Breast Radiology In-Training Test Questions for Diagnostic Radiology Residents



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© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- <u>www.acr.org</u> You are shown the screening mammogram right CC and MLO of a 55-year-old woman. Which one of the following is the MOST likely diagnosis?



- A. Fibroadenoma
- B. Hamartoma
- C. Hematoma
- D. Galactocele

Key: B

Findings:

Well-circumscribed mass of mixed attenuation containing fat.

Rationales:

Evaluating the density of a mass is important in providing a differential diagnosis. Density should be compared to the surrounding breast parenchyma or, as in this case of a fatty replaced breast, to the nipple. The differential diagnosis for a mass containing both radiolucent and radiopaque components would include: Hematoma, galactocele, intramammary lymph node, and hamartoma

(fibroadenolipoma). Encapsulated lesions of mixed density (fat containing) are benign and require no additional evaluation or work up.

A. *Incorrect.* While fibroadenomas may be well circumscribed as in this case, they do not contain fat and are usually isodense to fibroglandular tissue.

B. **Correct.** Hamartomas, also known as fibroadenolipomas, are of mixed density and are composed of adipose and fibroglandular elements. These masses are unusual but have a characteristic appearance. Hamartomas are usually painless and asymptomatic.

C. *Incorrect.* While hematomas may appear well circumscribed, they tend to be of moderate to high density and present in patients with a history of trauma or surgery. The history does not support this diagnosis since this patient is an asymptomatic screening patient.

D. *Incorrect*. These milk-filled cysts may be well circumscribed with high fat content and demonstrate a mixed density appearance. However, history is again of importance, since this is a postmenopausal patient and galactoceles occur in younger nursing women.

References:

Tabar L, Dean PB. *Teaching Atlas of Mammography*. 3rd ed. New York, NY: Thieme Stuttgart; 2001. Kopans DB. *Breast Imaging*. 2nd ed. Philadelphia, Pa: Lippincott Raven; 1998.

You are shown a CC view of the right breast (the first figure) following which a needle biopsy yielded fibroadenoma. A follow-up CC view of the right breast was obtained 6 months later (the second figure). What is the MOST likely diagnosis?



- A. Invasive lobular carcinoma
- B. Ductal carcinoma in situ
- C. Phyllodes tumor
- D. Tubular carcinoma

Key: C

Rationales:

A. *Incorrect*. The most common presentations of invasive lobular carcinoma are a spiculated mass, an ill-defined or obscured mass and architectural distortion. Occasionally, lobular carcinomas are diffusely infiltrating and may show only subtle findings on mammography.

B. *Incorrect*. Ductal carcinoma in situ (DCIS) is usually detected on mammography with calcifications being the mammographic hallmark. The calcifications are typically fine, linear, discontinuous, and branching, often in a ductal distribution. In about 10% of cases, only a soft tissue mass can be seen on mammography.

C. **Correct**. Mammographically, most phyllodes tumors are large, circumscribed, noncalcified masses that are round, oval, or lobulated. When small, the appearance may be identical to a fibroadenoma. When large, the size may suggest the diagnosis. The most common clinical presentation is a large rapidly growing mass.

D. *Incorrect*. Tubular carcinomas are usually small, irregularly shaped, and have spiculated margins. They are typically slow growing and small at the time of diagnosis. Due to the small size and slow growth, most tubular carcinomas are detected on mammography rather than on palpation.

You are shown CC and MLO mammograms (Figures 2A through 2D). What is the MOST likely clinical presentation?



- A. Peau d'orange skin in the left breast
- B. No symptom; patient presented for routine screening mammography
- C. Nipple discharge from the left breast
- D. Pruritus in the left breast

Key: A

Rationales:

A. **Correct**. The left mammogram is markedly dense compared with the right mammogram, and malignant calcifications are present in the left mammogram. The ultrasound image of the left breast shows thickened skin and a solid mass containing malignant calcifications. This is a case of inflammatory breast cancer. Hence, peau d'orange skin would be the most appropriate choice.

B. *Incorrect*. This is an incorrect choice because of all the reasons enumerated above.

C. Incorrect. Nipple discharge is not a usual presentation of inflammatory breast cancer.

D. Incorrect. Pruritus is not a usual presentation of inflammatory breast cancer.

Reference: Kopans DB. Breast Imaging. Lippincott, Philadelphia, 2nd edition, 1998, pp.590-2.

What does the calcification in the upper central breast MOST likely represent?



- A. Ductal carcinoma in-situ
- B. Skin calcification
- C. Milk-of-calcium
- D. Dystrophic calcification

Key: D

Rationale:

A. *Incorrect*. The calcification shown is not clustered or of suspicious morphology (e.g. not amorphous, linear, branching, or pleomorphic).

B. *Incorrect*. The calcification shown is not lucent or geometric-shaped, and does not project near or in the skin.

C. *Incorrect*. Milk-of-calcium calcifications are linear, meniscal, layering, or discoid in the lateral projection, and smudgy, round, or amorphous in the craniocaudal projection. The calcification shown does not meet the criteria for milk-of-calcium.

D. **Correct**. The calcification shown is coarse, chunky, distinct – it has the classic morphology of dystrophic calcification.

Reference:

Sickles EA. Breast calcifications: mammographic evaluation. Radiology 1986; 160:289-293. Linden SS, Sickles EA. Sedimented calcium in benign breast cysts: the full spectrum of mammographic presentations. Am J Roentgenol 1989; 152:967-71. According to MQSA and ACR criteria, which of the following constitutes optimal positioning for the MLO view?

- A. The pectoralis muscle should be concave in shape.
- B. The x-ray gantry should be angled at 45 degrees.
- C. Axillary lymph nodes should be visualized.
- D. The pectoralis muscle should reach the level of the nipple.

Key: D

Rationale:

A. *Incorrect.* The muscle should be convex.

- B. Incorrect. The angle depends on the patient habitus and ranges from 40-60 degrees.
- C. Incorrect. Not necessary to visualize lymph nodes.
- D. Correct. The PNL is the level to which the pectoralis muscle should extend

What is the current recommendation of the American Cancer Society regarding screening mammography in women aged 40-50?

- A. No screening for that age group
- B. Annual screening
- C. Routine screening every 2 years
- D. Routine annual mammography and ultrasound

Key: B

Rationale:

A. *Incorrect.* While the USPSTF recommends no screening for the 40-50 year age group, this was not adopted by the ACS or ACR.

B. **Correct.** The ACR and ACS recommend annual screening mammography for women beginning at age 40.

C. *Incorrect.* The USPSTF recommends biennial screening in women above the age of 50. There is no recommendation for biennial screening in women aged 40-50.

D. *Incorrect.* The ACR and ACS recommend annual screening mammography only. There is no recommendation for annual screening ultrasound.

Reference: American Cancer Society.

Which of the following changes can be noted on mammography after reduction mammoplasty?

- A. Redistribution of the breast tissue superiorly and swirling of tissue
- B. Skin thickening along the transverse scar
- C. Anatomic distribution of islands of breast tissue
- D. A fibrotic band in the subareolar region

Key: D

When discussing this needle localization with the surgeon, how should you describe the location of the tip of the wire in relation to the clip?



Options:

- A. Medial and superior to the clip
- B. Lateral and superior to the clip
- C. Lateral and inferior to the clip
- D. Medial and inferior to the clip

Key: B

A 46-year-old woman was diagnosed with invasive ductal carcinoma. Her baseline screening mammogram performed 9 months earlier had been read as BI-RADS Category 1. In the mammography audit, the baseline screening mammogram should be considered:

- A. True negative
- B. False negative
- C. True positive
- D. False positive

Key: B

Rationale:

A. *Incorrect.* This is a false negative study since the patient was found to have a cancer within the year follow up period.

B. **Correct.** Any biopsy proven cancer within a year of a negative mammogram is by definition a false negative study.

C. *Incorrect.* The study is considered a false negative study since it was read as negative but then found to be incorrectly so within a year's time.

D. *Incorrect.* The study is considered a false negative study since it was read as negative but then found to be incorrectly so within a year's time. A false positive study would be read as having an abnormality while in fact having no abnormality present.

Reference: D'Orsi CJ, Sickles EA, Mendelson EB, Morris EA. Follow up and outcome monitoring ACR BI-RADS Atlas 2013 2013: p.18.



Which of the following conditions is discordant with the mammographic findings?



- A. HIV infection
- B. Lymphoma
- C. Metastatic breast cancer
- D. CLL (chronic lymphocytic leukemia)

Key: C Rationale:

A. *Incorrect.* Bilateral axillary lymphadenoathy is typically associated with chronic systemic processes such as HIV, Lymphoma, CLL, or other infectious/inflammatory disease states. The mammographic findings would be considered concordant in this case.

B. *Incorrect.* Bilateral axillary lymphadenoathy is typically associated with chronic systemic processes such as HIV, Lymphoma, CLL, or other infectious/inflammatory disease states. The mammographic findings would be considered concordant in this case.

C. **Correct.** Bilateral axillary lymphadenoathy is typically associated with chronic systemic processes such as HIV, Lymphoma, CLL, or other infectious/inflammatory disease states. Metastatic breast cancer typically would present with an unilateral axillary lymphadenopathy, not bilateral.

D. *Incorrect.* Bilateral axillary lymphadenoathy is typically associated with chronic systemic processes such as HIV, Lymphoma, CLL, or other infectious/inflammatory disease states. The mammographic findings would be considered concordant in this case.

A patient presents with a new palpable mass in the right breast. What is the most appropriate recommendation based on the images shown?







Options:

- A. Routine annual mammography
- B. Six month follow up mammography
- C. Ultrasound guided core biopsy
- D. Breast MRI

Key: C

Rationale:

A. Incorrect. In a patient with a newly palpable solid mass, biopsy is necessary.

B. *Incorrect.* In a patient with a newly palpable solid mass, six month follow up mammography is not appropriate management. Six month follow is validated for probably benign findings such as noncalcified circumscribed solid masses, focal asymmetries and solitary groups of punctate calcifications.

C. Correct. In a patient with a newly palpable mass that is demonstrated to represent a solid mass under ultrasound, ultrasound guided core biopsy is the most appropriate recommendation.D: *Incorrect.* Additional imaging tests such as breast MRI would not be helpful in determining the etiology or long term outcome. Biopsy remains necessary for histologic evaluation.

Reference: Ikeda DM. Mammographic and Ultrasound Analysis of Breast Masses Breast Imaging: The Requisites 2004, Elsevier, Philadelphia, PA; p. 90-130.

Cardiac Radiology In-Training Test Questions for Diagnostic Radiology Residents



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© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- <u>www.acr.org</u> You are shown an axial contrast-enhanced CT scan of the chest. What is the MOST likely diagnosis?



Options:

- A. Ostium primum defect
- B. Ostium secundum defect
- C. Sinus venosus defect
- D. Patent foramen ovale

Key: C

A. *Incorrect*. Ostium primum defects are the second most common atrial septal defects (ASD), accounting for about 15 percent of all ASDs. The primum portion of the atrial septum is located inferiorly at the level of the mitral and tricuspid valves. Ostium primum defects are often associated with atrioventricular defects. The abnormality on the image is not in this location.

B. *Incorrect*. Ostium secundum defects are the most common ASD, accounting for approximately 75 percent of all ASDs, and are located near the fossa ovalis, in the middle of the atrial septum. The abnormality on the image is not in this location.

C. **Correct**. Sinus venosus defects are the third most common ASD accounting for approximately 10 percent of all cases. The sinus venosus portion of the atrial septum separates the left atrium from the superior vena cava. The defect in this case is located in the superolateral aspect of the atrial septum at the junction of the superior vena cava and right atrium, near the insertion of the right pulmonary veins, consistent with a sinus venosus ASD.

D. *Incorrect*. Patent foramen ovale occurs in up to 25 percent of adults. The flap of tissue covering the foramen ovale typically closes the defect since the left atrial pressure is higher than the right atrial pressure. Normally, this flap of tissue fuses with the septum after the first year of life. The abnormality on the image is not in the location of the foramen ovale.

You are shown axial and sagittally-reconstructed images from a contrast-enhanced CT scan of the chest obtained after a motor vehicle collision. What is the MOST likely diagnosis?





- A. Patent ductus arteriosus
- B. Traumatic aortic tear
- C. Ductus diverticulum
- D. Penetrating ulcer

Key: C

Rationales:

A. *Incorrect*. There is only a tiny strand of soft tissue density material connecting the proximal descending aorta and the left pulmonary artery. This represents the ligamentum arteriosum.
B. *Incorrect*. The bulge along the underside of the aorta is smooth and there is no evidence of any flap or periaortic hematoma. These findings make traumatic laceration highly unlikely.

C. **Correct**. The combination of a small, smooth bump along the bottom edge of the aorta along with the lack of any evidence of flap or mediastinal hematoma is typical of a ductus diverticulum. The soft tissue strand joining the bump to the pulmonary artery represents the ligamentum arteriosum, the remnant of the ductus arteriosus.

D. Incorrect. The bump has none of the hallmarks of penetrating atherosclerotic ulcer.

Which one of the following septal defects is MOST commonly associated with partial anomalous pulmonary venous drainage?

Options:

- A. Ostium primum
- B. Ostium secundum
- C. Ventricular
- D. Sinus venosus

Key: D

Rationale:

- A. Incorrect.
- B. Incorrect.
- C. Incorrect.

D. **Correct**. Drainage of the pulmonary veins should be assessed in all patients with congenital anomalies. Nearly all patients with sinus venosus atrial septal defect have anomalous pulmonary venous drainage, most commonly drainage of the right upper lobe to the superior vena cava. Approximately 10 percent of patients with an ostium secundum atrial septal defect will have anomalous pulmonary venous drainage.

References:

Boxt LM. Magnetic Resonance and Computed Tomographic Evaluation of Congenital Heart Disease. J Magn Reson Imag 2004; 19:827-847.

Miller SW. Congenital Heart Disease. In: Miller SW, ed. The Requisites: Cardiac Imaging. Philadelphia: Elsevier Mosby, 2005:284-365.

Concerning a patient presenting with an acute myocardial infarction accompanied by severe bradycardia, which vessel is MOST likely involved?

- A. Diagonal branch
- B. Left anterior descending coronary artery
- C. Right coronary artery
- D. Circumflex artery

Key: C

Rationales:

A. *Incorrect*. The diagonal artery is a branch of the left anterior descending coronary artery. The atrioventricular (AV) node artery, supplies the AV node. In 85-90 percent of patients, the AV node artery arises from the right coronary artery at the point where it gives off the posterior descending artery. B. *Incorrect*. The atrioventricular (AV) node artery, supplies the AV node. In 85-90 percent of patients, the AV node artery arises from the right coronary artery at the point where it gives off the posterior descending artery.

C. **Correct**. The atrioventricular (AV) node artery, supplies the AV node. In 85-90 percent of patients, the AV node artery arises from the right coronary artery at the point where it gives off the posterior descending artery.

D. *Incorrect*. The atrioventricular (AV) node artery, supplies the AV node. In 85-90 percent of patients, the AV node artery arises from the right coronary artery at the point where it gives off the posterior descending artery. A branch of the circumflex artery supplies the AV node in the remaining cases. **Reference:**

Chen JTT. Coronary Heart Disease. In: Chen JTT, ed. Essentials of Cardiac Imaging. Philadelphia: Lippincott-Ravin, 1997:201-214.

Concerning tricuspid valve regurgitation in adults, what is the MOST common etiology?

- A. Infective endocarditis
- B. Right ventricular hypertension
- C. Ebsteins' anomaly of the tricuspid valve
- D. Rheumatic heart disease

Key: B

Rationales:

A. *Incorrect*. Although tricuspid regurgitation frequently occurs in intravenous drug abusers with bacterial endocarditis, it is not as common as tricuspid regurgitation secondary to pulmonary hypertension.

B. **Correct**. The majority of cases of tricuspid regurgitation in adults result from high right sided pressures with or without right ventricular failure.

C. *Incorrect*. Ebstein's anomaly may result in tricuspid regurgitation, but is a rare disease.

D. *Incorrect*. Although patients with rheumatic valvular heart disease frequently have tricuspid regurgitation, it almost always results from high right sided pressures related to mitral stenosis. Primary involvement of the tricuspid valve occurs in only about 5% of patients with rheumatic heart disease. **Reference:** Kirklin JW, and Barratt-Boyes BG. Tricuspid valve disease. In Cardiac Surgery, Churchill-Livingston, New York, 1993. pp 589-591.

Which of the following findings is the MOST reliable sign of elevated right ventricular pressure on a contrast-enhanced CT scan of the chest?

- A. Leftward bowing of the interventricular septum
- B. Right ventricular hypertrophy
- C. Right ventricular enlargement
- D. Reflux of contrast into the inferior vena cava

Key: A

Rationales:

A. **Correct**. Abnormal curvature of the ventricular septum toward the left ventricle indicates elevated right ventricular pressure.

B. *Incorrect*. Although the right ventricle will hypertrophy under the stress of a pressure overload, wall thickening may be difficult to identify on routine, non-gated CT scans.

C. *Incorrect*. Enlargement of right ventricle indicates a volume overload, such as tricuspid regurgitation or a left to right shunt, or the presence of right ventricular failure. Elevated right ventricular pressure alone will not generally enlarge the chamber.

D. *Incorrect*. Reflux of contrast into the IVC can be seen with either high right sided pressures (atrial or ventricular), or with tricuspid regurgitation.

In regards to cyanotic congenital heart disease presenting in infancy, which one of the following is MOST common?

- A. Hypoplastic left heart syndrome
- B. Tetralogy of Fallot
- C. Truncus arteriosus
- D. Ventricular septal defect

Кеу: В

Rationales:

A. *Incorrect.* Although Hypoplastic left heart syndrome is the most common cause of congestive failure in the neonate, it only occasionally results in cyanosis.

B. **Correct**. Tetralogy of Fallot is the most common cause of cyanotic heart disease presenting in the first month of life.

C. *Incorrect.* Truncus arteriosus is a cause of cyanotic heart disease in infancy, but occurs with a much lower frequency than tetralogy of Fallot.

D. *Incorrect.* Ventricular septal defects are the most common, clinically evident congenital heart defect in infants, but only present with cyanosis after the development of secondary pulmonary hypertension. Therefore cyanosis is not characteristic in infancy.

Reference:

Miller SW. Cardiac Imaging: The Requisites. 2nd ed. Mosby, Inc., Philadelphia, PA. 2005.

What is the MOST common anomaly associated with partial anomalous pulmonary venous drainage of the left lung?

- A. A left superior vena cava draining to the coronary sinus
- B. Ostium secundum atrial septal defect
- C. A vertical vein draining to the left brachiocephalic vein
- D. Hypoplasia of the left pulmonary artery and lung

Key: C

Rationale:

A. *Incorrect.* Anomalous pulmonary venous drainage on the left is usually from the left upper lobe to a left vertical vein. A persistent left superior vena cava typically drains into the coronary sinus.B. *Incorrect.* Most patients with partial anomalous left pulmonary venous drainage have no other cardiac defects.

C. **Correct.** Anomalous pulmonary venous drainage on the left is usually from the left upper lobe to a left vertical vein, which then drains into the left brachiocephalic vein.

D. *Incorrect.* Hypoplasia of the ipsilateral pulmonary artery and lung is a feature of the congenital venolobar (scimitar) syndrome and is much more common on the right.

On a chest radiograph, what does the epicardial "fat pad" sign indicate?

- A. Morgagni hernia
- B. Cardiomegaly
- C. Pericardial effusion
- D. Mediastinal lipomatosis

Key: C

What is the most likely diagnosis?





- A. Myocardial infarction
- B. Hypertrophic cardiomyopathyC. Myocarditis
- D. Arrhythmogenic right ventricular dysplasia

Key: C

The soft tissue density structure indicated by the arrow anterior to the pulmonary vein is a:



Options:

- A. thrombosed left atrial appendage.
- B. bronchogenic cyst.
- C. pericardial recess.
- D. substernal goiter.

Key: A

Chest Radiology In-Training Test Questions for Diagnostic Radiology Residents



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© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- <u>www.acr.org</u> You are shown two CT images of a 30-year-old woman with a history of shortness of breath. Which one of the following is the MOST likely diagnosis?



