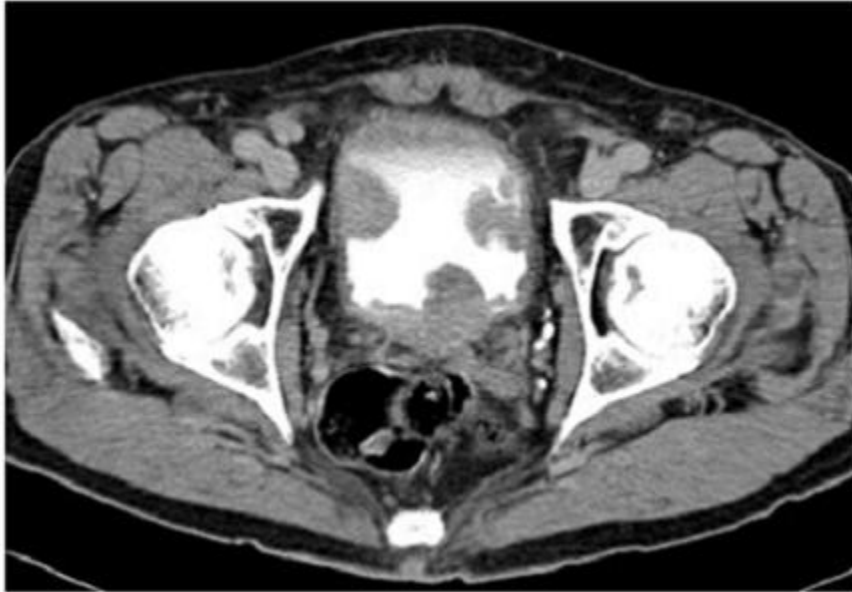
- A. Left testicular torsion
- B. Right testicular torsion
- C. Left epididymitis
- D. Left epididymo-orchitis

Key: C

References: Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: Findings: Enlarged left epididymis, hyperemic on color Doppler. Normal size and color Doppler flow of the right epididymis. No abnormal echotexture or abnormal hyperemia of visualized portion of either testicle on color Doppler. A. Incorrect. In testicular torsion, there could be hyperemia around a torsed testicle as a late finding, but there would be reduced or absent flow to the testicle. In this case, there is normal flow to the testes bilaterally on color Doppler. B. Incorrect. As above, in this case there is normal flow to the testes bilaterally, precluding the diagnosis of testicular torsion. C. Correct. Enlargement and hyperemia of the left epididymis, as seen here is characteristic of left epididymitis. D. Incorrect. Although there is evidence of left epididymitis, as above, the left testicle has normal flow on color Doppler, and normal echogenicity, with no evidence of orchitis.

8. You are shown a delayed contrast-enhanced CT image (Figure 4) in a 60-year-old with hematuria. What is the MOST LIKELY diagnosis?

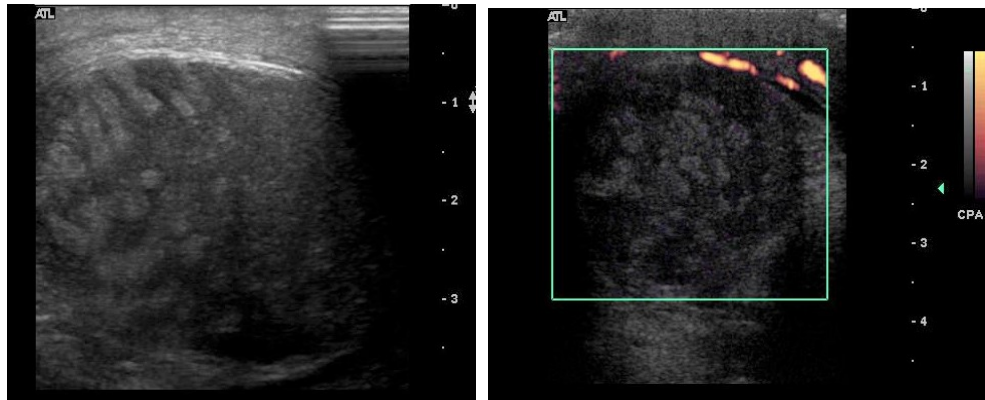


- A. Schistosomiasis
- B. Blood clots
- C. Cystitis cystica
- D. Transitional cell carcinoma

Key: D

Rationale: A. Incorrect. This is not a typical appearance for schistosomiasis; in particular, no calcifications of the masses are seen. B. Incorrect. Blood clots would not be expected to be adherent to the wall. C. Incorrect. These lesions are solid, whereas cystitis cystica would be expected to be cystic. D. Correct. Transitional cell carcinoma is often multifocal. Classically enhance. Rarely calcify.

9. A 21-year-old man presents with scrotal swelling and pain. What is the MOST likely diagnosis?



- A. Torsion with viable testicle
- B. Torsion with infarcted testicle
- C. Acute epididymo-orchitis
- D. Seminoma

Key: B

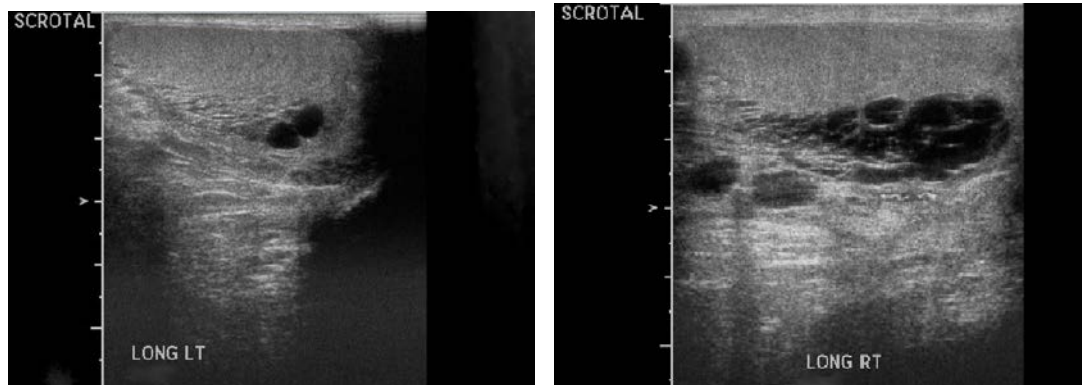
References:

Dunnick, et al. Textbook of Uroradiology, 5th Edition, Wolter Kluwer/Lippincott, Williams, & Wilkins, Philadelphia, 2013.

Rationale: Findings: Heterogeneous echotexture of the testicle, with no flow within the testicle on power Doppler.

A. Incorrect. The absence of flow on power Doppler is consistent with testicular torsion, but the presence of heterogeneity within the testicle is consistent with infarct, indicating the testicle is no longer viable. B. Correct. The absence of flow confirms torsion, with the heterogeneous appearance indicating infarction. C. Incorrect. With acute epididymo-orchitis, there would be abnormal increased flow within the testicle in the region of orchitis, not absent flow as in this case. D. Incorrect. Seminoma if this large would be hypervascular, not have absent flow as in this case.

10. Regarding these images of the scrotum, what is the MOST likely diagnosis?



- A. Bilateral germ cell tumors
- B. Bilateral testicular abscesses
- C. Tubular ectasia of the rete testis
- D. Tunica albuginea cysts

Key: C

References:

Paunipager B & Federle M, "Testicular Cystic Lesions," and Tublin M & Bhatt S, "Tubular Ectasia," STATdx, 2018, Elsevier, Inc.

Rationale: Findings: Cystic changes near the mediastinum testes bilaterally. A. Incorrect. Mixed germ cell tumors with teratomatous components will often have cystic areas within them, but do not form a network of tubule like this. Also germ cell tumors would not be expected to be centered in the mediastinum testes bilaterally. B. Incorrect. Testicular abscess usually occurs as a complication of epididymo-orchitis, for which there is no evidence in the images. The testicular parenchyma adjacent to the cystic areas appears normal. C. Correct. This is a typical appearance of tubular ectasia of the rete testis, with variable size cystic lesions near the mediastinum testes bilaterally. It is frequently bilateral and usually asymmetrical, as in this case. D. Incorrect. Tunica albuginea cysts occur within the tunica surrounding the testis, and are usually solitary and small, 2-3 mm.

**Interventional Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



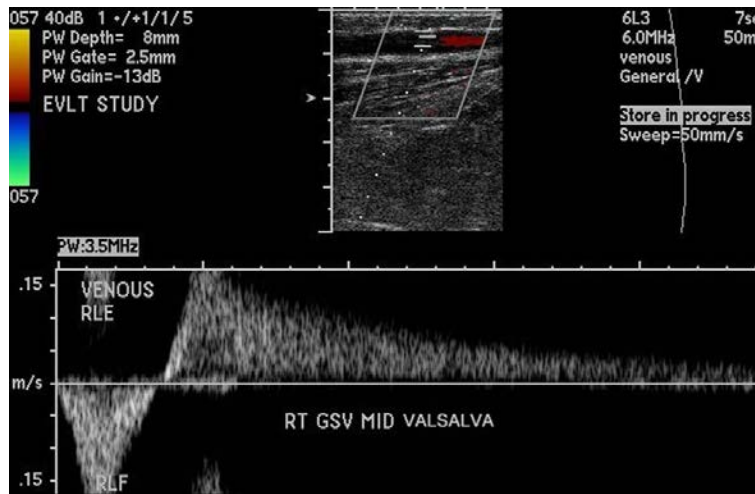
QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. You are shown duplex Doppler ultrasound images of the right greater saphenous vein during a Valsalva maneuver. What is the MOST likely diagnosis?



- A. Superficial thrombophlebitis
- B. Venous valvular insufficiency
- C. Arteriovenous fistula
- D. Phlegmasia cerulea dolens

Key: B

References:

Pellerito JS, Polak JF Introduction to Vascular Ultrasonography. Philadelphia, PA, Elsevier 2012.

Rationale: On Valsalva maneuver there is retrograde flow in the great saphenous vein indicating venous valvular insufficiency with reflux.

2. Based on the single frontal and lateral abdominal aortogram images shown, the patient MOST likely was referred for the evaluation of which of the following?



- A. Abdominal angina.
- B. Malignant hypertension.
- C. Gastrointestinal hemorrhage.
- D. Prospective renal donor.

Key: A

References:

Kaufman JA, Lee MJ. Vascular and Interventional Radiology. The Requisites. Mosby. 2004.

Rationale: The frontal aortogram shows no functioning left kidney, no filling of the splenic artery and collateral flow from the left colic branch of the inferior mesenteric artery into the mid colic artery. The lateral shows the superior mesenteric artery to be occluded at its origin and an all but occluded celiac trunk. These findings are sufficient to cause chronic intestinal ischemia.

3. The ovarian artery MOST commonly arises from what vessel?

- A. Aorta
- B. Uterine artery
- C. Ureteral artery
- D. Circumflex iliac artery

Key: A

References:

Pelage JP et al. Uterine fibroid vascularization and clinical relevance to uterine fibroid embolization. Radiographics 2005; 25:S99-S117.

Rationale: Although there are variants, the gonadal arteries most commonly are paired structures arising from the aorta just inferior to the renal arteries.

4. A hemodynamically stable patient with a large pulmonary embolus is BEST treated by which of the following?

- A. Anticoagulation.
- B. Systemic thrombolysis.
- C. Catheter-directed thrombolysis.
- D. Surgical thrombectomy.

