Breast Radiology In-Training Test Questions for Diagnostic Radiology Residents



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

© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown a left MLO and CC (magnification) mammogram. What is MOST descriptive of the calcifications?



- A. Lucent-centered, diffuse
- B. Dystrophic, segmental
- C. Pleomorphic, segmental
- D. Amorphous, regional

Key: A

Rationales:

A. **Correct.** The calcifications demonstrated on these images are skin calcifications. These develop in sweat glands and are typically polygonal in shape with central umbilication or lucent centers and often pathognomonic in appearance. These are most commonly located in the skin of the medial breast, in the axilla, and in the areola. Atypical appearances may require additional imaging with tangential views. The distribution, best seen on the MLO, is generalized or diffuse.

B. *Incorrect.* Dystrophic calcifications are coarse and irregular. Segmental distribution refers to a pattern of arrangement mimicking a ductal system and while this might be suggested on the CC view alone, this distribution is not reflected on the MLO.

C. *Incorrect.* Pleomorphic calcifications vary more than the regular appearance of these calcifications. D. *Incorrect.* The BI-RADS® definition of amorphous calcifications refers to "those that are sufficiently small or hazy in appearance that a more specific morphologic classification cannot be determined." Calcifications assigned to this category are considered of intermediate concern and in some settings require biopsy. That morphologic description does not apply to the skin calcifications seen in this unilateral mammogram.

Citations:

American College of Radiology (ACR) BI-RADS[®] – Mammography. 4th Edition. In: ACR Breast Imaging Reporting and Data Systems, Breast Imaging Atlas. Reston, VA. American College of Radiology, 2003. Wang S-C. Dermal calcifications. In: Birdwell RL, Morris EA, Wang S-C, Parkinson BT. Pocket Radiologist Breast Top 100 Diagnoses. Salt Lake City, Utah: W.B. Saunders with Amirsys; 2003:29-31.

2. A vacuum assisted needle biopsy is performed for calcifications. Follow-up excisional biopsy is recommended for which one of the following results?

- A. Stromal fibrosis
- B. Sclerosing adenosis
- C. Atypical ductal hyperplasia
- D. Apocrine metaplasia

Key: C

Rationales:

A. Incorrect. Stromal fibrosis is a benign diagnosis and does not require excisional biopsy.

B. *Incorrect.* Sclerosing adenosis represents a benign finding and presents as calcifications. No further excision is needed.

C. **Correct.** Atypical ductal hyperplasia is a proliferative change, which has an association with DCIS. Excisional biopsy yields DCIS in up to one third of the cases. The upgrade to DCIS is less common with larger gauge needles but does not obviate need for excision. Sampling error is the main cause of the upgrade.

D. *Incorrect.* Apocrine metaplasia is associated with fibrocystic changes and cysts. It is a benign diagnosis. **Citations:**

Cardenosa G. *Breast Imaging Companion*. Philadelphia, Pa: Lippincott Williams and Wilkins; 2001:239-241.

- 3. A normal mammogram is seen in which of the following conditions?
- A. Extracapsular silicone implant rupture
- B. Intracapsular silicone implant rupture
- C. Ruptured saline implant
- D. History of direct silicone injection

Кеу: В

Rationales:

A. *Incorrect.* The mammogram would be abnormal because silicone outside the fibrous capsule (that which is created by the body in reaction to the implant) can be seen mammographically as streaky densities, dense masses, and bright foci within lymph nodes. Mammography is sensitive enough to diagnose silicone implant rupture when the silicone is outside the fibrous capsule.

B. **Correct.** Mammography is not sensitive enough to detect intracapsular silicone implant rupture in most cases. Breast MRI without gadolinium-enhancement is a more sensitive examination. Specific findings described for the MRI findings of intracapsular rupture include the "linguine" sign created by the collapsed silicone envelope floating within the silicone held in place by the fibrous capsule. C. *Incorrect.* When a saline implant ruptures, the saline is resorbed leaving the collapsed silicone envelope has an easily recognized abnormal mammographic appearance.

D. *Incorrect.* The striking density of the silicone within lymphatics or ducts, the silicone-related granulomatous reaction within the breasts, and fat necrosis associated with injections of paraffin or other oils that may be injected with the silicone create a very abnormal mammogram.

- 4. Concerning MR imaging of breast implants, which one is TRUE?
- A. Breast MRI is the test of choice in evaluating saline implant integrity.
- B. The linguine sign is diagnostic of extracapsular implant rupture.
- C. Radial folds extend to the periphery, differentiating them from collapsed shell.
- D. Pre- and post-contrast images are necessary for the diagnosis of implant rupture.

Key: C

Rationales:

A. *Incorrect*. Rupture of a saline implant is a clinically obvious finding, because the implant deflates immediately. The saline is absorbed by the body so that by the time the patient presents for imaging evaluation, only the collapsed outer membrane is visible on mammography. MRI is not necessary for the diagnosis of a saline implant rupture.

B. *Incorrect*. The most reliable sign of intracapsular rupture on MRI is the presence of multiple, curvilinear low-signal intensity lines within the high intensity silicone. This is known as the "linguine sign." The diagnosis of extracapsular rupture is made by noting the presence of free silicone in the breast parenchyma.

C. **Correct**. Radial folds are a finding in normal implants and are a result of normal infolding of the Silastic elastomer membrane. These folds may be prominent enough to suggest an appearance of implant rupture. However, even prominent radial folds can be distinguished from a rupture because they are noted to extend to the periphery of the implant.

D. *Incorrect*. MRI for the detection of implant rupture is a distinct examination from the MRI examination performed for the detection and diagnosis of breast cancer. Specifically, MRI examinations tailored to exclude implant rupture do not use intravenous contrast, while MRI studies performed for the diagnosis of breast cancer rely on the use of intravenous contrast.

5. The Mammography Quality Standard Act (MQSA) requirements state that a facility must send each patient a summary of the mammography report within how many days?

- A. 7
- B. 14
- C. 30
- D. 60

Key: C

Rationales:

A. Incorrect

B. Incorrect

C. Correct. Each patient must receive a written report in lay terms within 30 days of her visit.

D. Incorrect

6. Concerning the epidemiology of breast carcinoma, which one is CORRECT?

A. African-American women have a greater 5-year survival rate than white women.

B. Mammographic density is a predictor of subsequent breast cancer risk.

C. Most women diagnosed have a family history of breast cancer.

D. Nonproliferative fibrocystic change is associated with a fivefold increased risk.

Key: B

Rationales:

A. *Incorrect*. The overall 5-year survival rates are lower in black women (73.5%) when compared to white women (87.9%). The overall poor survival rate among black women is largely due to later stage of diagnosis although poorer survival rates are seen at each stage of disease detection as well.

B. **Correct**. The mammographic appearance of the breast has been found to be a predictor of subsequent breast cancer risk. Patients with denser breasts are at an increased risk of developing breast cancer when compared to patients with fatty breast tissue. In fact, patients with areas of density of 75% or more had a nearly fivefold risk elevation.

C. *Incorrect*. Most women diagnosed with breast cancer have no family history of breast cancer. The proportion of women in the general population with a family history of breast cancer in a first degree relative has been estimated at 8%. Of those patients with breast cancer, 14% have a first degree relative with a history of breast cancer.

D. *Incorrect*. Nonproliferative fibrocystic change has not been shown to be associated with an increased risk of breast cancer. The risk increases in women with proliferative fibrocystic change without atypia (risk of 1.9) and further increases for women with atypical hyperplasia (risk of 5.3).

- 7. Concerning the diagnosis of Paget disease, which one is TRUE?
- A. Ultrasound is more sensitive than mammography.
- B. Breast conservation is contraindicated.
- C. It is most commonly bilateral.
- D. A palpable mass indicates a worse prognosis.

Key: D

Rationales:

A. *Incorrect*. Clinical exam and mammography are the main tools in the diagnosis of Paget's disease.B. *Incorrect*. Treatment depends on the underlying extent of disease and breast conservation is possible in some cases.

C. Incorrect. It is most commonly unilateral.

D. **Correct**. A palpable mass worsens the prognosis, probably due to the increased likelihood of axillary and distant metastasis in these patients.

8. Concerning invasive lobular carcinoma of the breast, which one is TRUE?

A. There is a higher rate of bilaterality than with ductal carcinoma.

B. It is the most common histologic subtype of breast carcinoma.

C. Pleomorphic calcifications are typically seen in association.

D. Pathologically there is a proliferation of angulated and elongated tubules.

Key: A

Rationales:

A. **Correct**. Up to one third of invasive lobular carcinomas are bilateral, with a higher rate of bilaterality and multicentricity than ductal carcinoma. Therefore, special attention should be given to the contralateral breast when a diagnosis of lobular carcinoma is made.

B. *Incorrect*. Invasive ductal carcinoma is the most common histologic subtype of breast carcinoma. Invasive lobular carcinoma accounts for less than 10% of all invasive breast carcinomas.

C. *Incorrect*. Associated calcifications are seen in only 20% of invasive lobular carcinomas. The most common presentations are a speculated mass, an ill-defined or obscured mass and architectural distortion. Many invasive lobular carcinomas are diffusely infiltrating and may show only subtle findings on mammography.

D. *Incorrect*. Histologically, invasive lobular carcinoma is characterized by small, monomorphic cells infiltrating the stroma in single file. A proliferation of angulated, oval and elongated tubules lined by a single epithelial layer is characteristic of tubular carcinoma.

Reference:

Diagnosis of Diseases of the Breast. 2nd ed. Elsevier Saunders Co., Philadelphia, PA. 2005. Cardenosa.

Breast Imaging Companion. 2nd ed. Lipincott Williams & Wilkins, Philadelphia, PA. 2001. Ikeda DM. Breast Imaging: The Requisites. Elsevier Mosby Co., Philadelphia, PA. 2004.

- 9. Concerning gynecomastia, which one is TRUE?
- A. It carries an increased risk of malignancy.
- B. It is typically echogenic on ultrasound.
- C. The pathology is similar to adenosis in females.
- D. It can be unilateral or bilateral.

Key: D

Rationales:

A. Incorrect. There is no increased risk of malignancy.

- B. *Incorrect*. Sonographically the breast is either normal or hypoechoic.
- C. Incorrect. The pathology is mostly ductal proliferation. Adenosis is a lobular process.
- D. Correct. Gynecomastia can be unilateral or bilateral.

10. Concerning BI-RADS[™] coding, which one is TRUE?

- A. Category 0 indicates that the patient requires a breast ultrasound examination.
- B. Category 3 lesions should be followed at 3-month intervals for 1 year.

C. Category 3 lesions have a 10% probability of carcinoma.

D. Category 5 lesions have a 95% chance of malignancy.

Key: D

Rationales:

A. *Incorrect*. The vast majority of findings placed into this category are managed with an initial short term follow up of 6 months, followed by a bilateral examination after a second 6-month interval, and then additional examinations until longer term stability is demonstrated. On occasion (patient wishes or clinical concerns), biopsy may be done.

B. *Incorrect*. BI-RADS[™] category 0 (assessment incomplete) is usually reserved for screening studies in which additional imaging evaluation is suggested. The additional imaging may include special mammographic views and/or ultrasound.

C. Incorrect. A finding placed in the BI-RADS category 3 should have less than a 2% risk of malignancy. It is not expected to change over the follow-up interval but the radiologist would prefer to establish its stability. A complete diagnostic imaging evaluation should be made before making a BI-RADS[™] category 3 assessment.

D. **Correct**. BI-RADS[™] category 5 lesions have a > 95% probability of being cancer. This category contains lesions for which one-stage surgical treatment could be considered without preliminary biopsy. **Reference:**

BI-RADS Breast imaging Atlas. American College of Radiology. 2003.Basset. Diagnosis of Diseases of the Breast. 2nd ed. Elsevier Saunders Co., Philadelphia, PA.

11. Concerning fibroadenomas, which of the following statements is TRUE?

A. Posterior acoustic enhancement is diagnostic on ultrasonography.

B. Calcifications typically develop centrally within the mammographic mass.

C. Dark internal septations and persistent enhancement are characteristic findings on MRI.

D. The presence of cystic spaces on ultrasonography indicates malignant degeneration.

Key: C

Rationales:

A. *Incorrect*. On ultrasound, they may demonstrate posterior acoustic enhancement or shadowing. Neither feature is diagnostic.

B. *Incorrect*. As the fibroadenoma ages, it may become sclerotic and less cellular. Popcorn like calcifications subsequently develop at the periphery of the mass and ultimately, the entire mass may be replaced by dense calcification.

C. **Correct**. On MRI, fibroadenomas have the classic appearance of an enhancing oval or lobulated mass with well circumscribed borders. They contain dark internal septations with a gradual initial enhancement rate and a persistent enhancement curve.

D. *Incorrect*. Fibroadenomas are typically hypoechoic on sonography but may contain cystic spaces. The presence of cystic spaces does not necessarily indicate malignant degeneration.

Reference:

Ikeda DM. The Requisites: Breast Imaging. Elsevier Mosby, Philadelphia, PA. 2004.

12. Approximately what percentage of breast cancers occur in men?

A. 1

B. 5

- C. 10
- D. 15

Key: A

Rationale:

A. **Correct**. Given data from the American Cancer Society, it is estimated that 1720 new cases of male breast cancer will be diagnosed in 2006. This is in contrast to the estimated 212,900 new cases of female breast cancer that will be diagnosed in the same time period. This suggests that approximately one out of every 100 new breast cancers will be in a male patient.