- A. Systemic lupus erythematosus
- B. Sarcoidosis
- C. Idiopathic pulmonary fibrosis
- D. Scleroderma

Key: D

Rationales:

A. *Incorrect.* Systemic lupus erythematosus (SLE) is a multisystem autoimmune disorder. Radiologic abnormality can involve the lungs, pleura, and the heart but do not involve the esophagus. Parenchymal disease may manifest as acute lupus pneumonitis, which is characterized as unilateral or bilateral air space disease or pulmonary hemorrhage. The incidence of interstitial fibrosis is very small in patients with SLE. The findings in the test case do not favor this diagnosis.

B. *Incorrect.* Sarcoidosis is a chronic granulomatous disease. It is predominantly an upper lung disease. It tends to be bilateral and fairly symmetric. Esophageal involvement is rare. The findings of basilar reticular opacities and dilated esophagus lead us away from this diagnosis.

C. *Incorrect.* IPF affects patients between 50 and 70 years old. Radiographic findings include reticular opacities in the peripheral distribution at the lung bases. Esophageal involvement is not reported. Thus, the presence of esophageal involvement and the young age of the patient in the case lead us away from this diagnosis.

D. **Correct.** Scleroderma is a connective tissue disorder that involves the pulmonary parenchyma, skin and GI tract. Pulmonary complications are the most common cause of death in these patients and pulmonary fibrosis is a frequent pulmonary manifestation. Esophageal involvement occurs in more than 50% of patients. Thus the combination of esophageal involvement and pulmonary changes are virtually pathognomonic of scleroderma.

Reference:

Muller NL, Fraser RS, Colman NC, Pare' PD. *Radiologic Diagnosis of Diseases of the Chest*. Philadelphia, Pa: W.B. Saunders; 2001.

Which one of the following lung diseases is classified as a smoking related disorder? **Options:**

- A. Diffuse panbronchiolitis
- B. Usual interstitial pneumonia
- C. Lymphocytic interstitial pneumonia
- D. Desquamative interstitial pneumonia

Key: D

Rationales:

A. Incorrect. Diffuse panbronchiolitis is a proliferative bronchiolitis that occurs mostly in Asians. It is an acute cellular bronchiolitis with inflammatory exudates in the small airways. It usually occurs between the fourth and seventh decades and is characterized by chronic inflammation in the respiratory bronchioles. Panbronchiolitis is likely infectious in etiology and responds to treatment with erythromycin although the exact causative agent has not been identified. There is no evidence of any increased prevalence in smokers.

B. Incorrect. Usual interstitial pneumonitis is one type of chronic interstitial pneumonia that is usually idiopathic (idiopathic pulmonary fibrosis) although it may be caused by toxic drugs, environmental exposure, and collagen vascular disease. It is characterized by the development of relentlessly progressive fibrosis and is associated with 2-3 year median length of survival from the time of diagnosis. No association with smoking has been established and there is no evidence of any increased prevalence among chronic smokers.

C. Incorrect. Lymphocytic interstitial pneumonia is a benign lymphoproliferative disorder characterized by ground-glass attenuation, centrilobular and subpleural lung nodules with thickening of the interlobular septa, and peribronchovascular interstitium. Perivascular cysts are seen in a minority of cases. No association with smoking is reported.

D. Correct. Desquamative interstitial pneumonia is characterized by the histologic feature of intraalveolar macrophagic accumulation. In most cases it is associated with cigarette smoking and is thought to represent the end of a spectrum of respiratory bronchiolitis—associated interstitial lung disease. It affects cigarette smokers 30-40 years old with a male to female ratio of 2:1. Bronchoalveolar lavage fluid contains increased numbers of alveolar macrophages with granules of "smoker's pigment." The prognosis for patients with DIP is good with cessation of smoking and steroid therapy. **References:**

Wittram C, Mark E, McLoud T. CT-histologic correlation of the ATS/ERS 2002 classification of idiopathic interstitial pneumonias. Radiographics. 2003;23 (5):1057-1071.

Ryu JH, Colby TV, Hartman TE, et al. Smoking-related interstitial lung disease: A concise review. Eur Resp. *J.* 2001; 17:122-132.

You are shown a PA chest radiograph and CT image from a 51-year-old man with shortness of breath. What is the MOST likely diagnosis?



- A. Pulmonary alveolar proteinosis
- B. Cardiogenic pulmonary edema
- C. Idiopathic pulmonary fibrosis
- D. Pneumocystis jiroveci pneumonia

Key: D

Findings: Chest radiograph demonstrates bilateral perihilar opacities. High resolution CT scan demonstrates bilateral thin walled cysts, ground glass and reticular opacities **Rationales**:

A. *Incorrect.* The most common radiographic manifestation of pulmonary alveolar proteinosis is ground glass and air space opacities which are located in a perihilar distribution such as in this case. The presence of ground glass opacities on the CT scan is consistent with pulmonary alveolar proteinosis. However, septal thickening is not prominent. The combination of ground glass opacities and septal thickening is sometimes referred to "crazy paving," an appearance most commonly seen in pulmonary alveolar proteinosis. The CT also demonstrates the presence of multiple relatively thin walled cysts. Such cysts are not a feature of pulmonary alveolar proteinosis.

B. *Incorrect*. Although the standard radiograph is somewhat suggestive of the "butterfly" or "bats wing" pattern identified in cardiogenic pulmonary edema, the heart is not enlarged and there is no evidence of Kerley B lines or pleural effusions. Multiple thin walled cysts are not a feature of congestive heart failure.

C. *Incorrect.* IPF occurs in patients between 50 and 70 years old. Radiographic findings include reticular opacities in the peripheral distribution at the lung bases. Thus, the presence of perihilar disease in our case, along with absence of disease in the subpleural basilar location, leads us away from the diagnosis. D. **Correct.** In patients with PCP, the chest radiograph classically demonstrates bilateral often perihilar reticular and ground glass opacification which may eventually become confluent and produce air space consolidation within several days. Cysts are visible on chest radiographs in 10% of patients although they are appreciated far more commonly on HRCT scans (33%). Cysts may occur in the acute or post infective period and range in number, size, shape and distribution. They are commonly multiple and have a predilection for the upper lobes. Spontaneous pneumothorax may be a feature of PCP infection and occurs in approximately 35% of patients with cysts.

Kerley B lines represent which one of the following?

- A. Dilated peripheral pulmonary veins
- B. Distended capillaries
- C. Distended lymphatics
- D. Thickened interlobular septa

Key: D

Rationales:

A. Incorrect.

B. Incorrect.

C. Incorrect.

D. **Correct**. Kerley B lines are short horizontal lines that are visible on chest radiograph adjacent to the costophrenic sulcus. They are approximately 1 to 2 cm long and are noted to extend to the pleural surface. They represent thickened interlobular septa and are visible in patients with lymphangitic arcinomatosis and pulmonary edema.

Which one of the following entities is MOST likely to cause a pneumothorax?

- A. Boerhaave's syndrome
- B. Desquamative interstitial pneumonia
- C. Metastatic osteogenic sarcoma
- D. Ruptured bronchus within 1 cm of the carina

Key: C

Rationales:

A. *Incorrect.* Boerhaave's syndrome represents perforation of esophagus following severe episodes of vomiting. In this instance, pneumomediastinum rather than pneumothorax is the expected consequence.

B. *Incorrect.* Recurrent pneumothorax may be associated with chronic infiltrative lung disease of any cause, but the prevalence is particularly high in two diseases; Langerhans cell histiocytosis (histiocytosis x) and lymphangioleiomyomatosis. Both of these entities are characterized by the presence of multiple lung cysts which may rupture through the visceral pleura causing a complicating pneumothorax. However, pneumothorax may be seen as a complication of the late stages of other types of infiltrative lung diseases that are associated with fibrosis and honeycombing. Desquamative interstitial pneumonia is not characterized by the presence of cysts. High resolution CT frequently demonstrates ground glass and alveolar opacities more marked in the mid and lower lung zones. Fibrosis and honeycombing are not features and the disease responds to steroid therapy.

C. **Correct.** Malignant neoplasms, particularly metastatic sarcoma, are occasional causes of spontaneous pneumothorax. The most common tumor type is metastatic osteogenic sarcoma. The mechanism for the development of pneumothorax is not clear, but it may be related to the presence of cavitation and subsequent rupture into the pleural space. The presence of a "spontaneous" pneumothorax in a child in the setting of a primary osteogenic sarcoma should prompt a CT examination to search for the presence of metastatic disease.

D. *Incorrect.* Pneumothorax which is unresponsive to chest tube drainage can be a feature of a ruptured bronchus which is sustained following blunt trauma usually in high speed motor vehicle accidents. However, the rupture must occur at a site in the bronchus which is contained within the mediastinal pleura. Thus tears close to the carina produce pneumomediastinum rather than pneumothorax.

Reference:

Smevik B, Klepp O. The risk of spontaneous pneumothorax in patients with osteogenic sarcoma and testicular cancer. Cancer. 1982; 49:1734-1737.

Mendez TL, Wadrous HF, Vassallo R, et al: Pneumothorax in pulmonary Langerhans Cell Histiocytosis. Chest. 2004; 125:1028-1032.

Wan YL, Tsauk T, Yeow KM, et al. CT findings of bronchial transection. Am J Emerg Med. 1997; 15:176-177.

Muller NL, Fraser RS, Colman NC, and Pare' PD. Radiologic Diagnosisof Diseases of the Chest. W.B. Saunders, Co., Philadelphia, PA 2001.

Which one of the following radiographic features is seen with allergic bronchopulmonary aspergillosis?

- A. Air crescent sign
- B. Central bronchiectasis
- C. Halo sign
- D. Pleural thickening

Key: B

Rationales:

A. Incorrect.

B. Correct. Allergic bronchopulmonary aspergillosis is a complex hypersensitivity reaction to aspergillus organisms colonizing the bronchial lumen. The inflammatory reaction results in cellular infiltration and release of proteolytic enzymes which produce tissue damage in the bronchial wall. Excessive mucus production leads to mucoid impaction of the airways. The radiographic hallmark is central bronchiectasis. Air-crescent sign, pleural thickening, and halo sign are not features of allergic bronchopulmonary aspergillosis.

C. Incorrect.

D. Incorrect.

You are shown two axial images from a CT scan of the chest of a 48-year-old woman with an abnormal chest radiograph (Figures 1A and 1B). Which one of the following is the MOST LIKELY diagnosis?



- A. Hamartoma
- B. Carcinoid Tumor
- C. Adenocarcinoma
- D. Granuloma

Key: B Pational

Rationales:

A. *Incorrect.* Though the lesion is round, and well-circumscribed, this lesion does not contain fat, which would be diagnostic for hamartoma. The calcifications are chunkier than the classic popcorn calcifications of pulmonary hamartoma. Usually, hamartomas have no effect on adjacent airways. The net result is that hamartoma is possible but not the most likely.

B. **Correct.** The affiliation with the airway, round nature and chunky eccentric calcifications are very typical for pulmonary carcinoid tumors. In fact, 40% of carcinoids may be calcified on CT. Another feature of carcinoid tumors is their effect on the airway (seen in up to 50% of cases). In this case, the effect is air-trapping.

C. *Incorrect.* These lesions may be anywhere in the lung but tend to be peripheral. They may present with areas of ground glass and somewhat spiculated borders. Smaller lesions may be smooth-bordered and round. Calcifications may be eccentric in adenocarcinomas. Usually adenocarcinomas do not result in air-trapping.

D. *Incorrect.* Granulomas tend to be smaller than 2 cm and are usually calcified. When calcified, they are entirely calcified, centrally calcified or lamellated. Airway effects from granulomas are rare. Though this lesion could be a granuloma, its CT appearance is not suggestive of one.

References:

Chong S, Lee KS, Chung MJ, Han J, Kwon OJ, Kim TS. Neuroendocrine tumors of the lung: clinical, pathologic, and imaging findings. Radiographics. 2006; 26:41-57.

Jeung MY, Gasser B, Gangi A, Charneau D, Ducroq X, Kessler R, Quoix E, Roy C. Bronchial carcinoid tumors of the thorax: spectrum of radiologic findings.

Radiographics. 2002; 22:351-65.

Which of the following is the MOST common location for a Morgagni hernia?

- A. Left cardiophrenic
- B. Right cardiophrenic
- C. Left paraspinal
- D. Right paraspinal

Key: B

Rationales:

A. Incorrect.

B. **Correct.** Morgagni hernia represents a congenital diaphragmatic defect. They occur in the right cardiophrenic angle. The hernia sac usually contains intraabdominal fat and may contain air filled loops of bowel.

C. Incorrect.

D. Incorrect.

References:

Muller NL, Fraser RS, Colman NC, and Pare' PD. Radiologic Diagnosis of Diseases of the Chest. W.B. Saunders, Co., Philadelphia, PA 2001.

Which statement is TRUE with respect to Desquamative Interstitial Pneumonia (DIP)?

- A. High-resolution CT characteristically shows diffuse ground glass opacities.
- B. The majority of patients are non-smokers.
- C. High-resolution CT characteristically shows peripheral honeycombing in the lower lobes.
- D. If untreated, it often progresses to Usual Interstitial Pneumonia (UIP).

Key: A

Rationale:

- A. **Correct.** This is the typical finding of DIP.
- B. Incorrect. Most patients are smokers.
- C. Incorrect. This is a finding of UIP, not DIP.

D. *Incorrect.* UIP and DIP are distinct pathologic entities, once thought to be related but now felt not to be.

Concerning lung screening, which of the following would be MOST suspicious for lung cancer?

- A. 7 mm solid nodule
- B. 10 mm ground glass nodule
- C. 9 mm mixed solid/ground glass nodule
- D. 8 mm polygonal shaped ground glass nodule

Key: C

Rationale:

A. *Incorrect.* Solid nodules are most numerous, but have been foound to have a lower rate of malignancy in screening studies. (See reference).

B. *Incorrect.* Ground glass nodules are nonspecific and an infectious/inflammatory etiology must be excluded.

C. **Correct.** On screening studies this type of nodule is associated with the highest risk of malignancy.

D. Incorrect. Polygonal shape nodule favors benign etiology.

Which one of the following conditions is MOST likely associated with hypervascular adenopathy?

- A. Small cell cancer
- B. Histoplasmosis
- C. Castleman disease
- D. Whipple disease

Key: C

Rationale:

- A. Incorrect.
- B. Incorrect.

C. **Correct.** Castleman's and Castleman's disease is also referred to as angiofollicular lymph node hyperplasia. It is a disease of unknown etiology. Two forms of the disease have been described, hyaline-vascular type and the plasma-cell type. On contrast-enhanced CT scan, adenopathy in Castleman's disease demonstrate dense contrast-enhancement.

D. Incorrect. Whipple's lymph nodes may demonstrate central fat attenuation.

Which one of the following sternal wire abnormalities is MOST characteristic of sternal dehiscence?

- A. Shift of the wire
- B. Resorption of the wire
- C. Rotation of the wire
- D. Fracture of the wire

Key: A

Rationale:

A. **Correct.** Sternal dehiscence is an uncommon but serious complication of median sternotomy. Displacement or shift of the sternal wires on chest radiographs is considered a highly specific sign of sternal dehiscence. Fracture and rotation of sternal wires are not thought to play a significant role in dehiscence. Resorption of wire does not occur. Studies have shown that sternal wire abnormalities usually precede the clinical detection of dehiscence by 1-3 days.

- B. Incorrect.
- C. Incorrect.
- D. Incorrect.

Which statement is TRUE regarding small airway diseases?

- A. Tree-in-bud is almost always secondary to a mycobacterial infection.
- B. Tiny nodules from small airway diseases tend to be centrilobular.
- C. Areas of decreased attenuation are associated with increased vessel caliber in these regions.
- D. Obliterative (constrictive) bronchiolitis usually manifests as peripheral ground glass opacities.

Key: B

Rationale:

A. *Incorrect.* The differential diagnosis for a tree-in-bud pattern includes infectious bronchiolitis (from any type of infection), aspiration and diffuse panbronchiolitis.

B. Correct. Poorly defined centrilobular nodules are the hallmark of small airway inflammation.

C. Incorrect. The vessels in the areas of decreased attenuation tend to be of smaller caliber.

D. *Incorrect.* This is a feature of organizing pneumonia. Obliterative bronchiolitis tends to present with a mosaic attenuation pattern.
Which statement is TRUE regarding traumatiac aortic injury (TAI)?

- A. An eccentric thrombus can be a manifestation of minimal aortic intimal injury.
- B. Aortic injuries seen on CT are most often detected within the ascending aorta.
- C. Mediastinal hemorrhage isolated to the anterior mediastinum is often associated with TAI.
- D. Pseudoaneurysms are rarely seen with TAI.

Key: A

Rationale:

A. **Correct.** In fact, in the era of MDCT, we are beginning to detect more of these as a manifestation of minimal TAI. In these patients, beta blockers may be the only treatment needed.

B. *Incorrect.* Most aortic injuries seen on CT will be dtected within the oartic isthmus.

C. *Incorrect.* An isolated anterior mediastinal hematoma is almost never associated with TAI. Usually these are from sternal fractures.

D. Incorrect. In fact, these are commonly encountered in the CT of TAI.

Which one of the following statements is true regarding barotrauma?

- A. Pulmonary fibrosis is a significant risk factor.
- B. Interstitial emphysema is the first radiographic manifestation.
- C. Only a minority of pneumothoraces in ventilation assisted patients are under tension.
- D. Tracheal tears are a recognized effect of barotrauma.

Кеу: В

Rationale:

A. *Incorrect.* Pulmonary fibrosis produces stiff noncompliant lungs that may require high pressures to ventilate, but because the lungs are not particularly stretched barotrauma is uncommon. Acute lung injury and COPD carry a much higher risk of barotrauma.

B. **Correct.** In barotrauma air initially escapes into the interstitial spaces of the lungs and tracks along the bronchovascular bundles toward the mediastinum. Pneumomediastinum and pneumothorax may occur subsequently.

C. *Incorrect.* Between 60 and 90% of pneumothoraces in patients on positive pressure ventilation are under tension.

D. *Incorrect.* Tracheal tears may occur in the ICU setting secondary to traumatic intubation or after blunt trauma or penetrating but not barotrauma.

References:

Bongard FS, Sux DX. Current critical care diagnosis and treatment 2nd ED, Lange Medical Books/McGraw Hill, New York.

Moffessante M, Berlot G, Bartolotto P. Chest roentgenology in the intensive care unit: An overview Eur Radiol 1998; 8:69-78.

Irwin RS, Rippe TM. Intensive care medicine 5th ed, Lippincott, Williams & Wilkins, PA 2003.

Gastrointestinal Radiology In-Training Test Questions for Diagnostic Radiology Residents



QUALITY IS OUR IMAGE

May, 2016

Sponsored by: Commission on Education Committee on Residency Training in Diagnostic Radiology

© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org You are shown a contrast-enhanced CT of a 62-year-old man with left lower quadrant abdominal pain. What is the MOST LIKELY diagnosis?



- A. Omental infarct
- B. Diverticulitis
- C. Mesenteric panniculitis
- D. Epiploic appendagitis

Key: D

Rationales:

A. *Incorrect.* Omental infarct is usually right sided, presenting as a large fat-containing mass centered in the omentum. It may or may not be adjacent to the colon. It is typically larger than the fatty mass of epiploic appendagitis and is less well defined.

B. *Incorrect*. Diverticulitis demonstrates marked colonic wall thickening in addition to the surrounding inflammatory changes in the fat. It occurs more commonly in the sigmoid colon.

C. *Incorrect.* Mesenteric panniculitis is an idiopathic, chronic, nonspecific process usually presenting as a solitary mass of heterogeneous fat at the root of the jejunal mesentery. There are often shotty lymph nodes.

D. **Correct**. Epiploic appendagitis presents with a paracolonic fat-containing mass with well circumscribed hyperattenuating rim ("ring sign") and central engorged/thrombosed vessel. It is located adjacent to the left colon in most cases and is typically smaller, more round, and better defined than omental infarction.