Key: A

References:

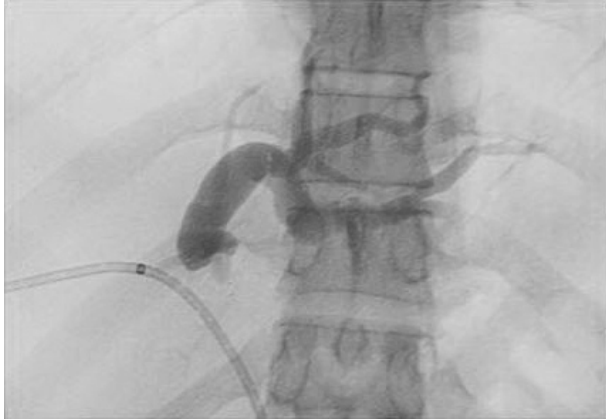
Kadir, Diagnostic Angiography, Chapter 20. Danhert, Radiology Review Manual.

Kaufman JA, Lee MJ. Vascular and Interventional Radiology. The Requisites. Mosby, 2004.

Mauro MA, Image-Guided Interventions, Saunders, 2008

Rationale: Intravenous administration of heparin is the initial therapy of choice to treat all forms of pulmonary thromboemboli. More aggressive therapy is reserved for hemodynamically unstable patients.

5. You are shown an AP view from a percutaneous trans-hepatic cholangiogram of a jaundiced patient. What is the MOST likely diagnosis?



- A. Pancreatic carcinoma
- B. Sclerosing cholangitis
- C. Cholangiocarcinoma
- D. Cholelithiasis

Key: C

References:

Valji K, Vascular and Interventional Radiology, Saunders 2006.

Rationale: The image shows a biliary drainage catheter passing from the right hepatic duct through the common hepatic duct. There is contrast in the dilated obstructed left hepatic duct. Unlike pancreatic carcinoma that typically obstructs the common bile duct, the usual point of biliary obstruction with cholangiocarcinoma is at the confluence of the right and left hepatic ducts as demonstrated here.

6. Concerning moderate (conscious) sedation, which drug is MOST appropriate to treat an overdose of midazolam (Versed)?

- A. Flumazenil (Mazicon)
- B. Reversid (Retroverze)
- C. Naloxone (Narcan)
- D. Fentanyl (Sublimaze)

Key: A

References:

Mauro MA, Image-Guided Interventions, Saunders, 2008.

Rationale: Midazolam is a commonly used short acting benzodiazepine. The antidote for an overdose of midazolam (or any other benzodiazepine) is flumazenil.

7. The left colic artery is typically a branch of what larger artery?

- A. Celiac artery
- B. Superior mesenteric artery
- C. Inferior mesenteric artery
- D. Left internal iliac artery

Key: C

References:

Kadir. Atlas of Normal and Variant Angiographic Anatomy, p. 302, 304, 305, 306.

Rationale: The left colic artery is the first branch of the inferior mesenteric artery. It courses superiorly to supply the descending colon. At Griffiths point, in the region of the splenic flexure, it anastomoses with the middle colic artery a branch of the superior mesenteric artery.

8. A patient presents with venous insufficiency and varicose veins. Which one of the following is a CONTRAINDICATION for catheter-based vein ablation?

- A. Venous stasis ulcer
- B. Lymphedema
- C. Deep venous thrombosis
- D. Pelvic congestion syndrome

Key: C

References:

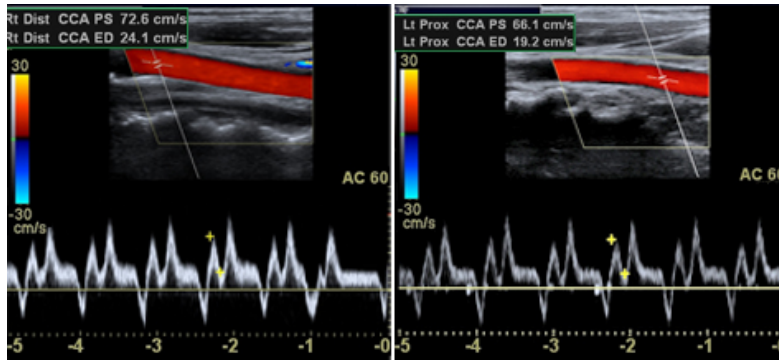
Kaufman JA, Lee MJ. Vascular and Interventional Radiology. The Requisites. Mosby. 2004.

Min RJ, Khilnani N, Zimmet SE, Endovenous laser treatment of saphenous vein reflux: long-term results. J Vasc Interv Radiol 14: 991-996, 2003.

Mauro MA, Image-Guided Interventions, Saunders, 2008.

Rationale: A contraindication to great saphenous vein ablation is dependency on the saphenous system for venous drainage because of significant deep vein obstruction.

9. You are shown images of the right and left common carotid arteries. What BEST explains the wave forms?



- A. Aortic insufficiency
- B. Mitral insufficiency
- C. Increased intracranial pressure
- D. Intra-aortic balloon pump

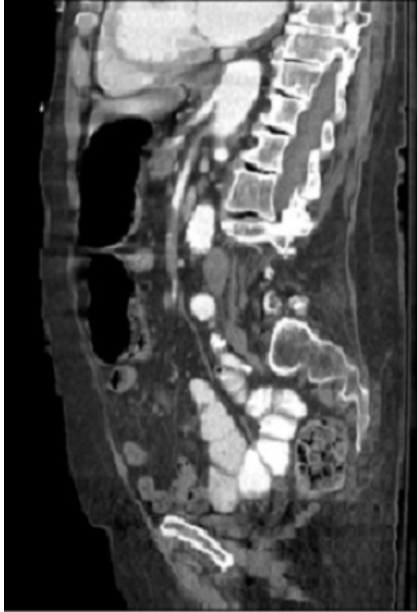
Key: D

References:

Catch a wave: Doppler US Quiz, Radiographics 2015; 35.

Rationale: The waveforms for both the right and left common carotid arteries show two systolic peaks. The first peak represents the left ventricular contraction. The second peak is caused by inflation of the intra-aortic balloon. As the downward pointing peak illustrates, late in diastole there is retrograde flow in both the right and left carotid arteries caused by deflation of the balloon.

10. This patient presented to the emergency department with abdominal pain. What is the MOST significant diagnosis?



- A. Superior mesenteric artery embolus
- B. Superior mesenteric vein thrombosis
- C. Aortic dissection
- D. Leaking aortic aneurysm

Key: A

References:

Saad NEA, Vedantham S, Gould JE. Vascular and Interventional Imaging, Mosby, 2010.

Mauro MA, Image-Guided Interventions, Saunders, 2008.

Rationale: There is a partially occlusive filling defect or defects within the contrast opacified superior mesenteric artery characteristic for a thromboembolus.

**Neuroradiology
In-Training Test Questions
for Diagnostic Radiology Residents**



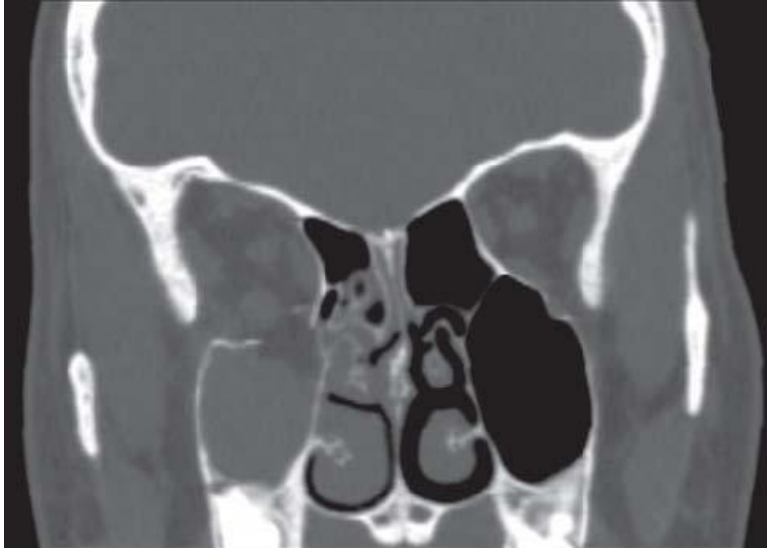
QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. Based upon this coronal CT view of the face in a 25-year-old man with eye pain, what is the MOST likely diagnosis?



- A. Blowout fracture
- B. Maxillary sinusitis
- C. Neoplasm of the maxillary sinus
- D. Orbital lipoma

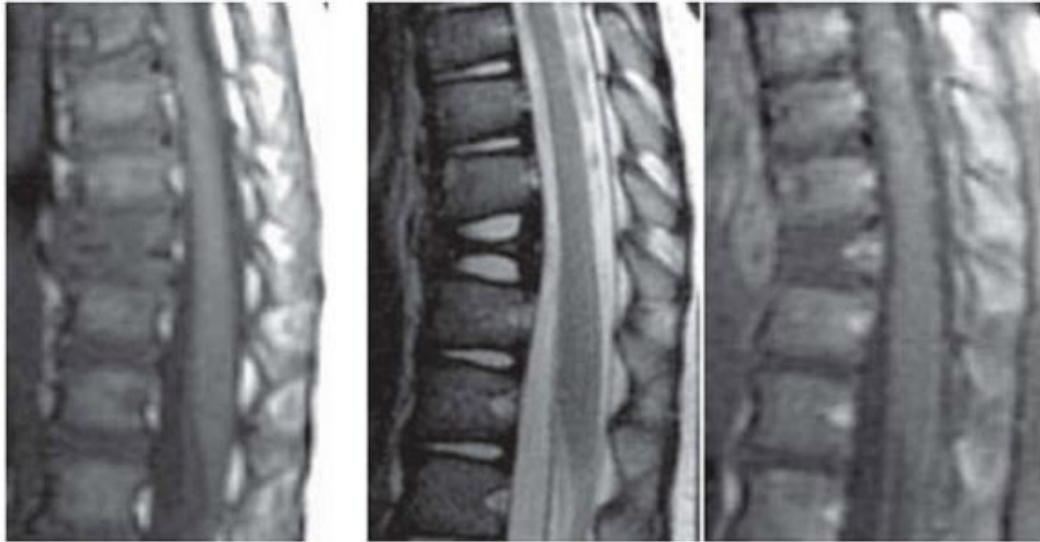
Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010 188-189.

Rationale: A. Correct. There is a depressed orbital floor fracture appreciated on the right with fat herniating through the defect with probable hemorrhage in the right maxillary sinus as evidenced by opacification of the sinus on bone window evaluation. The inferior rectus is also somewhat enlarged likely related to post traumatic edema/hematoma. B. Incorrect. Though one might see opacification of the maxillary sinus in acute sinusitis one would most likely see an intact orbital floor and no defect in the floor. The rectus muscle would not be involved. C. Incorrect. The location of the defect and fat herniating through the defect are consistent with trauma not neoplastic erosion. D. There is no orbital mass appreciated

2. You are shown sagittal T1-weighted, T2-weighted, and gadolinium-enhanced T1-weighted MR images of the thoraco-lumbar spine in a 17-month-old girl with back pain. What is the MOST likely diagnosis?



- A. Langerhans cell histiocytosis
- B. Traumatic compression fracture
- C. Leukemia
- D. Osteomyelitis

Key: A

References:

Langerhans Cell Histiocytosis of the Spine: Long term follow up in children. J Bone Joint Surg Am. 2004 Aug; 86-A(8):1740-50.

Rationale: A. Correct. Langerhans cell histiocytosis commonly presents with a vertebral plana appearance as seen here. B. Incorrect. The degree of compressions as well as the signal characteristics are not consistent with trauma. C. Incorrect. Leukemia can present with vertebral plana but one would suspect diffuse marrow involvement not focal disease as seen in this case. D. Incorrect. Osteomyelitis would involve the disc space and two adjacent vertebral bodies not an isolated vertebral lesion seen here.