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

- 13. Concerning invasive lobular carcinoma, which one of the following is TRUE?
- A. The most common mammographic finding is a dominant mass with calcifications.
- B. It accounts for approximately 20% of all breast cancer cases.
- C. An ill-defined hypoechoic mass on ultrasonography is typical.
- D. It is easily distinguished from invasive ductal carcinoma on mammogram and ultrasound.

Key: C

Rationales:

A. *Incorrect*. Invasive lobular carcinoma (ILC) is probably the most difficult type of breast cancer to identify using any imaging modality. This type of breast cancer is most commonly seen on mammogram as a spiculated mass or area of architectural distortion. However, many ILC tumors are subtle and are difficult to detect due to a diffusely infiltrative nature. Calcifications are not typical but may occur in up to 20% of cases.

B. *Incorrect*. ILC accounts for approximately 10% of all breast cancer cases and is the second most common type after invasive ductal carcinoma (IDC) not otherwise specified.

C. **Correct**. ILC is usually seen on ultrasound as an ill-defined solid mass of decreased echogenicity. There is often considerable post tumoral shadowing.

D. *Incorrect*. Unfortunately, there are no specific distinguishing factors between ILC and IDC on any imaging modality including mammogram, US, MRI and PET. However, the overall subtle nature of ILC makes it one of the most difficult tumors to detect.

References:

Bassett LW, Jackson VP, Fu KL, Fu YS. Diagnosis of Diseases of the Breast. 2nd Edition. Elsevier Saunders, Philadelphia, PA. 2005.

Cardenosa. Breast Imaging Companion. 2nd. Lippincott Williams & Wilkins Philadelphia, PA. 2001 Powell DE; Stelling CB. The Diagnosis and Detection of Breast Disease. Mosby, St. Louis, MO. 1994.

14. Concerning tubular carcinoma of the breast, which is CORRECT?

A. It has a less favorable prognosis than invasive ductal carcinoma.

- B. It is typically a well-circumscribed mass.
- C. Microcalcifications are frequently associated.
- D. It is commonly histologic grade 1.

Key: D

Rationales:

A. *Incorrect*. Tubular carcinoma has a more favorable prognosis than invasive ductal carcinoma.B. *Incorrect*. Tubular carcinomas are not typically well circumscribed. They are slow growing and have an

irregular shape and are spiculated.

C. Incorrect. Microcalcifications occur infrequently (10-15%) in tubular carcinoma.

D. Correct. Tubular carcinomas are well differentiated and nearly always grade1.

15. Concerning complex sclerosing lesions (radial scars), which one of the following is TRUE?

A. They are typically related to prior trauma or an invasive surgical procedure.

B. They usually present as palpable masses at clinical exam.

C. Mammographic features include a circumscribed mass with a central lucency.

D. They have been shown to be associated with tubular carcinoma.

Key: D

Rationales:

A. *Incorrect*. Complex sclerosing lesions, radial scars, are not related to prior trauma or surgery and are not in fact "scars" at all. The etiology of radial scars is unknown.

B. *Incorrect*. Radial scars are typically seen on mammography or are incidentally found at excisional biopsy but are not characteristically palpable on physical exam

C. *Incorrect*. Classic mammographic features of a complex sclerosing lesion include a spiculated mass with a central lucency. This is often considered to represent entrapped fat.

D. **Correct**. Radial scars do have an association with tubular carcinoma, invasive ducal carcinoma, DCIS and atypical hyperplasia. Because of this relationship and to avoid sampling error at core needle biopsy, it is often felt that surgical excision is required to exclude any related malignancy.

References:

Bassett LW, Jackson VP, Fu KL, Fu YS. Diagnosis of Diseases of the Breast. 2nd Edition. Elsevier Saunders, Philadelphia, PA. 2005.

Cardenosa. Breast Imaging Companion. 2nd edition. Lippincott Williams & Wilkins Philadelphia, PA. 2001

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© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown contrast-enhanced chest CT images of a 30-year-old woman. Which one of the following is the MOST likely diagnosis?



- A. Primary pulmonary hypertension
- B: Biventricular heart failure
- C. Ebstein's anomaly of the tricuspid valve
- D. Ventricular septal defect

Key: A

Findings:

The right ventricle, right atrium, and pulmonary trunk are enlarged. The interventricular septum is straightened rather than normally bowed to the right, which indicates elevated right ventricular pressure. The left ventricle is normal size but displaced posteriorly. The left lower lobe is atelectatic. **Rationales:**

A. **Correct.** The findings indicate pulmonary arterial hypertension with right heart dysfunction and enlargement. In young adult women, primary (idiopathic) pulmonary hypertension is a common cause of pulmonary hypertension.

B. *Incorrect.* The left ventricle size is normal, and no pulmonary edema is present. Furthermore, left ventricular failure does not enlarge the main pulmonary artery.

C. *Incorrect*. Although Ebstein's anomaly may cause right atrial enlargement, the main pulmonary artery does not enlarge. The blood flow is shunted to the systemic circulation via an atrial septal defect; thus, the pulmonary blood flow is normal to diminished.

D. *Incorrect.* Ventricular septal defect is a rare cause of Eisenmenger's syndrome in adults. **Citations:**

Granton JT, Rabinovitch M. Pulmonary arterial hypertension in congenital heart disease. *Cardiol Clin.* 2002; 20(3): 441-57.

Fishman AP. Clinical classification of pulmonary hypertension. *Clin Chest Med.* 2001; 22(3): 385-91. Voelkel NF, Tuder RM. Severe pulmonary hypertensive diseases: a perspective. *Eur Respir J.* 1999; 14(6):1246-50.

2. You are shown a frontal chest radiograph of a 15-year-old boy. Which one of the following is the MOST likely diagnosis?



- A. Aortic stenosis
- **B:** Pulmonic stenosis
- C. Atrial septal defect
- D. Partial absence of pericardium

Key: B

Findings:

The heart size is normal, and the main and left pulmonary arteries are enlarged. The right pulmonary artery and remainder of the pulmonary vascularity are normal.

Rationales:

A. *Incorrect.* In patients with aortic stenosis, the size of the heart and pulmonary arteries is typically normal. The size of the ascending aorta may be normal or exhibit post-stenotic dilatation.

B. **Correct.** Most cases of pulmonic stenosis occur at the valvular level, and the heart size is normal. In almost all cases, the main and left pulmonary arteries are dilated due to the post-stenotic jet that preferentially strikes these vessels.

C. *Incorrect.* A ventricular septal defect manifests radiographically as shunt vascularity with increase size of the main, central, and peripheral pulmonary arteries due to increased vascular flow through the lungs. D. *Incorrect.* Partial absence of the pericardium is most common on the left and produces an unusual contour of the left cardiac border when a portion of the heart herniates through the pericardial defect. This contour abnormality does not conform to enlargement of the pulmonary artery segment or the left artium.

Citations:

Cooley RN, Schreiber MH. Radiology of the Heart and Great Vessels. Baltimore. 1978. Williams and Wilkins.

Elliott, LP. Cardiac Imaging in Infants, Children and Adults. Philadelphia. 1991. JB Lippincott.

3. You are shown a posteroanterior chest radiograph and images of the chest and head from a Tc-99m MAA lung perfusion scan of a 31-year-old man. Which one of the following is the MOST likely diagnosis?



- A. Pulmonary infarcts of sickle cell disease
- B. Arterial injection of the radiotracer
- C. Mitral hemosiderosis
- D. Eisenmenger's physiology

Key: D

Findings:

On the chest radiograph, the main and central pulmonary arteries are markedly enlarged and rapidly taper in size in the lung periphery, compatible with pulmonary arterial hypertension. The heart size is upper normal, and left atrial size is normal. The lung perfusion scan, with images of the head and thorax, reveals 99mTc MAA activity within the lungs and brain.

Rationales:

A. *Incorrect.* Multiple pulmonary infarcts manifest as pulmonary perfusion defects, which are not present.

Radiotracer should not normally accumulate in the brain.

B. *Incorrect.* Accidental injection of the radiotracer into an antecubital artery would cause most of the radiotracer to sequester initially in the distal small vessels of the hand. Those particles that entered the venous circulation would then be trapped in the lungs, without significant accumulation of radiotracer in the brain.

C. *Incorrect.* With mitral stenosis, no cardiac shunt is present. The heart size may be normal while the left atrium is typically enlarged. Long-standing pulmonary venous hypertension may induce pulmonary artery hypertension. Patients with mitral stenosis may have recurrent episodes of pulmonary hemorrhage and hemoptysis, which may then progress to pulmonary hemosiderosis and rarely ossification. In these instances, a calcium or bone-avid radiotracer may be deposited at the lung bases, the predominant site of hemosiderosis.

D. **Correct.** Occasionally, with a hemodynamically significant left-to-right cardiac shunt, the pulmonary artery hypertension and vascular resistance may become so high that right heart pressures exceed those of the left heart, and the direction of the cardiac shunt reverses. Thus, a left-to-right shunt becomes a right-to-left shunt, a phenomenon known as Eisenmenger's physiology. In normal individuals, intravenous injection of appropriately labeled 99mTc MAA should only accumulate in the lungs. With a right-to-left cardiac shunt, the radiotracer will lodge not only in the lungs but also cross via the shunt to the organs supplies by the systemic circulation, such as the brain. Free pertechnetate is an occasional

contaminant of 99mTc MAA preparation, is normally excreted by the kidneys, and should not localize in the brain.

Citations:

Treves S. Detection and Quantification of Cardiovascular Shunts with Commonly Available Radionuclides: *Semin Nuc Med.* 1980; 10;16-26.

4. Which of the following is a TRUE statement concerning acute aortic intramural hematoma?

A. It is best identified with contrast-enhanced CT.

B: The ascending thoracic aorta is most commonly involved.

C. Penetrating atheromatous ulcer is a common cause.

D. Involvement of the ascending thoracic aorta is treated conservatively.

Key: C

Rationales:

A. *Incorrect.* Acute intramural hematoma (IMH) exhibits high attenuation and is best identified on unenhanced CT.

B. Incorrect. Most penetrating atheromatous ulcers involve the descending thoracic aorta.

C. Correct. Penetrating atheromatous ulcer is a major cause of intramural hematoma.

D. *Incorrect.* Treatment is generally the same as for aortic dissection, and involvement of the ascending aorta typically mandates emergent surgical repair, while involvement of the descending aorta is treated medically to control hypertension.

Citations:

Castaner E, Andreu M, Gallardo X, et al. CT in nontraumatic acute thoracic aortic disease: typical and atypical features and complications. *RadioGraphics.* 2003; 23 Spec No: S93-110.

Yoshida S, Akiba H, Tamakawa M, et al. Thoracic involvement of type A aortic dissection and intramural hematoma: diagnostic accuracy—comparison of emergency helical CT and surgical findings. *Radiology*. 2003; 228(2): 430-5.

5. You are shown a posteroanterior (PA) and lateral chest radiograph of a 64-year-old man with chest pain. What is the MOST likely diagnosis?



- A. Congestive heart failure
- **B:** Aortic stenosis
- C. Mitral valve disease
- D. Pericardial effusion

Key: B

Rationales:

A. *Incorrect*. The chest radiograph shows normal heart size and vascularity. There is no evidence of pulmonary edema.

B. Correct. The chest radiograph shows normal heart size and vascularity. On the lateral view, there is calcification of the aortic valve, consistent with aortic stenosis. Identification of calcification of the aortic valve on a chest radiograph is usually associated with clinically significant aortic stenosis.

C. *Incorrect*. The chest radiograph shows normal heart size and vascularity. There is no evidence of left atrial enlargement or pulmonary venous hypertension.

D. *Incorrect*. The chest radiograph shows normal heart size and vascularity. There is no evidence of pericardial effusion.

Reference:

Lipton MJ, Coulden R. Valvular heart disease. Radiol Clin N Am 1999;37:319-339Gowda RM, Boxt LM. Calcifications of the heart. Radiol Clin N Am 2004;42:603-617

6. Concerning the position of the interventricular septum on short axis images of the heart, which one is TRUE?

A. It has a normal convexity toward the right ventricle.

B: It has a sinusoid shape.

C. It has a straight course separating the right and left ventricles.

D. Its convexity varies in position during the cardiac cycle.

Key: A

Rationales:

A. **Correct**. On short axis images, the interventricular septum is curved with the convexity toward the right ventricle. This appearance is maintained during systole and diastole. Straightening, bowing with convexity toward the left ventricle and sinusoidal appearance of the interventricular septum are abnormal.

B. *Incorrect*. On short axis images, the interventricular septum is curved with the convexity toward the right ventricle. This appearance is maintained during systole and diastole. Straightening, bowing with convexity toward the left ventricle and sinusoidal appearance of the interventricular septum are abnormal.

C. *Incorrect*. On short axis images, the interventricular septum is curved with the convexity toward the right ventricle. This appearance is maintained during systole and diastole. Straightening, bowing with convexity toward the left ventricle and sinusoidal appearance of the interventricular septum are abnormal.