References:

McClure MJ, Khalili K, Sarrazin, et al. Radiologic features of epiploic appendagitis and segmental omental infarction. Clin Radiol 2001; 56(10):819-827.

Pereira JM, Sirlin CB, Pinto PS, et al. Disproportionate fat stranding: A helpful CT sign in patients with acute abdominal pain. RadioGraphics 2004; 24(3):703-715.

Sandrasegaran K, Maglinte DD, Rajesh A, et al. Primary epiploic appendagitis: CT diagnosis. Emerg Radiol 2004; 11(1):9-14.

Singh AK, Gervais DA, Hahn PF, et al. CT appearance of acute appendagitis. AJR 2004;183(5):1303-1307.



You are shown CT images of the liver in a 76-year-old man. What is the MOST likely diagnosis?

- A. Pneumobilia
- B. Portal vein thrombosis
- C. Biliary obstruction
- D. Portal venous gas

Rationales:

A. *Incorrect.* The CT demonstrates branching structures filled with gas ramifying throughout the liver. The extensive involvement extending to the subcapsular liver is, however, unusual for pneumobilia. The second, more inferior image shows the portal vein bifurcation to be filled with gas, establishing the diagnosis of portal vein gas.

B. *Incorrect.* The portal vein and its branches are abnormally hypodense. The extreme intraluminal low density is consistent with gas, not thrombus. The extensive involvement, to include very peripheral small branches, is more likely to be from gas than clot. Portal vein thrombus is macroscopically more limited in distribution, and usually involves more central branches near the hepatic hilum.

C. *Incorrect.* Biliary obstruction can cause widespread, bilobar dilation of intrahepatic bile ducts. Although small biliary radicles can be distended with bile, these are usually inconspicuous compared to small peripheral portal venules filled with gas, which is extremely hypoattenuating. Morphologic evaluation of the dilated structures from the hilum into the hepatic parenchyma can help to differentiate abnormal bile ducts from portal venules.

D. **Correct**. This CT scan demonstrates extensive portal venous gas. The dilated structures are filled with gas, not bile, which would be of fluid density. The portal vein bifurcation is outlined with gas. This helps to confirm that the gas is in the portal vein rather than the biliary tree. The subcapsular distribution is typical of portal vein gas, as opposed to biliary dilation, which tends to have a less peripheral distribution. The portal vein gas was found at surgery to be from ischemia of the entire small and large bowel. This was thought to be secondary to hypotension and sepsis associated with the patient's multisystem organ failure.

References:

Paran H, Epstein T, Gutman M, et al. Mesenteric and portal vein gas: computerized tomography and clinical significance. Dig Surg 2003; 20:127-32

Which one of the following usually involves the proximal small bowel?

- A. Lymphoma
- B. Sprue
- C. Giardiasis
- D. Yersenia

Key: C

Rationales:

A. Incorrect. Lymphoma most commonly involves the ileum.

B. Incorrect. Sprue involves the entire small bowel.

C. Correct. Giardiasis commonly involves the proximal small bowel.

D. Incorrect. Yersenia usually involves just the terminal ileum.

References:

Herlinger H, Ekberg OT. Other Inflammatory Conditions of the Small Bowel. In: Gore RM, Levine MS, eds. Gastrointestinal Radiology, (2nd ed). Philadelphia: W.B. Saunders 2000; 746-758

Concerning focal nodular hyperplasia, which of the following is an atypical feature?

- A. Fibrous central scar
- B. Discontinuous peripheral enhancement
- C. Isodensity to the liver on unenhanced and portal venous phase images
- D. Hyperenhancement on arterial phase images

Key: B

In which of the following hepatic lesions would signal intensity on high b value (700) diffusion weighted images typically be the greatest?

- A. Hepatic cyst
- B. Hepatic hemangioma
- C. Liver metastasis
- D. Hematoma

Key: C

What diagnosis is indicated by this multiplanar reformatted image through the pancreas?



- A. Pancreatic adenocarcinoma
- B. Pancreatic neuroendocrine tumor
- C. Side branch intraductal pancreatic mucinous neoplasm
- D. Focal autoimmune pancreatitis

Key: A

Concerning pancreatic pseudocysts, which of the following is an indication for drainage?

- A. Size greater than 5 cm
- B. Exocrine dysfunction
- C. Endocrine dysfunction
- D. Gastric outlet obstruction

Key: D

Which one of the following findings suggests secondary achalasia?

- A. Marked esophageal dilatation
- B. Long segment narrowing in distal esophagus
- C. Long standing dysphagia
- D. Absent primary peristalsis

Key: B

Concerning Meckel's diverticula, which one of the following is true?

- A. Usually asymptomatic in the first years of life
- B. False diverticulum
- C. Diverticulitis is a known complication.
- D. Tc99m scintigraphy is 20-30% sensitive in detecting gastrointestinal bleeding.

Key: C

The small bowel feces sign suggests which of the following diagnoses?

- A. Low-grade small bowel obstruction
- B. Cystic fibrosis
- C. Crohn disease
- D. Ischemic enteritis

Key: A

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



QUALITY IS OUR IMAGE

May, 2016

Sponsored by: Commission on Education Committee on Residency Training in Diagnostic Radiology

© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- <u>www.acr.org</u> According to the American College of Radiology's Appropriateness Criteria[®] (ACR AC[®]) which of the following age definitions BEST describes an infant?

- A. "Birth to 1 month old"
- B. "Birth to 3 months old"
- C. "Birth to 1 year of age"
- D. "Birth to 18 months of age"

Key: C

A 15-year-old girl with a history of lymphoma comes for a follow-up CT scan. After questioning the patient, a pregnancy test is performed and is positive. Her mother wants to know why you have canceled the CT. Which one of the following is the MOST appropriate response?

- A. The CT scanner is not functioning
- B. Her daughter is pregnant and should not receive radiation
- C. Her daughter may discuss the situation with her
- D. A pregnancy test needs to be performed before scanning

Key: C Rationales:

A. Incorrect.

B. Incorrect.

C. **Correct.** Minors have the right to make decisions concerning their pregnancy, and whether to inform their parents. Under no circumstances may the physician inform the parents without the consent of the minor or reveal the results of the pregnancy test to the parents unless the minor requests that the parents be informed.

D. Incorrect.

Guidelines for which one of the following are included in the ACR Appropriateness Criteria™?

- A. Quality improvement for angiography, angioplasty and stent placement
- B. Communication of abnormal findings in diagnostic radiology
- C. Appropriate behavior by diagnostic radiologists and radiation oncologists
- D. The efficient use of imaging examinations for specific clinical situations

Key: D

Which one of the following risk/benefit relationships must you discuss with a patient when seeking consent for direct care or research intervention?

- A. All those inherent in the intervention for society in general
- B. Only those that may result directly from the intervention
- C. Only those seen in previous administrations/studies with the intervention
- D. Only those considered significant by physician or principal investigator

Key: B

Rationales:

A. *Incorrect.* You must assess only the impact of the specific intervention on subjects and others but not for society in general.

B. Correct. You must assess only the direct impact of the specific intervention on subjects and others.

C. Incorrect. You must include risks and benefits that might appear for the first time.

D. Incorrect. You must think broadly about risks and benefits and not limit deliberations to those

identified by physician or principal investigator.

Reference:

Belmont Report: http://history.cit.nih.gov/history/laws/belmont.html

Concerning x-ray attenuation, the function of a beam filter is BEST for which reason?

- A. Increases x-ray tube output
- B. Decreases the heel effect
- C. Decreases overall x-ray energy
- D. Absorbs undesirable low energy (soft) x-rays

Key: D

Rationales:

A. *Incorrect.* A filter absorbs a fraction of the x-rays resulting in lower tube output

B. *Incorrect.* The beam filter in a typical radiography system is uniform in thickness and thus does not modify the heel effect

C. *Incorrect*. A beam filter absorbs soft x-rays and hardens the beam, thereby increasing the overall beam energy

D. **Correct**. The main function of a beam filter is to absorb low energy x-rays (both bremsstrahlung and characteristic x-rays). This hardens the x-ray beam and reduces patient skin dose as low energy x-rays only get absorbed at the skin surface and do not assist in forming an image.

Consider the following hypothetical 2 x 2 table generated from a study on diagnostic test performance: The ________ is calculated as 40/100 or 40%

	Disease Positive	Disease Negative
Test Positive	40	60
Test Negative	10	90

- A. Positive predictive value
- B. Negative predictive value
- C. Sensitivity
- D. Specificity

Key: A

Rationale:

A. **Correct.** When a 2 x 2 table, like the one above, is generated from a study of a disease specific risk factor, the upper left row percent (Yes & Disease Positive / All Yes = 50/100 = 50%) is called the 'risk' of disease. When the same table comes from the study of a diagnostic test, the upper left row percent is called the 'positive predictive value'. Therefore, the correct answer is A (risk, positive predictive value). B. *Incorrect.* Obviously untrue because of the definition of 'sensitivity' and 'attributable risk'. C. *Incorrect.* Obviously untrue because of the definition of 'sensitivity' and 'attributable risk'. D. *Incorrect.* The specificity has no meaning for a study of a risk factor.

Even if earlier diagnosis has no effect on the time of death from disease, survival time may appear longer in patients who have undergone screening. What is this apparent increase in survival known as?

- A. Lead time bias
- B. Length bias
- C. Over diagnosis bias
- D. Increased intensity of screening bias

Key: A

Rationale:

A. **Correct.** Lead time bias pertains to comparisons between screened and non-screened patients that are not adjusted for the timing of diagnosis. If the cancer is detected earlier but early diagnosis has no effect on the time of death from disease, there is no actual survival benefit.

- B. Incorrect.
- C. Incorrect.
- D. Incorrect.

You interpret a pre-op chest radiograph performed on a 56-year-old man. There are no comparison studies. There is a non-calcified 7-mm nodule in the left upper lobe, and the rest of the examination is negative. What is the MOST appropriate strategy to take concerning reporting this case?

- A. Dictate the findings, sign the report, and do nothing else
- B. Contact the referring physician, convey the findings, and dictate the report to include language documenting your discussion
- C. Dictate the findings, sign the report, and fax a copy to the referring physician's office
- D. Contact the patient directly without notifying the referring physician, tell him the findings, and arrange for him to come into your facility for chest CT scan for further evaluation

Key: B

Rationale:

A. *Incorrect.* The strategy articulated is one that the ACR Guideline is specifically meant to discourage.
B. **Correct.** This is exactly the sort of situation anticipated by the ACR Guideline on Communication in the section dealing with an "unexpected finding". Option B is correct in that it conforms most closely to the ACR Guideline recommendations.

C. *Incorrect*. Faxing a copy of the report may be convenient. However, faxes are imperfect means of communication and you have no record that the intended recipient actually got the information and is a potential HIPAA violation.

D. *Incorrect.* Although directly communicating with the patient (option D) is listed in the ACR Guideline as an option when a responsible physician—or their agent—cannot be contacted, ACR Guidelines recommend that reasonable attempts to contact the referring physician be made.

Concerning patient care, early (first-trimester) obstetric ultrasound demonstrates unexpected fetal demise. The attending radiologist is on-site and confirms the findings. Which one of the following is the MOST appropriate action for the radiologist?

- A. Dictate the final report and have technologist discharge patient from the department.
- B. Notify the referring clinician and discuss the findings with the patient according to the direction of the referring clinician.
- C. Inform the patient that the scan is abnormal and have the technologist discharge the patient from the department.
- D. Notify the referring clinician of the findings and have the technologist discuss the findings with the patient.

Key: B

Rationales:

A. *Incorrect*. In the setting of clinically significant unexpected findings, the referring clinician should be notified of the results and recommendations per the ACR Practice Guideline for Communication: Diagnostic Radiology.

B. *Incorrect.* The referring clinician should be notified of the results and recommendations. Per the ACR Practice Guideline for Communication: Diagnostic Radiology, "in those situations in which the interpreting physician feels that the finding do not warrant immediate treatment but constitute significant unexpected findings, the interpreting physician or his/her designee should communicate the findings to the referring physician, other healthcare provider, or an appropriate individual in a manner that reasonably insures receipt of the findings."

C. *Incorrect*. In the setting of clinically significant unexpected findings, the referring clinician should be notified of the results and recommendations per the ACR Practice Guideline for Communication: Diagnostic Radiology.

D. Incorrect. It is not appropriate to have the technologist discuss the findings with the patient.

Concerning ethics, when a patient suffers a medical complication, that may have resulted from the physician's mistake or judgment the physician is ethically required to:

- A. Inform the patient's primary care physician of the facts.
- B. Report the facts to the department chairperson.
- C. Inform the patient of the facts necessary to understand what has occurred.
- D. Inform the hospital/practice risk management committee/appointee.

Key: C

Rationale:

A. Incorrect.

B. Incorrect.

C. **Correct.** "It is a fundamental ethical requirement that a physician should at all times deal honestly and openly with patients...Situations occasionally occur in which a patient suffers significant medical complications that may have resulted from the physician's mistake or judgment. In these situations, the physician is ethically required to inform the patient of all of the facts necessary to ensure understanding of what has occurred." Ideally, the physicians should inform the patient and primary care physician of the facts when medical complications occur. However, the physician is not ethically required to inform the patient to inform a department chairperson and risk management committee/appointee of such information, this is not an ethical requirement of the physician.

D. Incorrect.

Concerning patient care, a supervising physician is necessary for the performance of an examination for which intravascular contrast material is administered. Which of the following fulfills the minimal necessary requirements for the supervising physician?

- A. Fellowship training in diagnostic radiology, which includes interpretation of contrast-enhanced studies
- B. Board certification in radiology or 6 months formal dedicated training in the interpretation and formal reporting of general radiographs
- C. Licensed physician who demonstrates sufficient knowledge of pharmacology, indications, and contraindications for the use of contrast agents
- D. Medical degree or doctor of osteopathy

Key: C

Rationales:

ACR Practice Guideline for the Use of Intravascular Contrast Media state the supervising physician needs to a licensed physician with the following qualifications: Certification in Radiology, Diagnostic Radiology, or Radiation Oncology by the American Board of Radiology, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada or Le College des Medecins du Quebec.

Or

The physician shall have documented a minimum of 6 months of formal dedicated training in the interpretation and formal reporting of general radiographs, including patients of all ages, in an Accreditation Council for Graduate Medical Education (ACGME), approved residency program including radiographic training on all body areas.

Or

The physician whose residency or fellowship training did not include the above may still be considered qualified to administer contrast media provided the physician can demonstrate sufficient knowledge of the pharmacology, indications, and contraindications for the use of contrast agents to enable safe administration and has the ability to recognize and initiate treatment for adverse reactions. And

The physician supervising a contrast-enhanced imaging study should be familiar with the various contrast agents available and the indications for each. The physician should also be familiar with the patient preparation for the examination, including any necessary hydration or bowel preparation.

She/he should have an understanding about the volume and concentration of the appropriate contrast material required for a given examination (see the ACR Manual on Contrast Media). While Board certification in Radiology or 6 months of formal training in the interpretation and formal reporting of general radiographs meet the requirements, these exceed the minimal requirement and are not the best answer. Fellowship training in a Diagnostic Radiology fellowship including the interpretation of contrast enhanced studies is not a requirement to serve as supervising physician of a contrast enhanced study. MD and DO do not meet the minimal requirements to serve as the supervising physician for a contrast enhanced study. A physician who, demonstrates sufficient knowledge of pharmacology, indications and contraindications for the use of contrast agents, meets the minimal requirement to serve as the supervising physician.

Concerning the American College of Radiology, which of the following statements is TRUE?

- A. Its accreditation program defines how various radiological procedures should be performed.
- B. Its Appropriateness Criteria[®] define the most appropriate way to diagnose or treat a given clinical condition with diagnostic/interventional radiology or radiation oncology.
- C. Its certification program issues certificates to candidates who demonstrate adequate levels of knowledge and ability on a written examination (Physics of Medical Imaging and Diagnostic Imaging sections) and an oral examination.
- D. The ACR Practice Guidelines and Technical Standards document that standards are being met for various modalities in a practice using a survey process.

Key: B

Rationales:

A. *Incorrect.* Option A is false because the Standard Program defines how various radiological procedures should be performed.

B. Correct.

C. Incorrect. Option C is false because The American Board of Radiology, not the American College of Radiology, issues certificates to candidates in Diagnostic Radiology.

D. *Incorrect.* Option D is false because the Accreditation program documents that Standards are being met.



Using the following graph of test performance, which of the following statements is CORRECT?

- A. A positive test more reliably rules in the diagnosis than a negative test rules out the diagnosis.
- B. A negative test more reliably rules out the diagnosis than a positive test rules in the diagnosis.
- C. Test performance is dependent on the underlying population.
- D. Test performance cannot be determined from the information provided.

Key: A

Rationales:

A. **Correct.** When a test has a very high sensitivity, a negative result effectively rules out the diagnosis (SnNout). When a test has a very high specificity, a positive result effectively rules in the diagnosis (SpPin).

- A. Incorrect.
- C. Incorrect.
- D. Incorrect.

References:

Evidence-Based Medicine. Eds: Sackett et al. 2000. Churchill Livingstone.

What is the best ethical argument for full medical disclosure when patients have medical complications, which may have resulted from a physician's mistake or judgment?

- A. To resolve patient concerns regarding the unknown etiology of a medical problem
- B. To avoid disciplinary action from the department chairperson
- C. To avoid retribution from angry patients or their family members
- D. To meet the requirements of the hospital/practice risk-management committee

Key: A

Rationales:

A. **Correct.** "It is a fundamental ethical requirement that a physician should at all times deal honestly and openly with patients...Situations occasionally occur in which a patient suffers significant medical complications that may have resulted from the physician's mistake or judgment. In these situations, the physician is ethically required to inform the patient of all of the facts necessary to ensure understanding of what has occurred." While it may be prudent to inform a department chairperson and risk management committee/appointee of such information, this is not an ethical requirement of the physician. While honest communication with patient and family member often decreases legal liability, this is not an ethical requirement of the physician.

Reference:

<u>www.acr.org</u> Education portal, Nonclinical Skills Webcast, Module 5: Ethics section 8.12 "Patient Information," AMA Council on Ethical and Judicial Affairs, Code of Medical Ethics, Current Opinions, 1998.

Which of the following statements accurately describes the American College of Radiology Code of Ethics?

- A. It is a framework by which radiologists may determine the propriety of conduct in their relationship with patients, the public, colleagues, and members of allied professions.
- B. It is a set of laws that govern the methods by which radiology is practiced in the United States.
- C. It is composed of principles of ethics with no disciplinary procedures.
- D. It should be used as a set of guidelines for evaluating a radiologist's eligibility for state licensure.

Key: A

Rationales:

A. **Correct**. The Code of Ethics of the ACR states, "The Code of Ethics of the American College of Radiology is intended to aid the radiology community, individually and collectively, in maintaining a high level of ethical conduct. The code is not a set of laws but rather a framework by which radiologists may determine the propriety of conduct in their relationship with patients, with the public, with colleagues, and with members of allied professions." The ACR Code of Ethics is composed of three sections, which include: Principles of Ethics, Rules of Ethics, and Disciplinary Procedures for Violation of Rules of Ethics. The ACR Code of Ethics is not intended to be used as criteria for a radiologist's eligibility for state licensure.

B. Incorrect.

C. Incorrect.

D. Incorrect.

References:

www.acr.org , business practice issues, ethics, ACR Code of Ethics.

Which of the following is TRUE concerning the American College of Radiology practice guidelines on patient care and breast ultrasound?

- A. An appropriate indication for breast ultrasonography is radiation therapy planning.
- B. Breast ultrasonography should be performed by a board-certified radiologist only.
- C. Breast ultrasonography may be performed by a radiation technologist when the attending physician is present.
- D. Breast ultrasonography may be performed with a real-time scanner that operates at a center frequency of at least 5 MHz.