3. Which one of the following is MOST likely to be an intradural, extramedullary lesion of the spine?
- A. Meningioma
 - B. Disk herniation
 - C. Astrocytoma
 - D. Metastasis

Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010 560-561.

Rationale: A. Correct. The most common intradural extramedullary lesion of the spine is a meningioma or schwannoma. The best choice here is meningioma. They account for 25 percent of spinal canal neoplasms. B. Incorrect. Disk herniations are the most common extradural lesions of the spine. C. Incorrect. Astrocytomas are intramedullary lesions in the spine. D. Incorrect. Though leptomeningeal metastasis are seen in the intradural extramedullary space, meningiomas are more common.

4. Which one of the following is MOST likely to cause a jugular foramen mass?
- A. Paraganglioma
 - B. Astrocytoma
 - C. Schwannoma
 - D. Meningioma

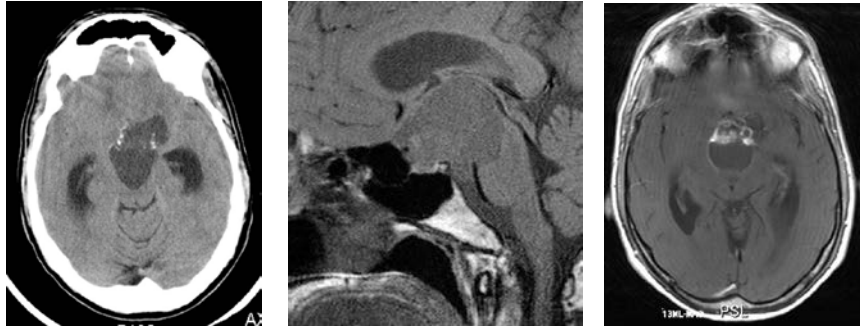
Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010 384,399-401.

Rationale: A. Correct. Paragangliomas are common at the level of the Jugular foramen. They have a characteristic salt and pepper appearance on MR imaging due to the vascularity of the lesion. B. Incorrect. Astrocytomas are parenchymal lesions found in the intraxial compartment of the brain. C. Incorrect. Schwannomas can occur in association with nerves IX, X and XI at the level of the jugular foramen but paragangliomas are more common. D. Incorrect. Meningiomas do not occur in this region.

5. You are shown an axial unenhanced CT image and sagittal unenhanced T1-weighted and axial gadolinium-enhanced T1-weighted MR images of the brain on a 50-year-old man with headaches. What is the MOST LIKELY diagnosis?



- A. Craniopharyngioma
- B. Giant internal carotid artery aneurysm
- C. Rathke's cleft cyst
- D. Oligodendroglioma

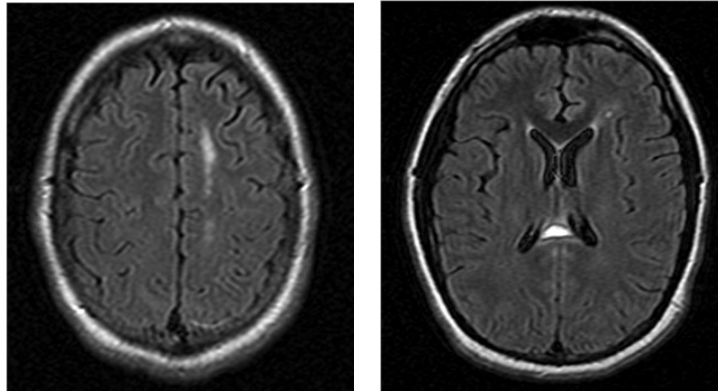
Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010: p.374.

Rationale: A. Correct. The lesion has the hallmarks of a craniopharyngioma on MRI, cyst formation, calcification and enhancement in the suprasellar compartment. B. Incorrect. A giant internal carotid would not be cystic in appearance on CT, it would be hyperdense. C. Incorrect. A Rathkes cleft cyst is more commonly hyperintense on T1 weighted imaging. They are not calcified and they do not enhance. D. Incorrect. Oligodendrogliomas are glial neoplasms that are not cystic and do not occur in the suprasellar region.

6. A 25-year-old male presents to the ED in coma. You are shown two FLAIR images. What is the BEST diagnosis?



- A. Multiple Sclerosis
- B. Marchiafava-Bignami Disease
- C. CADASIL
- D. Diffuse Axonal Injury

Key: D

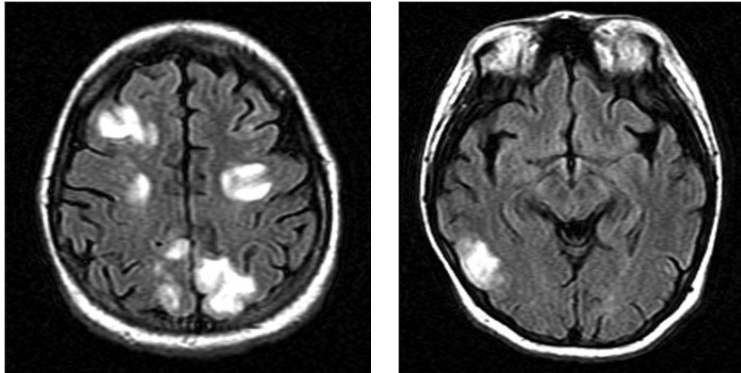
References:

Acute Marchiafava-Bignami Disease: MR Findings in Two Patients; Andres Arbelaez, Adriana Pajon and Mauricio Castillo: American Journal of Neuroradiology November 2003, 24 (10) 1955-1957.

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010: p.180-181.

Rationale: A. Incorrect. Though MS can present with a splenial lesion as well as lesions in the centrum semiovale, the presentation of this patient is not consistent with MS. Patients with MS present with various neurologic deficits but not to the ED in coma. B. Incorrect. Marchiafava-Bignami Disease is in the differential of colossal lesions but patients with this disease have a history of alcoholism. The disease affects the body of the corpus callosum first followed by the genu and then the splenium of the corpus callosum. C. Incorrect. CADASIL is the acronym for Cerebral Autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy. It is caused by the mutation of the NOTCH3 gene on Chromosome 19. Patients present with recurrent TIAs, strokes dementia and depression. It typically involves the subcortical U fibers of the anteroinferior temporal lobes, subinsular region, external capsule zones and inferior frontal lobes. The pattern of disease and presentation in this patient are not consistent with CADASIL. D. Correct. The location of the lesions and the presentation are consistent with white matter shear injury as seen in Diffuse axonal Injury in the setting of trauma. Patients present to the ED in coma with frequently little to no findings on initial CT evaluation.

7. A 25-year-old female presented with fluctuating motor and sensory deficits. You are shown two FLAIR images. The lesions did not enhance with gadolinium and resolved two weeks post therapy. Which of the following is the BEST diagnosis?



- A. Lupus Cerebritis
- B. Lymphoma
- C. Cerebral Infarction
- D. Cerebral Amyloid

Key: A

References:

MRI findings in central nervous system systemic lupus erythematosus are associated with immunoserological parameters and hypertension. JNeurol. 2003 Nov; 250(11):1348-54.

Rationale: A. Correct. Lupus Cerebritis should be considered in a female of reproductive age with a complicated neurologic presentation. Subcortical infarcts as seen on the FLAIR imaging are seen in this entity. B. Incorrect. Though CNS lymphoma may be multifocal and infiltrative, the age of the patient and the lack of enhancement described in the history argue against lymphoma as a diagnosis. C. Incorrect. Multifocal Cerebral Infarction would not be expected to resolve two weeks post therapy as stated in this case. D. Incorrect. Cerebral Amyloid Angiopathy is a disease of older patients that presents with foci of hypointensity on susceptibility weighted imaging and hemorrhage.

8. The “dural tail sign” is a characteristic of which of the following lesions?

- A. Meningioma
- B. Oligodendroglioma
- C. Metastatic disease
- D. DNET

Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010: p.59-62.

Rationale: A. Correct. Meningiomas are the most common extra axial neoplasms of the brain that arises from the dura and are associated with an enhancing dural tail which is seen in 72 percent of patients with meningiomas. B. Incorrect. Oligodendrogliomas are intraxial lesions that occur in the frontal lobes most commonly that are associated with calcification but do not involve the dura. C. Incorrect. Metastatic disease can involve the dura either via direct extension from the bone or via hematogenous spread. A dural tail in association with a dural metastasis can be seen though not considered characteristic of this entity. D. Incorrect. DNET, or Dysembryoplastic neuroepithelial tumors are found in the temporal and frontal lobes and usually cause seizures. These lesions are intraxial involving the cortical and subcortical region.

9. Rasmussen’s encephalitis:

- A. Involves progressive cerebral hemiatrophy.
- B. More commonly presents in adults.
- C. Is frequently bilateral.
- D. Is associated with Lyme disease.

Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010: p.224.

Rationale: A. Correct. Rasmussen’s encephalitis is a disease of children of 6 to 8 years. Focal motor seizures are followed by progressive loss of ipsilateral motor function associated with cognitive decline. Cerebral atrophy is a late finding in the disease. B. Incorrect. Rasmussen’s is believed to be viral induced autoimmune mediated disease of children. C. Incorrect. Rasmussen’s is a unilateral process. D. Incorrect. As mentioned, the etiology is believed to be a viral induced autoimmune disease.

10. Which of the following is the MOST common paraganglionic tumor in the neck?
- A. Carotid body
 - B. Glomus vagale
 - C. Laryngeal glomus
 - D. Glomus jugulare

Key: A

References:

The Requisites, Neuroradiology; Third Edition, Mosby Elsevier 2010: p.497-498.

Rationale: A. Correct. The most common location of paragangliomas in the head and neck is at the level of the carotid body. B. Incorrect. Though a location of paragangliomas, the carotid body paraganglioma is the most common. C. Incorrect. Glomus tumors of the larynx do exist but are extremely rare. D. Incorrect. Glomus Jugulare is a location/type of paraganglioma occurring at the level of the jugular foramen but the carotid body is the more common location.

Musculoskeletal Radiology In-Training Test Questions for Diagnostic Radiology Residents



QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. Based upon this PA ulnar deviation view of the wrist, what is the MOST likely diagnosis?



- A. Osteomyelitis
- B. De Quervain tenosynovitis
- C. Hypertrophic osteoarthropathy
- D. Rheumatoid arthritis

Key: B

References:

Resnick D, Kang HS, Pretterklieber ML Wrist and Hand Internal Derangement of Joints Saunders, 2007.

Rationale: There is focal periostitis at the radial styloid. The radial styloid itself is normal. This is secondary to adjacent inflammation at the extensor pollicis brevis and abductor pollicis longus tendons (De Quervain's tenosynovitis). The periosteal reaction of osteomyelitis is usually associated with abnormal underlying bone. The periosteal reaction of hypertrophic osteoarthropathy is more diffuse involving both the radius and ulna. New bone formation is not a feature of rheumatoid arthritis.

2. You are shown an AP radiograph of a 30-year-old woman. What structure is MOST likely injured?



- A. Posterior cruciate ligament
- B. Iliotibial band
- C. Medial meniscus
- D. Anterior cruciate ligament

Key: D

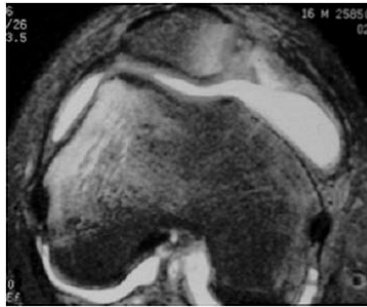
Rationale: There is a Segond fracture, an avulsion fracture at the lateral aspect of the proximal tibia at the site of capsular attachment with contributing oblique fibers from the lateral collateral ligament and iliotibial band, related to varus stress with an accompanying twisting injury. This fracture is almost always associated with ACL rupture although the mechanism of injury involved is, perhaps, the least common associated with an ACL injury.