D. *Incorrect*. On short axis images, the interventricular septum is curved with the convexity toward the right ventricle. This appearance is maintained during systole and diastole. Straightening, bowing with convexity toward the left ventricle and sinusoidal appearance of the interventricular septum are abnormal.

Reference:

Boxt LM. Radiology of the right ventricle. Radiol Clin N Am 1999;37:379-400

7. What is the MOST likely explanation for enlargement of the right atrium in a patient with mitral valve stenosis?

- A. Tricuspid valve regurgitation
- B: Pulmonary valve stenosis
- C. Tricuspid valve stenosis
- D. Tricuspid valve prolapse

Key: A

Rationale:

A. **Correct**. Chronic pulmonary venous hypertension in patients with mitral stenosis leads to elevated pulmonary arterial and right ventricular pressures. If severe, these will result in failure of the right ventricle, usually with tricuspid regurgitation.

B. *Incorrect*. The most frequent cause of pulmonary valve stenosis is a congenital valvular defect. Pulmonary valve stenosis secondary to rheumatic heart disease is very rare.

C. *Incorrect*. Rheumatic heart disease is the predominant cause of mitral stenosis. The tricuspid valve is primarily affected in only 5% of patients with rheumatic heart disease.

D. *Incorrect*. Tricuspid valve prolapse is associated with mitral valve prolapse and can result in tricuspid regurgitation and subsequent right atrial enlargement. Tricuspid valve prolapse is not associated with mitral stenosis.

8. Enlargement of which one of the following structures is the MOST reliable radiographic sign of pulmonary valve stenosis?

- A. Pulmonary trunk
- B: Right ventricle
- C. Left main pulmonary artery
- D. Right and left main pulmonary arteries

Key: C

Rationale:

A. *Incorrect*. The pulmonary trunk may be either normal or enlarged on radiographs in patients with pulmonary valve stenosis. Isolated pulmonary trunk enlargement is more frequent with idiopathic dilatation of the pulmonary artery.

B. *Incorrect*. The right ventricle hypertrophies in response to the pressure overload caused by pulmonary valve stenosis. Ventricular dilatation only occurs if ventricular failure or tricuspid regurgitation is present.

C. **Correct**. Enlargement of the left main pulmonary artery, with or without pulmonary trunk enlargement, is the radiographic hallmark of pulmonary valve stenosis.

D. *Incorrect*. Enlargement of both main pulmonary arteries is characteristic of either overcirculation or pulmonary arterial hypertension. Enlargement of the right pulmonary artery is not a feature of pulmonary valve stenosis

9. Regarding hypertrophic cardiomyopathy, which one of the following is an associated valvular abnormalty?

A. Aortic valve stenosis

- B: Mitral valve stenosis
- C. Systolic anterior motion of the mitral valve
- D. Mitral valve prolapse

Key: C Rationales:

A. *Incorrect.* Outflow obstruction in the setting of hypertrophic cardiomyopathy occurs in a subvalvular location. While the aortic valve may close prematurely during mid-systole, aortic valve stenosis is not characteristic of hypertrophic cardiomyopathy.

B. *Incorrect*. Although mitral valve regurgitation may coexist with hypertrophic cardiomyopathy, it is not a characteristic of hypertrophic cardiomyopathy.

C. **Correct**. The increased flow velocity occurring through the narrowed subvalvular left ventricular outflow tract draws the anterior leaflet of the mitral valve anteriorly due to the Venturi effect. This results in further obstruction of the left ventricular outflow tract.

D. *Incorrect*. The mitral value is typically drawn anteriorly during systole in the setting of hypertrophic cardiomyopathy. Prolapse posteriorly into the left atrium is not a characteristic of hypertrophic cardiomyopathy.

Reference:

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

10. Which of the following statements is TRUE regarding myocardial bridges?

- A. They occur in 5% of autopsy specimens.
- B: They are better depicted by CT than by angiography.
- C. They require surgical therapy.
- D. They most frequently affect the right coronary artery.

Key: B

Rationales:

A. *Incorrect*. In autopsy series, myocardial bridging, an intramuscular course of the coronary artery, occurs in 30% of specimens.

B. **Correct**. Because multiplanar reformatted images can be obtained from the CT dataset, CT is better able to detect the intramuscular course of the coronary artery.

C. Incorrect. In most cases, myocardial bridges are clinically silent.

D. Incorrect. Myocardial bridges are most frequently seen with the left anterior descending artery.

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© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown high-resolution CT images of a 40-year-old man taken in expiration. What type of emphysema is demonstrated?



A. Paraseptal

- **B:** Panacinar
- C. Centrilobular
- D. Paracicatricial

Key: B

Findings:

Uniform low attenuation in both lungs with paucity of pulmonary vessels, which are attenuated peripherally.

Rationales:

A. *Incorrect.* Paraseptal emphysema is characterized by multiple areas of subpleural emphysema often with visible thin walls that correspond to interlobular septa. The emphysema is localized in the subpleural zones and along the interlobar fissures.

B. **Correct.** Panacinar or panlobular emphysema is characterized on high-resolution CT by the presence of fewer and smaller than normal pulmonary vessels. The lungs appear of low attenuation and usually measure less than minus 910 Hounsfield units. Panacinar emphysema is almost always more severe in the lower lobes but may appear diffuse. In this case, the extensive lung destruction associated with paucity of peripheral vessels is readily detectable. This type of emphysema is characteristically identified in patients with alpha one antitrypsin deficiency.

C. *Incorrect.* Centrilobular emphysema is characterized on high-resolution CT by the presence of multiple small round areas of abnormally low attenuation several millimeters to a centimeter in diameter and distributed throughout the lung but usually with an upper lobe predominance. This is in contradistinction to the current case where the involvement is more marked at the bases of the lungs and individual well defined lucencies cannot be identified. The lucencies in centrilobular emphysema tend to be multiple, small and spotty. Centrilobular emphysema may become more severe and the areas of lung destruction may become more confluent and the centrilobular distribution may no longer be recognizable. The HRCT appearance can then closely simulate panlobular emphysema. However, such severe disease would not be expected in a 40-year-old. The development of centrilobular emphysema is directly related to smoking and is much more commonly seen in individuals in the sixth and seventh decades of life.

D. *Incorrect.* Paracicatricial or irregular emphysema is focal emphysema usually found adjacent to parenchymal scars, in diffuse pulmonary fibrosis and in the pneumoconiosis, particularly when progressive massive fibrosis is present. It is usually recognized on CT when associated fibrosis or scarring is identified. There is no evidence of fibrosis either focal or diffuse in the demonstrated case.

Citations:

Cardoso WV, Thurlbeck WM. Pathogenesis and terminology of emphysema. *Am J Respir Crit Care Med.* 1994;149:1383-1389.

Webb WR. High-resolution computed tomography of obstructive lung disease. *Radiol Clin North Am.* 1994;32:745-755.

Spouge D, Mayo JR, Cardoso W, et al. Panacinar emphysema: CT and pathologic correlation. *J Comput Assist Tomogr.* 1993;17:710-713.

2. A false negative F-18 FDG PET study is MOST likely to occur in which one of the following lung carcinomas?

- A. Bronchioloalveolar
- B: Small cell
- C. Squamous cell
- D. Large cell

Key: A

Rationales:

A. **Correct.** Bronchioloalveolar carcinoma. False-negative studies in primary lung cancer (negative PET which proves to be a tumor) are unusual but may be seen with small (less than 10 mm) in diameter lung cancers. False-negative examinations also occur in lung malignancies of low metabolic activity. Such tumors include both bronchioloalveolar carcinoma and carcinoid tumors. Another cause of a false-negative PET study is the presence of hyperglycemia in the patient being studied.

B. Incorrect.

C. Incorrect.

D. *Incorrect.* Positron emission tomography (PET) with F-18 labeled fluorodeoxyglucose is a glucose analogue label with positron emitting fluorine 18. It is a useful imaging modality in evaluating patients with lung cancer. PET takes advantage of one of the characteristic features of malignant cells, increased glucose metabolism. Because most malignant tumors are metabolically active, tumor cells take up increased amounts of FDG relative to normal lung tissue. The tumors listed in choices B to D are all malignant, highly metabolically active tumors, and would be expected to be positive on FDG/PET imaging.

Citations:

Kim BT, Kim Y, Lee KS, et al. Localized form of bronchioloalveolar carcinoma: FDG PET findings. *AJR*. 1998;170:935-939.

Gupta NC, Maloof J, Gurel E. Probability of malignancy in solitary pulmonary nodules using fluorine-18-FDG and PET. *J Nucl Med.* 1996;37:943-948.

Erasmus JJ, McAdams HP, Patz Jr EF, et al. Evaluation of primary pulmonary carcinoid tumors using FDG PET. *AJR*. 1998;170:1369-1373.

3. You are shown two images from a high-resolution CT of the chest of a 40-year-old female smoker with a 1-year history of increasing shortness of breath. What is the MOST LIKELY diagnosis?



- A. Centrilobular emphysema
- B: Lymphangioleiomyomatosis
- C. Langerhans cell histiocytosis
- D. Lymphocytic interstitial pneumonia

Кеу: В

Findings: Diffuse cystic lung disease. Lungs are uniformly involved with no evidence of architectural distortion.

Rationales:

A. *Incorrect*. Centrilobular emphysema which occurs in smokers is recognized by the presence of multiple lucencies which are predominant in the upper lobes. Characteristically these areas of centrilobular emphysema do not have well defined walls and therefore can be differentiated from cysts. Upper lobe predominance is a key feature and differs from the test case in which there is diffuse involvement.

B. **Correct**. Lymphangioleiomyomatosis. This disease occurs in young to middle-aged women of reproductive age. It is characterized by the presence of cysts with well-defined thin walls measuring 1-2 mm in diameter. The distribution is usually diffuse and other features of interstitial lung disease or fibrosis are notably absent, i.e. reticulation, small nodules, honeycombing and traction bronchiectasis. There is no evidence of architectural distortion.

C. *Incorrect*. Langerhans cell histiocytosis does occur in smokers but is characterized by a number of different features. Nodules up to 1 cm in diameter are common. These nodules frequently cavitate and in the end state of the disease a cystic pattern can be noted. However, a purely cystic pattern is extremely unusual. Upper lobe involvement predominates, and the bases, particularly the costophrenic angles are free of disease, a feature which is not present in the test case.

D. *Incorrect*. CT features of lymphoid interstitial pneumonia include 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. Most of these CT features are not present in the test case. The cysts are diffuse and not perivascular in location. **References:**

Johkoh T, Muller NL, Pickford HA, et al: lymphocystic interstitial pneumonia:Thin section CT findings in 22 patients. Radiology. 1999; 212:567-572.

Kulweic EL, Lynch DA, Aguayo SM, et al: Imaging of pulmonary histiocytosis. Radiographics. 1992; 12(3):512-526.

Palisa E, Sang P, Roman A, et al: Lymphangioleimyomatosis: Pulmonary and abdominal findings with pathologic correlations. Radiographics. 2002; 22:(S)185-198.

Webb WR. Radiology of obstructive pulmonary disease. AJR. 1997; 167:637-647.

4. You are shown a PA chest radiograph of a 54-year-old woman with shortness of breath and cough. What is the MOST LIKELY diagnosis?



- A. Miliary tuberculosis
- B: Pulmonary alveolar microlithiasis
- C. Lymphangitic carcinomatosis
- D. Idiopathic pulmonary hemosiderosis

Key: B

Rationales:

A. *Incorrect*. Miliary TB represents diffuse hematogenous spread of the tuberculin bacillus throughout the lungs. The radiographic appearance is that of tiny 1-2 mm nodules throughout the lungs. Our case has much more numerous micronodules than seen in miliary TB.

B. **Correct**. Correct. Pulmonary alveolar microlithiasis (PAM) is a rare condition of uncertain etiology. The chest radiograph shows numerous very fine micronodules throughout both lungs, more so in the middle and lower lung zones. The radiographic findings have been described as that of a sand-storm like appearance. Our case has classic features seen in PAM.

C. Incorrect. Lymphangitic carcinomatosis is characterized by metastatic tumor involvement of the lymphatic system. The typical chest radiographic findings include reticulonodular or linear opacities, septal lines and mediastinal or hilar adenopathy. These features are absent in our case.
D. Incorrect. Idiopathic pulmonary hemosiderosis is a rare disease of unknown etiology. It most commonly occurs in children in their first decade of life. It is seen as diffuse airspace opacities following an episode of acute hemorrhage. As the blood products break down, there is deposition of hemosiderin into the pulmonary interstitium and lymphatics. Thus, the radiographic findings following repeated bouts of bleeding appear as a reticular pattern. These features are absent in our case.
References:

Lauta VM: Pulmonary Alveolar Microlithiasis: An overview of clinical and pathological features together with possible therapies. Respir Med. 2003 Oct;97(10):1081-5.

Muller, N.L., Fraser, R.S., Colman, N.C., and Pare', P.D. Radiologic Diagnosis of Diseases of the Chest, W.B. Saunders, Co., Philadelphia, PA 2001

5. Which one of the following is MOST LIKELY to be associated with small cell carcinoma?

- A. Brachial plexopathy
- B: Hypoglycemia
- C. Hyponatremia
- D. Pupillary constriction

Key: C

Rationales:

A, B and D are Incorrect.