Key: A

Rationales:

A. **Correct**. ACR Practice Guideline for Performing and Interpreting Diagnostic Ultrasound Examination states "Physicians who perform and/or interpret diagnostic ultrasound examinations 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." Regarding studies performed by a diagnostic medical sonographer, it states "When a sonographer performs the examination, that person should be qualified by appropriate training to do so. This qualification can be demonstrated by certification or eligibility for same by a nationally recognized certifying body." Therefore, distractors B and C are incorrect. ACR Guideline for the Performance of a Breast Ultrasound Examination states, "Breast ultrasound should be performed

with a high-resolution and real-time linear array scanner operating at a center frequency of at least 7 MHz..." Therefore, answer D is incorrect. Per ACR Practice guidelines, "appropriate indications for breast sonography include: 1. Identification and characterization of palpable and nonpalpable abnormalities and further evaluation of clinical and mammographic findings. 2. Guidance of interventional procedures. 3. Evaluation of problems associated with breast implants. 4. Treatment planning for radiation therapy." **References**

<u>www.acr.org</u>, Quality and Safety, Guidelines/Standards, Ultrasound, ACR Practice Guideline for Performing and Interpreting Diagnostic Ultrasound Examinations, ACR Practice Guideline for the Performance of a Breast Ultrasound Examination.

The American College of Radiology Practice Guidelines for patient care and stereotactic breast biopsy state that:

- A. A radiopaque marker or clip must be placed at the time of biopsy.
- B. Physicians participating in stereotactic biopsy of the breast should obtain 3 hours of Category 1 CMEs in stereotactically guided biopsy of the breast every 3 years.
- C. The referring physician is responsible for obtaining the results of cytopathologic or histopathologic sampling.
- D. No specific requirements are required for the radiologic technologist participating in stereotactic biopsy of the breast.

Key: B

Rationales:

B. Correct. While many radiologists place a radiopaque marker/clip at the time of stereotactic breast biopsy, this is not a requirement per the ACR Practice guidelines. The ACR Practice guidelines do state that the physician's report of the procedure should include "clip placement, if performed". Therefore, answer A is incorrect. The ACR Practice guidelines state "...Initially, 3 hours of Category 1 CME didactic instruction in stereotactically guided biopsy and performance of at least three stereotactic breast biopsy procedures under the supervision of a qualified physician. Completion of a residency or fellowship program that includes instruction in stereotactic breast needle procedures is also acceptable...The physician should obtain 3 hours of Category 1 CME in stereotactically guided breast biopsy every 3 years...". Answer B is correct. The ACR Practice guidelines state "...physician who performs the procedure is responsible for obtaining the results of the cytopathologic or histopathologic sampling to determine if the lesion has been adequately biopsied. These results should be communicated to the referring physician and/or to the patient...". Therefore, answer C is incorrect. The ACR Practice guidelines state the radiologic technologist participating in stereotactic biopsy must have "...Initially, 3 hours of Category A continuing education units in stereotactically guided biopsy, plus documentation of five hands-on procedures under the guidance of a qualified technologist and/or the manufacturer's application specialist. For maintenance of competence, participation in at least 12 stereotactically guided biopsies per year is recommended...". Therefore, answer D is incorrect.

References:

<u>www.acr.org</u>, Quality and Safety, Guidelines/Standards, Breast Imaging and Intervention, ACR Practice Guideline for the Performance of Stereotactically Guided Breast Interventional Procedures.

These skills required to practice Systems-Based Practice can be gained through the following educational activities:

- A. Regular review of literature, including ACR standards, attending conferences on regulation and reimbursement, and participation in conferences related to disease-specific imaging evaluations.
- B. Regular review of literature, including ACR standards and attending conferences on regulation and reimbursement.
- C. Regular review of literature, including ACR standards.
- D. Regular review of literature, including ACR standards, attending conferences related to disease-specific imaging evaluations and conferences on regulation and reimbursement.

Key: A

The professionalism of residents and health care professionals can be assessed through

- A. Global ratings by faculty.
- B. CME course credits.
- C. Web training certificates.
- D. Global ratings by faculty, web training certificates, and conference attendance log.

Key: D

Residents and health care professionals should demonstrate a commitment to fulfill professional responsibilities by demonstrating the following skills

- A. Develop and maintain positive work habits, maintain confidentiality, and adhere to regulatory standards regarding human subjects.
- B. Develop and maintain positive work habits.
- C. Adhere to regulatory standards regarding human subjects.
- D. Develop and maintain positive work habits, and adhere to regulatory standards regarding human subjects.

Key: A

Residents and health care professionals show understanding of Systems-Based Practice by demonstrating the following skills

- A. Demonstrate knowledge of best practice including record-keeping, discipline, and staff management.
- B. Learn about licensing and accreditation regulatory issues, and demonstrate knowledge of best practice including record-keeping, discipline, and staff management.
- C. Learn about licensing.
- D. Learn about licensing though, knowledge of accreditation regulatory issues are not necessary.

Key: B

Residents and health care professionals can gain the skills required to practice Systems-Based Practice through the following activities

- A. Attend local and national Radiology society meetings.
- B. Interact with billing coders, administrators, and staff, and participate in local and national Radiology societies
- C. Interact with administrators.
- D. Interact with billing coders, administrators, and staff, and attend local and national Radiology society meetings.

Key: B

The ACR Practice Guideline for Adult Sedation/Analgesia specifically excludes patients:

- A. who are normal and healthy (ASA I).
- B. who have mild systemic disease (ASA II).
- C. who are not undergoing an imaging diagnostic or therapeutic procedure.
- D. with snoring.

Key: C

With regard to CPT billing codes, a dedicated specific billing modifier is required, with appropriate documentation in the report, for all of the following EXCEPT a service or procedure that:

- A. was reduced or increased.
- B. was performed by more than one physician.
- C. was performed in more than one location.
- D. changes the definition of the code being modified.

Key: D

Genitourinary Radiology In-Training Test Questions for Diagnostic Radiology Residents



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May, 2016

Sponsored by: Commission on Education Committee on Residency Training in Diagnostic Radiology

© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org You are shown an image from a hysterosalpingogram of a 34-year-old woman with infertility. What does this image demonstrate?



- A. Salpingitis isthmica nodosa
- B. Adhesions of fallopian tube
- C. Hydrosalpinx
- D. Contrast intravasation

Key: D

Rationales:

A. *Incorrect.* Salpingitis isthmica nodosa involves the isthmic portion of the fallopian tube. Hysterosalpingogram will reveal small outpouchings of contrast outside the expected lumen of the tube. It is seen in 4% of infertility cases. It indicates scarring and is associated with an increased incidence of ectopic pregnancy.

B. *Incorrect.* Adhesions or clumping of a fallopian tube cause convolution of the tube but not the appearance of multiple serpentine structures in the expected location of the isthmic portion of the tube.C. *Incorrect.* A hydrosalpinx is a dilated, fluid-filled fallopian tube. Usually the ampullary portion of the tube is dilated. The fallopian tube may or may not be obstructed.

D. **Correct**. Contrast intravasation into the uterine wall causes multiple serpentine venous structures to fill adjacent to the uterus. The contrast-filled veins often mimic the appearance of the fallopian tube. Often venous intravasation occurs when the fallopian tube is blocked, as in this case. Confirmation occurs after waiting 2-3 minutes, in which time the contrast dissipates from the veins. Contrast in a fallopian tube would not change in density in that time. Unfortunately, once venous intravasation occurs again with the next immediate injection.

Reference:

Ubeda B, Paraira M, Alert E, Abuin RA. Hysterosalpingography: Spectrum of normal variants and nonpathologic findings. AJR 2001; 177:131-135.

What is the Bosniak classification of a renal cyst with complex septations and dense calcification?

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

Key: C

Rationales:

A. *Incorrect.* Bosniak I cysts are simple cysts and have no septations or calcifications. These require no further evaluation.

B. *Incorrect.* Bosniak II cysts have some atypical features, but are most likely benign. This group of cysts can have thin septations or calcifications but not complex septations or dense calcifications. Some lesions in this group are followed (subgroup IIF). Hyperdense, nonenhancing cysts are included in the Bosniak II category.

C. **Correct.** Bosniak III cysts can have dense calcifications, complex septations, and multiloculated cysts. This group cannot be distinguished from malignancy, and often these lesions require surgical exploration.

D. *Incorrect.* Bosniak IV cystic masses have features, which strongly suggest malignancy, such as an enhancing solid component or thick irregular walls. Lesions in this category are treated as presumed renal carcinomas.

References:

Sandler CM, Newhouse JH, Amis Jr SE, Dunnick NR. *Textbook of Uroradiology*. 3rd ed. Philadelphia, Pa: Lippincott, Williams, & Wilkins; 2001.

Adenocarcinoma of the prostate gland MOST commonly occurs in what location?

- A. Central zone
- B. Transitional zone
- C. Peripheral zone
- D. Fibromuscular stroma

Key: C

Rationales:

A. *Incorrect.* Only approximately 5% of carcinomas occur in this region of the prostate.

B. *Incorrect*. This area accounts for about 5% of the prostate volume and is located in the periurethral tissue. This zone accounts for approximately 10% of prostate cancers. This area is prone to benign prostatic hyperplasia.

C. **Correct**. This area accounts for about 70% of the volume of the prostate gland and approximately 85% of prostate cancer is located in this zone.

D. *Incorrect.* This is the nonglandular portion of the prostate gland and is located anteriorly. It does not typically present with pathology.

References:

1. Dunnick, Sandler, Newhouse, Amis, Textbook of Uroradiology. 3rd edition. Philadelphia, PA: Lippincott Williams & Wilkins, 2001, pp 4, 394-408.

2. Zagoria RJ, Tung GA, Genitourinary Radiology, The Requisites. First edition. St. Louis, MO: Mosby, 1997, pp 303-326.

Which one of the following BEST characterizes an adrenal lesion as a benign adenoma?

- A. Attenuation less than 10 HU on non-contrast CT
- B. Enhancement washout less than 50% on delayed contrast-enhanced CT
- C. Increase in signal on out-of-phase images using chemical shift MRI technique
- D. Attenuation greater than 50 HU on delayed contrast-enhanced CT

Key: A

Rationales:

A. **Correct.** Approximately 80% of benign adrenal adenomas contain adequate intracellular lipid to give HU less than 10 on noncontrast CT. This is generally accepted as definitive evidence of benignity. B. *Incorrect.* A small percentage of benign adenomas do not have adequate intracellular lipid to give attenuation values less than 10 on noncontrast CT. In these cases, intravenous contrast can be given and washout characteristics studied. Metastases tend to "hold" onto contrast longer than benign adrenal adenomas. Thus, adenomas have greater enhancement washout {[(E-D)/(E-U)]x100}, where E is enhanced attenuation value, D is delayed enhancement value, and U is the unenhanced attenuation value, and the accepted threshold value for a benign adrenal adenoma is **greater than** 60% washout. Washout less than 60% would be indeterminate and other lesions such as metastases would have to be considered. If unenhanced CT has not been performed, a relative enhancement washout can be calculated {[(E-D)/(E)/E]x100}, and greater than 40%-50% indicates benign adenoma.

C. *Incorrect.* Chemical shift MRI imaging uses the same physiological principles as noncontrast CT in evaluating an adrenal nodule. Intracytoplasmic lipid in a benign adenoma results in cancellation or loss of signal on out-of-phase images rather than no change or increase in signal intensity.

D. *Incorrect.* Attenuation values of 30-40 HU or less on delayed, contrast-enhanced CT images almost always indicate a benign adenoma. An attenuation value of greater than 50 HU would be in determinant.

- B. Incorrect.
- C. Incorrect.
- D. Incorrect.

References:

Sandler CM, Newhouse JH, Amis Jr SE, Dunnick NR. *Textbook of Uroradiology*. 3rd ed. Philadelphia, Pa: Lippincott, Williams, & Wilkins; 2001.

Dunnick NR, Korobkin M. Imaging of adrenal incidentalomas: Current status. AJR. 2002:179.

You are shown three images from a contrast-enhanced MR exam on a man with renal cell carcinoma. Based on these images, what is the stage by Robson classification?



- A. Stage II
- B. Stage IIIA
- C. Stage IIIB
- D. Stage IV

Key: B

Rationales:

A. *Incorrect.* Stage II extends beyond the renal capsule but not through Gerota's fascia or into the renal veins or local lymph nodes. Stage II includes involvement of the ipsilateral adrenal gland, which this patient does have on the left.

B. Correct. Stage IIIA extends into the renal vein and may progress into the inferior vena cava.

C. Incorrect. Stage IIIB involves regional lymph nodes but no extension into the renal veins or IVC.

D. Incorrect. Stage IV includes distant metastases.

Concerning renal angiomyolipomas, which one finding is MOST diagnostic?

- A. Fluid/fluid levels
- B. Fat
- C. Homogeneous soft tissue
- D. Large irregular calcification

Key: B

Rationales:

A. *Incorrect*. These lesions may occasionally hemorrhage but are usually incidental masses with mixed amounts of soft tissue and macroscopic fat.

B. *Correct*. While other lesions such as renal cell carcinoma, oncocytoma, Wilm's and metastasis have also been reported with areas of fat within these tumors, these cases are rare.

C. *Incorrect*. Angiomyolipomas have varying amounts of fat and soft tissue. Some have no fat visible by CT and a solid soft tissue renal mass in such a case is indistinguishable from renal cell carcinoma and should be treated as such.

D. *Incorrect*. Calcification in angiomyolipomas is unusual but may occur if there has been prior hemorrhage.

You are shown a contrast-enhanced CT of a 65-year-old woman with diabetes and intermittent fevers. What is the MOST likely diagnosis?





- A. Acute pyelonephritis
- B. Xanthogranulomatous pyelonephritis
- C. Acute left ureteral obstruction
- D. Multilocular cystic nephroma

Key: B

Findings:

Images demonstrate left cortical thinning, dilated collecting system, infiltration of the fat adjacent to the left kidney, and calcifications in the left renal collecting system.

Rationales:

A. *Incorrect.* In early acute pyelonephritis, the kidney may actually appear within normal limits on CT, particularly on noncontrast scanning, but in more advanced cases, after intravenous contrast may demonstrate striated nephrogram or focal wedge-like areas of abnormally decreased enhancement. Although the infiltration of fat seen around the kidney in this case could be seen with acute pyelonephritis, the obstructing stone, cortical thinning, and dilated, fluid-filled collecting system suggests a more chronically obstructed, infected system.

B. **Correct.** Xanthogranulomatous pyelonephritis is a chronic suppurative granulomatous infection in the setting of chronic obstruction. Common organisms are Proteus mirabilis and E Coli. Histologically there is diffuse infiltration by plasma cells and lipid-laden macrophages. Symptoms are generally of long duration, and the affected kidney is nonfunctioning. The kidney is diffusely enlarged, but maintains its reniform shape, with one or more relatively large calculi typically seen. The renal pelvis is typically poorly defined or normal in size, as in this case.

C. *Incorrect.* While acute obstruction could result in hydronephrosis and perinephric stranding, it would not account for the cortical thinning seen here, and with acute obstruction, one would expect to see dilatation of the renal pelvis.

D. *Incorrect.* Multilocular cystic nephroma is an uncommon renal neoplasm containing many cysts of varying sizes, surrounded by a thick fibrous capsule. Calcifications may rarely be seen, but are usually only in the cyst walls or intervening stroma. It would not account for the significant infiltration of the adjacent perinephric fat seen in this case.

References:

Sandler CM, Newhouse JH, Amis Jr SE, Dunnick NR. *Textbook of Uroradiology*. 3rd ed. Philadelphia, Pa: Lippincott, Williams, & Wilkins; 2001.

Concerning cervical carcinoma, what stage is a lesion that is confined to the upper two thirds of the vagina on clinical exam and that shows right hydroureter to the level of a poorly defined cervical soft tissue mass on CT exam?

- A. Stage II A
- B. Stage II B
- C. Stage III A
- D. Stage III B

Key: D

Rationales:

A. *Incorrect*. At stage II A the tumor has spread beyond the cervix but has no obvious parametrial involvement, is confined to the upper two thirds of the vagina and no invasion of the ureter or bladder.
B. *Incorrect*. Stage II B has obvious parametrial involvement but does not extend to the pelvic side wall.
C. *Incorrect*. Stage III A extends to the lower third of the vagina but not the pelvic sidewall and does not obstruct the ureters or invade adjacent organs.

D. **Correct**. Stage III B tumors extend to pelvic sidewall and/or causes hydronephrosis or non-functioning kidney.

Which one of the following conditions is MOST closely associated with female pelvic inflammatory disease (PID)?

- A. Intramural pseudodiverticulosis
- B. Salpingitis isthmica nodosa
- C. Adenomyosis
- D. Leukoplakia

Key: B

Rationales:

A. *Incorrect.* Intramural pseudodiverticuli are prominent submucosal esophageal glands associated with gastroesophageal reflux and Candida..

B. **Correct.** Salpingitis isthmica nodosa manifests as tiny diverticula arising from the fallopian tubes secondary to chronic inflammation. They is most easily seen during hysterosalpingography.

C. *Incorrect.* Adenomyosis is the presence of endometrial glands and supporting tissue in the myometrium. Increased incidence due to childbirth, Cesarean section, trauma, and tubal ligation.
D. *Incorrect.* Leukoplakia is an inflammatory condition of the ureter or bladder, associated with chronic urinary tract infection and not PID per se.

You are shown images from an IVU and a CT of a 35-year-old woman with frequent urinary tract infections. Which one of the following is the MOST likely diagnosis?



- A. Focal renal infarct with scar
- B. Focal acute pyelonephritis
- C. Obstructive uropathy
- D. Reflux nephropathy

Key: D

Findings:

IVU demonstrates complete duplication of both the right and left collecting systems. There is dilatation of both lower pole-collecting systems, right more than left. The right lower pole calyces are blunted. The CT image demonstrates cortical thinning of the lower pole of the right kidney overlying a dilated calyx that shows a contrast-urine level confirming it is a dilated calyx. The combination of cortical scarring overlying a dilated calyx is typical of reflux nephropathy.

Rationales:

A. *Incorrect.* A focal renal infarct may produce a cortical scar in the chronic stage, but generally there is not underlying calyceal dilatation.

B. *Incorrect.* Focal, acute pyelonephritis can produce a region of decreased enhancement or low density in the kidney after IV contrast. However, the focal inflammatory process should not demonstrate a cystic nature that was seen on this exam as confirmed by the fluid-contrast level.

C. *Incorrect.* Ureteral obstruction could produce similar findings of cortical atrophy and dilated collecting system. However, in cases with completely duplicated collecting systems, the lower pole moiety more commonly is complicated by reflux than by obstruction. Also, the focal cortical thinning over the calyces (as opposed to dilated system with generalized cortical thinning) favors reflux.

D. **Correct.** Completely duplicated collecting systems often have renal complications associated with the ureteral duplication. The ureter draining the lower pole moiety typically enters the bladder slightly above and more lateral to the normal position on the trigone and this predisposes that ureter to reflux. The upper pole moiety enters the bladder inferiorly and medially (Meyer-Weigert Law) and can be complicated by obstruction. The upper pole moiety ureter can also insert ectopically outside of the bladder and this is also typically associated with obstruction.

References:

Sandler CM, Newhouse JH, Amis Jr SE, Dunnick NR. *Textbook of Uroradiology*. 3rd ed. Philadelphia, Pa: Lippincott, Williams, & Wilkins; 2001.

You are shown two ultrasound images of the scrotum in a 44-year-old man. What is the MOST LIKELY diagnosis?



- A. Testicular torsion
- B. Seminoma
- C. Epididymo-orchitis
- D. Lymphoma

Key: B Rationales:

A. *Incorrect.* Testicular torsion typically presents as acute testicular pain with or without testicular enlargement. Testicular echogenicity is typically homogeneous, with normal testicular echogenicity initially, becoming hypoechoic with ongoing torsion and infarct.

B. **Correct.** The images show an intratesticular mass. Seminoma is the most common solid intratesticular neoplasm.

C. *Incorrect.* While epididymo-orchitis can cause enlargement of the testicle as well as hypoechoic areas within the testicle, it is not typically painless.

D. *Incorrect.* While lymphoma could present as a testicular mass, it is less common than germ cell tumors such as seminoma.

What characterizes Type II posterior urethral injury?