3. Concerning injuries of the wrist, which is MOST severe?
- A. Lunate dislocation
 - B. Scapholunate dissociation
 - C. Dorsal intercalated segment instability
 - D. Perilunate dislocation

Key: A

Rationale: A fall on the outstretched hand (FOTOSH) may result in a pattern of injury to the wrist based on the propagation of force from the radial to the ulnar side of the wrist through a lesser and/or greater arc vector: around the lunate (lesser arc) or through the scaphoid, capitate, triquetrum (greater arc) or, more likely, both, if the force is great enough. The most common lesser arc injury, therefore, is scapholunate ligament tear. The most common greater arc injury is scaphoid fracture. If the force generated is great enough, injury may result in dorsal dislocation of the capitate, with scapholunate dissociation or scaphoid fracture, a perilunate dislocation. Even greater force may lead to lunate dislocation anteriorly.

4. You are shown an axial fat-suppressed fast spin echo T2-weighted image of a 16-year-old boy following knee trauma. What is the MOST likely diagnosis?



- A. Ruptured anterior cruciate ligament
- B. Hyperextension injury
- C. Patellofemoral dislocation
- D. Direct impaction ("dashboard") injury

Key: C

References:

Sanders TG, Medynski MA, Feller JF, Lawhorn KW. Bone Contusion Patterns of the Knee at MR Imaging: Footprint of the Mechanism of Injury. Radiographics 2000; 20:S135-S151.

Rationale: There is impaction at the medial patella and contusion at the lateral aspect of the lateral femoral condyle with thickening and abnormal signal of the medial patellar retinaculum/medial patellofemoral ligament. This is secondary to impaction following spontaneous reduction of a lateral patellofemoral dislocation.

5. Concerning acute ankle inversion, which ligament is FIRST to be injured?
- A. Calcaneofibular
 - B. Anterior talofibular
 - C. Posterior talofibular
 - D. Posterior talofibular

Key: B

Rationale: Inversion injuries of the ankle tend to affect the anterior talofibular ligament first, followed by the calcaneofibular ligament. The posterior talofibular ligament is rarely injured. This is why we so commonly see isolated chronic sprain of the anterior talofibular ligament or chronic sprain of both the anterior talofibular and calcaneofibular ligaments.

6. Concerning osteosarcoma, what type has the worst prognosis?
- A. Secondary
 - B. Telangiectatic
 - C. Periosteal
 - D. Parosteal

Key: A

Rationale: Osteosarcoma secondary to underlying pathology or radiation has the worst prognosis. The prognosis of telangiectatic osteosarcoma is similar to that of the more common subtype. Periosteal osteosarcoma and parosteal osteosarcoma have a much better prognosis, both being lower grade tumors.

7. You are shown an AP radiograph of the left hip of a 75-year-old man with hip pain (Figure 5). What is the MOST LIKELY diagnosis?

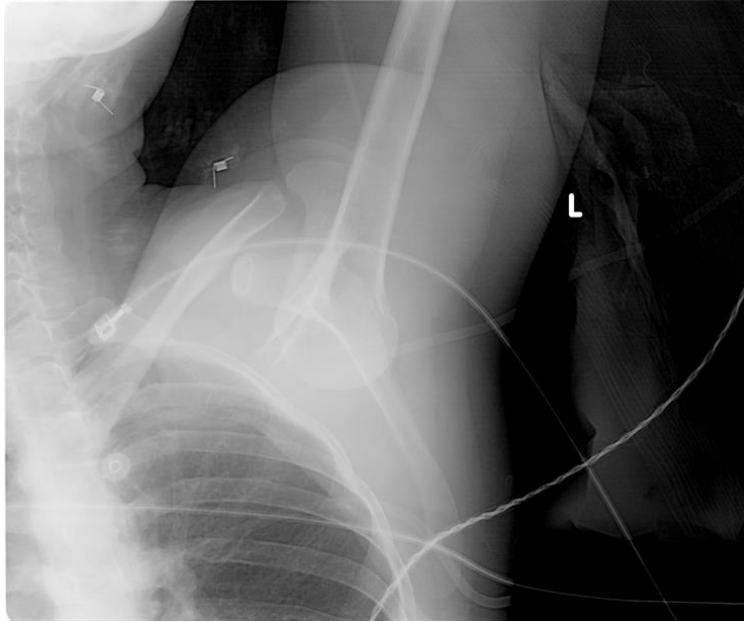


- A. Giant cell tumor
- B. Transient osteoporosis of the hip
- C. Plasmacytoma
- D. Paget's Disease

Key: D

Rationale: There is bone loss at the proximal femur extending from the articular surface of the femoral head to the subtrochanteric region where there is a well-defined, angulated, blade of grass, flame-shaped advancing edge. There is cortical splitting at the medial cortex of the subtrochanteric femur. There is a fracture at the intertrochanteric/subtrochanteric region. The bone is not destroyed. It is resorbed. These findings are compatible with the lytic phase of Paget's disease. Transient osteoporosis of the hip (a focal phenomenon secondary to underlying stress fracture) involves the head and neck only, with no clearly defined advancing edge. Bone tumors destroy bone and distort its shape.

8. You are shown an AP radiograph. Which one of the following is correct?



- A. There is posterior dislocation.
- B. Neurologic and vascular injury may result.
- C. Rotator cuff tears are unusual.
- D. Open reduction is necessary.

Key: B

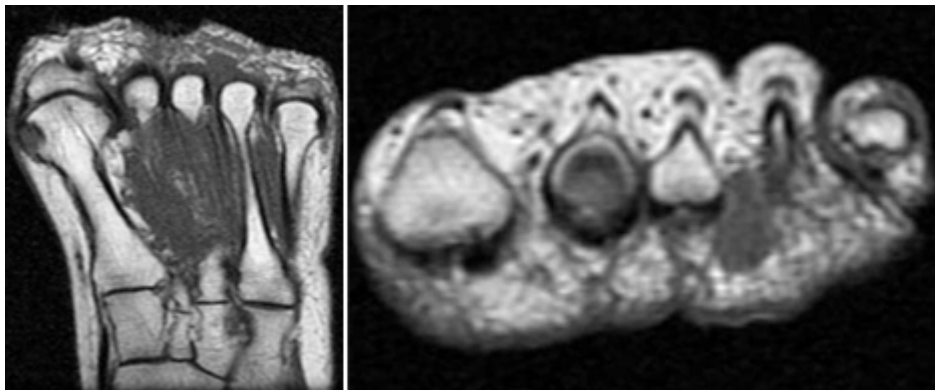
Rationale: The humeral head is dislocated inferiorly with the arm held in an abducted position. Luxatio erecta or inferior shoulder dislocation is the least common type of glenohumeral dislocation. Neurovascular injuries to the brachial plexus are common. Rotator cuff tears and fractures are also associated. Closed reduction is often indicated especially in older patients.

9. What is one of the characteristic radiographic findings of erosive osteoarthritis?
- A. Preservation of the joint space
 - B. MCP joint involvement
 - C. Ankylosis
 - D. Central erosion

Key: D

Rationale: The characteristic radiographic appearance of erosive osteoarthritis reflects osteoarthritis (joint space narrowing, osteophyte formation, subchondral sclerosis) and central erosion, all of which contributes to the "gull-wing" configuration. The articular cartilage and, therefore, the joint space, is not preserved. Erosive osteoarthritis involves the distal and proximal interphalangeal joints. The MCP joints are not involved. Interphalangeal joint fusion occurs in approximately 15% of cases.

10. Which of the following is characteristic of the pathology demonstrated?



- A. Entrapment of the medial and lateral plantar nerves
- B. More common in men
- C. Scattered mitosis and hypercellularity
- D. Diffuse high-signal intensity on T2W images

Key: A

Rationale: There is a soft tissue mass at the plantar aspect of the metatarsal heads at the third webspace. This is characteristic of a Morton's neuroma, a reactive/degenerative phenomenon secondary to damage to the peripheral medial and lateral plantar nerves secondary to entrapment. This is not a true peripheral nerve sheath tumor but rather a mass of inflammation, fibrosis and torn peripheral nerve, a sequela of a compression neuropathy.

**Nuclear Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



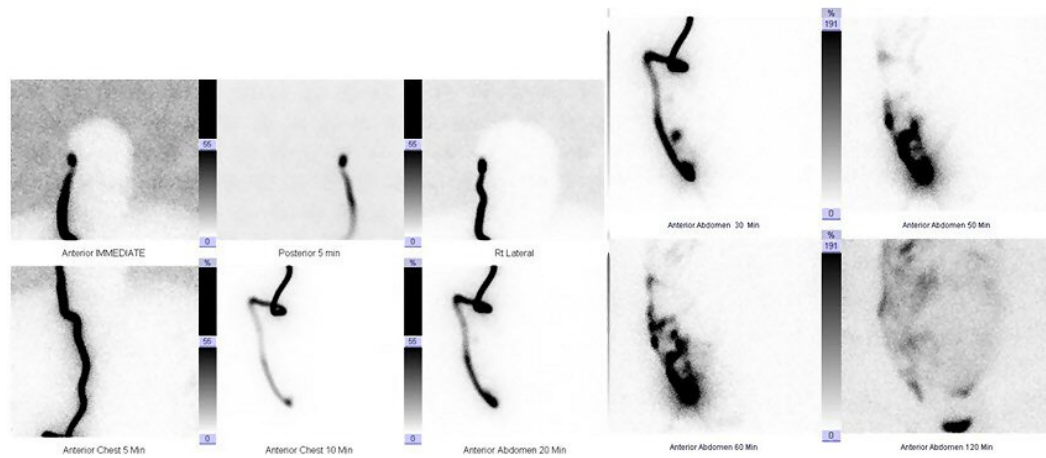
QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. You are shown serial images from a Tc-99m diethylene-triamine-pentaacetic acid (DTPA) radionuclide CNS shunt study. Which one of the following statements is CORRECT?



- A. This is a normal study
- B. There is high-grade obstruction of the efferent limb of the shunt
- C. There is abnormal loculation of activity in the peritoneal cavity
- D. There is scintigraphic evidence of diffuse peritonitis

Key: A

References:

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Correct. The tracer was injected in the reservoir located in the right scalp region. The activity is shown to freely course through the VP shunt catheter. Images of the abdomen and pelvis show free spillage of the tracer into the peritoneal catheter. These findings confirm a patent shunt from the reservoir to the peritoneal cavity. B. Incorrect. The activity courses normally through the efferent limb as shown on the anterior chest and abdomen images. C. Incorrect. The final image of the abdomen and pelvis shows dissipation of the tracer throughout the peritoneal cavity. No loculation of activity is present. D. Incorrect. This study is not used to diagnose peritonitis or other inflammatory/infectious process.

2. A post-menopausal woman with osteoporosis undergoes dual-energy x-ray absorptiometry (DEXA) scanning, demonstrating marked osteopenia of the lumbar spine and hip, but normal bone density of the distal forearm. What is the BEST explanation for these findings?