C is Correct. Small cell carcinoma is a form of lung cancer. It accounts for 15 – 20% of all lung cancers. It is characterized by rapid growth, early metastasis and extremely poor prognosis. It is associated with paraneoplastic syndromes, including Cushing's syndrome and inappropriate ADH secretion. Inappropriate ADH secretion results in hyponatremia. Hypoglycemia, Brachial plexopathy and pupillary constriction are not clinical features of small cell carcinoma. The most common tumor responsible for hypoglycemia in the thorax is Solitary fibrous tumor of the pleura. Brachial plexopathy and pupillary constriction are more likely to occur with superior sulcus tumor.

6. Concerning pulmonary veno-occlusive disease, which of the following are characteristic CT findings?

- A. Enlarged left atrium and diffuse interstitial edema
- B: Enlarged left atrium and normal lung parenchyma
- C. Normal-sized left atrium and normal lung parenchyma
- D. Normal-sized left atrium and diffuse interstitial edema

Key: D

Rationales:

A, B and C are Incorrect.

D is **Correct.** Pulmonary venoocclusive disorder is a rare disorder characterized by obliteration of small pulmonary veins. This leads to pulmonary hypertension. The causes are many and include viral infections, inhaled toxins and immune complex deposition within the lung to name a few. Diagnosis is suggested in a patient with pulmonary hypertension when radiographic features demonstrate enlarged pulmonary arteries, diffuse interstitial edema and small to normal sized left atrium.

7. Which finding is characteristic of sarcoidosis?

- A. Anterior mediastinal adenopathy
- B: Basilar reticular opacities
- C. Peribronchovascular nodules
- D. Random nodules

Key: C

Rationales:

A. *Incorrect*. Bilateral hilar and right paratracheal adenopathy is common. Anterior mediastinal adenopathy / mass usually signify Lymphoma or Thymoma.

B. *Incorrect*. The disease in sarcoidosis tends to be predominantly upper lobe in distribution.

C. Correct. Peribronchovascular or perilymphatic nodules are typically seen in patients with sarcoidosis.
 Nodules in sarcoidosis are also noted in the subpleural location and along the interlobular septa.
 D. *Incorrect*. Random nodules usually represent hematogenous metastasis or miliary infection, such as Tuberculosis.

References:

Muller, N.L., Fraser, R.S., Colman, N.C., and Pare', P.D. Radiologic Diagnosis of Diseases of the Chest. W.B. Saunders, Co., Philadelphia, PA 2001

8. How does the left superior vena cava return blood to the heart?

- A. Pulmonary veins
- B: Azygos vein
- C. Sinus of Valsalva
- D. Coronary sinus

Key: D

Rationales:

A. Incorrect.

B. Incorrect. The left superior vena cava drains into the right atrium via the coronary sinus.

C. Incorrect. The sinus of Valsalva is at the root of the aorta.

D. **Correct**. The left superior vena cava (SVC) drains into the right atrium via the coronary sinus. A leftsided SVC, a normal anatomic variant, is found in 0.3% of normal individuals. 80% of such individuals also have a right-sided SVC and 60% have a left BCV connecting to the right and left SVCs.

9. Which one of the following is characteristic of acute pulmonary emboli on CT angiography?

- A. Thickened, narrowed pulmonary arteries
- B: Pulmonary artery webs
- C. Central filling defect within the pulmonary arteries
- D. Mosaic perfusion of the lung parenchyma

Key: C

Rationales:

A. Incorrect.

B. *Incorrect*. Webs are seen with chronic emboli and represent residual thrombus or scarring in a recanalized vessel. Occasionally, these may calcify. They are much easier to see on angiography or coronal reconstructions of pulmonary embolism protocol CT.

C. **Correct**. The railroad track sign or doughnut sign (with the clot centrally and contrast peripherally) is a direct sign of acute pulmonary embolus on CT. Chronic pulmonary embolus tends to be eccentric. Occasionally, acute pulmonary embolus may be eccentric. The margin with the lumen, in these cases, tends to be convex as compared to chronic pulmonary embolus which has a flat or concave margin to the lumen.

D. *Incorrect*. Mosaic attenuation or perfusion is a finding more commonly seen with chronic emboli. The vessels in the darker regions are attenuated and the darker regions do not demonstrate air-trapping.

10. You are shown two chest radiographs of a 49-year-old man with cough. Which one of the following is the MOST likely diagnosis?



- A. Mucus plug
- B: Lung cancer
- C. Pneumonia
- D. Loculated pleural effusion

Key: B

Findings: Right upper lobe collapse from a central mass (Reverse S of Golden). **Rationales**:

A. Incorrect.

B. **Correct**. This radiograph represents the classic findings of right upper lobe collapse with increased opacity and volume loss. The central mass results in a convex inferior border which simulates a backwards "S" when viewed adjacent to the upper portion of collapse. This "Reverse S of Golden" should trigger the reader to think of a mass when it is present, usually bronchogenic carcinoma. *C. Incorrect*.

D. Incorrect.

References:

Woodring JH, Reed JC. Types and mechanisms of pulmonary atelectasis. J Thorac Imag 1996;11:92-108. Woodring JH, Reed JC. Radiographic manifestations of lobar atelectasis. J Thorac Imag 1996;109-144.

11. Which one of the following is MOST likely to cause obliteration of a portion of the descending aortic interface?

A. Pericardial cyst

- B: Bronchogenic cyst
- C. Lymphoma
- D. Neurogenic tumor

Key: D

Rationales:

A. Incorrect.

- B. Incorrect.
- C. Incorrect.

D. **Correct**. The descending aortic interface is formed by the juxtaposition of the aerated lung and the opacity of the left lateral margin of the descending thoracic aorta. The interface is visible from the top of the aortic arch to the level of the diaphragm inferiorly. Since the descending thoracic aorta is a posterior structure, abnormalities that obliterate the descending aortic interface are within the posterior mediastinum. Of the choices provided, only neurogenic tumors occur in the posterior mediastinum. Thus, they are most likely to obliterate the descending aortic interface.

References:

Muller, N.L., Fraser, R.S., Colman, N.C., and Pare', P.D. Radiologic Diagnosis of Diseases of the Chest. W.B. Saunders, Co., Philadelphia, PA 2001

12. Concerning idiopathic pulmonary fibrosis, which of the following is TRUE regarding the distribution of disease?

- A. Upper and central
- B: Upper and peripheral
- C. Lower and central
- D. Lower and peripheral

Key: D

Rationales:

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

D. **Correct**. Idiopathic pulmonary fibrosis affects patients between 50 and 70 years old. 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. Radiographic findings include reticular opacities at the lung bases in peripheral distribution.

References:

Muller, N.L., Fraser, R.S., Colman, N.C., and Pare', P.D. Radiologic Diagnosis of Diseases of the Chest. W.B. Saunders, Co., Philadelphia, PA 2001

Gastrointestinal Radiology In-Training Test Questions for Diagnostic Radiology Residents



QUALITY IS OUR IMAGE

April, 2015

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

© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown a spot view of the distal ileum from a small bowel series in a 48-year-old man. What is the MOST likely diagnosis?



- A. "Backwash ileitis" of ulcerative colitis
- B: "Pipestem bowel" of strongyloides infection
- C. Tuberculosis
- D. Crohn's ileitis

Key: A

Rationales:

A. **Correct.** The terminal ileum shows loss of mucosal folds and diffuse subtle nodularity with no ulceration or stricture. The ileocecal valve is gaping, but the ileocecal angle is preserved. The cecum is normal contour and shows diffuse superficial ulceration. These findings are characteristic of backwash ileitis of ulcerative colitis.

B. *Incorrect.* Strongyloides stercoralis infection is more common in the jejunum, with mucosal fold effacement and areas of narrowing.

C. *Incorrect.* Tuberculosis of the ileum shows ulceration and hypertrophic changes. The mucosal folds first thicken and then become effaced. Though the ileocecal valve is widely patent, this is usually accompanied by loss of the ileocecal angle and shrinkage of the cecum ("coned cecum").

D. *Incorrect.* Crohn's disease involving this much ileum is unlikely to be this homogeneous. It is more likely to show ulceration, more pronounced nodularity, stenosis, and eccentric bowel involvem

2. You are shown a contrast-enhanced CT of an elderly woman with chronic right upper quadrant pain. What is the MOST likely diagnosis?



- A. Acute calculous cholecystitis
- B: Traumatic gallbladder rupture
- C. Gallbladder carcinoma
- D. Adenomyomatosis

Key: C

Rationales:

A. *Incorrect.* The CT scan demonstrates a gallstone with rim calcification in the gallbladder. There is abnormal gallbladder wall thickening. The gallbladder pathology is complicated by contiguous involvement of the adjacent hepatic parenchyma, but this appears more extensive than pericholecystic inflammatory changes. Acute calculous cholecystitis is a consideration in this case, but the absence of fever and an elevated WBC makes this diagnosis unlikely.

B. *Incorrect.* Blunt abdominal trauma can cause gallbladder perforation or avulsion of the cystic duct. A traumatic perforation can result in either an intrahepatic or extrahepatic biloma. By CT, a biloma appears as a homogeneous, low-density, thin-walled, round to oval to lobulated collection. Fig. 3 does not show a discrete fluid collection typical of a biloma. In addition, no history of trauma is given.

C. **Correct.** Rationale: Gallbladder carcinoma is the most common cancer of the biliary tree. It is associated with cholelithiasis in 60 - 90% of cases. Gallbladder cancer is three times more common in women than in men, and it most often occurs in the eighth decade of life. Contiguous spread of neoplasm into the adjacent liver is common. This usually obviates curative surgery. As a result, the five year survival is only 3%.

D. *Incorrect.* Adenomyomatosis is a benign disorder of the gallbladder mucosa and muscular wall. It has two pathologic components that contribute to imaging findings. Intramural diverticula (Rokitansky-Aschoff sinuses) can appear as small hypoechoic spaces or can be filled with cholesterol crystals appearing as small echogenic foci with comet-tail acoustic artifact. Wall thickening can be

circumferential (waist-like), diffuse, or focal. Focal adenomyomatosis usually occurs in the fundus and cannot be differentiated from a polypoid gallbladder carcinoma. However, because adenomyomatosis is benign, gallbladder wall disruption with contiguous invasion of the liver would not be expected.

3. Concerning acute pancreatitis on a helical CT with dynamic bolus contrast enhancement, which finding is the BEST prognostic indicator of morbidity and mortality?

- A. Size of the pancreas
- B: Location and size of fluid collections
- C. Presence of biliary obstruction
- D. Pancreatic parenchymal enhancement

Key: D

Rationales:

A. *Incorrect.* While this is one of the indicators of the severity of acute pancreatitis, it is not the most predictive of M & M.

B. *Incorrect.* While this is one of the indicators of the severity of acute pancreatitis, it is not the most predictive of M & M.

C. Incorrect. While this is a complication of acute pancreatitis, it is not the most predictive of M & M.

D. **Correct.** There is general agreement that the development and extent of pancreatic necrosis are the most important indicators of disease severity. Necrosis is diagnosed when portions of the gland do not enhance.

4. What disease is associated with mesenteric desmoid tumors?

- A. Gardner's syndrome
- B: Carcinoid tumors
- C. Lymphoma
- D. Peritoneal mesothelioma

Key: A

A. **Correct.** Desmoid tumors occur predominately in patients with Gardner's syndrome who have had abdominal surgery.

B. *Incorrect.* Carcinoid tumors may have a similar appearance to desmoid tumors but are not associated with them.

- C. Incorrect. No association.
- D. Incorrect. No association.

- 5. Concerning focal hepatic fatty sparing, what is its appearance on imaging studies?
- A. Hypodense on CT relative to remaining liver
- B: Hyperechoic on US relative to remaining liver
- C. Demonstrates no signal loss on fat-suppressed MR images
- D. Heterogeneous enhancement

Key: C

Rationales:

A. *Incorrect*. Areas of fatty sparing are hyperdense.

B. Incorrect. Fatty sparing is hypoechoic.

C. Correct.

D. Incorrect. Enhancement pattern is similar to the entire liver.

Reference:

In: Lee JKT, Sagel SS, eds. Computed Body Tomography with MRI Correlation, Third Edition. Philadelphia: Lippincott-Raven, 1998.

6. You are shown an image from an abdominal CT performed in a 42 year-old man with a long history of Crohn's disease, who now presents with abdominal pain and distention. What is the MOST LIKELY diagnosis?



- A. Crohn's colitis
- B: Metastatic adenocarcinoma
- C. Abscess perforation with peritonitis
- D. Small bowel obstruction

Key: B

Rationales:

A. *Incorrect*. The ascending and descending colon are opacified by oral contrast and are unremarkable. The irregular band of soft tissue density in the anterior periphery of the peritoneal cavity is an omental cake.

B. **Correct.** The images show ascites and an omental cake compatible with peritoneal carcinomatosis. The most likely primary in a male patient of this age with this history of Crohn's disease is a small bowel adenocarcinoma. The heterogeneous mass anterolateral to the left iliac vessels is a surgically proven ileal adenocarcinoma, though I would not expect the observer to recognize this from this single image. "The risk for the development of small bowel adenocarcinoma is greater in patients with Crohn's disease than in the general population although the magnitude of this increased risk is unclear. Risk factors associated with the development of small bowel carcinoma in Crohn's disease include male sex, duration of disease, associated fistulous disease, and the presence of surgically excluded loops of bowel. Crohn's colitis has been associated with an increased risk of colorectal carcinoma in patients with long-standing colitis, strictures, fistulae, and right-sided colonic disease." (1)

C. *Incorrect*. While intraperitoneal perforation of abscess with infection may complicate Crohn's disease, this is extremely rare. While it would cause free fluid, it would not cause an omental cake.