- A. The membranous urethra is disrupted with extension of injury into the proximal bulbous urethra and/or disruption of the urogenital diaphragm (UGD).
- B. On urethrography, contrast material extravasates into the perineum.
- C. Disruption of the urethra above the urogenital diaphragm.
- D. The posterior urethra is stretched but intact.

Key: C

Rationales:

A. *Incorrect.* This is the definition of Type III posterior urethral injury.

B. Incorrect. Extravasation of contrast below the urogenital diaphragm (UGD) into the perineum on

urethrography indicates disruption of the UGD and signifies Type III injury.

C. Correct. This is the definition of Type II posterior urethral injury.

D. Incorrect. This is the definition of Type I posterior urethral injury.

Which of the following is a TRUE statement about the risk of iodinated contrast-induced nephropathy in patients with pre-existing renal insufficiency?

- A. High-osmolar agents are associated with the same risk as low-osmolar agents.
- B. The risk for patients with diabetes mellitus is the same as it is for patients without the disease.
- C. Intravenous hydration decreases the risk.
- D. A previous allergic reaction to an iodinated contrast agent increases the risk.

Key: C

Rationales:

A. Incorrect. High osmolar agents have greater incidence of CIN

B. *Incorrect*. Diabetic patients have increased risk of CIN especially if they already have baseline renal insufficiency

C. **Correct**. IV hydration with ½ normal saline 12 hours before and after contrast administration decreases the incidence of CIN in patients with chronic renal insufficiency.

D. *Incorrect*. Allergic reactions are a separate contrast reaction type and are not considered a risk factor for CIN. Pre-existing renal insufficiency, diabetes mellitus (especially with pre-existing renal insufficiency), dehydration, cardiovascular disease with CHF and myeloma are among the risk factors with increased incidence of CIN.

Reference:

Manual on Contrast Media, version 5.0, American College of Radiology, 2004.

Which statement is TRUE concerning endometriosis?

- A. CT is abnormal in most patients.
- B. Endometriomas are typically anechoic on ultrasound.
- C. It most commonly affects postmenopausal women.
- D. It usually presents with multiple very small deposits.

Key: D

Rationales:

A. Incorrect. CT is normal in most patients although larger endometriomas may be seen.

B. *Incorrect*. Larger endometriomas usually have internal echoes from debris. Most patients with endometriosis have no abnormalities on US related to this entity.

C. *Incorrect*. Women 30 -40 years old are most commonly affected. The growth of endometriosis appears to be estrogen sensitive and grow under cyclical hormonal influence.

D. **Correct**. These small implants are usually not seen by any imaging modality. Laparoscopy is typically used for diagnosis.

Reference:

Dunnick, Sandler, Newhouse, Amis, Textbook of Uroradiology. 3rd edition. Philadelphia, PA: Lippincott Williams & Wilkins, 2001, pp 505-506.

Which of the following is a TRUE statement concerning primary megaureter?

- A. The lower one third of the ureter is most commonly dilated.
- B. There is mechanical obstruction in the lower ureter.
- C. Both ureters are involved in 75% of cases.
- D. There is blunting of the calyces.

Key: A

Rationales:

A. **Correct**. Most cases involve dilatation only the lower third of the ureter although the lowest portion of the ureter adjacent to the ureterovesicle junction is normal in caliber. Severe cases can involve the entire ureter but are less common.

B. *Incorrect*. There is functional obstruction of the juxtavesical ureter due to inadequate musculature which fails to transmit normal peristalsis and is less distensible than normal ureter. This portion of the ureter is relatively normal with normal ureter above this level.

C. *Incorrect*. It is unilateral in 75% of cases. Left side is more commonly affected than right and it is more common in men than women.

D. *Incorrect*. In contrast to true ureteral obstruction, the calyces are typically sharp with no delay in excretion or other signs typical of acute obstruction.

References:

Zagoria RJ, Tung GA, Genitourinary Radiology, The Requisites. First edition. St. Louis, MO: Mosby, 1997, pp 177-178.

Dunnick, Sandler, Newhouse, Amis, Textbook of Uroradiology. 3rd edition. Philadelphia, PA: Lippincott Williams & Wilkins, 2001, pp 25, 326-327.

Which of the following is a TRUE statement concerning papillary necrosis?

- A. Papillary clefts and cavities represent early stages of papillary necrosis.
- B. The "lobster claw" deformity refers to the radiographic pattern of the papillary form of papillary necrosis.
- C. The radiographic findings of advanced papillary necrosis are best appreciated on the corticomedullary phase of contrast enhancement.
- D. The medullary and papillary forms of papillary necrosis are radiographically indistinguishable.

Key: B

Concerning the risk of nephrotoxity caused by IV administration of iodinated contrast, which of the following is TRUE?

- A. Intravenous iodinated contrast is the most common cause of acute renal failure in hospitalized patients.
- B. Diabetic patients taking metformin have the highest risk of developing contrast induced nephrotoxicity.
- C. The most important intervention to prevent contrast induced nephrotoxicity in high-risk patients is adequate patient hydration before and after contrast is given.
- D. The most important intervention to prevent contrast induced nephrotoxicity in high risk patients is administration of acetylcysteine before and after contrast is given.

Key: C

Which of the following is true regarding testicular rupture?

- A. It can be treated conservatively.
- B. MRI is the modality of choice for its diagnosis.
- C. Contour irregularity is the only significant sonographic predictor for diagnosis.
- D. Loss of blood flow on color Doppler sonography is the best determinant of rupture.

Key: C

Regarding male urethral strictures, which one of the following is TRUE?

- A. Traumatic strictures are usually multiple and long segment.
- B. latrogenic strictures are usually in the penile urethra.
- C. Infectious strictures are usually from tuberculosis.
- D. Infectious strictures are usually in the bulbar urethra.

Key: D

Which of the following is TRUE regarding Leydig cell tumors of the testicle?

- A. Ten percent are malignant.
- B. Ninety percent secrete estrogen or testosterone and can cause gynecomastia.
- C. Ultrasound usually demonstrates an ill-defined mass.
- D. They are more prevalent in adult patients than in pediatric patients.

Key: B

Concerning transitional cell carcinoma (TCC), which of the following is TRUE?

- A. They represent the second most common primary neoplasm of the bladder.
- B. Ureteral TCC neoplasms most commonly occur in the middle third of the ureter.
- C. Benign ureteral strictures are reliably differentiated from malignant ureteral strictures on excretory urography.
- D. Renal papillomas are associated with an increased risk of TCC.

Key: D

Which statement is TRUE concerning ureteral pseudodiverticulosis?

- A. The lesions are due to projecting hyperplastic buds of ureteral epithelium.
- B. The distal third of the ureter is most commonly affected.
- C. It is not associated with transitional cell carcinoma.
- D. Cytologic evaluation of ureteral washings reveals cellular atypia in less than 10% of cases.

Key: A

Musculoskeletal Radiology In-Training Test Questions for Diagnostic Radiology Residents



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May, 2016

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Joint bodies are NOT associated with:

- A. synovial chondromatosis.
- B. joint instability.
- C. osteopoikilosis.
- D. tuberculosis.

Key: C

Rationale:

A: *Incorrect.* Synovial chondromatosis, now considered a benign neoplasm, is a proliferative disorder of the synovium resulting in numerous cartilagenous bodies within a joint, bursa or tendon sheath which may go on to ossify.

B: *Incorrect.* Any injury to the osteochondral surfaces may result in joint bodies. Joint instability, whether patella-femoral or glenohumeral, for example, may result in such injury.

C: **Correct.** Osteopoikilosis is a benign sclerosing dysplasia characterized by multiple periarticular bone islands, often seen about the hips and knees.

D: *Incorrect.* Musculoskeletal TB most often involves joints. Septic spondylitis is most common but large synovial joints may beinvolved as well. Tuberculous arthritis often results in innumerable "rice" bodies that represent sloughed, endstage inflamed synovium.

Concerning MRI of the knee, what does the "double PCL" sign indicate?

- A. Bucket-handle tear of the medial meniscus
- B. Anterior subluxation of the tibia
- C. Anterior cruciate ligament rupture
- D. Posterior cruciate ligament rupture

Key: A

Rationales:

A. **Correct.** A bucket-handle tear is a longitudinal tear of the body of the meniscus with displacement of the inner rim of that tear into the intercondylar notch of the knee. When such a tear involves the medial meniscus, the flipped fragment characteristically lies underneath the curve of the posterior cruciate ligament, usually mimicking it in contour and low signal intensity, thus giving rise to the "double PCL" sign.

B. *Incorrect*. Anterior subluxation of the tibia causes buckling of the PCL, not a "double PCL".
C. *Incorrect*. Rupture of the anterior cruciate ligament leads to anterior subluxation of the tibia, thus causing buckling of the PCL. When the edema and hemorrhage of an acute, complete ACL tear is resolved, the remaining ligament may be seen dropped within the notch, its slope almost parallel to the intercondylar eminence, beneath the PCL, similar to but not characteristic of the "double PCL" sign.
D. *Incorrect*. Rupture of the PCL appears as swelling or discontinuity of the ligament.

References:

Kaplan, Helms, Dussault, Anderson, Major. Musculoskeletal MRI. WB Saunders Co., Philadelphia, PA. 2001.

Resnick, Kang: Internal derangements of joints: Emphasis on MR imaging. WB Saunders Co., Philadelphia, PA, 1997.

You are shown AP and lateral radiographs of a 24-year-old man with chronic leg pain. What is the MOST likely diagnosis?



- A. Brodie's abscess
- B. Osteoid osteoma
- C. Stress fracture
- D. Non-ossifying fibroma

Key: A

Rationales:

A. **Correct**. A Brodie's abscess may be evident during the subacute or chronic stages of osteomyelitis. They are characteristically 1-4 cm lucent subcortical lesions surrounded by spongy bone eburnation and periosteal reaction. The lucency itself usually demonstrates an elongated appearance with the suggestion of loculations and tracts or channels. There is an elongated, channel-like, multilculated lytic lesion at the proximal tibia adjacent to the anterior cortex, with surrounding sclerosis and chronic periosteal reaction.

B. *Incorrect*. The nidus of osteoid osteoma is generally smaller than 1.5 cm. Most are cortically based and surrounded by exuberant reactive uniform sclerosis.

C. Incorrect. The lucency of a stress fracture is linear and intracortical in location.

D. *Incorrect*. A Nonossifying fibroma is a benign geographic lesion that occurs most frequently in a metadiaphyseal location. It is cortically based and is usually surrounded by a thin, well-defined, lobulated sclerotic margin. Periosteal reaction without fracture is rare.

Concerning reflex sympathetic dystrophy (RSD), which one is characteristic?

- A. Diffuse unilateral appendicular osteopenia
- B. Articular accumulation of 99m Tc-pertechnetate
- C. Joint space narrowing and osseous erosion
- D. Injury to a nerve containing a large sympathetic component

Key: B

Rationales:

A. *Incorrect*. Soft tissue swelling and regional osteoporosis are the most significant radiographic findings of RSD. There may be rapid and severe osteopenia, usually periarticular in nature. Reduced bone density results from synovial inflammation and hyperemia and can be bilateral in one-fourth to one-half of cases.

B. **Correct**. There is intra-articular accumulation of 99m Tc-pertechnetate in patients with RSD secondary to the increased vascularity of the synovial membrane.

C. *Incorrect*. Joint space preservation and absence of osseous erosion is characteristic of RSD. Joint space loss and osseous erosion are features of inflammatory/septic arthritis which may also demonstrate marked periarticular osteopenia.

D. *Incorrect*. Nerve injury may or may not be a component of RSD. Complex regional pain syndrome, a more recent designation for RSD, refers to two types: Type I, associated with injury to nerves with a large sympathetic component such as the sciatic or median nerve and Type II, associated with no nerve injury.

Malignant transformation is most common in which one of the following disorders?

- A. Ollier's disease
- B. Melorheostosis
- C. Multiple hereditary exostoses
- D. Maffucci's syndrome

Key: D

Rationales:

A. *Incorrect*. Ollier's disease or enchondromatosis is a rare non-hereditary, dysplastic condition characterized by multiple, widespread, benign cartilaginous foci, intraosseous or sub-periosteal, of varying size and shape (round, angular or linear). The latter appears as radiolucent columns or channels extending from the physis to the metaphysis and diametaphyseal region. Complications include growth deformity and malignant transformation. The estimated rate of malignant transformation, which occurs in the adult, has ranged from 5-30%, some authors claiming up to 25%.

B. *Incorrect*. Melorheostosis is a rare disorder characterized by its distinct radiographic findings and clinical course. The patients exhibit painful, swollen joints with limited range of motion, muscle and joint contracture and tendon/ligament shortening. There are numerous growth deformities including scoliosis and limb length discrepancies. Usually one limb is affected. Surface cortical hyperostosis, the radiographic hallmark, may involve one or more bones and the dense osseous excescences may resemble wax flowing along one side of a burning candle. These bony masses may involve adjacent articulations. Ossification and calcification may occur at the paraarticular soft tissues, ultimately leading to ankylosis of the nearby joint. The pathogenesis is unknown. The distribution of involvement often corresponds to zones of the skeleton supplied by individual sensory nerves or sclerotomes suggesting that the disorder may be the sequela of a sensory nerve lesion. Malignant transformation does not occur.

C. *Incorrect*. Multiple hereditary exostosis or multiple cartilaginous exostosis is a common, autosomal dominant, dysplastic condition characterized by multiple cartilage-capped exostosis distributed throughout the skeleton in a bilateral, symmetric fashion. The exostoses may vary in size and shape and point away from the physis. The bones themselves may be exhibit expansile remodeling, shortening and angular deformities. Complications also include fracture, impingement and compression of adjacent structures usually nerves, vessels and tendons, bursa formation and inflammation and malignant transformation. The estimated rate of such transformation has ranged from <1% up to 25%, probably 2-5%.

D. **Correct**. Maffucci's syndrome is a non-hereditary, dysplastic condition characterized by multiple widespread cartilaginous foci (enchondromatosis) and soft tissue vascular malformations, most commonly hemangiomas. These may occur in the viscera. The distributions of the cartilaginous and vascular lesions usually, though not always, coincide. The radiographic appearance is that of enchondromatosis with soft tissue masses and phleboliths. Although malignant transformation of both the cartilage and soft tissue lesions has been noted, the risk is much greater for the skeletal component. Many estimate the rate of malignant transformation at 20% or more. Despite the vary varying estimates, it is generally agreed that the rate of malignant transformation if greater with Maffucci's S. than Ollier's. It should be noted that several forms of enchondromatosis have recently been noted and that Ollier's disease and Maffucci's S. do not encompass all of them.

Which of the following structures is essential to maintaining the arch of the foot?

- A. Plantar fascia
- B. Posterior tibial tendon
- C. Spring ligament
- D. Peroneal brevis tendon

Key: B

Rationales:

A. *Incorrect*. The plantar fascia assists in supporting the midfoot arch but is considered a secondary support. Rupture does not produce significant separation of the plantar fascia and does not result in flatfoot deformity. The clinical presentation is one of pain and swelling at the heel.

B. **Correct**. Complete rupture of the posterior tibial tendon frequently results in pes planus deformity, the posterior tibial tendon being a primary support of the midfoot arch. It is opposed by the peroneus brevis tendon which everts the heel and abducts the foot. Posterior tibial tendon rupture allows the unopposed peroneal brevis tendon to result in hindfoot valgus and forefoot abduction. Once the calcaneus is in a valgus position, the Achilles tendon will further evert the calcaneus. The talo-navicular joint is gradually disrupted as all the medial ligaments become stretched and elongated.

C. *Incorrect*. The spring ligament extends from the sustentaculum tali to the plantar aspect of the navicular. It supports the talar head and therefore the longitudinal arch of the foot. It is thick and strong and almost never ruptures during routine foot/ankle trauma. Although the spring ligament serves as a secondary support of the midfoot arch, it is not a primary support and as long as the posterior tibialis tendon is intact, the midfoot does not collapse.

D. *Incorrect*. As discussed, rupture of the peroneal brevis tendon would allow the posterior tibial tendon to function unopposed. This injury is caused by repeated ankle sprain or chronic peroneal subluxation. It does not lead to a pes planus deformity.

References:

Yu JS. Posterior tibial tendon tear. In: Case Review – Musculoskeletal Imaging. St. Louis, MO: Mosby, 2001:107-108.

Schweitzer ME, Karasick D. MR imaging of disorders of the posterior tibialis tendon. AJR Am J Roentgenol. 2000; 175: 627-35.

Yu JS. Pathologic and post-operative conditions of the plantar fascia: review of MR imaging appearances. Skeletal Radiol. 2000; 29: 491-501.

You are shown a lateral radiograph of the spine and AP radiograph of the pelvis of a 60 year old man. What is the MOST LIKELY diagnosis?



- A. Diffuse idiopathic skeletal hyperostosis
- B. Ankylosing spondylitis
- C. Psoriatic arthritis
- D. Ossification of the posterior longitudinal ligament

Key: A

Rationales:

A. **Correct.** There is ossification of the anterior longitudinal ligament involving numerous (>4) levels with relative preservation of the disc spaces and there is extensive bone proliferation at the pelvis, at the trochanters, ischial tuberosities, iliac spines and iliac crests without sacroiliitis. These are typical features of DISH. The most common site of involvement is the vertebral column, Forestier's disease, which characteristically involves the thoracic region. The preservation of the disc spaces and extensive spinal involvement help distinguish DISH from degenerative disc disease. Normal S-I joints exclude a diagnosis of AS which may otherwise demonstrate a similar proliferative enthesopathy at the pelvis.

B. *Incorrect*. Sacroiliitis is a diagnostic criterion for ankylosing spondylitis and the S-I joints in this case are normal. The syndesmophytes of AS represent ossification of the annulus fibrosis of the disc and, therefore, are thinner and more vertical than the ossification of the anterior longitudinal ligament seen in DISH.

C. *Incorrect.* The paravertebral ossification of Psoriatic arthritis, like that of Reiter's syndrome, is relatively larger, bulky or irregular, unilateral or asymmetric in distribution and to the side of the vertebral column. The S-I joints may or may not be involved. Proliferative ensethopathy at the pelvis may be present.

D. *Incorrect.* The posterior longitudinal ligament is not affected in this patient. Although ossification of the posterior longitudinal ligament (OPLL) may be seen at the thoracic spine, with or without cervical spine involvement, isolated cervical spine involvement is more typical. There are no associated abnormalities at the pelvis.

References:

Miller and Schweitzer. Diagnostic Musculoskeletal Imaging. McGraw-Hill, NY, 2005. Resnick. Diagnosis of Bone and Joint Disorders. 4th ed. W.B. Saunders, NY, 2002 Concerning sacroiliitis, which of the following is MOST LIKELY to be mono-articular?

- A. Tuberculosis
- B. Progressive systemic sclerosis
- C. Inflammatory bowel disease
- D. Reiter's syndrome

Key: A

Rationales:

A. **Correct**. Tuberculous spondylitis is the most common form of skeletal tuberculosis. Extra-spinal articular disease typically involves large joints such as the knee and hip but any joint may be involved. Monoarticular involvement is characteristic. Osteomyelitis without septic arthritis is relatively uncommon.

B. Incorrect. Sacroiliitis is not a feature of progressive systemic sclerosis or scleroderma.

C. *Incorrect*. The sacroiliitis associated with ulcerative colitis and Crohn's disease is identical to that of ankylosing spondylitis, bilateral and symmetric.

D. *Incorrect*. Sacro-iliitis in Reiter's syndrome is common. The involvement tends to be bilateral, symmetric or asymmetric. Asymmetric and rarely, unilateral involvement is more common in Reiter's syndrome and psoriatic arthritis than ankylosing spondylitis.

References:

Miller and Schweitzer. Diagnostic Musculoskeletal Imaging. McGraw-Hill, NY, 2005.

Chew. Skeletal Radiology: The Bare Bones. 2nd ed. Williams and Wilkins, Baltimore, 1997.Resnick. Diagnosis of Bone and Joint Disorders.4th ed. W.B. Saunders, NY, 2002.

Concerning chronic renal disease, which of the following is MOST closely associated?