- A. Inappropriate scanning of the dominant forearm rather than the non-dominant
- B. Insensitivity of forearm bone density measurement secondary to preponderance of cortical bone
- C. Underestimation of the bone density in the spine and hip secondary to arthritic changes
- D. Scan performed too distally in the forearm

Key: B

References:

<https://www.iscd.org/wp-content/uploads/2012/10/ISCD2007OfficialPositions-Adult.pdf>

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Incorrect. Although there can be increased cortical thickness and density of the dominant forearm in certain populations, the differences in dominant and non-dominant forearm BMD would not account for the normal density of the forearm in this patient with osteoporosis. B. Correct. The forearm has more cortical bone than the spine and hip, which have more cancellous bone. Forearm evaluation is indicated in patients with hyperparathyroidism, which primarily affects cortical bone as well as patients who are obese or have spinal/hip hardware. C. Incorrect. Arthritic changes are associated with falsely increased bone mineral density in the setting of osteophyte formation and sclerotic changes. D. Incorrect. The distal forearm is the correct area to scan so that would not explain the differences in density.

3. A patient with pernicious anemia had a normal Stage 1 Schilling Test. Which one of the following could explain the result?

- A. Prior radioisotope study
- B. Incomplete urine collection
- C. Prior resection of terminal ileum
- D. Concurrent vitamin B-12 therapy

Key: A

References:

Zuckier LS, Chervu LR. Schilling evaluation of pernicious anemia: current status. J Nucl Med. 1984 Sep; 25(9):1032-9.

Rationale: A. Correct. If a prior radioisotope study was performed, excreted tracer from that study could falsely elevate the urinary activity creating a false negative exam. B. Incorrect. There is not enough information to know if this would cause a normal or abnormal result. C. Incorrect. This would result in poor absorption and low urine count, which is abnormal. D. Incorrect. Vitamin B-12 is administered for the exam, so concurrent use would not affect the test.

4. Reduced occipital lobe glucose metabolism on F-18 FDG (fluorodeoxyglucose) cerebral PET imaging is MOST common in which one of the following progressive dementias?

- A. Alzheimer
- B. Pick
- C. Parkinson
- D. Lewy body

Key: D

References:

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Incorrect. The typical pattern of Alzheimer disease hypometabolism is temporal and parietal lobe involvement. B. Incorrect. Pick disease is another name for frontotemporal dementia. As the name implies, the hypometabolism is present in the frontal and temporal lobes. C. Incorrect. I-123 DaTScan is the imaging test of choice for Parkinson dementia. The striatum is affected in Parkinson disease. D. Correct. Dementia with Lewy Body has a hallmark pattern of occipital lobe hypometabolism.

5. Which of the following is the MOST appropriate use of F-18 fluorodeoxyglucose (FDG) PET imaging in breast carcinoma?

- A. Screening
- B. Differentiating benign from malignant breast masses
- C. Differentiating pulmonary metastasis from primary lung carcinoma
- D. Treatment monitoring

Key: D

References:

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Incorrect. PET-CT does not have the sensitivity to be used as a screening tool for breast cancer. In addition, the radiation dose and cost are not suited for a screening exam.

B. Incorrect. PET-CT cannot readily differentiate benign from malignant masses. C. Incorrect. Although some imaging features on the localization CT can help differentiate a primary bronchogenic carcinoma from metastasis, only histopathologic evaluation can truly differentiate the two entities. D. Correct. The most useful role of PET-CT in breast carcinoma is the ability to monitor treatment response.

6. What is the MOST commonly cited threshold for the diagnosis of malignancy using standardized uptake value (SUV) on PET imaging for a solitary pulmonary nodule?

- A. 1
- B. 1.5
- C. 2.5
- D. 3

Key: C

References:

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Incorrect. B. Incorrect. C. Correct. Although using an absolute cut-off for benign vs malignant disease is not always practical while interpreting PET-CT exams, the generally accepted SUV is 2.5. Many readers prefer intrinsic comparison to blood pool and hepatic activity as cut-offs. D. Incorrect.

7. Concerning the use of extremity radiation badges in Nuclear Medicine procedures, which one of the following describes the correct placement of a ring badge?

- A. Dominant hand TLD detector to palm.
- B. Dominant hand TLD detector to dorsum.
- C. Non-dominant hand TLD detector to palm.
- D. Non-dominant hand TLD detector to dorsum.

Key: A

Rationale: A. Correct. The correct way to wear a ring badge is the TLD detector to the palm as this is the side which would be closest to the radioactive source during daily handling of radioactivity. B. Incorrect. C. Incorrect. D. Incorrect.

8. What is the maximum allowable total effective dose equivalent annual occupational radiation exposure for an adult?

- A. .05 mSv (5 mrem)
- B. 50 mSv (5 rem)
- C. 5 Sv (500 rem)
- D. 50 Sv (5000 rem)

Key: B

References:

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Incorrect. B. Correct. The annual occupational total effective dose equivalent limit as determined by the NRC is 5 rem. C. Incorrect. D. Incorrect.

9. Which of the following is the MOST appropriate pharmacologic stress agent for patients undergoing myocardial perfusion imaging who have severe bronchospasm?

- A. Dipyridamole
- B. Adenosine
- C. Dobutamine
- D. Aminophylline

Key: C

References:

<https://www.asnc.org>

Rationale: A. Incorrect. Dipyridamole should be administered with caution in patients with a history of reactive airway disease or severe obstructive pulmonary disease. B. Incorrect. Adenosine should be administered with caution in patients with a history of reactive airway disease or severe obstructive pulmonary disease. C. Correct. Dobutamine is the preferred agent for pharmacologic stress in patients with a history of significant reactive airway disease or severe obstructive pulmonary disease. D. Incorrect. Aminophylline should be available for the treatment of vasodilator-induced bronchospasm.

10. Analysis of an equilibrium multigated-acquisition (MUGA) radionuclide cardiac study is performed, with the background region of interest placed over the spleen. The resulting calculated left ventricular ejection fraction will be:

- A. artifactually reduced.
- B. artifactually elevated.
- C. unchanged.
- D. variably affected.

Key: B

References:

Bennet P, Oza, U. Diagnostic Imaging Nuclear Medicine. 2nd ed. Elsevier. 2016.

Rationale: A. Incorrect. B. Correct. The calculation of left ventricular ejection fraction is $(ED - BKGD) / (ES - BKGD)$. ED= end diastolic volume, ES= end systolic volume, and BKGD= background activity adjacent to the heart. If the BKGD is drawn over the spleen, the denominator decreases while the numerator remains unchanged (mathematical cancellation of the BKGD in the numerator). As the denominator decreases the LVEF will increase. Answers C and D are Incorrect.

**Pediatric Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. A one week old neonate presents with abdominal distension. Based on the findings, what is the MOST appropriate next management step?



- A. Rectal biopsy
- B. Creation of colostomy
- C. Pull-through procedure
- D. Observation and possible repeat enema

Key: A

References:

Hernanz-Schulman, M. Imaging of neonatal gastrointestinal obstruction, *Radiol Clin North Amer*, 1999; 37(6):1163-1186.

Hernanz-Schulman M. Colon – Congenital and neonatal abnormalities. Caffey's Pediatric Diagnostic Imaging, Thirteenth Edition. 2018, Mosby Elsevier, Philadelphia, PA.

Rationale: Findings: The contrast enema demonstrates a zone of transition, with a normal caliber rectum, and a dilated proximal sigmoid and descending colon. A large meconium plug is also present, but the presence of the zone of transition is consistent with the diagnosis of Hirschsprung disease. A. Correct. The contrast enema findings are typical of Hirschsprung disease. The next step is confirmation with rectal biopsy. B. Incorrect. The enema is typical of Hirschsprung disease, and the most appropriate next step is confirmation with rectal biopsy. A colostomy may be necessary before definitive management with pull-through procedure, but would only be done after confirmation of the findings with biopsy. C. Incorrect - The enema findings are consistent with Hirschsprung disease. The most appropriate subsequent step is confirmation with rectal biopsy; a pull-through procedure would be the eventual surgical repair, after diagnosis is established. D. Incorrect. The enema findings are consistent with Hirschsprung disease, and the most appropriate next step is confirmation with rectal biopsy. Observation would be indicated if the findings were typical of conditions such as meconium plug or small left colon syndrome, with rectal biopsy if child's symptoms do not resolve.

2. Which one of the following findings is observed in MOST patients with Dandy Walker malformation?

- A. Intact vermis
- B. Small cisterna magna
- C. Elevated tentorium cerebelli
- D. Agenesis of the corpus callosum

Key: C

References:

Garel C, MRI of the fetal brain. Springer Verlag New York 2004.

Malformations of the CNS. In: Menkes, Sarnat and Harvey: Child Neurology. Barkovich JA. Pediatric Neuroimaging.

Wilson ME et al. US Case of the Day Dandy Walker variant with agenesis of the corpus callosum. Radiographics 1994; 14:678.

Rationale: A. Incorrect. In patients with Dandy Walker, there is deficiency of the vermis. Therefore, this option is incorrect. B. Incorrect. In patients with Dandy Walker, the posterior fossa is enlarged, and the CSF space is enlarged. The cisterna magna is not small. C. Correct. The Dandy Walker malformation is characterized by torcula-lambdoid inversion, reflecting the elevation of the tentorium cerebelli. D. Incorrect. Although there is an increased incidence of agenesis of the corpus callosum in patients with Dandy Walker, seen in as many as 20% of patients, it is not a characteristic finding in MOST patients.

3. Which one of the following is characterized by the finding of a microcolon?

- A. Duodenal atresia
- B. Meconium plug syndrome
- C. Meconium ileus
- D. Short-segment Hirschsprung disease

Key: C

References: Hernanz-Schulman M. Neonatal Gastrointestinal Obstruction. Radiol Clin North Am, 1999 Nov; 37(6):1163-86, vi-vii.

Hernanz-Schulman M. Colon – Congenital and neonatal abnormalities. : Caffey's Pediatric Diagnostic Imaging, Thirteenth Edition. 2018, Mosby Elsevier, Philadelphia, PA.

Rationale: A. Incorrect. Microcolon is a term used to describe an unused colon, and therefore it is seen in cases of distal atresia. In patients with duodenal atresia, sufficient succus entericus is generated by the bowel distal to the duodenal atresia to allow development of a normal caliber colon. B. Incorrect. Meconium plug syndrome. This syndrome causes obstruction at the level of the colon, and therefore it is not associated with a microcolon. C. Correct. Meconium ileus is an obstruction of the distal small bowel, caused by abnormal, inspissated meconium, typically in patients with cystic fibrosis. Because the obstruction is in the distal small bowel, the colon will be unused, will be small, and termed microcolon. D. Incorrect. Short-segment Hirschsprung disease, like meconium plug syndrome, is an obstruction at the level of the colon, and therefore it is not associated with a microcolon.

4. A right aortic arch is MOST commonly seen in which of the following?
- A. Truncus arteriosus
 - B. D- transposition of the great arteries
 - C. Ebstein's anomaly
 - D. Patent ductus arteriosus

Key: A

References:

Popescu et al. Right Heart Lesions Caffey's Pediatric Diagnostic Imaging, Twelfth Edition. 2013, Mosby Elsevier, Philadelphia, PA.

Mahan et al. Conotruncal anomalies Caffey's Pediatric Diagnostic Imaging, Twelfth Edition. 2013, Mosby Elsevier, Philadelphia, PA.

Rebolledo JR. Ebstein's anomaly with right aortic arch. J Pediatr 1967; 71:66.