D. *Incorrect*. While small bowel obstruction may complicate Crohn's disease, the bowel dilatation in this patient is due to short gut and not obstruction. It does not account for the signs of peritoneal carcinomatosis. **References**:

Bernstein D, Rogers A. Malignancy in Crohn's disease. *Am J Gastroenterol* 1996;91(3):434-40. Greenstein AJ, Sachar DB, Mann D, et al. Spontaneous free perforation and perforated abscess in 30 patients with Crohn's disease. *Ann Surg* 1987;205(1):72-6.
7. You are shown an image from a small bowel series on a 35-year-old man with abdominal pain and diarrhea. What is the MOST likely diagnosis?



- A. Lymphoma
- **B:** Carcinoid
- C. Graft versus host disease
- D. Sprue

Key: C

Rationales:

A. *Incorrect*. Lymphoma while producing a diffuse abnormality in the small bowel, it most commonly dilates and ulcerates (aneurismal dilatation) the intestine.

B. *Incorrect*. Carcinoid usually produces asymmetric fold thickening and a tethered appearance due to metastatic disease in the small bowel mesentery.

C. Correct. This is a classic appearance of graft versus host disease, a ribbon bowel.

D. *Incorrect.* While sprue can produce changes in the small bowel with total absence of mucosal folds, the moulage sign, sprue usually produces dilatation of the bowel and the findings are usually more common in the jejunum not the ileum.

References:

Herlinger H, Jones B, Jacobs JE. Miscellaneous Abnormalities of the Small Bowel. In: Gore RM, Levine MS, eds. Textbook of Gastrointestinal Radiology, Philadelphia: W.B. Saunders 2000;865-883

8. Concerning CT findings in the pancreas following blunt abdominal trauma, which of the following is TRUE?

A. Injury typically involves the pancreatic head region.

B: Contusion appears as low attenuation fluid separating enhancing pancreatic parenchyma.

C. Presence of fluid surrounding the pancreas is highly specific of glandular injury.

D. Focal glandular enlargement indicates injury.

Key: D

Rationales:

A. *Incorrect*. Injury to the pancreas after blunt abdominal trauma typically involves the midline or the neck portion of the pancreas.

B. *Incorrect*. Low attenuation fluid separating two portions of the enhancing pancreatic parenchyma is consistent with laceration, not contusion.

C. *Incorrect*. The presence of fluid surrounding the pancreas is not specific for glandular injury. Fluid surrounding the pancreas may be due to injury (post traumatic pancreatitis or acute hemorrhage) but can also be seen in patients with aggressive fluid resuscitation.

D. Correct. Subtle changes of pancreatic injury include focal pancreatic enlargement.

References:

Novelline R, Rhea JT, Bell T. Helical CT of abdominal trauma. Radiol Clin North Am 1999;37:591-612

9. Concerning primary biliary cirrhosis, which of the following is TRUE?

A. Predominately affects the extrahepatic bile ducts

- B: Associated with antimitochondrial antibodies
- C. More common in males than females
- D. Rapidly progresses to liver failure

Key: B

Rationales:

A. *Incorrect.* Primary biliary cirrhosis (PBC) does not affect the extrahepatic bile ducts. PBC is characterized by the necroinflammatory destruction of medium to small intrahepatic bile ducts. Periportal fibrosis and cirrhosis can ensue.

B. **Correct**. PBC is highly associated with antimitochondrial antibodies (AMA).

These autoantibodies are found in 95% of PBC patients.

C. Incorrect. PBC affects females rather than males in 90% of cases.

D. *Incorrect*. The natural history of PBC is one of slow progression. At least 25% of patients are initially asymptomatic. End-stage liver disease (ESLD) occurs over the course of 10-15 years.

References:

Chung RT, Podolsky D: Cirrhosis and its complications. In: Braunwald E, Fauci AS, Kasper DL, et al, eds. Harrison's principles of internal medicine. 15th ed. New York, NY:McGraw-Hill, 2001;1754-1767. Lindor KD: Primary biliary cirrhosis: clinical spectrum and mechanisms of disease. In: Bacon BR, Goodman ZD, Brunt EM, course directors. Liver disease in the 21st century: clinico-pathologic correlates. AASLD postgraduate course syllabus, 2003; 168-171.

10. Which of the following is TRUE regarding amebiasis?

A. It is caused by the protozoan Entamoeba dispar.

B: It is the most common parasitic cause of death worldwide.

C. It most commonly affects the right colon.

D. Extraintestinal complications of amebiasis are uncommon.

Key: C

Rationales:

A. *Incorrect.* Although 10% of the world's population is infected by *Entamoeba*, most are infected by the noninvasive species *E. dispar*, which results in an asymptomatic carrier state or self-limited infection. Amebiasis is caused by the invasive species *Entamoeba histolytica*.

B. Incorrect. Amebiasis is the third most deadly parasitic infection worldwide, after schistosomiasis and malaria.

C. **Correct.** Amebiasis most frequently involves the cecum and ascending colon. The rectum and sigmoid can be involved. The terminal ileum is spared.

D. *Incorrect*. Extraintestinal infection by *E. histolytica* is not uncommon and often involves the liver. The genitourinary tract can be involved by direct extension or by hematogenous spread. Amebiasis can cause genital ulcers and fallopian tube infection. Cerebral involvement occurs in 0.1% of patients, and can be rapidly fatal. **References**:

Reed S: Amebiasis and infection with free-living amebas. In: Braunwald E, Fauci AS, Kasper DL, et al, eds. Harrison's Principles of Internal Medicine, 15th ed. New York, NY:McGraw-Hill, 2001;1199-1203. Rubesin SE, Bartram CI, Laufer I: Inflammatory bowel disease. In: Levine MS, Rubesin SE, Laufer I, eds. Double contrast gastrointestinal radiology, 3rd ed. Philadelphia, PA:W.B. Saunders, 2000;417-470. Horga MA, Naparst TR, Dhawan VK: Amebiasis. In: eMedicine. March 30, 2006. (http://www.emedicine.com/ned/topic80.htm)

(http://www.emedicine.com/ped/topic80.htm)

11. Concerning nonalcoholic steatohepatitis, which one of the following is CORRECT?

A. Noninvasive imaging can distinguish between nonalcoholic steatohepatitis and nonprogressive nonalcoholic fatty liver disease.

B: Noninvasive imaging can detect mild (< 30%) fatty infiltration of the liver.

C. Histopathology reveals necroinflammatory changes and eventually fibrosis of the liver.

D. It does not result in cirrhosis.

Key: C

Rationales:

A. *Incorrect*. Noninvasive imaging can detect moderate to severe fatty liver disease. However, it can not distinguish between nonprogressive, noninflammatory nonalcoholic fatty liver disease, and progressive, inflammatory nonalcoholic steatohepatitis.

B. *Incorrect*. Noninvasive imaging can not detect fatty infiltration that is < 30% of hepatic mass.

C. **Correct.** By definition, NASH is a necroinflammatory condition of the liver with hepatocyte injury and lobular inflammation. These histopathologic changes are associated with the eventual development of hepatic fibrosis.

D. *Incorrect.* Hepatic fibrosis in NASH can evolve into cirrhosis. Like all cirrhotic livers, NASH- related cirrhosis is associated with an increased risk of hepatocellular carcinoma, which is estimated to occur in about 7% of cases. **Reference**s:

Brunt EM: Primary biliary cirrhosis: clinical spectrum and mechanisms of disease. In: Bacon BR, Goodman ZD, Brunt EM, course directors. Liver disease in the 21st century: clinico-pathologic correlates. AASLD postgraduate course syllabus, 2003;65-74.

Park SH, Kim PN, Kim KW, et al: Macrovesicular hepatic steatosis in living liver donors: use of CT for quantitative and qualitative assessment. *Radiology* 2006;239:105-112.

Saadeh S, Younossi ZM, Remer EM, et al: The utility of radiological imaging in nonalcoholic fatty liver disease. *Gastroenterology* 2002 123:745-750.

Shimada M, Hashimoto E, Taniai M, et al: Hepatocellular carcinoma in patients with non-alcoholic steatohepatitis. *J Hepatol* 2002 37:154-160.

12. Concerning pseudomembranous colitis, which one of the following is TRUE?

A. Clostridium difficile is the most common cause of antibiotic-related diarrhea.

B: Pseudomembranous colitis caused by C. difficile does not typically occur with administration of cephalosporins and penicillins.

C. Pseudomembranous colitis usually spares the sigmoid colon.

D. Pseudomembranous colitis is mediated by the release of C. difficile toxins.

Key: D

Rationales:

A. *Incorrect*. Antibiotic-related diarrhea is common, but only 10-20% of antibiotic-related diarrhea is caused by *C. difficile*.

B. *Incorrect.* Pseudomembranous colitis caused by *C. difficile* can occur with any antibiotic, especially clindamycin, cephalosporins and penicillins.

C. *Incorrect*. Pseudomembranous colitis is most often a pancolitis, but can be a segmental colitis. The sigmoid colon is spared in about 10% of cases.

D. **Correct.** Pseudomembranous colitis caused by *C. difficile* is toxin-mediated. The production of both an enterotoxin (Toxin A) and a cytotoxin (Toxin B) is required to cause pseudomembranous colitis. **References**:

Watanabe JM, Surawicz CM: Colitis: pseudomembranous, microscopic, and radiation. In: McNally PR, ed. GI/liver Secrets, 3rd ed. Philadelphia, PA:Elsevier Mosby, 2006;435-442.

Kawamoto S, Horton KM, Fishman EK: Pseudomembranous colitis: spectrum of imaging findings with clinical and pathologic correlation. *Radiographics* 1999;19:887-897.

13. Concerning angiosarcoma of the spleen, which one of the following is TRUE?

A. The spleen is not typically enlarged.

B: Malignant fibrous histiocytoma is more common than angiosarcoma.

C. Spontaneous rupture occurs in approximately 10% of patients.

D. Prognosis is very poor with only 20% survival rate at 6 months.

Key: D

Rationales:

A. Incorrect. The spleen is usually enlarged.

B. Incorrect. Angiosarcoma is the most common non-lymphoid primary malignant of the spleen.

C. Incorrect. Spontaneous rupture occurs in 30%, not 10%.

D. **Correct**. The prognosis is very poor.

References:

Mortele KJ, Mergo PJ, Kunnen M, Ros PR. Tumoral Pathology of the Spleen. In: Baert AL, Heuck FHW, Youker JE, eds. Medical Imaging of the Spleen. Berlin: Springer 2000;101-122.

14. Which of the following statements about duodenal adenocarcinoma is TRUE?

A. The jejunum is a more common site for primary adenocarcinoma than the duodenum.

B: The classic appearance on upper gastrointestinal examination is an apple core lesion.

C. There is an increased risk of adenocarcinoma in patients with a duodenal web.

D. Duodenal carcinoid is more common than duodenal adenocarcinoma.

Кеу: В

Rationales:

A. *Incorrect.* The duodenum is a more common site than the jejunum.

B. **Correct**. A short annular constricting ulcerative (apple core) lesion is the classic radiographic appearance.

C. Incorrect.

D. Incorrect. Duodenal carcinoid is rare.

References:

Gourtsoyiannis NC. Primary Malignant Neoplasms. In: Imaging of Small Intestinal Tumours. Gourtsoyiannis NC, Nolan DJ, eds. Amsterdam: Elsevier, 1997;105-189

15. Concerning Peutz-Jeghers Syndrome, which one of the following is TRUE?

A. It is an autosomal-recessive inherited trait.

B: It is associated with a high risk for the development of adenocarcinoma of the pancreas.

C. It represents 50% of hereditary gastrointestinal polyposis syndromes.

D. Approximately 80% of patients have gastric polyps.

Key: B

Rationales:

A. Incorrect. Peutz-Jeghers is inherited as an autosomal dominate trait.

B. Correct. There is an increased risk of a number of malignancies.

C. Incorrect. It represents about 10% of the hereditary polyposis syndromes.

D. Incorrect. Approximated 30% of patients have gastric polyps.

References:

Gourtsoyiannis NC, Nolan DJ. Polyposis Syndromes. In: Gourtsoyiannis NC, Nolan DJ, eds. Imaging of Small Intestinal Tumours. Amsterdam: Elsevier 1997;213-229.

General Competency In-Training Test Questions for Diagnostic Radiology Residents



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April, 2015

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

© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. The prevalence of a condition increases in a population being subjected to a diagnostic test. Which of the following should increase as a result?

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

Key: C

Rationales:

A. *Incorrect.* The sensitivity of a diagnostic test is the proportion of subjects with positive test results in a population of subjects who have the condition being tested for. The sensitivity is a characteristic of the test, and does not depend on the prevalence of the condition in the population being tested.
B. *Incorrect.* The specificity of a diagnostic test is the proportion of subjects with negative test results in a population of subjects who do NOT have the condition being tested for. The specificity is a characteristic of the test, and does not depend on the prevalence of the condition being tested for. The specificity is a characteristic of the test, and does not depend on the prevalence of the condition in the population being tested.