- A. Neuropathic osteoarthropathy
- B. Tarsal tunnel syndrome
- C. Destructive spondyloarthropathy
- D. Hypertrophic osteoarthropathy

Key: C

Rationales:

A. *Incorrect*. Neuropathic osteoarthropathy may result from several underlying disorders including diabetes mellitus, syphilis, and numerous congenital insensitivity to pain syndromes. Radiographic findings of bone destruction and fragmentation may mimic the destructive spondyloarthropathy associated with renal dialysis.

B. *Incorrect.* Carpal tunnel syndrome is a known complication of patients undergoing hemodialysis. This has been attributed to edema, venous congestion and subsequent compression of the median nerve related to the access site. Amyloid deposition, B2-microglobulin, in the synovium also results in such compression. Tarsal tunnel syndrome is not a clinical manifestation related to chronic renal disease.

C. **Correct**. Patients undergoing renal dialysis for at least 2-3 years may develop a destructive spondyloarthropathy, most common at the cervical region. This may or may not be symptomatic. Radiographic findings of disc space loss, endplate erosion and reactive sclerosis mimic septic spondylitis, neuropathic spondyloarthropathy and CPPD deposition disease. Although chronic hyperparathyroidism and ligamentous laxity may be contributing factors, amyloid deposition seems primary.

D. *Incorrect.* Hypertrophic osteoarthropathy, usually associated with pulmonary disorders (hypertrophic pulmonary osteoarthropathy, HPO) most notably bronchogenic carcinoma, is a triad of painful swollen joints, clubbing and periosteal new bone formation. Although this is associated with numerous disorders including inflammatory bowel disease, biliary cirrhosis, chronic lung diseases, and congenital cyanotic heart disease, there is no association with chronic renal disease.

References:

Miller and Schweitzer. Diagnostic Musculoskeletal Imaging. McGraw-Hill, NY, 2005.

Manaster, Disler, May. Musculoskeletal Imaging. The Requisites. 2nd ed. Mosby, St. Louis, 2002. Resnick. Diagnosis of Bone and Joint Disorders. 4th ed. W.B. Saunders, NY, 2002.

You are shown coronal and axial fat-suppressed T1-weighted MR arthrographic images of a 24-year-old man with right shoulder pain. Which of the following is the MOST LIKELY diagnosis?



- A. Hill-Sachs lesion
- B. Bankart lesion
- C. Perthes lesion
- D. SLAP lesion

Key: C

Rationales:

A. *Incorrect.* The Hill-Sachs fracture deformity is a fracture at the posterior lateral aspect of the humeral head, superiorly, acquired following anterior shoulder dislocation and subsequent impaction at the anterior inferior glenoid. It is best seen on axial images at the level of the coracoid or higher. It should not be confused with the normal posterior humeral groove, seen more distally.

B. *Incorrect*. A Bankart lesion is an anterior labral avulsion at the inferior glenohumeral ligament attachment with rupture of the anterior scapular periosteum and marked periosteal stripping. It is associated with anterior shoulder dislocation. Although contrast is seen beneath the detached labrum, it is confined by the intact overlying periosteum.

C. **Correct**. A Perthes lesion is a Bankart variant, an anterior labral avulsion at the inferior glenohumeral ligament attachment with intact scapular periosteum and mild periosteal stripping. The intra-articular contrast is seen beneath the labrum at the detachment site and extends medially beneath the mildly stripped, but otherwise intact, periosteum.

D. Incorrect. The superior labrum is intact.

Reference:

Stoller DW. Shoulder. In: Stoler DW, Tirman PF, Bredella MA, eds. Orthopaedics. Salt Lake City, UT: Amirsys, 2004: 58-93.

Concerning osteosarcoma, which ONE of the following statements is true?

- A. May mimic an aneurysmal bone cyst or giant cell tumor.
- B. A periosteal osteogenic sarcoma occurs at the ends of a tubular bone.
- C. Parosteal osteosarcomas typically presents in the sixth to eighth decades of life.
- D. A Codman's triangle represents tumor infiltration of the periosteum.

Key: A

Neuroradiology In-Training Test Questions for Diagnostic Radiology Residents



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May, 2016

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© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org Regarding retinoblastoma, which of the following is TRUE?

- A. Occular calcification is seen in 50% of patients.
- B. Signal on MR is increased on T1WI and on T2WI.
- C. The involved globe is smaller than normal.
- D. It is the most common ocular malignancy of infancy.

Key: D

Rationales:

A. Incorrect: Calcifications are seen in greater than 90% of patients

B. Incorrect: Signal on MR is increased on T1 and decreased on T2

C. *Incorrect*: The involved globe is normal in size. This helps differentiate retinoblastoma from other entities that involve calcification of the globe including retinopathy of prematurity, Coat's disease and phthisis bulbi which are all associated with a small globe.

D. **Correct**: Retinoblastomas are the most common ocular malignancy of infancy **Reference**:

Yousem David M, Da Motta Ana Carolina: Head and Neck Imaging Case Review Series, Mosby, Philadelphia, PA 2006 p. 109.

Which of the following is TRUE regarding intracranial epidural hematoma?

- A. The majority have an associated skull fracture.
- B. The typical shape is crescentic.
- C. The hematoma may cross the calvarial sutures.
- D. Most occur in the posterior fossa.

Key: A

Regarding Marchiafava Bignami disease, which of the following statements is true?

- A. Lesions are most common in the brain stem.
- B. Lesions are commonly seen in the corpus callosum.
- C. The clinical presentation is acute.
- D. It is an infectious process

Key: B

Which of the following is TRUE regarding spinal vascular malformations?

- A. The majority of patients have a bruit over the spine by auscultation.
- B. A cutaneous angioma is also present over the affected spinal territory in most patients.
- C. Most patients have a history of progressive neurologic deficit in one or more extremity.
- D. The Foix-Alajouanine syndrome consists of subarachnoid hemorrhage and back pain due to a ruptured spinal vascular malformation.

Key: C

Patients with normal pressure hydrocephalus (NPH) are most likely to respond to ventricular shunting if which of the following are true?

- A. There is no evidence of transependymal flow adjacent to lateral ventricles.
- B. Memory problems predominate over gait apraxia.
- C. Cerebrospinal (CSF) flow rates measured by cardiac gated MRI are high.
- D. There is absence of a flow void through the aqueduct of Sylvius.

Key: C

Rationale:

A: *Incorrect.* Transependymal CSF flow correlates with positive outcome after ventricular shunting. However, T2 hyperintense transependymal flow can be difficult to distinguish from periventricular and deep white matter ischemic change which correlates with poor surgical outcome.

B: *Incorrect*. Patients with gait apraxia and recent clinical onset have more favorable response to shunting than patients in whom memory impairment predominates or in those who have long-standing symptoms.

C: Correct. Increased CSF flow rates correlate with a good response to shunting.

D: *Incorrect.* A flow void through the aqueduct reflects increased CSF velocity which is correlated with good outcome after ventricular shunt placement.

Nuclear Radiology In-Training Test Questions for Diagnostic Radiology Residents



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May, 2016

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© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org You are shown a posterior Tc-99m MDP bone scintigram obtained in a 58-year-old man with back pain. What is the MOST likely diagnosis?



- A. Metastatic prostate carcinoma
- B. Acute osteomyelitis
- C. Metastatic renal carcinoma
- D. Prior radiation therapy

Key: C

Findings:

Whole-body and spot images of the skeleton demonstrate a focal area of decreased tracer uptake within the vertebral body of T12. The remainder of the study demonstrates only mild arthritic changes. The focal "hot spot" in the region of the left elbow is related to a small amount of extravasation of the dose at the site of injection.

Rationales:

A. Incorrect. Prostate carcinoma has a high predilection for metastasis to the skeleton, and bone scintigraphy is a highly sensitive examination for detection of prostate carcinoma metastatic to bone. Prostate carcinoma often metastasizes early to the thoracolumbar spine via the vertebral venous plexus of Batson. However, in the vast majority of cases, prostate carcinoma bone metastases demonstrate increased tracer uptake on Tc-99m MDP or Tc-99m HDP bone scans. Radiographically, prostatic carcinoma bone metastases are often associated with sclerotic lesions on plain films or CT. In this case, the lesion demonstrates decreased tracer uptake, a relatively uncommon finding that is more often associated with aggressive, lytic destructive lesions or metastases from primary lesions less likely to result in blastic or bone-forming lesions, such as renal and thyroid carcinoma. Statistically, "cold" bone metastases are most often due to metastatic lung or breast carcinoma. Therefore, while plausible, metastatic prostate carcinoma is not the most likely etiology for the findings in this case. B. Incorrect. Acute osteomyelitis is most often associated with focal skeletal hyperemia on the flow portion of 3-phase bone scans and with focal increased bone uptake on the blood pool and delayed static images. In children, acute osteomyelitis is occasionally associated with decreased tracer uptake on bone scintigraphy secondary to decreased perfusion to involved sites due to the presence of pus under pressure within the involved bone. However, this appearance is much less commonly encountered in adult patients, and when it occurs, it is primarily encountered in the long bones. Therefore, osteomyelitis would be an unlikely explanation for the finding in this case. In addition, no history suggesting the presence of an infectious process was given.

C. **Correct.** Renal carcinoma is one of the primary neoplasms that may be associated with wellcircumscribed, expansile lytic metastases on radiographs and "photopenic" skeletal metastases on bone scintigrams, along with thyroid carcinoma. As noted above, statistically the most common primary neoplasms associated with "cold" metastases are lung and breast carcinoma. "Cold" lesions or absence of abnormal tracer uptake may also be seen in multiple myeloma, a lesion arising within the bone marrow, for which plain radiographs are overall more sensitive than skeletal scintigraphy for detection. Only a small percentage of metastases detected on bone scintigraphy are "cold" lesions, like the lesion in this case.

D. *Incorrect*. Radiation therapy can produce decreased tracer uptake on bone scintigrams secondary to reduction in regional blood flow and microvascular injury and injury to osteoblasts, with resultant decreased new bone formation. However, it would be unusual for a radiation therapy port to involve only a single vertebral level. In addition, in the current case the entire vertebra is not involved, with activity remaining in portions of the posterior elements, which would not be anticipated in the case of postradiation changes. Therefore, radiation therapy is not the most likely etiology for the finding in this case.

Reference:

Alazraki NP: Case 1: "Cold" Bone Metastasis. In: Siegel BA, ed. *Nuclear Radiology II*. Chicago, III: American College of Radiology; 1978:2-17.

A Tc-99m sulfur colloid scan performed in a 25-year-old woman reveals an incidental round, hyperintense area of activity within the liver. Which of the following is the MOST likely etiology for this finding?

- A. Cavernous hemangioma
- B. Hepatocellular carcinoma
- C. Hepatic adenoma
- D. Focal nodular hyperplasia

Key: D

Rationale:

A: Incorrect. This would be a cold lesion on sulfur colloid exam.

B: Incorrect. These lesions are usually cold but can have accumulation of activity.

C: Incorrect. This lesion is also cold.

D: **Correct.** About two-thirds of these lesions are either isointense or hyperintense compared with the normal liver activity. In addition, FNH most commonly occurs in younger women.

Which of the following findings on an In-111 Zevalin[®] scan would constitute a CONTRAINDICATION to radioimmunotherapy with Y-90 Zevalin[®]?

- A. Lack of tumor uptake
- B. Liver activity greater than bowel activity
- C. Lung activity greater than liver activity
- D. Lack of significant genitourinary activity

Key: C

Which of the following statements about Y-90-ibritumomab tiuxetan (ZevalinR) radioimmunotherapy (RIT) for indolent non-Hodgkin's lymphoma is TRUE?

- A. It targets CD-15 receptors on immature B cells.
- B. Tc-99m labeled ZevalinR is used for imaging prior to therapy.
- C. Unlabeled rituximab (RituxanR) must be intravenously infused before therapy.
- D. Bone marrow involvement of less than or equal to 50% is a prerequisite.

Key: C

Rationales:

A. Incorrect. Y-90 ZevalinR targets CD-20 receptors on mature B-cells.

B. *Incorrect.* Pre-RIT imaging is performed using In-111 labeled ZevalinR. ZevalinR is not available labeled with Tc-99m.

C. **Correct**. Rituximab is given prior to administration of Y-90 ZevalinR to deplete binding sites on circulating B-cells, which would otherwise bind to the radiopharmaceutical and reduce the effectiveness of the RIT.

D. Incorrect. Bone marrow involvement must be less than 25%, not 50%.

Reference:

Biodistribution and dosimetry results from a phase III prospectively randomized controlled trial of Zevalin radioimmunotherapy for low-grade, follicular, or transformed B-cell non-Hodgkin's lymphoma. Crit Rev Oncol Hematol. 2001 Jul-Aug; 39(1-2):181-94.PMID: 11418315.

Concerning the Nuclear Regulatory Commission (NRC) annual occupational dose limits, which one of the following is correct?

- A. The maximum allowable annual dose to the lens is 50 rem.
- B. The maximum dose to individuals < 18 years old is 20% of the adult dose limit.
- C. The regulations do not include exposure incurred during voluntary participation in medical research.
- D. The dose limits include exposure to persons who have been administered radioactive material and released.

Key: C

Which ONE of the following is a required patient preparation for an F-18 FDG (fluorodeoxyglucose) PET oncology study?

- A. One hour fast prior to radiotracer injection
- B. Intravenous infusion of insulin to maximize tumor uptake
- C. Achieving a serum glucose level < 150 mg/dL
- D. Laxative administration to minimize bowel uptake

Key: C

Rationale:

A: *Incorrect.* Patients should be fasting for a minimum of 4-6 hours prior to injection.

B: *Incorrect.* Insulin increases muscle uptake and degrades image quality, also resulting in decreased tumor uptake. Diabetic patients may take their normal oral medications or long-acting insulin, but should not receive short-acting insulin for at least 4 hours prior to FDG administration.

C: **Correct.** Elevated serum glucose levels result in altered biodistribution similar to the effects of insulin, with associated competitive inhibition of tumor uptake. Many laboratories routinely check the serum glucose levels prior to FDG injection.

D: *Incorrect.* Bowel preparation is not a routine part of patient preparation for a PET oncology study. Bowel uptake is a normal finding, although focal areas of uptake raise suspicion of underlying neoplastic or inflammatory pathology. Similarly, diuretic or muscle relaxant pre-treatment, while useful in selected patients, is generally not considered a standard part of the patient preparation for a PET study.

Concerning stress myocardial perfusion imaging in patients with left bundle branch block, which ONE of the following statements is correct?

- A. The sensitivity of the study is reduced in this clinical setting.
- B. Exercise treadmill testing is associated with an increased false positive rate.
- C. Use of dobutamine as a pharmacologic stress agent is preferable to adenosine.
- D. Use of dipyridamole is not recommended because of its chronotropic effects.

Key: B

A 58 year-old man is scheduled to undergo radioactive immunotherapy with Yttrium-90 ibritumomab tiuxetan (Zevalin). You are shown anterior and posterior 48 hour Indium-111 Zevalin images. What is the correct interpretation?





- A. Normal biodistribution.
- B. Abnormal biodistribution. No significant splenic activity.
- C. Abnormal biodistribution. No definite tumor uptake.
- D. Abnormal biodistribution. Excessive bone marrow uptake.

Key: D

Regarding the C-14 urea breath test for the detection of Helicobacter pylori (H. pylori) infection, which of the following medications will LEAST likely affect the results?

- A. Antibiotics
- B. Bismuth compounds
- C. Proton pump inhibitors
- D. Antacids

Key: D

Rationale:

A: *Incorrect.* Concurrent antibiotic therapy may result in a false negative test, not a false positive. Patients should be off antibiotic therapy for at least one month prior to the study.

B: Incorrect. Antibiotics and bismuth compounds for 30days before the test.

C: Incorrect. Sucralfate and proton pump inhibitors(e.g., omeprazole, esomeprazole,

lansoprazole, rabeprazole, pantoprazole) for 2 weeks before the test.

D: **Correct.** False negative studies may occur in patients on antibiotic therapy or in patients receiving bismuth, proton pump inhibitors or sucralfate, which should be discontinued for at least 30 days (antibiotics or bismuth) or 2 weeks (proton pump inhibitors, sucralfate), respectively. However, simple antacid therapy does not affect the results.

References:

http://interactive.snm.org/docs/pg_ch07_0403.pdf .

You are shown 24 hour anterior and posterior whole-body In-111 Ibritumomab Tiuxetan (Zevalin) images obtained prior to Y-90 Ibritumomab Tiuxetan (Zevalin) therapy. Based on the findings demonstrated, which of the following statements regarding Zevalin radioimmunotherapy for this patient is correct?



- A. It may be given in view of the normal biodistribution demonstrated.
- B. It may be given despite the presence of altered biodistribution.
- C. It is contraindicated because of altered biodistribution.
- D. It is contraindicated because of the absence of tumor uptake.

Key: C

Rationale:

A: *Incorrect.* The In-111 Zevalin images are not normal. The images demonstrate altered biodistribution of the tracer, with increased uptake in the liver and bone marrow, as well as somewhat prominent bowel activity. Altered biodistribution is a contraindication to Y-90 Zevalin therapy.

B: Incorrect. Altered biodistribution is a contraindication to Y-90 Zevalin therapy.

C: **Correct.** When administering Y-90 Ibritumomab Tiuxetan (Zevalin) for treatment of relapsed or refractory, low-grade or follicular B-cell Non-Hodgkin's Lymphoma, including patients with rituximab refractory follicular Non-Hodgkin's Lymphoma, imaging with In-111 Ibritumomab Tiuxetan (Zevalin) is required prior to therapeutic injection. "The criteria for altered biodistribution are met if any of the following is detected on visual inspection of the required gamma images: Intense localization of radiotracer in the liver and spleen and bonemarrow indicative of reticuloendothelial system uptake. Increased uptake in normal organs (not involved by tumor) such as: 1. Diffuse uptake in normal lung more intense than the liver.2. Kidneys have greater intensity than the liver on the posterior view.3. Fixed areas (unchanged with time) of uptake in the normal bowel greater than uptake in the liver.4. In less than 0.5% of patients receiving In-111 Zevalin, prominent bone marrow uptake was observed, characterized by clear visualization of the long bones and ribs." Altered biodistribution is a contraindication to Y-90 Zevalin administrastion.

D: *Incorrect*. Demonstration of tumor uptake on In-111 Zevalin images is not a prerequisite for Y-90 Zevalin therapy. In addition, some of the upper abdominal uptake demonstrates on the images may represent sites of tumor uptake.

Regarding center of rotation offset error in SPECT imaging, which of the following statements is MOST correct?

- A. It produces uncorrectable image distortion.
- B. It is detected using anthropomorphic phantoms.
- C. It is more detrimental in the central portion of the field of view.
- D. It characteristically produces ring artifacts.

Key: D

Rationale:

A: *Incorrect*. Within the spatial resolution limits of the acquisition system, the offset data can be mathematically shifted or corrected after the fact. Usually the maximum offset is one pixel for a typical 128 x 128 image matrix.

B: *Incorrect*. Although SPECT phantom imaging results will be adversely affected by an offset center of rotation (COR), the standard analytic method requires SPECT acquisition of either a point or a line source of radioactivity with specialized camera/computer acquisition and processing programs used to identify and correct the COR offset.

C: *Incorrect*. Misregistration and resultant blurring from COR offset is equally detrimental over the entire field of view.

D: **Correct.** The difference between the mechanical center of rotation for each SPECT detector assembly and the center of the projected image matrix will produce this characteristic artifact.

Pediatric Radiology In-Training Test Questions for Diagnostic Radiology Residents



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May, 2016

Sponsored by: Commission on Education Committee on Residency Training in Diagnostic Radiology

© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org A newborn infant presents on the second day of life with a distended abdomen and bilious emesis. A radiograph of the abdomen demonstrates markedly distended intestinal loops throughout the abdomen. What is the BEST next diagnostic examination?

- A. Upper GI study
- B. Contrast enema
- C. Abdominal CT with IV contrast
- D. Abdominal ultrasound

Key: B

Rationales:

The case describes a distal bowel obstruction in a newborn. An upper GI study would not be warranted in cases of a newborn with a distal bowel obstruction. The correct test of choice would be a contrast enema (Option C), preferably performed with water soluble, isotonic contrast in case of a perforation. **Reference:**

Kirks DR (Ed.) 1998. Practical Pediatric Imaging, 3rd Ed. Lippincott, Philadelphia.