Rationale: A. Correct. Right aortic arch is seen in approximately 35% of patients with truncus. B. Incorrect. A right aortic arch may be seen in a minority of patients with D-transposition, typically less than 10%. C. Incorrect. A right arch in a child with Ebstein's anomaly is rare. D. Incorrect. Similarly, right arch is not associated with patent ductus arteriosus.

5. Which of the following ovarian masses in children is associated with abnormal sexual development?
- A. Cystic teratoma
 - B. Dysgerminoma
 - C. Granulosa cell tumor
 - D. Endodermal sinus tumor

Key: C

References:

Epelman M. Imaging of pediatric ovarian masses, Pediatric Radiology 2011; 41:1085.

Anthony EY. Adnexal masses in female pediatric patients, AJR 2012; 198: W426.

Rationale: A. Incorrect. Cystic teratoma is the most common, benign tumor of the ovary, and is not associated with abnormal sexual development. There is a rare association with immune-mediated limbic encephalitis. B. Incorrect. Dysgerminoma is a malignant germ cell tumor, which are not associated with abnormal sexual development. C. Correct. Granulosa cell tumors are the most common malignant neoplasm of sex cord origin and are often hormonally active, presenting with precocious puberty or with menstrual irregularities after puberty. D. Incorrect. Endodermal sinus tumors, or yolk sac tumors, are germ cell neoplasms which are not associated with abnormal sexual development.

6. A contrast enema is performed on a one-day-old infant presenting with bilious emesis and abdominal distension. Based on the findings, which of the following is the MOST likely diagnosis?



- A. Hirschprung Disease
- B. Meconium Plug Syndrome
- C. Meconium ileus
- D. Small Left Colon Syndrome

Key: C

References:

Hernanz-Schulman M. Neonatal Gastrointestinal Obstruction. Radiol Clin North Am, 1999 Nov;37(6):1163-86, vi-vii.

Hernanz-Schulman M. Colon – Congenital and neonatal abnormalities. : Caffey's Pediatric Diagnostic Imaging, Thirteenth Edition. 2018, Mosby Elsevier, Philadelphia, PA.

Rationale: Findings: The examination shows a microcolon, which is a term applied to an unused colon; this happens in infants with congenital distal bowel obstruction. A. Incorrect. Patients with Hirschsprung disease should demonstrate a zone of transition between normal caliber colon distally, and dilated colon proximally. Such findings are not present in this case. B. Incorrect. Patients with meconium plug syndrome do not have a microcolon. The colon is normal in caliber, and demonstrates a large filling defect representing the meconium plug. C. Correct. There is microcolon with dilated proximal small bowel loops. Multiple filling defects are consistent with inspissated meconium. D. Incorrect. In patients with small left colon syndrome, the left colon and often portions of the sigmoid are small, similar to a microcolon; however, unlike the findings in the test case, the remainder of the colon, including the rectum, is normal in caliber. Therefore this answer is not correct.

7. Which of the following is associated with Shwachman – Diamond Syndrome?
- A. Exocrine pancreatic insufficiency
 - B. Multiple fractures
 - C. Epiphyseal dysplasia
 - D. Radial ray anomalies

Key: A

References:

Burroughs L et al. Shwachman Diamond Syndrome – a review of the clinical presentation, molecular pathogenesis, diagnosis and treatment. Hematol Oncol Clin North Am 2009; 23(2):233.

Rationale: A. Correct. Shwachman Diamond syndrome (SDS) is associated with exocrine pancreatic insufficiency, hematologic abnormalities with abnormal hematopoiesis typically neutropenia, and neoplastic predisposition to development of leukemia. B. Incorrect. Multiple fractures are not part of this syndrome. C. Incorrect. Metaphyseal dysostoses have been reported, but epiphyseal dysplasia is not part of this syndrome. Metap. D. Incorrect. Radial ray anomalies are not part of this syndrome.

8. You are shown an extremity radiograph on a 4-month-old with irritability and altered mental status. What is the MOST likely diagnosis?



- A. Rickets
- B. Congenital syphilis
- C. Non-accidental trauma
- D. Scurvy

Key: C

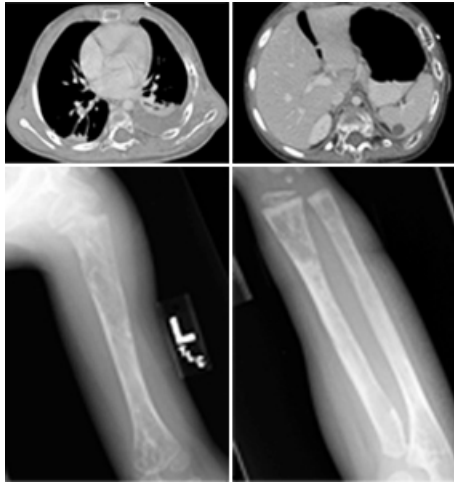
References:

Strouse PJ and Boal DB 144. Child Abuse. *Caffey's Pediatric Diagnostic Imaging, Twelfth Edition*. 2013, Mosby Elsevier, Philadelphia, PA.

Shore RM. Metabolic Bone Disease 140. *Caffey's Pediatric Diagnostic Imaging, Twelfth Edition*. 2013, Mosby Elsevier, Philadelphia, PA.

Rationale: Findings: The radiograph shows bucket-handle lesions in the distal femur and proximal tibia with extensive periosteal reaction, characteristic of non-accidental trauma. A. Incorrect. In patients with rickets there is widening of the physes, loss of the zones of provisional calcification, and irregular metaphyses. However, the findings of child abuse described and seen on this image are not present. B. Incorrect. Although patients with congenital syphilis may show periosteal reaction, the bucket handle lesions are not seen. C. Correct. Bucket handle lesions and periosteal reaction typical of child abuse. D. Incorrect. In scurvy there is profound osteopenia with Wimberger rings. Although there could be periosteal reaction due to subperiosteal hemorrhage, the bucket handle lesion is not seen.

9. A 6-year-old girl presents with a 3-year history of recurrent shortness of breath. Based on the CT and plain radiographs, what is the MOST LIKELY diagnosis?



- A. Lymphoma
- B. Metastatic neuroblastoma
- C. Infantile myofibromatosis
- D. Generalized lymphangiomatosis

Key: D

References:

Putta et al. Young patient with generalized lymphangiomatosis: differentiating the differential. Indian J Radiol Imaging 2016; 26(3):411.

Hausbrandt PA. A rare case of infantile myofibromatosis and review of the literature. J Pediatr Orthop 2010; 19:122.

Rationale: Findings: Pleural effusions, lytic bone lesions, splenic cyst. This constellation of findings is typical of lymphangiomatosis. A. Incorrect. Although lymphoma can present with splenic involvement and pleural effusion, the diffuse lytic bone lesions in multiple bones are not characteristic. B. Incorrect. Metastatic neuroblastoma does not typically involve the spleen. Bone lesions are diffuse marrow involvement, or focal destructive lesions. C. Incorrect. Infantile myofibromatosis occurs mainly in infancy and is characterized by solitary or multiple soft tissue nodules; bone lesions are not common, but when they occur they resemble those seen in histiocytosis, with focal lytic areas and sclerotic rims, rather than the diffuse, expansile lesions seen here. D. Correct. Typical findings as noted, include pleural effusions, lytic lesions involving multiple bones, and cystic lesions in the spleen.

10. What is the MOST likely cause of a unilateral impression upon the subglottic airway?
- A. Subglottic hemangioma
 - B. Croup
 - C. Retropharyngeal abscess
 - D. Subglottic stenosis

Key: A

References:

Philpps et al. Infantile subglottic hemangioma: a review and presentation of two cases of surgical excision. *Int J Pediatr Otorhinolaryngol* 1997; 41:71.

Rosbe KW et al. Propranolol in the management of airway infantile hemangiomas. *Arch Otolaryngol Head Neck Surg* 2010; 136:658.

Rationale: A. Correct. Unilateral impression upon the subglottic airway is the classic appearance for a subglottic hemangioma. B. Incorrect. Croup typically causes symmetric tapering of the subglottic airway leading to a "steeples" sign. C. Incorrect. A retropharyngeal abscess typically causes mass effect posterior to the oropharyngeal airway rather than effacement of the subglottic airway. D. Incorrect. Subglottic stenosis may resemble croup with generalized symmetric tapering of the subglottic airway or may cause a more focal constriction of the subglottic airway.

**Physics Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. What is the average energy of a 100 kVp x-ray beam?

- A. 10 KeV
- B. 25 KeV
- C. 40 KeV
- D. 78 KeV

Key: C

References:

J.T. Bushberg, J.A. Seibert, E.M. Leidholdt, and J.M. Boone, The Essential Physics of Medical Imaging, 3rd edition, Lippincott Williams Wilkins (2012). P 173, Figure 6-3 and caption

Rationale: A. Incorrect, too low. A typical filtered X-ray beam has no x rays below about 10 keV. The average energy of the filtered spectrum is typically 1/3 to 1/2 the maximum energy, which is 100 keV for a 100 kVp x-ray beam. B. Incorrect, too low. The average energy of the filtered spectrum is typically 1/3 to 1/2 the maximum energy, which is 100 keV for a 100 kVp x-ray beam. C. Correct. The average energy of the filtered spectrum is typically 1/3 to 1/2 the maximum energy, which is 100 keV for a 100 kVp x-ray beam. D. Incorrect, too high. The average energy of the filtered spectrum is typically 1/3 to 1/2 the maximum energy, which is 100 keV for a 100 kVp x-ray beam.

2. For an abdominal radiograph of a very large patient, which method is MOST likely to improve x-ray transmission?

- A. Increasing mAs
- B. Increasing the kVp
- C. Increasing the tube-patient distance
- D. Decreasing the tube-patient distance

Key: B

References:

RadioGraphics 1998: 18:731-744, Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 2nd Edition, p. 164.

Rationale: A. Incorrect. Increasing the mAs increases the number of x rays striking the patient, but does not affect the energy of the beam and therefore does not affect the percentage of the beam that is transmitted through the patient. B. Correct. Increasing the kVp increases the average beam energy, making the beam more penetrating. A greater percentage of the beam is transmitted through the patient. C. Incorrect. Increasing the tube-patient distance does not affect the energy of the beam or penetrability of the beam. D. Incorrect. Decreasing the tube-patient distance does not affect the energy of the beam or penetrability of the beam.

3. Compared to standard contact imaging, which of the following may compromise image quality of magnification views in mammography?

- A. Increased image noise
- B. Increased scatter
- C. Increased motion blur
- D. Decreased contrast

Key: C

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 2nd Edition, p. 210.

Rationale: A. Incorrect. Quantum noise is decreased compared to standard contact imaging because there are more photons per object area creating the image. B. Incorrect. The air gap between the breast support surface and image receptor reduces scattered radiation. C. Correct. The small focal spot limits the tube current, so that exposure times are longer. Motion during the long exposure time can cause blurring. D. Incorrect. Reduced scatter improves contrast.

4. The digital radiography system that employs direct conversion of x-rays into a signal (electrons) is BEST represented by which one of the following?

- A. Photostimulable storage phosphor imaging system (computed radiography)
- B. Optically coupled charge-coupled device (CCD) camera
- C. CsI – TFT flat panel array
- D. Amorphous selenium – TFT flat panel array

Key: D

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 3rd Edition, p. 214-222.

Rationale: A. Incorrect. When photostimulable storage phosphors absorb x rays, some of the energy is trapped and stored, and is read out later using laser light. B. Incorrect. CCD detectors form images from visible light. C. Incorrect. CsI is a scintillator, which produces light photons when x rays interact. The light then has to be converted into a signal. D. Correct. Amorphous selenium is a semiconductor. When x rays are absorbed the energy is converted directly into charge, producing electron hole pairs in proportion to incident x ray energy.