C. **Correct.** The positive predictive value is the posttest probability of a condition being present, given a positive test. The pretest probability of the condition is the same as the prevalence of the condition. Therefore, as the pretest probability of the condition increases, the posttest probability following a positive test also increases.

D. *Incorrect.* The negative predictive value is the posttest probability of a condition being present, given a negative test. The pretest probability of not having the condition decreases as the pretest probability of having the condition increases. The pretest probability is the same as the prevalence. Therefore, as the prevalence increases, pretest probability of not having the condition decreases, and the posttest probability of not having the condition following a negative test also decreases.

2. What is the MOST appropriate outcome measure in the evaluation of the effectiveness of cancer screening effectiveness?

- A. Number of disease cases identified
- B: Survival from time of diagnosis
- C. Overall mortality
- D. Disease specific mortality

Key: D

Rationale:

Screening aims to prevent or delay the effects of advanced disease. Depending on the contribution of disease-specific mortality to overall mortality, significantly reducing the death rate from a disease may still have an almost immeasurable effect on the overall mortality rate. Thus, disease specific mortality reduction is the most appropriate outcome measure in the evaluation of screening effectiveness.

3. Concerning HIPAA, which of the following requires written authorization prior to disclosure of Protected Health Information (PHI)?

A. Treatment, payment, and health care operations

- B: Public health activities
- C. Psychotherapy notes
- D. Cadaveric organ, eye, or tissue donation

Key: C

Rationales:

A. *Incorrect*. Permitted uses and disclosures of PHI include disclosure to related treatment, payment, and health care operations activities.

B. *Incorrect*. Disclosure for national priority purposes is permitted without authorization, including disclosure to public health authorities by law to collect and receive such information for disease prevention and control. Disclosure for FDA regulation and control of communicable diseases does not require authorization.

C. **Correct**. Disclosure of psychotherapy notes requires individual's authorization with the following exceptions: 1) originating covering entity may use notes for treatment or 2) covering entity may disclose for own training or for legal defense in proceedings originated by individual, for HHS to investigate compliance with Privacy Rules, to avert imminent threat to public health or safety, or for lawful activities or medical examiner or coroner.

D. *Incorrect*. PHI may be disclosed without authorization to facilitate donation and transplantation of cadaveric organs, eyes and tissue.

References:

United States Department of Health & Human Services OCR Privacy brief

www.hhs.gov/ocr/hipaaUniversity of Michigan Health Systems HIPAA Learning Module www.med.umich.edu/hipaa

4. What is the objective of ACR practice guidelines?

- A. Ensure a successful outcome from radiological interventions
- B: Establish legal standards for radiological practice
- C. Assist radiologists in providing appropriate care
- D. Ensure accurate radiological diagnosis

Key: C

Rationales:

Options A, B and D are incorrect. These guidelines are an educational tool designed to assist practitioners in providing appropriate radiological care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. It should be recognized, therefore, that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. It is expected that practitioners will follow a reasonable course of action based on

current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

5. Which of the following statements accurately reflects the American College of Radiology Code of Ethics?

A. The determination of whether or not to participate in quality assurance and utilization review is based on the discretion of the radiologist.

B: With regard to expert medical testimony, members may accept compensation contingent upon the outcome of litigation.

C. Prior to practicing in a hospital or other health-care entity, a radiologist must be board eligible or board certified.

D. Members should not enter into an agreement that prohibits the provision of medically necessary care or that requires care at below acceptable standards.

Key: D

Rationales:

A. *Incorrect*. The Rules of Ethics from the ACR Code of Ethics state "...A radiologist who regularly interprets radiographs and other images should reasonably participate in quality assurance, utilization review and other matters of policy that affect the quality of patient care...".

B. *Incorrect*. The Rules of Ethics from the ACR Code of Ethics state "In providing expert medical testimony, members should exercise extreme caution to ensure that the testimony provided is non-partisan, scientifically correct, and clinically accurate. The radiologist or radiation oncologist shall not accept compensation that is contingent upon the outcome of litigation".

C. *Incorrect*. The Rules of Ethics from the ACR Code of Ethics state "Prior to practicing in a hospital or other health care entity, a radiologist or radiation oncologist shall apply, and be accepted, as a member of that entity's medical staff in accordance with the medical staff's bylaws and in the same manner as all other physicians".

D. **Correct**. The Rules of Ethics from the ACR Code of Ethics state "Members should not enter into an agreement that prohibits the provision of medically necessary care or that requires care at below acceptable standards. Notwithstanding policies of a health plan, radiologists should advocate cost-effective appropriate studies or therapies that will benefit the patient, whose welfare is paramount".

References:

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

6. Which of the following is TRUE concerning the American College of Radiology Practice Guidelines on patient care and pelvic ultrasound?

A. The endometrium does not need to be evaluated in asymptomatic postmenopausal women.

B: A transrectal or transperineal approach is useful in patients who cannot tolerate a vaginal probe.

C. Transabdominal and transvaginal imaging must both be performed as patient's initial evaluation at a hospital or health care facility.

D. No recommendations specific to an examination performed by male physician or sonographer.

Key: B

Rationales:

B. **Correct**. ACR Practice Guidelines for the Performance of Pelvic Ultrasound state "...The endometrium should be analyzed for thickness, focal abnormality, and the presence of fluid or mass in the endometrial cavity. Assessment of the endometrium should allow for variations expected with phases of the menstrual cycle and with hormonal supplementation. If the endometrial stripe is difficult to image or ill-defined, a comment should be added to the report." Therefore, answer A is incorrect. While initial evaluation with both transabdominal and transvaginal approach is ideal, this is not a requirement of the ACR Practice Guidelines. The ACR Practice Guidelines state "All relevant structures should be identified by the transabdominal or transvaginal approach. In many cases, both will be needed..." Therefore C is incorrect. The ACR Practice Guidelines state "When possible, a female member of the physician or hospital's staff should be present as a chaperone in the examining room if a male is performing the examination." Therefore, answer D is incorrect. The ACR Practice Guidelines Specifications of the Examination state "...A Transrectal or transperineal approach is useful in patients who cannot tolerate a vaginal probe (e.g. virgins, postmenopausal women)." Therefore, answer B is correct. **References**:

www.acr.org, Quality and Safety, Guidelines/Standards, Ultrasound, ACR Practice Guideline for the Performance of Pelvic Ultrasound in Females

7. According to HIPAA, the privacy rule gives patients the right to:

A. refuse treatment by a health-care provider.

B: refuse release of protected health information (PHI) to Health & Human Services when it is undertaking a compliance investigation.

C. request disclosure of PHI for a spouse without requiring consent of said party.

D. request that PHI in their records be corrected or changed.

Key: D

Rationales:

D. Correct. A covered entity MUST disclose PHI (protected health information) in only two situations: a. to individuals (or their personal representatives) specifically when they request access to, or an accounting of disclosures of, their PHI; and b. to HHS (Health & Human Service) when it is undertaking a compliance investigation or review or enforcement action. Therefore, answer B is incorrect. The Privacy rule does not allow disclosure of PHI of a patient, aged 18 years or older, to a family member without the patient's consent. Answer A is incorrect. The Privacy rule gives patients the right to: have their PHI

protected, inspect and copy their records, request that PHI in their records be corrected or changed, ask for limits on how their PHI is used or shared, ask that they be contacted such as at work and not at home, and get a list of disclosures made of their PHI. The Privacy rule does not specifically address treatment issues or the right to refuse treatment. The Privacy rule sets "national standards for the protection of health information, as applied to the three types of covered entities: health plans, health care clearinghouses, and health care providers who conduct certain health care transactions electronically." Therefore, answer A is incorrect.

References:

United States Department of Health & Human Services OCR Privacy summary www.hhs.gov/ocr/hipaa University of Michigan Health Systems HIPAA Learning Module www.med.umich.edu/hipaa

8. Concerning HIPAA, which of the following information is considered part of the Protected Health Information (PHI)?

- A. First names of patient's children
- B: Photograph of extremity
- C. Name of employer
- D. Patient's e-mail address

Key: D

Rationales:

Protected Health Information (PHI) includes "individually identifiable health information" and "information that identifies the individual or for which there is a reasonable basis to believe can be used to identify the individual". The first names of a patient's children cannot be used to reliably identify a patient. Therefore, answer A is incorrect. A full face photograph is considered part of Protected Health Information (PHI). However, a photograph of an extremity cannot reasonably be used to identify an individual. Therefore, a photograph of an extremity is not part of PHI. Answer B is incorrect. The name of a patient's employer is not part of PHI. Answer C is incorrect. The patient's e-mail address can be used to identify an individual. E-mal address is part of PHI. Answer D is correct.

References:

United States Department of Health & Human Services OCR Privacy summary www.hhs.gov/ocr/hipaa University of Michigan Health Systems HIPAA Learning Module www.med.umich.edu/hipaa

Genitourinary Radiology In-Training Test Questions for Diagnostic Radiology Residents



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April, 2015

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© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. 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, further attempts to visualize the tube are futile since the intravasation usually occurs again with the next immediate injection.

Citations:

Ubeda B, Paraira M, Alert E, Abuin RA. Hysterosalpingography: Spectrum of normal variants and nonpathologic

findings. AJR 2001;177:131-135.

- 2. Regarding testicular torsion, which one of the following is TRUE?
- A. Color Doppler is more sensitive than power Doppler for detecting flow.
- B: It is associated with an abnormal mesenteric attachment bilaterally.
- C. It accounts for 70 % of cases of acute scrotal pain in adolescents.
- D. Symmetric homogeneous echogenicity of the testes excludes the diagnosis.

Кеу: В

Rationales:

A. *Incorrect.* Power Doppler is more sensitive than color Doppler for detecting flow, especially in neonates and young boys. Power Doppler shows superiority in demonstrating intratesticular vessels. Power Doppler is limited somewhat by being more sensitive to patient motion than color Doppler.

B. **Correct.** Cases of intravaginal torsion are caused by a bell-clapper deformity of attachment of the mesentery to the testis. The abnormality is bilateral in nearly all cases.

C. *Incorrect.* Testicular torsion only accounts for 30% of cases of scrotal pain in boys age 12-18. Epididymoorchitis or torsion of an appendix testis/epididymis are much more common causes of scrotal pain.

D. *Incorrect.* In early torsion (when most critical to detect torsion to permit salvaging the testicle), testes may have normally preserved gray-scale appearance. Later gray-scale ultrasound may demonstrate decreased echogenicity of the testis, testicular swelling or reactive hydrocele. Early on, the sonographic diagnosis of testicular torsion relies on the demonstration of decreased or absent flow in the torsed testis on color or power Doppler.

Citations:

Dogra VS, Gottlieb RH, Oka M, Rubens DJ. Sonography of the scrotum. Radiology. 2003;227(1):18-36.

3. You are shown a sagittal T2-weighted image from an MR of the pelvis in a 38-year-old woman with pelvic pain. What is the MOST likely diagnosis?



- A. Leiomyoma
- **B:** Adenomyosis
- C. Endometrial cancer
- D. Cervical cancer

Key: B

Rationales:

A. *Incorrect.* Although leiomyomas typically have low intensity on T2 weighted images, they would be expected to be round and well defined.

B. **Correct.** Adenomyosis results from the presence of heterotopic endometrial glands and stroma in the myometrium with adjacent myometrial hyperplasia. It is frequently associated with symptoms of pelvic pain, hypermenorrhea, and uterine enlargement. The diffuse thickening of the low intensity junctional zone is typical of diffuse adenomyosis of the uterus (junctional zone thickness 12 mm is generally considered diagnostic), and other imaging findings include poor definitions of the borders of the junctional zone, or the presence of high-signal foci on T2- or T1-weighted images. This case demonstrates diffuse adenomyosis; focal adenomyosis may also be seen.

C. *Incorrect.* For endometrial cancer, one would expect the high intensity endometrial stripe to be thickened, as well as inhomogeneous.

D. *Incorrect.* For cervical cancer, one would expect an isointense mass in the area of the cervix, which may deform the endocervical canal or disrupt the low-signal-intensity fibrous stroma, and one may see tumor extension towards the vagina and/or parametrium. In this case, the endocervical canal and cervical region appears normal.

Reference:

Smelka RC. Abdominal-Pelvic MRI. Wiley-Liss, New York, NY. 2002

4. You are shown three images from a CT scan focusing on the right adrenal gland. The images include a non-contrast CT scan, early enhanced phase, and delayed enhanced phase. What is the BEST diagnosis?



- A. Lipid rich adenoma
- B: Lipid poor adenoma
- C. Myelolipoma
- D. Indeterminate nodule

Key: D

Rationales:

- A. *Incorrect*. Diagnosis of a lipid rich adrenal adenoma is made on the non-contrast CT with HU < 10. The HU in this case on the non-contrast phase is 27.
- B. Incorrect. Lipid poor adenoma can be diagnosed if % washout is > 60%. In this case the calculated % washout is 53%. Additionally, the early enhanced phase image shows some heterogeneity of the lesion and washout calculations should be done only on homogeneous lesions.
- C. Incorrect. Myelolipoma is diagnosed by identifying macroscopic fat within the mass
- D. **Correct**. This nodule is indeterminant by CT washout criteria. A malignant neoplasm can't be excluded and followup or biopsy would be indicated. Additionally, close inspection of the images shows there is heterogeneity in this mass rendering washout evaluation of questionable value. Approximately 3 years after this study, the patient was found to have a very large adrenocortical carcinoma.