Which of the following radiographic findings is MOST useful in excluding the diagnosis of hyaline membrane disease in a newborn infant?

- A. Pleural effusion
- B. Hyperinflation
- C. Unossified humeral epiphyses
- D. Asymmetric pulmonary opacity

Key: B

Rationales:

A. *Incorrect*. While pleural effusion is an uncommon finding in hyaline membrane disease, its presence or absence is not specific in excluding the diagnosis. Small pleural effusion may be seen in transient tachypnea of the newborn which can co-exist with hyaline membrane disease, especially on early radiographs. Although in the appropriate clinical setting, the presence of diffuse ground glass opacity with accompanying pleural effusion should raise the question of infection, particularly group B streptococcal pneumonia, pleural effusion alone cannot exclude hyaline membrane disease.

B. **Correct**. The underlying cause of hyaline membrane disease is deficiency of surfactant; this lipoprotein complex produced by Type II pneumocytes coats alveoli and prevents them from collapsing in expiration. Diffuse alveolar atelectasis with pulmonary underaeration is the hallmark of this disease. Increased lung volumes would strongly suggest excluding hyaline membrane disease as a diagnostic possibility. With early intubation and administration of exogenous surfactant, characteristic radiographic findings may be less marked and more transient.

C. *Incorrect*. Ossification of humeral epiphyses may be used as a sign of skeletal maturity on a chest radiograph. Ossified humeral epiphyses are not seen in infants less than thirty-six weeks of gestation and are present in approximately 40% of term infants. Therefore the presence of humeral epiphyses would diminish the likelihood of hyaline membrane disease, a disease of prematurity. Unossified epiphyses would not be useful in excluding the disease.

D. *Incorrect*. While diffuse symmetric ground glass opacity is the characteristic feature of hyaline membrane disease, some variation of this pattern is not uncommon. Lower lobe involvement tends to be more marked than upper lobe; opacity may be more marked on the right than on the left side. After surfactant administration there is often asymmetric clearing of the lungs. Therefore, the presence of asymmetry does not exclude the diagnosis of hyaline membrane disease.

References:

Swischuk LE. Respiratory Distress in the Newborn. Imaging of the Newborn, Infant, and Young Child. Baltimore: Williams & Wilkins, 1997:25-47.

Newman B, Bowen A, Oh KS. A Practical Approach to the Newborn Chest. Current Problems in Diagnostic Radiology. 1990; 14(2)47-84.

Newman B. Imaging of Medical Disease of the Newborn Lung. Radiol Clin North Am 1999:37(6)1049-1065.

Concerning the conversion of hematopoietic bone marrow to fatty bone marrow, which portion of the femur is the last to convert?

- A. Proximal epiphysis
- B. Proximal metaphysis
- C. Diaphysis
- D. Distal metaphysis

Key: B

Rationales:

A. *Incorrect*. The epiphyses almost immediately convert from hematopoietic marrow to fatty marrow as soon as they are ossified.

B. **Correct**. The epiphyses convert to fatty marrow soon after they ossify. Diaphysis precedes metaphysis and distal precedes proximal. Therefore, within the femurs, the proximal metaphyses are the last portion of the bone to convert from hematopoietic marrow to fatty marrow. Commonly in teenagers, residual patchy hematopoietic marrow is still present within the proximal femoral metaphysis on MR imaging.

C. *Incorrect*. The diaphysis converts from hematopoietic marrow to fatty marrow before the metaphyses.

D. *Incorrect*. Conversion proceeds from distal to proximal. The distal femoral metaphyses therefore convert from hematopoietic marrow to fatty marrow prior the proximal femoral metaphyses. **References:**

Jaramillo D, Laor T, Hoffer FA, et al. Epiphyseal marrow in infancy: MR imaging. Radiology 1991; 180: 809-812

Laor T, Jaramillo D, Oestrich. Musculoskeletal system. In: Kirks DR, Griscom NT, Practical Pediatric Imaging: Diagnostic Radiology of Infants and Children, 3rd ed. Lippincott-Raven, Philadelphia, 1998, 327-510; Moore SG, Dawson KL. Red and yellow marrow in the femur: age related changes in appearance at MR imaging. Radiology 1990; 175:219-223

Ricci C, Cova M, Kang YS, et al. Normal age-related patterns of cellular and fatty marrow distribution in the axial skeleton: MR imaging study. Radiology 1990; 177:83-88

Which one of the following is a characteristic feature of renal duplication in girls?

- A. Reflux into the upper system
- B. Ectopic lower pole ureter
- C. Incontinence
- D. Duplication of the uterus

Key: C

Rationales:

A. *Incorrect*. Although reflux may occur into either the upper or lower moieties of an uncomplicated duplication, the typical consequence of duplication is obstruction of the ectopic upper pole ureter, and reflux into the lower moiety, likely secondary to interference of the abnormal upper pole ureter with the normal antireflux tunnel mechanism of the orthotopic lower pole.

B. *Incorrect*. The lower pole ureter inserts normally at the trigone. The upper pole ureter arises above the normal ureteric bud, and therefore inserts ectopically, medially and inferiorly within the bladder, or along the course of the mesonephric duct. Therefore, option B is false.

C. *Correct.* The ureters are derivatives of the mesonephric duct, and therefore ectopic ureters insert along its derivatives or remnants. In boys, the ectopic ureter will always insert above the sphincter, medially into the bladder, or into the seminal vesicles. However, in girls with duplex kidney, the ectopic ureter may insert below the sphincter, into the urethra, or into the vagina, resulting in urinary incontinence. This is characterized by constant dampness. Therefore, option C is correct.

D. Incorrect. Duplication of the uterus, with obstruction of one of the two systems, is typically associated with ipsilateral renal agenesis or dysgenesis. However, renal duplications are not typically associated with duplication of the uterus.

Which of the following is a sequela of periventricular leukomalacia?

- A. Schizencephaly
- B. Symmetrical periventricular cysts
- C. Basal ganglia vasculopathy
- D. Lissencephaly

Key: B

A. *Incorrect*. Schizencephaly is the result of an in utero event leading to cerebral clefts lined by abnormal transcerebral columns of gray matter. This is not a sequela of periventricular leukomalacia.

B. **Correct**. Periventricular leukomalacia is a result of ischemia to the premature vascular watershed zone in the periventricular white matter, resulting in periventricular leukomalacia and multiple periventricular cysts.

C. *Incorrect*. Lenticulostriate vasculopathy associated with many etiologies, particularly in utero TORCH infection.

D. *Incorrect*. Lissencephaly is a migration disorder resulting in a smooth cortex with abnormal neuronal layers. In some cases it may follow CMV infection

References:

Rumack C, Drose J. Neonatal and infant brain imaging. Rumack, Wilson, Charboneau (ed) third edition Diagnostic Ultrasound, St Louis Elsevier Mosby 2005

Perlman JM, Rollins N: Surveillance protocol for the detection of intracranial abnormalities in premature neonates. Arch Pediatr Adol Med 2000; 154:822.

Bass WT, Jones MA White LE et al: Ultrasonographic differential diagnosis and neurodevelopmental outcome of cerebral white matter lesions in premature infants J Perinatol 1999; 19:330

Which of the following is associated with decreased pulmonary vascularity?

- A. Ebstein anomaly
- B. Complete AV canal
- C. Supracardiac total anomalous pulmonary venous connection
- D. Infracardiac total anomalous pulmonary venous connection

Key: A

Concerning alignment deformities of the lower extremities, which of the following is CORRECT?

- A. Physiologic bowing follows physiologic knock knee.
- B. The neck-shaft angle of the femur is increased in coxa valga.
- C. Blount disease causes valgus deformity of the tibia.
- D. In clubfoot, the axis of the talus extends medial to the first metatarsal.

Key: B

Rationale:

A: *Incorrect.* Physiologic bowing precedes physiologic knock knee. Physiologic bowing typically occurs in children less than 2 years of age. Physiologic knock knee typically occurs at 3 to 4 years of age. Both may be evident at different times in the same child, with physiologic bowing preceding physiologic knock knee.

B: **Correct.** In coxa valga, the femoral neck and shaft are abnormally straight with increase in the neck-shaft angle. In distinction, with coxa vara, the femoral neck-shaft angle is decreased.

C: *Incorrect.* Blount disease, also referred to as tibia vara, causes varus angulation of the proximal tibia, not valgus angulation. Deformity of the medial epiphysis and metaphysis of the proximal tibia result in depression of the medial articular surface of the proximal tibia and medial angulation of the diaphysis of the tibia relative to the proximal epiphysis.

D: *Incorrect.* In club foot, also known as talipes equinovarus, there is varus deformity of the hindfoot. The calcaneus, the more distal bone, is angulated medially. The metatarsals are similarly displaced. As a result, the extended axis of the talus, the more proximal bone, passes lateral to the first metatarsal. In distinction, with hindfoot valgus, the extended axis of the talus does pass medial to the first metatarsal. Concerning imaging of a child with a bronchial foreign body, which one is CORRECT?

- A. A decubitus radiograph with the affected side up will be helpful in demonstrating ipsilateral air trapping.
- B. A nuclear medicine ventilation perfusion scan will likely demonstrate symmetrical lung perfusion but asymmetrical ventilation.
- C. On fluoroscopy the mediastinum will shift away from the affected side in expiration.
- D. The majority of foreign bodies are radiopaque and visible on chest radiographs.

Key: C

Rationales:

A. *Incorrect*. When placed in the decubitus position, the dependent (down) lung deaerates and the nondependent lung expands. Therefore to demonstrate air trapping i.e. lack of dependent deflation, the useful decubitus view is with the affected side down.

B. *Incorrect*. When the lung is abnormally ventilated there is also decreased perfusion due to reflex vasoconstriction. There may be very little perfusion of the affected side when significant air trapping is present.

C. **Correct.** This is one of the cardinal observations in fluoroscopic evaluation of a foreign body. On inspiration the mediastinum is in its normal location i.e. central. With expiration the mediastinum shifts towards the normal lung which deflates, and away from the persistently hyperinflated abnormal lung. Other fluoroscopic observations include lack of deflation and decreased diaphragmatic excursion on the affected side.

D. *Incorrect*. Only a small number of foreign bodies are radiopaque. The most common endobronchial foreign bodies are ingested foods, such as peanuts and raw carrots. Therefore the radiographic features rely on secondary findings, predominantly air trapping distal to the foreign body due to partial obstruction of the affected airway. With a larger or more long standing foreign body, pulmonary opacity due to atelectasis or post obstructive pneumonia may occur.

References:

Swischuk LE. Respiratory System. Imaging of the Newborn, Infant, and Young Child. Baltimore: Williams & Wilkins, 1997:129-130.

Newman B, Oh KS. Abnormal pulmonary aeration in infants and children. Radiologic Clinics of North America, 1988:26(2);323-339.

Moncada R, Baker D, Kenny J, Leininger B. Reversible unilateral pulmonary hypoperfusion secondary to acute check-valve obstruction of a main bronchus. Radiology, 1973:106:361-362.

Which statement is CORRECT regarding duodenal obstruction? **Options:**

- A. Plain films may be normal in patients with volvulus.
- B. Nonbilious vomiting excludes the diagnosis.
- C. Atresia is secondary to intrauterine ischemia.
- D. Windsock duodenum is typically found in neonates.

Key: A

Rationales:

A. **Correct**. Volvulus obstructs at the third portion of the duodenum, and presents with bilious vomiting. Volvulus occurs about the axis of the superior mesenteric artery, and leads to ischemia of its territory, from the duodenojejunal junction to the splenic flexure. Therefore, insufficient time elapses for marked duodenal dilatation to occur, and the plain films may be normal, or demonstrate relative paucity of distal gas with longer or more severe obstruction. Absence of bowel distension may lead to a false sense of security and diminished concern for obstruction.

B. *Incorrect*. Although most cases of duodenal atresia or stenosis occur distal to the ampulla of Vater, the obstruction may lie proximal to the ampulla in a minority of patients, in whom the emesis may be nonbilious. Therefore, nonbilious vomiting does not exclude the diagnosis, and this option is incorrect.
C. *Incorrect*. Although small bowel and colonic atresias are considered to be secondary to an intrauterine ischemic event, duodenal atresia is believed to be the result of failure of recanalization. Therefore this option is incorrect.

D. *Incorrect*. Windsock duodenum is the result of stretching of duodenal membrane in patients with membranous duodenal stenosis. Therefore, it is typically seen in older patients.

Which of the following statements regarding hypoplastic left heart syndrome is TRUE?

- A. The left atrium is typically large due to mitral valve atresia.
- B. The coronary arteries are small due to hypoplasia of the ascending aorta.
- C. The aorta is perfused from the pulmonary artery through a patent ductus arteriosus.
- D. Cardiac ischemia is common due to poor antegrade perfusion of the coronary arteries.

Key: C

Which of the following is true regarding hypertrophic pyloric stenosis?

- A. It can be diagnosed clinically by bilious projectile vomiting.
- B. It is easiest to palpate when the stomach is most distended
- C. It is diagnosed when the pyloric muscle thickness is greater than 3 mm.
- D. It is most common in infants aged 4-6 months.

Key: C

Based on the lower extremity radiograph of this 11-year-old child, which of the following statements is TRUE?



- A. Fibular overgrowth is a hallmark finding of this condition
- B. This child has mesomelic shortening of appendicular bones
- C. Membranous ossification is inherently abnormal in this condition
- D. Abnormal spinal curvature rarely occurs

Key: A

Rationale:

A: **Correct.** The findings are consistent with achondroplasia. Appendicular manifestations of achondroplasia include fibular overgrowth, metaphyseal flaring with V-shaped physes, and trident appearance of the digits.

B: Incorrect. Achondroplasia manifests with rhizomelic shortening.

C: *Incorrect.* Achondroplasia is a disorder primarily of endochondral bone growth, with relatively normal membranous bone growth.

D: Incorrect. Abnormal spinal curvature is frequently found in the setting of achondroplasia.

Physics Radiology In-Training Test Questions for Diagnostic Radiology Residents



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A computed radiography image with a 10-bit pixel depth will have how many possible shades of gray?

- A. 256
- B. 1024
- C. 4094
- D. 8192

Кеу: В

Rationales:

- A. Incorrect.
- B. **Correct**. Pixel depth is computed as 210 = 1024
- C. Incorrect.
- D. Incorrect.

Which of the following would result in an abnormally noisy pelvic CT image?

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

Key: D

- A. *Incorrect.* Higher kVp yields lower image noise.
- B. Incorrect. Increasing slice thickness decreases image noise.
- C. Incorrect. Normally smoothing algorithms decreases image noise.
- D. **Correct**. Lower tube current means fewer x-ray photons, therefore increased image noise.

Reference:

Bushberg, Seibert, Leidholdt, Boone. Essential Physics of Medical Imaging. Second Edition., Lippincott Williams and Wilkens, 2002.

A lateral abdominal radiograph is taken of a pregnant woman with a transmission path length of 30 cm. If the entrance dose is 10 mGy (1 rad), and the half-value layer thickness for the x-ray beam is 3 cm of tissue, what is the approximate dose to the center of the uterus from the primary radiation?

- A. 0.3 mGy
- B. 1 mGy
- C. 2 mGy
- D. 5 mGy

Key: A

Rationale:

The middle of the uterus would be midline in the patient, at a depth of 15cm. Since the HVL equals 3 cm of tissue, the radiation must pass through 5 HVL's of tissue to reach the uterus. The primary radiation will then be reduced by $(1/2)^5$ or 1/32nd of the incident intensity.

References:

Bushberg JT, Seiabert JA, Leidholdt EM, and Boone JM. The Essential Physics of Medical Imaging, 2nd edition. Lippincott Williams & Wilkins (2002), Chap 3, p48.

Which of the following will most likely NOT reduce the radiation dose during fluoroscopy?

- A. Decreasing the source to skin distance with constant source to image distance
- B. Minimizing use of magnification mode
- C. Using low-frame rate pulsed fluoroscopy
- D. Increasing beam filters

Key: A

Rationale:

A: **Correct.** Decreasing SSD increases patient dose as the patient is closer to the x-ray source. B: *Incorrect.* Magnification mode yields higher radiation exposure to patient. Therefore minimizing magnification mode decreases patient dose.

C: *Incorrect.* Low-frame rate pulsed fluoroscopy reduces the radiation dose to patient. Radiation dose decreases as pulse rate decreases. The dose decreases nearly 30-40% if the pulse rate decreases from 30 fps to 15 fps.

D: Incorrect. Additional beam filters removes the soft x-rays which tends to increase patient dose.

Concerning programmable ultrasound scanner settings, which of the following is TRUE?

- A. Time gain compensation (TGC) decreases the amplification (gain) applied to deeper tissues to create a uniform signal intensity at all depths.
- B. Dynamic range refers to the ratio of the highest to the lowest amplitude displayed on the screen in decibels.
- C. M-mode ultrasound uses a substantially increased amount of acoustic energy to form an image as compared to gray scale imaging.
- D. Pulse repetition frequency is a measure of the amplitude of the ultrasound pulse.

Key: B

Reference:

Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound. 3rd ed. Mosby Yearbook Inc., St. Louis, MO. 2005, Page 9-12.

A radioactive spill of Tc-99m results in a contamination level of 1000 cpm at 2 PM. What would you expect the contamination level to be at 8 AM the following day?

- A. < 10 cpm
- B. 125 cpm
- C. 250 cpm
- D. 500 cpm

Key: B

Rationales:

Technicium-99m is the most commonly used radionuclide in nuclear medicine with a half-life of 6 hours. By 8 AM the contamination will have decayed over 18 hours or 3 half-lives, reducing the activity to one eighth (0.5x0.5x0.5). Therefore the count rate should be around 125 cpm (counts per minute). **References:**

A. Wolbarst, Physics of Radiology (1993), Chapter 39.

J.T. Bushberg, et al., The Essential Physics of Medical Imaging (2002), Chapter 18.

What is the latent image in computed radiography (CR)?

- A. Optical density patterns on a digital laser film
- B. Absorbed x-ray photons in the phosphor
- C. Electrons trapped in semi-stable energy wells
- D. Digitally stored values in each pixel of the image

Key: C

Rationales:

The latent image is the unobservable change of the detector arising from x-ray interactions in the object and the absorption of the x-ray pattern onto the detector. CR (computed radiography) is a modality that uses photostimulable storage phosphor (PSP) technology to acquire the x-ray information and subsequently render a visible image after stimulating the latent image electrons that are stored in semistable traps within the PSP (typically made of barium fluoro bromide (BaFBr). A. *Incorrect.* The laser film represents the final image, not the temporary unobservable latent image. B. *Incorrect.* X-ray photons induce the storage of electrons, but do not comprise the latent image information

C. **Correct.** Electrons are trapped by the storage phosphor upon excitation by locally absorbed x-rays. The latent image information is subsequently rendered visible by excitation of a laser beam (diameter typically 100 mm) and emission of shorter wavelength light photons upon return to the ground state. D. *Incorrect.* The digitally stored values represent the final, observable image, not the unobservable image.

Reference:

J.T. Bushberg, et al. *The Essential Physics of Medical Imaging*, (Second Edition), Lippincott Williams and Wilkins, 2002, Chapter 11.

Concerning axial resolution in ultrasound, which of the following is TRUE?

- A. It is worse at greater depths.
- B. It is generally better with lower frequency transducers.
- C. It requires a high Q factor.
- D. It is generally better than lateral resolution.

Key: D

Rationales:

A. Incorrect. Axial resolution is the same at all depths.

B. *Incorrect.* The axial resolution is dependent on the pulse length with smaller spatial pulse lengths improving the axial resolution. Smaller spatial pulse lengths are achieved with higher frequency transducers because the wavelength is much smaller and thus the spatial pulse length is much smaller. *C. Incorrect.* A high Q transducer has a narrow bandwidth and a corresponding long spatial pulse length which degrades the axial resolution.