5. A CT scan is performed at 120 kV and 100 mAs. A region-of-interest measurement from the CSF in the ventricles yields an average CT number of 10 with a standard deviation of 8. The scan is repeated with 400 mAs. What is the expected CT number and standard deviation of the CSF?

- A. CT number of 10 with a standard deviation of 4
- B. CT number of 10 with a standard deviation of 2
- C. CT number of 40 with a standard deviation of 4
- D. CT number of 40 with a standard deviation of 2

Key: A

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 3rd Edition, p. 363-364.

Rationale: A. Correct. The noise or standard deviation is proportional to the square root of the dose. The dose went up by a factor of 4 from 100 mAs to 400 mAs, so the standard deviation goes down by a factor of 2. The CT number is related to the attenuation coefficient of the tissue and does not change with an increase in mAs, which does not affect the energy of the beam. B. Incorrect. See rationale for A. C. Incorrect. See rationale for A. D. Incorrect. See rationale for A.

6. To keep patient dose as low as reasonably achievable for digital radiography examinations using a CR or DR detector, the mAs is selected to provide acceptable:

- A. system spatial resolution.
- B. optical density.
- C. luminance on the image monitor.
- D. signal to noise ratio.

Key: D

References:

Bushberg, Seibert, Leidholdt, Boone, Essential Physics of Medical Imaging. 2nd Edition. Lippincott Williams and Wilkins, 2002. Pages 278-279.

Bushberg, Seibert, Leidholdt, Boone, Essential Physics of Medical Imaging. 3rd Edition. Lippincott Williams and Wilkins, 2012. pages 60-61.

Rationale: A. Incorrect. Although the ability to distinguish small low contrast objects is affected by image noise, the spatial resolution of the system is not directly affected by the mAs. B. Incorrect. Optical density refers to an image on film. C. Incorrect. Monitor luminance is a feature of the monitor, not the image. D. Correct. The image quality is largely determined by the signal to noise ratio.

7. Which of the following digital detectors directly converts x-ray signals into an electrical charge?
- A. Photostimulable storage phosphor
 - B. Structured cesium-iodine (CsI) scintillator
 - C. Amorphous selenium (aSe) semiconductor
 - D. Charge-coupled devices (CCD) photodiode

Key: C

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 3rd Edition, p. 214-222.

Rationale: A. Incorrect. When photostimulable storage phosphors absorb x rays, some of the energy is trapped and stored, and is read out later using laser light. B. Incorrect. CsI is a scintillator, which produces light photons when x rays interact. The light then has to be converted into a signal. C. Correct. Amorphous selenium is a semiconductor. When x rays are absorbed the energy is converted directly into charge, producing electron hole pairs in proportion to incident x ray energy. D. Incorrect. CCD detectors form images from visible light.

8. Which of the following occurs when the x-ray field is collimated to the smallest possible size to cover the specific anatomic region?
- A. Geometric unsharpness is decreased
 - B. Image contrast is improved
 - C. A higher grid ratio is needed
 - D. Geometric magnification is increased

Key: B

References:

Bushberg, Seibert, Leidholdt, Boone, Essential Physics of Medical Imaging. 2nd Edition. Lippincott Williams and Wilkins, 2002, pages 166-167.

Rationale: A. Incorrect. Geometric unsharpness depends on geometric factors such as focal spot size and magnification. B. Correct. Collimation to a smaller field of view reduces scatter, which improves image contrast. C. Incorrect Higher grid ratios will reduce scatter, but reducing the field of view by collimating to the smallest possible size already reduces scatter, so making that change would not make a higher grid ratio needed. D. Incorrect. Changing the size of the x ray field does not affect the magnification. Magnification is determined by distances from x ray source to image receptor and x ray source to object.

9. In what direction do chemical shift artifacts manifest in MRI?

- A. Frequency encoded
- B. Phase encoded
- C. Slice encoded
- D. Slice select

Key: A

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 3rd Edition, p. 481.

Rationale: A. Correct. The chemical shift phenomenon arises as a result of the slightly shielded magnetic environment experienced by protons in fat, causing a lower frequency (about 3 parts per million) compared to protons in water. Because of this frequency shift, the major chemical shift artifact occurs in the frequency encode gradient direction (answer A). Note; the “slice encode” gradient is a gradient that is applied for volumetric ordering of the proton locations in a 3D acquisition. B. Incorrect. See explanation under choice A. C. Incorrect. See explanation under choice A. D. Incorrect. See explanation under choice A.

10. A CT angiography image is likely to be abnormally noisy if it is acquired with which of the following parameters?

- A. Higher than normal tube voltage
- B. Thicker than normal slice thickness
- C. Lower than normal tube current
- D. Smoothing reconstruction algorithm

Key: C

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 3rd Edition, p. 223-224,366.

Rationale: A. Incorrect. Higher tube voltage decreases image noise, with all other factors the same, since more x rays are used to form the image (more x rays are produced and a greater percentage are transmitted through the patient). B. Incorrect. Increasing slice thickness actually decreases image noise, since more photons are used to form the image. C. Correct. The lower tube current results in fewer x-ray photons, thereby increasing image noise. D. Incorrect. Smoothing algorithm decreases appearance of image noise.

**Ultrasound Radiology
In-Training Test Questions
for Diagnostic Radiology Residents**



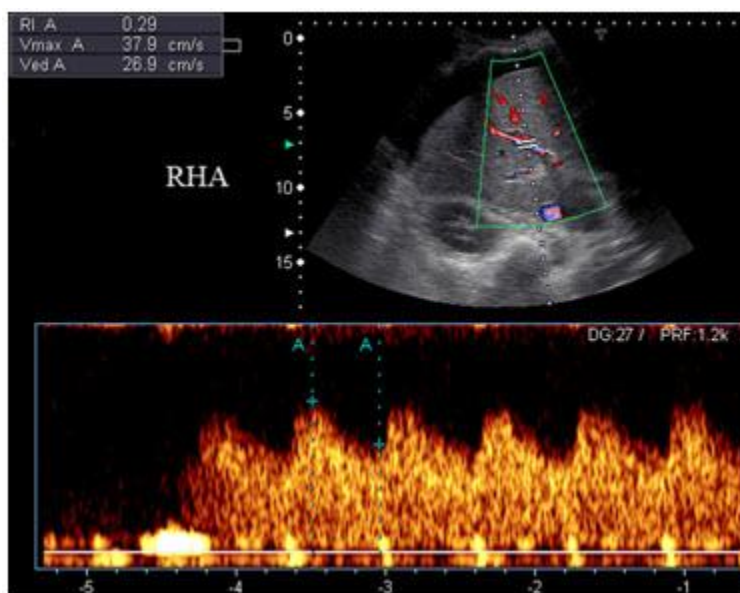
QUALITY IS OUR IMAGE

May, 2018

Sponsored by:

*Commission on Publications and Lifelong Learning
Committee on Residency Training in Diagnostic Radiology*

1. You are shown color and spectral Doppler evaluation of the right hepatic artery of a 34-year-old woman, 72 hours status post liver transplant (Figure 6). Which one is the MOST LIKELY diagnosis?



- A. Normal hepatic artery
- B. Hepatic artery stenosis
- C. Pseudoaneurysm of hepatic artery
- D. Arterio-venous fistula

Key: B

References:

McNaughton DA and Abu-Yousef MM. Doppler US of the liver made simple. Radiographics 2011; 31:161-188.

McNamara MM, Lockhart ME and Robbin ML. Emergency Doppler evaluation of the liver and Kidneys. Radiol Clin N Am 42(2004) 397-415.

Rationale: A. Incorrect. Normal hepatic artery waveforms should have a brisk upstroke and RI in the range of 0.55-0.7. B. Correct. The RI of 0.29 in this case is low (normal 0.55-0.7). A low RI is suspicious for an upstream narrowing such as hepatic artery stenosis. Low RI can also be seen in the setting of distal vascular shunts. The upstroke in this waveform is also abnormal, both delayed and lower than expected compatible with a "tardus parvus" waveform, which is also suspicious for proximal narrowing. C. Incorrect. Pseudoaneurysm is a rare complication of liver transplant that typically occurs at the arterial anastomosis. On greyscale imaging a pseudo aneurysm appears as a cystic structure with turbulent flow shown on color and spectral Doppler imaging. D. Incorrect. Arterio-venous fistulas may be seen in liver transplant livers following biopsy. The typical appearance is a focus of aliasing on color Doppler imaging.

2. What is the minimal threshold beta hCG level at which an intrauterine gestational sac should be visualized by transvaginal ultrasound?

- A. 50 IU (IRP)
- B. 500 IU (IRP)
- C. 2,000 IU (IRP)
- D. 10,000 IU (IRP)

Key: C

References:

Doubilet PM et al. Diagnostic criteria for nonviable pregnancy early in the first trimester. The New England Journal of Medicine. 2013; 369:1443-51.

Rationale: A. 50IU (IRP) Incorrect. An intrauterine gestation sac is not routinely identified at a bCG level of 50 IU. B. 500 IU (IRP) Incorrect. An intrauterine gestation sac is not routinely identified at a bCG level of 500 IU. C. 2,000 IU (IRP) Correct. The literature has shown that an intrauterine gestational sac should be visible by transvaginal sonography when the bCG level is 2000, however case reports have described normal gestations with cardiac activity after initial US showed no gestational sac at bCG levels between 2,000-3,000. D. 10,000 IV (IRP) Incorrect. An intrauterine gestation should be seen by transvaginal US at threshold levels below 10,000 IU.

3. You are shown longitudinal gray scale image of the testis in an asymptomatic 57 year old man (Figure 2). A color flow Doppler ultrasound of the abnormal area did not reveal any flow. What is the MOST LIKELY diagnosis?



- A. Tubular ectasia of rete testis
- B. Intratesticular varicocele
- C. Testicular tumor
- D. Testicular abscess

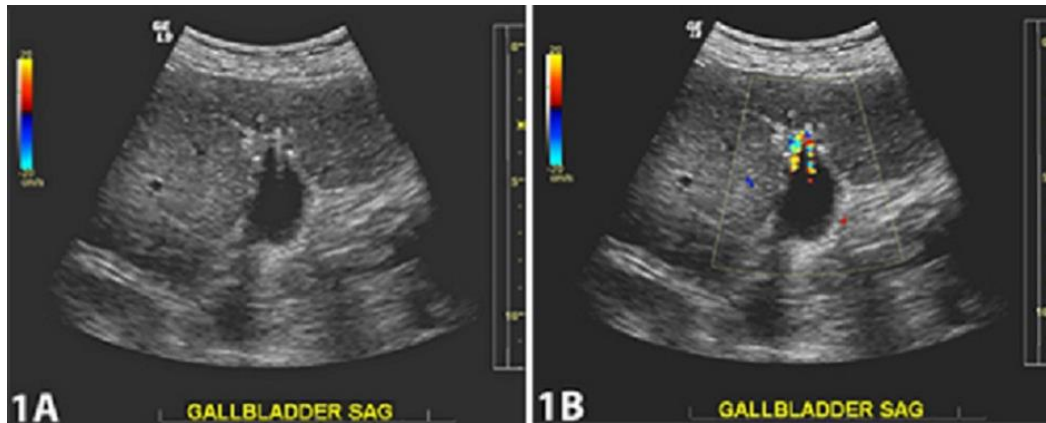
Key: A

References:

Sommers D and Winter T. Ultrasonography evaluation of scrotal masses. Radiologic Clinics of North America 2014; 52:1265-1281.