References:

Dunnick NR, Korobkin M. Imaging of Adrenal Incidentalomas: Current Status. AJR: 179. September 2002. 559-568.

5. What is the MOST likely diagnosis?



- A. Autosomal dominant polycystic kidney disease (APCD)
- B: Acquired cystic renal disease
- C. Tuberous sclerosis
- D. von Hippel-Lindau disease

Key: C

Rationales:

A. *Incorrect*. The kidneys are often enlarged in adult polycystic kidney disease, but the enlargement is due to innumerable renal cysts, not fatty tumors. The masses in this case contain macroscopic fat as evidenced by the HU number of -97 consistent with angiomyolipomas, not cysts. Additionally, there is no association of APCD with lung cysts.

B. *Incorrect.* Acquired cystic renal disease is a condition affecting patients with renal failure. The kidneys are typically small, not enlarged, as in this case. Multiple cysts develop often complicated by hemorrhage and calcification. Additionally, there is increased risk for developing renal cell carcinomas that present as solid masses.

C. **Correct**. The renal masses in this case have macroscopic fat consistent with angiomyolipomas. 80% of patients with tuberous sclerosis have renal angiomyolipomas and 1% of patients with tuberous sclerosis have lung cysts indistinguishable from those found in lymphangiomyomatosis.

D. *Incorrect*. Renal cysts and renal cell carcinomas develop in patients with VHL, but there is no association with angiomyolipomas. Additionally, there is no association of VHL with lung cysts. **References**:

Dunnick NR et al: Textbook of Uroradiology, 3rd Ed. Philadelphia. Lippincott, Williams & Wilkins. 109-111, 114, 116. 2001.

Federle et al: Diagnostic Imaging. Amirsys. Salt Lake City. III:3:56. 2004

Webb WR et al: High Resolution CT of the Lung, 3rd Ed. . Philadelphia. Lippincott, Williams & Wilkins. 431-435. 2001

6. You are shown a plain radiograph of the abdomen in a 55-year-old woman. Which one of the following is the MOST likely diagnosis?



- A. Chronic glomerulonephritis
- B: Acute cortical necrosis
- C. Hyperparathyroidism
- D. Milk-alkali syndrome

Key: C

Rationales:

A. *Incorrect*. Chronic glomerulonephritis is a cause of cortical nephrocalcinosis, not medullary nephrocalcinosis as is seen in this case.

B. *Incorrect*. Acute cortical necrosis is a cause of cortical nephrocalcinosis, not medullary nephrocalcinosis as is seen in this case.

C. Correct. Hyperparathyroidism is the *most* common cause of medullary nephrocalcinosis. Other common causes include renal tubular acidosis type I (distal type), and medullary sponge kidney.
D. *Incorrect.* Although milk-alkali syndrome is known to cause medullary nephrocalcinosis, it is much less common than hyperparathyroidism, renal tubular acidosis type I (distal type), and medullary sponge kidney.

Reference:

Dunnick NR et al: Textbook of Uroradiology, 3rd Ed. Philadelphia. Lippincott, Williams & Wilkins. 178-182, 2001.

Federle et al: Diagnostic Imaging. Amirsys. Salt Lake City. III:3:52-54. 2004 Rationale: 7. Which of the following is a TRUE statement about renal medullary carcinoma?

A. It is classically seen in young men and older women.

- B: It is associated with African-American patients with sickle cell trait.
- C. It arises from a metanephric blastema by 5 years of age.
- D. It is a benign renal neoplasm usually present at birth.

Key: B

Rationales:

A. *Incorrect.* Multilocular cystic nephroma is the renal neoplasm that is classically seen in young male patients and older females.

B. **Correct**. Medullary carcinoma is the renal neoplasm that is classically seen in young black patients with sickle cell trait.

C. *Incorrect*. Wilms' tumor is a renal neoplasm that arises from the matanephric blastema and is usually diagnosed by age 5.

D. Incorrect. Mesoblastic nephroma is a benign renal neoplasm usually present at birth.

Reference:

Dunnick et. Al. Textbook of Uroradiology 3rd ed. Lippincott, Williams & Wilkins, Philadelphia, PA. 2001.; enemy to gur2154

Interventional Radiology In-Training Test Questions for Diagnostic Radiology Residents



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© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown a single image from a percutaneous transhepatic cholangiogram of a jaundiced patient. What is the MOST likely diagnosis?



- A. Gallbladder carcinoma
- B: Sclerosing cholangitis
- C. Pancreatic carcinoma
- D. Choledochocele

Key: C

Findings: There is a tapering almost to the point of complete obstruction of the strictured distal common bile duct. There is marked dilatation of the intra and extra hepatic ducts proximal to the stricture. There is partial filling of a markedly distended gall bladder.

Rationales:

A. *Incorrect*. Gallbladder carcinoma causes obstruction at the level of the proximal common hepatic duct or higher. Because gallbladder carcinoma usually arises in the setting of chronic cholecystitis you will not expect to see a distended gallbladder.

B. *Incorrect*. Sclerosing cholangitis typically causes diffuse, multifocal strictures often with a beaded appearance in the intra and extrahepatic ducts.

C. **Correct**. The "rat tailed" appearance of the extrinsic obstruction and the location of the stricture at the level of the head of the pancreas make this diagnosis the favorite. The "Courvoisier's gallbladder" is also typical.

D. *Incorrect*. A choledochocele appears as a focal cystic collection of contrast at the level of the ampulla. **Reference:**

SCVIR Syllabus Series: Biliary Interventions.

2. You are shown an image from an abdominal aortogram. Which one of the following BEST describes the patient?



A. 25-year-old woman with recently discovered hypertension

B: 45-year-old man with acute renal failure

C. 70-year-old man with poorly controlled hypertension

D. 80-year-old woman being evaluated for an aortic stent graft

Key: C

Findings:

There is a severely atherosclerotic, but not ectatic abdominal aorta with atheromatous plaques and ulcers including an atheromatous plaque causing osteal stenosis of the right renal artery. **Rationales:**

A. *Incorrect*. This is an elderly patient with atheromatous disease. In a young woman, a more common cause for renal vascular hypertension would be fibromuscular dysplasia, the most characteristic appearance of which is a string-of-bead appearance along the course of the renal artery.

B. *Incorrect*. Even for a 45 year-old, this is advanced atherosclerotic disease and renal failure is unusual with unilateral renal artery stenosis. Not the best choice.

C. **Correct**. The age is right for the amount of disease in the aorta. The renal artery stenosis could easily explain the difficult to control hypertension.

D. *Incorrect*. Aortic stent grafts are typically used as an alternative to surgery for abdominal aortic aneurysms.

Reference:

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

3. Which one of the following conditions primarily involves the veins of the lower extremity?

- A. Kasabach-Merritt syndrome
- B: Kawasaki disease
- C. Klatskin tumor
- D. Klippel-Trenaunay syndrome

Key: D

Rationales:

A. *Incorrect*. Kasabach-Merrit syndrome is a consumption coagulopathy associated with large hemangiomas.

B. *Incorrect*. Kawasaki disease, mucocutaneous lymph node syndrome is a childhood necrotizing vasculitis affecting small and medium sized arteries. Coronary artery aneurysms are the most striking cardiovascular manifestation.

C. Incorrect. Klatskin's tumor is a cholangiocarcinoma.

D. **Correct**. Klippel-Trenaunay syndrome is a congenital disorder that features markedly abnormal lower extremity veins.

Reference:

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

4. A young healthy patient presents with acute right subclavian vein thrombosis following vigorous exercise. What is the MOST likely diagnosis?

A. May-Thurner syndrome

- B: Budd-Chiari syndrome
- C. Paget-Schroetter syndrome
- D. Parkes-Weber syndrome

Key: C

Rationales:

A. Incorrect. May-Thurner syndrome involves the left iliac vein

B. *Incorrect*. Budd-Chiari is a syndrome of hepatic venous drainage

C. Correct. Paget Schoetter is an upper extremity effort thrombosis syndrome.

D. *Incorrect*. Parkes-Weber syndrome is characterized by hypoplasia or absence of the deep veins of the legs, limb hypertrophy, atypical varicosities, port-wine stains and high-flow arteriovenous malformations. **Reference**:

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

5. You are shown subtracted and non-subtracted images from an inferior vena cavagram obtained prior to placing a filter. What does it show?



- A. Eustachian valve
- B: Budd Chiari syndrome
- C. Renal vein thrombosis
- D. Right iliac vein thrombosis

Key: A

Findings:

There is a valve at the junction of the inferior vena cava and the right atrium.

Rationales:

A. **Correct.** This valve, a remnant of the embryonic right valve of the sinus venosus, is called a Eustachian valve (valvula venae cavae inferioris).

B. *Incorrect*. Budd Chiari syndrome is not necessarily caused by hepatic vein thrombosis and can be caused by web like obstructions in the suprahepatic inferior vena cava. But what is shown here are vein cusps not impeding the flow of blood. Notice there is no reflux of contrast into tributary veins.

C. And D. *Incorrect*. It is a mistake to misinterpret the inflow of nonopacified blood from the iliac or renal veins as thrombus.

References:

Kaufman JA, Lee MJ. Vascular and Interventional Radiology. The Requisites. Mosby. 2004. Schuchlenz HW et al. Persisting Eustachian valve in adults: relation to patent foramen ovale and cerebrovascular events. J Am Soc Echocardiogr 2004; 17:231 6. You are shown two images from a catheter-based contrast study. Why was this procedure performed?



A. To evaluate chronic pelvic pain

- B: Prior to embolization to increase an abnormal sperm count
- C. For staging of a seminoma in a nondescended testis
- D. Prior to embolization of uterine leiomyomata

Key: A

Findings:

Note that the catheter ascends to the right of the midline, indicating that it is within the vena cava rather than the aorta. The catheter then crosses the midline at approximately L1 (likely in the left renal vein), and then descends to the left of midline (in the expected location of the left gonadal vein). The examination is a gonadal venogram. A normal gonadal venogram would demonstrate antegrade flow of contrast (back along the catheter). But this study demonstrates reflux down the incompetent left gonadal vein into the pelvis in the region of the female reproductive organs with anastomoses to the retroperitoneal veins and drainage via the left internal iliac vein.

Rationales:

A. Correct. Pelvic pain is the most common presenting complaint in women with ovarian vein reflux.

- B. Incorrect. The varicocele is not within the scrotum.
- C. Incorrect. Gonadal venograms are not commonly performed to evaluate seminomas.

D. Incorrect. This is a venous not arterial catheterization.

References:

Kadir. Diagnostic Angiography, 1st edition, p.488. SCVIR Workshop Book, 2000, pp. 125-132

7. Concerning popliteal artery entrapment syndrome, which of the following is TRUE?

A. Medial deviation of the popliteal artery is common.

- B: The majority of patients are women.
- C. The syndrome is an acute complication of trauma.
- D. Patients usually become symptomatic in the later decades of life.

Key: A

Rationales:

A. Correct. The commonest form of popliteal artery entrapment, about 50% of cases, results from the popliteal artery deviating medial to the normally attached medial head of the gastrocnemius muscle. B. *Incorrect.* 90% of cases have been reported in men.

C. Incorrect. Except for a rare surgical misadventure, this is a congenital condition resulting from an anomalous relation of the popliteal artery to the insertion of the calf muscles behind the knee.D. Incorrect. Although not all entrapped popliteal arteries become symptomatic, more than half of the patients present prior to or during the third decade of life.Reference:

Abou-Zamzam AM et al. Nonatherosclerotic Vascular Disease. In: Vascular Surgery; A Comprehensive Review, Moore, ed. W.B. Saunders; 1998, 132-134.

Murray A et al. Popliteal Artery Entrapment. Br J Surg 1991; 78:1414-1419.Gibson MH et al. Popliteal Entrapment Syndrome. Ann Surg 1977; 185:341-348

8. After endograft repair of an abdominal aortic aneurysm, a type II endoleak is characterized by:

- A. porosity of the graft material.
- B: modular graft component separation.
- C. proximal or distal graft attachment failures.
- D. reversal of flow in the aortoiliac branch arteries.

Key: D

Rationales:

A. Incorrect. Type IV endoleak is due to the porosity of the fabric of the endograft wall, during less than the 30-day period following implantation. Usually seen immediately following endograft implantation, this was more commonly seen with the first or second generation endografts.

B. Incorrect. An endoleak that occurs at the junction of modular endograft components is classified as a type III. Disruption of the fabric of the endograft or a hole related to a suture are also classified as a type III endoleak

C. Incorrect. Type I endoleak involves the proximal or distal attachment sites of the endograft.

D. Correct. One example. The left colic artery, a branch of the inferior mesenteric artery, often communicates freely with the middle colic artery, a branch of the superior mesenteric artery. Following the placement of a stent graft, the blood pressure in the excluded aneurysmal sac will decrease. Under this circumstance the higher blood pressure in the middle colic artery may reverse the direction of flow through the left colic artery, backing blood up into the aneurysmal sac. However, the hemodynamics of these type II leaks are complex. At the same time that there may be reversal of flow through some lumbar branch arteries to fill the sac, blood flow through other branches may be in the normal direction exiting the sac.