D. **Correct**. Axial resolution is generally better than lateral resolution. Axial resolution is of the order of 1mm or less while lateral resolution could be on the order of 2 to 5 mm.

Reference:

The Essential Physics of Medical Imaging by Bushberg JT et. al., Second Edition, Chapter 16: Ultrasound.

Ultrasound Radiology In-Training Test Questions for Diagnostic Radiology Residents



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May, 2016

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© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org You are shown two ultrasound images from the right upper quadrant of a 30-year-old HIV-positive patient. What is the MOST likely pathogen?



- A. Candida
- B. Mycobacterium avium-intracellulare
- C. Cryptosporidium
- D. Coccidioides

Key: C

Findings: Markedly thickened gallbladder wall without gallstones or pericholecystic fluid detected. **Rationales**: The above findings are concerning for HIV cholangiopathy. HIV cholangiopathy is an opportunistic infection of the biliary tree which may occur in individuals with advanced HIV infection. Marked thickening of the wall of the bile ducts and gallbladder is seen. The most common pathogens isolated from these individuals include Cryptosporidium, CMV, and Microsporidium. Although Candida, Mycobacterium avium-intracellulare, and coccidioides are pathogens which can infect immunocompromised patients, they are not considered a common cause of HIV cholangiopathy. **References:**

Middleton WD, Kurtz AB, Hertzberg BS: Ultrasound: The Requisites, 2nd ed. St. Louis, Mosby, 2004. Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound. 3rd ed. Mosby Yearbook Inc., St. Louis, MO. 2005.

You are shown an image from a second trimester OB ultrasound. What is the MOST LIKELY diagnosis?



- A. Gastroschisis
- B. Bladder exstrophy
- C. Teratoma
- D. Omphalocele

Key: A

A. **Correct**. Bowel loops are seen to extend through an anterior abdominal wall defect and are not covered by a membrane. This appearance is consistent with gastroschisis.

B. *Incorrect.* Bladder exstrophy is characterized by lower anterior abdominal wall mass inferior to the umbilicus representing the protruding exposed posterior surface of the bladder rather than the free floating bowel loops on submitted image.

C. *Incorrect.* Although teratomas can appear complex by ultrasound, origin from the anterior abdominal wall is not typical.

D. *Incorrect*. Although bowel loops are seen to extend through an anterior abdominal wall defect, these bowel loops are floating free within the amniotic fluid and are not covered by a membrane. This appearance is consistent with gastroschisis rather than omphalocele.

References:

Ultrasonography in Obstetrics and Gynecology by Peter W. Callen. Publisher – W B Saunders. 2000, Page 492-494.

Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound. 3rd ed. Mosby Yearbook Inc., St. Louis, MO. 2005, Pages 1377-1382, 1385.

A 24 year old man is referred for a thyroid ultrasound following the detection of a thyroid abnormality seen on a chest CT. The ultrasound shows a single 1 cm hypoechoic nodule containing small foci of calcifications. The following statement is true.

- A. Fine needle aspiration is not indicated because thyroid nodules are unlikely to be malignant in younger patients.
- B. Evaluation of the internal vascularity of thyroid nodule is the most useful ultrasound criterion in differentiating potentially benign from malignant nodules.
- C. Despite its small size of less than 1.5cm, fine needle aspiration of this nodule should be recommended.
- D. Serum calcitonin levels are useful for detecting recurrence from papillary thyroid cancer.

Key: C

Which one of the following is a reliable sonographic sign of a monochorionic diamniotic twin pregnancy?

- A. Thin membrane between sacs in the first trimester
- B. Twins of the same gender in separate sacs
- C. Lack of a "twin peak" or "delta" sign
- D. The placentas of each sac are contiguous with each other

Key: C

Rationales:

A. *Incorrect.* A thick membrane consists of 2 chorions and 2 amnions, which separate dichorionic twins. A thin membrane has no chorion, only 2 amnions. A thick membrane may appear thin later in pregnancy, but not in the first trimester.

B. *Incorrect*. If the twins are of different genders, they are dizygotic and thus dichorionic, diamniotic. If they are of the same gender they may be dizygotic as well as monozygotic.

C. **Correct**. A "twin peak sign" represents a beak-like tongue of placenta protruding between the two doublemembranes of a dichorionic diamniotic twin. It is not present in a monochorionic pregnancy, because the single chorion surrounds both sacs. However, this sign is not always seen in a dichorionic pregnancy.

D. *Incorrect*. Visualization of 2 separate placentas is consistent with a dichorionic pregnancy. However, 2 separate placentas that abut each other may be indistinguishable in appearance from a single placenta.

Reference:

Brant. Ultrasound: The Core Curriculum. 1st ed. Lippincott Williams & Wilkins, Philadelphia, PA. 2001.

What is the MOST important feature differentiating hemorrhagic cysts from endometriomas?

- A. Hemorrhagic cysts are often multiple.
- B. Hemorrhagic cysts have thick walls.
- C. Hemorrhagic cysts do not have through transmission.
- D. Hemorrhagic cysts regress during a 6-10 week period.

Key: D

Rationales:

A. *Incorrect.* Endometriomas are frequently multiple and hemorrhagic cysts are usually solitary.

B. *Incorrect.* Hemorrhagic cysts have thin walls and endometriomas have thick walls.

C. Incorrect. Hemorrhagic cysts and endometriomas typically have acoustic through transmission.

D. Correct. Hemorrhagic cysts and endometriomas may appear similar on sonography.

However, hemorrhagic cysts usually resolve on follow up at 6-10 weeks, whereas endometriomas tend to show little change in size and internal pattern over the next few menstrual cycles. This is the main feature that differentiates hemorrhagic cysts from endometriomas and other malignant ovarian neoplasms.

References:

Jain KA. Sonographic Spectrum of Hemorrhagic Ovarian Cysts. *J Ultrasound Med.* 21:879-886. Woodward PJ, Sohaey R, and Mezzetti, Jr TP. Endometriosis: Radiologic-Pathologic Correlation. *RadioGraphics.* 2001; 21: 193-216. A 20-year-old woman with a normal quadruple screen has a sonogram at 18-weeks gestational age. What is the MOST appropriate next step?



- A. Perform an amniocentesis to assess for trisomy 21
- B. Perform a chorionic villous sampling to assess for trisomy 18
- C. Perform a fetal survey to assess for morphologic abnormalities
- D. No further follow-up is needed

Key: C

Rationale:

A. Incorrect. A is not correct since amniocentesis is not recommended unless other indications of trisomy 18 are present. In addition the amniocentesis would be to assess for trisomy 18 not trisomy 21.
B. Incorrect. B is not correct since chorionic villous sampling is performed in the first trimester.
C. Correct. The image shows bilateral choroid plexus cysts. Choroid plexus cysts are associated with a low incidence of trisomy 18. When a choroid plexus cyst is visualized it is important to perform a formal fetal survey to look for morphologic abnormalities such as cardiac abnormalities, clenched fists, and micrognathia.

D. Incorrect. D is not correct since it is important to assess for other findings of aneuploidy.

A 50-year-old woman was found to have a 2-cm hyperechoic mass in her right kidney. What follow-up, if any, should be recommended?

- A. No follow-up is recommended as this is most likely a benign angiomyolipoma
- B. MRI of the abdomen to further characterize the mass
- C. Unenhanced CT scan of the abdomen to assess for the presence of fat
- D. Follow-up with renal ultrasound in six months

Key: C

Rationales:

A. *Incorrect*. Small, < 3cm, renal cell cancers can be hyperechoic and can be confused with an angiomyolipoma (AML)

B. Incorrect. MRI is not the test of choice to evaluate for the presence of fat.

C. **Correct**. CT is the test of choice to assess for the presence of fat to characterize this lesion as an AML.

D. *Incorrect*. This mass could be a small renal cell cancer. Therefore, an unenhanced CT scan needs to be performed first. If this mass is found to be an AML, it then can be followed by ultrasound.

Concerning nuchal translucency, which of the following is TRUE?

- A. It is thickening of the cranial and nuchal soft tissues in the first trimester.
- B. It decreases with increasing gestational age.
- C. The most common aneuploidy seen with an abnormal nuchal translucency is trisomy 21.
- D. Nuchal translucency should be measured with the fetal neck in the transverse orientation.

Key: C

Rationales:

A. *Incorrect.* Nuchal translucency is a measurement of the thickness of only the nuchal soft tissues.

B. Incorrect. Normal nuchal translucency increases with increasing gestational age.

C. Correct. The most common aneuploidy seen with an abnormal nuchal thickness is trisomy 21.

D. *Incorrect.* Nuchal translucency should be measured on a sagittal section of the fetal neck.

Reference:

Callen PW. Ultrasonography in Obstetrics and Gynecology, Fourth Edition, 2000, Page 38-39.

Which statement is TRUE concerning ovarian torsion?

- A. Visualization of an ovary that is normal in size and echotexture, but without detectable flow on power Doppler, is diagnostic of ovarian torsion.
- B. The presence of arterial blood flow detected on color or power Doppler in an enlarged heterogeneous and tender ovary virtually excludes the diagnosis of ovarian torsion.
- C. The whirlpool sign refers to visualization of the coiled or twisted adnexal vascular pedicle.
- D. In adult women, an intraovarian mass such as a cystic teratoma or an ovarian cyst is rarely associated with ovarian torsion.

Key: C

Which of the following is true concerning Doppler ultrasound of renal vascular hypertension?

- A. Finding a high velocity jet of the main renal artery is a highly sensitive but low specificity finding.
- B. Finding high resistance parenchymal flow predicts successful outcome of surgical repair of the anastomosis.
- C. An acceleration time of >.07 seconds is the threshold commonly used to define a tardus parvus waveform.
- D. It has low sensitivity because accessory arteries are found in almost 10% of individuals.

Key: C

A 15 year old boy presents with acute right testicular pain and swelling. Which of the following statement is true?

- A. Normal echogenicity of the right testicle on gray scale imaging excludes the diagnosis of testicular torsion.
- B. If testicular torsion is suspected on sonography, the diagnosis should be confirmed by testicular scintigraphy before surgery is considered.
- C. If the images you are presented with demonstrate the absence of flow within the testicle, you should first verify that the sonographer used low wall filter, low pulse repetition frequency and high Doppler gain setting
- D. Torsion of the spermatic cord of 180 degrees is sufficient to cause complete occlusion of the testicular artery.

Key: C

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



QUALITY IS OUR IMAGE

May, 2016

Sponsored by: Commission on Education Committee on Residency Training in Diagnostic Radiology

© 2016 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org You are shown a single image from a non-contrast-enhanced CT scan of the chest. What is the MOST appropriate next step?



- A. Excisional biopsy
- B. Percutaneous needle biopsy
- C. Radiofrequency ablation
- D. Coil embolization

Key: D

Findings:

A single cross sectional image in this case shows a nodule associated with two dilated tortuous pulmonary vessels.

Rationales:

A. Incorrect.

- B. Incorrect.
- C. Incorrect.

D. **Correct.** The findings are diagnostic for a pulmonary arteriovenous malformation. The nodule is the saccular communication between the feeding pulmonary artery and the draining pulmonary vein. It is incorrect to think this is a solid tumor, perhaps a small lung cancer. The diagnosis could be confirmed with a CT angiogram, but certainly it would be incorrect to perform a needle biopsy of a vascular lesion. Standard therapy is coil embolization. It would be too invasive to excise this lesion, particularly as they are so often multiple. Radiofrequency ablation at this point is an experimental technique for malignant lung lesions not amenable to surgery. Not recommended here.

References:

SCVIR Syllabus Series: Thoracic and Visceral Vascular Interventions, Chapter 5. Valgi p 278, Kaufman p211.

Fernando HC, Hoyas AD, Litle V, Belani CP, Luketich JD. Radiofrequency ablation: identification of the ideal patient. Clin Lung Cancer. 2004; 6:149-53.

Drug-eluting stents used in the treatment of coronary artery disease reduce the likelihood of which of the following?

- A. Post-procedure elastic recoil
- B. Post-procedure platelet aggregation
- C. Development of neointimal hyperplasia
- D. Progression of atherosclerotic occlusive disease

Key: C

Rationales:

A. Incorrect.

B. Incorrect.

C. **Correct.** The advantage of a stent over angioplasty alone is it prevents elastic recoil. The purpose of the eluted drugs is to retard neointimal hyperplasia as a cause for in-stent stenosis. These are not antiplatelet medications or drugs to inhibit progressive atherosclerosis. Although drug eluting stents have revolutionized the treatment of coronary artery disease, it has been difficult to show that they are an improvement over bare stents for the treatment of superficial femoral artery disease. D. *Incorrect.*

For patients requiring permanent hemodialysis, what is the advantage of a native arteriovenous fistula?

- A. Most durable
- B. Most easily declotted
- C. Most easily accessed
- D. Most rapidly available for use after placement

Key: A

Rationales:

A. **Correct**. Fistulas have superior longevity in comparison to bridge grafts. But they take several weeks for the access to mature, for the egress veins to enlarge sufficiently to provide adequate blood flow and become large enough to accept large bore needles. They may never mature. Synthetic grafts are ready for use in two weeks. Tunneled catheters are available for use immediately following placement. Further, tunneled catheters are the most easily accessed. The patient doesn't have to be struck. But tunneled catheters are not recommended for long-term hemodialysis because of the risk of infection and early failure rate. Bridge grafts are easier to declot than native fistulas because the clot is usually confined to the synthetic graft, the grafts are superficial and the anatomy straightforward.

References:

Kaufman JA, Lee MJ. Vascular and Interventional Radiology. The Requisites. Mosby. 2004. LaBerge JM. Interventional Radiology Essentials. Lippincott Williams & Wilkins. 2000. Valji K. Vascular and Interventional Radiology. WB Saunders Company. 1999. Concerning the mechanism of radiofrequency tumor ablation, which is the MOST important parameter governing tissue destruction?

- A. Wavelength
- B. Tissue vascularity
- C. Tissue temperature
- D. Number of probes

Key: C

References:

Goldberg SN, Gazelle GS, Mueller PR. Thermal ablation therapy for focal malignancy: A unified approach to underlying principles, techniques and diagnostic imaging guidance. AJR 2000; 174:323-331.

Goldberg SN, Dupuy DE. Image-guided radiofrequency tumor ablation: challenges and opportunities – Part I. J Vasc Interv Radiol 2001; 12:1021-1032.

Which one of the following embolic agents should be selected for temporary occlusion of an artery?

- A. Gelfoam pledgets
- B. Absolute alcohol
- C. Polyvinyl alcohol
- D. N-Butyl cyanoacrylate

Key: A

Rationales:

A. **Correct**. Gelfoam pledgets are absorbed by the body over 4-6 weeks and are very useful when temporary occlusion is desired. Gelfoam powder is of course also absorbed by the body, but because the powder particles are so small they often infarct tissue which is of course permanent.

B. *Incorrect*. Absolute alcohol is a powerful sclerosant, destroying any tissue it comes in contact with. On or off target it does permanent damage.

C. *Incorrect*. Polyvinyl alcohol, despite the name is solid particulate matter. It is considered a permanent agent, but occluded arteries sometimes do recanalize, perhaps because of the tendency of the material to clump.

D. *Incorrect.* N-Butyl cyanoacrylate, a glue, polymerizes into a permanent contour-filling solid upon contact with blood.

References:

Kaufman JA, Lee MJ. Vascular and Interventional Radiology. The Requisites. Mosby. 2004. Valji K. Vascular and Interventional Radiology. WB Saunders Company. 1999.

A 52-year-old construction worker had bluish discoloration and numbness of the fifth finger of his right hand. You are shown an arteriogram of the right hand and wrist. The proximal arteries were intact. What is the MOST likely diagnosis?



- A. Paget-Schroetter syndrome
- B. Giant cell arteritis
- C. Scleroderma
- D. Hypothenar hammer syndrome

Key: D

Findings:

There is disruption of the ulnar artery at the wrist.

Rationales:

A. *Incorrect.* All 4 possible answers are associated with occlusions of upper extremity blood vessels. However, Paget-Schroetter is a syndrome of venous occlusion at the thoracic outlet.

B. *Incorrect.* Giant cell arteritis is associated with long strictures of the subclavian and axillary arteries. C. *Incorrect.* Scleroderma does cause small vessel occlusions of the arteries of the hand and wrist and should be seriously considered in the differential diagnosis, but the patient is a male construction worker, and it is the ulnar artery that is occluded.

D. **Correct.** Finger ischemia resulting from repetitive trauma to the ulnar artery, often the result of occupational exposure, is hypothenar hammer syndrome.

References:

Taylor LM. Hypothenar hammer syndrome. J Vasc Surg. 2003; 37:697.

Valji K. *Vascular and Interventional Radiology.* Philadelphia, Pa: W.B. Saunders; 1999. Vedantham S, Gould J. *Case Review Vascular and Interventional Imaging.* St. Louis, Mo: Mosby; 2004.

Concerning acute gastrointestinal hemorrhage, which statement is TRUE?

- A. Radionuclide scanning should not be performed.
- B. Bright red blood per rectum excludes an upper gastrointestinal bleed.
- C. The angiographic diagnosis is based upon the visualization of contrast extravasation into the bowel lumen.
- D. Bleeding from Mallory-Weiss tears may be diagnosed upon injection of either the superior or inferior mesenteric arteries.

Key: C

Rationales:

A. *Incorrect.* Radionuclide scanning is more sensitive than arteriography in detecting gastrointestinal hemorrhage and can be helpful in localizing the bleed.

B. *Incorrect.* About 10% of patients with brisk upper gastrointestinal hemorrhage, bleeding proximal to the ligament of Treitz, will have bright red blood per rectum.

C. **Correct.** The hallmark of gastrointestinal hemorrhage is extravasation of contrast material into the bowel.

D. *Incorrect.* Mallory-Weiss tears occur at the gastroesophageal junction, not in the distribution of either the superior or inferior mesenteric arteries.

References:

Kaufman JA, Lee MJ. *Vascular and Interventional Radiology: The Requisites*. St. Louis, Mo: Mosby; 2004. Valji K. *Vascular and Interventional Radiology*. Philadelphia, Pa: W.B. Saunders; 1999.

A patient with diffuse pedal ischemia, a non-healing ulcer and focal gangrene of the foot was found to have an elevated rather than decreased ankle brachial index. Which of the following is the MOST LIKELY explanation?

- A. Diabetes
- B. Atrial fibrillation
- C. Congestive heart failure
- D. Venous gangrene

Key: A

Rationales:

A. Correct. Medial arterial calcification is commonly found in diabetics with peripheral arterial disease. These heavily calcified vessels are frequently not compressible. This may lead to falsely elevated ankle brachial index measurements.

References:

Janssen A. Pulsatility index is better than ankle-brachial Doppler index for non-invasive detection of critical limb ischaemia in diabetes. Vasa 2005; 34:235-41.

Sacks D et al. Position statement on the use of the ankle-brachial index in the evaluation of patients with peripheral vascular disease. J Vasc Interv Radiol2002; 13:353.

You are shown an image from an IVC venogram performed from a right femoral approach. The patient has developed a subarachnoid hemorrhage while being anticoagulated for left-sided deep venous thrombosis. The maximum caval diameter is 25 mm measured using a pigtail catheter. Which of the following statements regarding the placement of an IVC filter is CORRECT?



- A. It should be placed at the level marked "A."
- B. It should be placed at the level marked "B."
- C. It should be placed at the level marked "C."
- D. It should not be placed because it is contraindicated.

Key: C

You are asked to implant a venous access port in a cancer patient receiving bevacizumab (Avastin) therapy. Which of the following complications is of special concern?

- A. Infection
- B. Venous thrombosis
- C. Port occlusion
- D. Wound dehiscence

Key: D

Rationale:

D: **Correct.** Bevacizumab (Avastin) is a recombinant humanized monoclonal immunoglobulin G1 antibody now FDA approved to treat colorectal, lung and breast cancer. Bevacizumab binds to and inhibits the biological activity of human vascular endothelial growth factor. The drug interferes with endothelial cell proliferation and new blood vessel formation (angiogenesis). Patients are at increased risk of wound dehiscence when receiving bevacizumab within 10 days of a port placement.