Rationale: A. Tubular ectasia of the rete testis. Correct. Tubular ectasia of the rete testis typically occurs as a result of inflammatory or traumatic obstruction of the epididymis. Sonographic findings of cystic or tubular structures along the mediastinum testis with no internal flow on color Doppler imaging is characteristic of this diagnosis. B. Incorrect. Intratesticular varicoceles appear as dilated, tubular structures coursing through the testis. Vascular flow within the varicoceles may be seen on color Doppler imaging. C. Incorrect. The appearance of testicular tumor on ultrasound is variable. Most lesions are solid and hypoechoic compared to the normal testicular parenchyma. Lesions may have calcifications, echogenic components or cystic components. Vascular flow within the lesion is often detected on color Doppler imaging. D. Incorrect. Sonographic features of intra-testicular abscess include enlarged testis with a focal fluid-filled or hypoechoic mass. Gas may be identified within an abscess as bright echogenic foci with posterior acoustic shadowing.

4. What is the MOST likely diagnosis?



- A. Emphysematous cholecystitis
- B. Porcelain gallbladder
- C. Impacted gallstones
- D. Adenomyomatosis

Key: D

References:

Levy AD, Murakata LA, Abbott RM, Rohrmann CA. From the archives of the AFIP. Benign tumors and tumorlike lesions of the gallbladder and extrahepatic bile ducts: radiologic-pathologic correlation. *Radiographics* 2002; 22:387-413

Rationale: A. Incorrect. Gas within the gallbladder in patients with emphysematous cholecystitis appears as linear, echogenic foci with posterior "dirty" shadowing. B. Incorrect. In porcelain gallbladder, the gallbladder wall is calcified and appears diffusely echogenic with posterior acoustic shadowing. C. Incorrect. Impacted gallstones are located in the neck of the gallbladder and are echogenic, shadowing and non-mobile. D. Correct. The grey scale image shows focal thickening of the gallbladder wall with echogenic foci that show posterior comet tail artifact. The color Doppler image shows twinkle artifact associated with the echogenic foci. These findings are characteristic of adenomyomatosis.

5. Theca lutein cysts are MOST commonly associated with:
- A. Stein-Leventhal syndrome.
 - B. gestational trophoblastic disease.
 - C. elevated serum progesterone levels.
 - D. a normal singleton pregnancy.

Key: B

References:

Shaaban AM et al. Gestational trophoblastic disease: clinical and imaging features. Radiographics 2017; 37:681-700.

Rationale: A. Incorrect. Stein-Leventhal syndrome, also called polycystic ovary syndrome is associated with an abnormal appearance of the ovaries on ultrasound including ovaries with increased volume and numerous, small, typically peripherally oriented cysts. This diagnosis is not associated with theca lutein cysts. B. Correct. Theca lutein cysts are large functional ovarian cysts that result from ovarian stimulation by high levels of beta hCG. Theca lutein cysts are typically bilateral and can be seen in up to 20% of patients with gestational trophoblastic disease due to high levels of beta hCG. C. Incorrect. Theca lutein cysts are not seen in association with elevated serum progesterone levels. D. Incorrect. Theca lutein cysts are not an expected finding in the setting of a normal singleton pregnancy.

6. You are shown a transverse image of the uterus from a 24-year-old woman with a positive urine pregnancy test (Figure 3). What is the MOST LIKELY diagnosis?



- A. Ectopic pregnancy
- B. Anembryonic pregnancy
- C. Complete hydatidiform mole
- D. Normal 8-week intrauterine pregnancy

Key: C

References:

Shaaban AM et al. Gestational trophoblastic disease: clinical and imaging features. Radiographics 2017; 37:681-700.

Rationale: A. Incorrect. The lesion shown is located within the endometrial canal. Ectopic pregnancies are located outside of the endometrial canal. B. Incorrect. Failed intrauterine pregnancy is diagnosed with no embryo is seen on transvaginal ultrasound with a mean sac diameter of greater than or equal to 25mm. C. Correct. This image shows an enlarged uterus with an intrauterine mass that is echogenic with cystic spaces of varying size. No fetal parts are identified. In the setting of elevated hCG, the imaging features are characteristic of a complete hydatidiform mole (CHM). CHM occur when an empty ovum (no maternal chromosomes) is fertilized by a sperm which then duplicates its DNA. D. Incorrect. No normal fetal parts are shown on this image. In a normal intrauterine gestation, the gestational sac, yolk sac and fetus should be visible by 8 weeks.

7. Fetal head circumference during the second trimester of pregnancy on an obstetrical ultrasound should be measured at the level of the:

- A. frontal horns and cerebellum.
- B. paired thalami and cerebellum.
- C. paired thalami and cavum septi pellucidi.
- D. cavum septi pellucidi and cerebellum.

Key: C

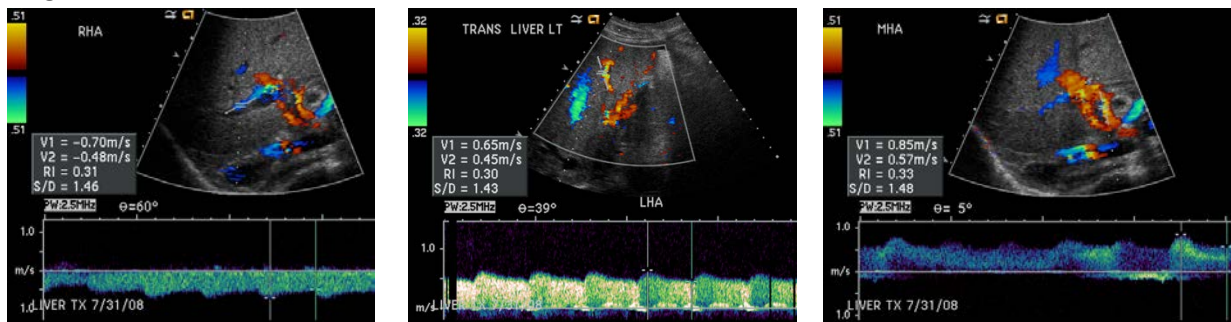
References:

Salomon LJ et al. Practice guidelines for performance of the routine mid-trimester fetal ultrasound scan. *Ultrasound Obstetrics and Gynecology* 2011; 37:116-126.

Hadlock FP et al. Fetal biparietal diameter:rational choice of plane of section for sonographic measurement *AJR* 1982;138:871-874.

Rationale: A. Incorrect. Fetal head circumference is the length of the outer cranium perimeter, obtained in the transaxial plane at the level of the paired thalami and septi pellucidi. B. Incorrect. Fetal head circumference is the length of the outer cranium perimeter, obtained in the transaxial plane at the level of the paired thalami and septi pellucidi. C. Correct. Fetal head circumference is the length of the outer cranium perimeter, obtained in the transaxial plane at the level of the paired thalami and septi pellucidi. D. Incorrect. Fetal head circumference is the length of the outer cranium perimeter, obtained in the transaxial plane at the level of the paired thalami and septi pellucidi.

8. You are shown Doppler images of the main, left, and right hepatic arteries (Figure 1, Figure 2 and Figure 3) in a patient who underwent a liver transplant two months ago. What is the MOST likely diagnosis?



- A. Proximal hepatic artery stenosis
- B. Distal hepatic artery stenosis
- C. Hepatic venous anastamotic stricture
- D. Transplant rejection

Key: A

References:

McNaughton DA and Abu-Yousef MM. Doppler US of the liver made simple. Radiographics 2011; 31:161-188.

Rationale: A. Correct. The main, left and right hepatic arteries all show tardus-parvus waveforms and low resistive index, imaging features suspicious for an upstream hepatic arterial stenosis. B. Incorrect. Tardus parvus waveforms and low resistance flow as shown on these images indicate an arterial stenosis proximal to the site of imaging. C. Incorrect. The main, left and right hepatic arteries all show tardus-parvus waveforms and low resistive index, imaging features suspicious for an upstream hepatic arterial stenosis. D. Incorrect. The main, left and right hepatic arteries all show tardus-parvus waveforms and low resistive index, imaging features suspicious for an upstream hepatic arterial stenosis.

9. What is a characteristic ultrasound finding of an endometrioma?
- A. Well-defined unilocular or multilocular cystic mass with low level internal echoes
 - B. Complex cyst with reticular type pattern with internal echoes and septations
 - C. Highly echogenic and attenuating mass
 - D. Hypoechoic mass with posterior attenuation of the sound beam

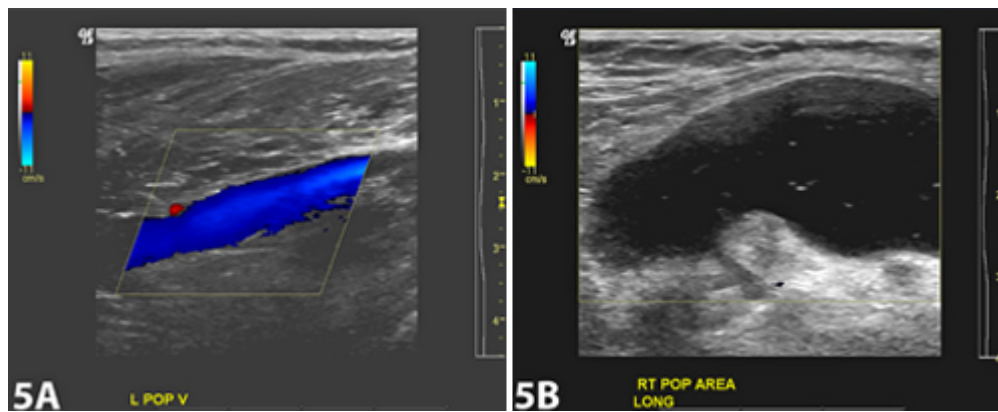
Key: A

References:

Brown DL, Dudiak KM and Laing FC. Adnexal masses: US characterization and reporting. Radiology 2010;254; 342-354.

Rationale: A. Correct. The characteristic appearance of an endometrioma is a well-defined unilocular or multilocular cystic lesion with low level internal echoes. B. Incorrect. A complex cyst with reticular type pattern is commonly seen with a hemorrhagic cyst. C. Incorrect. Mature cystic teratomas, commonly referred to as ovarian dermoid cysts, tend to have a highly echogenic component with posterior acoustic attenuation or shadowing. Other key US imaging features that can be seen in mature cystic teratomas include echogenic lines and dots, fluid-fluid levels and floating globules. D. Incorrect. Thecomas or fibromas, are hypoechoic masses on US with posterior attenuation of the sound beam.

10. You are shown two images of the left lower extremity in a patient with left lower extremity pain. What is the MOST LIKELY diagnosis?



- A. Pseudoaneurysm
- B. Baker cyst
- C. Deep vein thrombus in the popliteal vein
- D. Popliteal artery aneurysm

Key: B

References:

Ward EE, Jacobson JA, Fessell DP, Hayes CW and Holsbeeck MV. Sonographic detection of Baker's cysts: comparison with MR imaging. American Journal of Roentgenology 2001; 176:373-380.

Rationale: A. Incorrect. Pseudoaneurysm can appear as a cystic structure in the popliteal fossa on B-mode imaging but would show internal vascular flow on color Doppler imaging. B. Correct. A Baker's cyst is fluid within a distended bursa between the median head of the gastrocnemius and semimembranosus tendon. C. Incorrect. The most sensitive finding of deep vein thrombus in the popliteal vein is non compressibility of the popliteal vein. D. Incorrect. Popliteal artery aneurysm would appear as focal cystic dilation of the popliteal artery of B-mode imaging and would show internal vascular flow on color Doppler imaging.