References:

Veith FJ et al. Nature and significance of endoleaks and endotension: summary of opinions expressed at an international conference. J Vasc Surg 2002; 35:1029-35

Choke E, Thompson M. Endoleak after endovascular aneurysm repair: current concepts. J Cardiovasc Surg 2004; 45:349-663. Stavropoulos et al. Use of CT Angiography to Classify Endoleaks after Endovascular Repair of Abdominal Aortic Aneurysms. J Vasc Interv Radiol 2005; 16:663-6674. Kaufman et al. Endovascular Repair of Abdominal Aortic Aneurysms. AJR 2000; 175:289-302 Rationale:

Musculoskeletal Radiology In-Training Test Questions for Diagnostic Radiology Residents



QUALITY IS OUR IMAGE

April, 2015

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

© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown axial T1- and T2-weighted MR images of a 23-year-old woman with foot pain. Which one of the following is the MOST likely diagnosis?



- A. Posterior tibial tendon tear
- **B:** Subtalar coalition
- C. Dysplasia epiphysealis hemimelica
- D. Tarsal tunnel syndrome

Key: B

Findings:

Narrowing with closely opposed irregular articular interface at the medial subtalar joint with maldevelopment of the sustentaculum tali, which slopes downward.

Rationales:

A. *Incorrect.* Posterior tibial tendon tears may be incomplete with thickening of the tendon, type I, incomplete with tendon attenuation, type II and complete, type III. Associated fluid at the tendon sheath is typical. Prominence of the medial soft tissues may be present. The posterior tibial tendon in the test case is normal.

B. **Correct.** The medial facet of the subtalar joint is one of the most common sites of developmental coalition of the foot. Such unions may be fibrous, cartilaginous or bony. In either case, there is close approximation of the 2 bones, often with down-sloping of the sustentaculum tali as seen in the test case. C. *Incorrect.* Dysplasia epiphysealis hemimelica—also known as Trevor's disease, tarsal aclasis, tarsoepiphyseal aclasis—is a development anomaly (dysplasia) in which a bony outgrowth, exostosis like in appearance, develops at an epiphysis or epiphysioid bone (epiphysealis) usually involving one side of the joint and one side of the body (hemimelica). The most common sites are the ankle and knee. The abnormal appearance of the medial subtalar joint in the test case represents coalition, not a bony outgrowth.

D. *Incorrect.* Tarsal tunnel syndrome is a compressive neuropathy involving the posterior tibial nerve resulting from any space-occupying lesion, behind and below the medial malleolus, beneath the flexor retinaculum. The tarsal tunnel in the test case is normal.

Citations:

Stoller, Tirman, Bredella. *Diagnostic Imaging Orthopaedics*. Amirsys Inc. Salt Lake City, UT. Resnick, Niwayama. *Diagnosis of Bone and Joint Disorders*. W.B. Saunders. Philadelphia, PA. Fourth Ed.

2. The "rotator cuff interval" is defined as the anatomic space between which tendons?

- A. Supraspinatus and infraspinatus
- B: Infraspinatus and teres minor
- C. Long head of biceps and subscapularis
- D. Supraspinatus and subscapularis

Key: D

Rationales:

A. *Incorrect.* The scapula spine separates the supraspinatus and infraspinatus musculature. The tendons are adjacent to one another.

B. *Incorrect.* There is no separation or interval between the adjacent infraspinatus and teres minor tendons.

C. *Incorrect.* The long head of the biceps tendon courses through the rotator cuff interval but does not define its border.

D. **Correct.** The rotator cuff interval is a "space" between the supraspinatus and subscapularis tendons through which the long biceps tendon travels from its origin on the supraglenoid tubercle to the bicipital groove.

Citations:

Bigoni BJ, Chung CB. MR imaging of the rotator cuff interval. *Magn Reson Imaging Clin N Am* 2004; 12:61-73.

Chung CB, Dwek JR, Cho Gj, et al. Rotator cuff interval: evaluation with MR imaging and MR arthrography of the shoulder in 32 cadavers. *J Comput Assist Tomogr* 2000; 24(5):738-43.

- 3. Concerning giant cell tumor of bone, which one of the following is associated?
- A. Periosteal reaction
- B: Paget's disease
- C. Matrix mineralization
- D. Hyperparathyroidism

Key: B

Rationales:

A. *Incorrect*. The lack of periosteal reaction is characteristic of GCT unless there is an associated fracture.
 B. **Correct**. Although a rare complication, numerous tumors are known to arise in Pagetoid bone including osteosarcoma (most common), chondrosarcoma, malignant fibrous histiocytoma and metastatic disease. Giant cell tumor rarely arises in the pelvic and fascial bones.

C. Incorrect. The lack of matrix mineralization is characteristic of GCT.

D. *Incorrect*. Many bone lesions demonstrate histology populated with giant cell tumors including nonossifying fibroma, giant cell reparative granuloma, osteitis fibrosa cystica (brown tumor) and giant cell tumor. The brown tumor of hyperparathyroidism however, is otherwise unrelated to GCT of bone.

4. Maisonneuve fracture is associated with:

- A. Fracture of the sustentaculum tali.
- B: subtalar dislocation.
- C. tear of the spring ligament.
- D. tear of the tibiofibular syndesmosis.

Key: D

Rationales:

A. *Incorrect*. The exact mechanism for the Maisonneuve fracture is poorly understood, but it likely results from multidirectional forces. Associated ankle injuries include fracture of the medial malleolus or tear of the deltoid ligament, fracture of the posterior malleolus, and a tear of the anterior or posterior talofibular ligaments. The sustentaculum tali may fracture as a component of a depressed, comminuted intra-articular calcaneal fracture. The posterior subtalar joint is typically involved. The medial subtalar joint is typically spared.

B. *Incorrect*. The Maisonneuve fracture does not extend into the hindfoot. Forces begin at the tibiotalar joint, and extend proximally.

C. *Incorrect*. The spring ligament courses between the calcaneus and the navicular. The hindfoot and midfoot are not involved in the Maisonneuve fracture.

D. **Correct**. The unique feature of the Maisonneuve fracture is the extension of the force proximally through the tibiofibular syndesmosis to the proximal fibula shaft or neck where a fracture is encountered.

- 5. Concerning the ankle tendons, which one is CORRECT?
- A. The flexor digitorum longus inserts on the distal shaft of the third through fifth metatarsal.
- B: The peroneus brevis inserts on the base of the fifth metatarsal.
- C. The tibialis posterior inserts on the distal first metatarsal shaft.
- D. The flexor hallucis longus inserts on the head of the first metatarsal.

Кеу: В

Rationales:

A. *Incorrect*. The flexor digitorum longus originates at the posterior surface of the tibia, and inserts at the plantar surface of the bases of the distal phalanges of the second through fifth toes.

B. **Correct**. The peroneus brevis originates at the lower two thirds of the lateral fibula, and inserts on the fifth metatarsal base laterally.

C. *Incorrect*. The tibialis posterior originates from the tibia, fibula and interosseous membrane. The insertion is variable, and can include the second through fourth metatarsals, cuneiforms, cuboid, and navicular.

D. *Incorrect*. The flexor hallucis longus originates at the mid-to distal fibula, and inserts on the plantar surface of the base of the distal phalanx of the great toe.

6. You are shown sagittal proton density and coronal proton density fat-suppressed MR images. What is the MOST likely diagnosis?



- A. Meniscal flounce
- B: Bucket-handle tear
- C. Myxoid degeneration
- D. Discoid meniscus

Key: D

Rationales:

A. *Incorrect*. Meniscal flounce refers to a physiologic change in the shape of the meniscus, presumably due to traction related to positioning, which may be observed during routine MR imaging. The undulating appearance may mimic a tear.

B. *Incorrect*. The bucket-handle tear involves a longitudinal tear at the periphery of the meniscus, usually the medial, with displacement of the more central meniscal tissue (the bucket handle) to the intercondylar notch.

C. Incorrect. Increased signal within the substance of the meniscus that does not extend to its superior or inferior articular surface may represent several phenomena including peripheral neurovascular structures, degeneration and perhaps intrasubstance tear. Such menisci are usually not torn.
Prominent areas of increased signal intensity within the substance of a meniscus are more significant when the meniscus is discoid in nature, indicative of cavitation, or there is an associated meniscal cyst.
D. Correct. There is excessive meniscal tissue occupying the lateral joint compartment, like a disc between two adjacent vertebrae. Normal menisci are semilunar fibrocartilage structures at the periphery of the medial and lateral joint compartments. The etiology of the discoid meniscus is unknown. The lateral meniscus is almost always involved.

7. Concerning Paget's disease of bone, which one is MOST characteristic?

- A. Decreased alkaline phosphatase
- B: Osteitis fibrosa cystica
- C. Looser's zones
- D. Spinal stenosis

Key: D

Rationales:

A. *Incorrect*. Serum alkaline phosphatase is elevated secondary to increased rate of bone formation and osteoblastic activity. Serum and urinary hydroxyproline is elevated secondary to increased rate of bone resorption and osteoclastic activity. The degree to which these are elevated is roughly related to the stages and activity of the disease. Serum calcium and phosphate levels are normal.

B. *Incorrect*. Osteitis fibrosa cystica refers to the skeletal alterations secondary to hyperparathyroidism. Osteoporosis circumscripta refers to Pagetic, osteolytic involvement of the skull.

C. *Incorrect*. A Looser's zone or pseudofracture refers to focal unmineralized osteoid seen in patients with osteomalacia. They are probably stress related but are not fractures. They have a typical adiographic appearance: short linear lucency, perpendicular to the cortex, incompletely traversing the bone, often with a sclerotic margin. They are usually bilateral and symmetric, involving the posterior proximal ulna, pubic rami, medial proximal femora, ribs and axillary margins of the scapula. Though stress fractures related to Paget's disease are similar in appearance, these are less generalized, and notably involve the convex rather than concave, bowed cortex.

D. **Correct**. Paget's disease commonly affects the vertebra, usually the anterior and posterior elements. Cortical thickening and subsequent enlargement of bone may result in central, lateral recess or neural foraminal stenosis. Collapse of an involved vertebral body may also narrow the spinal canal.

8. Mazabraud's syndrome refers to the association of fibrous dysplasia and which one of the following?

- A. Facial deformity
- B: Soft tissue myxomas
- C. Malignant transformation
- D. Endocrinopathy

Key: B

Rationales:

A. *Incorrect*. The skull and facial bones are common sites for both monostotoic and polyostotic fibrous dysplasia, more common with the latter, approximately 50% of cases. The maxilla, frontal, sphenoid, and ethmoid bones are typically involved. The facial deformity resulting from bilateral involvement of the mandible in patients with Familial fibrous dysplasia of the jaw has been referred to as cherubism. B. **Correct**. Mazabraud described and emphasized the association of soft tissue myxomas with fibrous dysplasia. Fibrous dysplasia in such cases is most often polyostotic. The patients are usually woman, some with McCune-Albright syndrome. The myxomas range in size and the thigh has been reported as the most common site of involvement. Malignant bone tumors have been reported, the incidence greater than that of fibrous dysplasia itself.

C. *Incorrect*. Malignant transformation of monostotic or polyostotic fibrous dysplasia is rare, <1%. Osteosarcoma, fibrosarcoma, malignant fibrous histiocytoma and chondrosarcoma have been described. The incidence is higher in patients with Mazabraud's syndrome but the syndrome is a reference to the association of fibrous dysplasia and soft tissue myxomas.

D. *Incorrect*. The McCune-Albright syndrome describes polyostotic fibrous dysplasia, cutaneous pigmentation and sexual precocity or precocious pseudopuberty. The mature gonadal function implied by the term puberty is not present. There are incomplete forms without cutaneous pigmentation. Other endocrinopathies including Cushing's disease, acromegaly, hyperthyroidism, hyperparathyroidism, pheochromocytoma and diabetes have also been associated with fibrous dysplasia.

- 9. Concerning aneurysmal bone cysts, which of the following are associated?
- A. Fibrous dysplasia
- B: Osteoid osteoma
- C. Enchondroma
- D. Plasmacytoma

Key: A

Rationales:

A. **Correct**. Aneurysmal bone cysts are often superimposed upon existing benign and malignant tumors most notably giant cell tumor, nonossifying fibroma, fibrous dysplasia, chondroblastoma, osteoblastoma, osteosarcoma, chondrosarcoma and hemangioendothelioma. In the case of telangiectatic osteosarcoma, the two different components of the lesion may appear similar or identical with imaging. This may result in errors with percutaneous biopsy if only portions of the cyst are sampled. Nonossifying fibroma is a benign, cortically based lesion that is usually found in long tubular bones. The etiology is argued, but many feel the nonossifying fibroma to be the sequelae of unrecognized trauma to the periosteum that leads to focal hemorrhage. Aneurysmal bone cysts are also felt by many to represent prior trauma, not neoplasia. It is therefore intuitive that the two lesions could be found in the same location. Fibrous dysplasia is a hamartomatous disorder of osteoblasts that fail to undergo differentiation. The monostotic form is most common. Skin and endocrine anomalies may be associated with the polyostotic form. Although fibrous dysplasia may rarely be associated with malignant transformation, new symptoms or growth of a known focus of fibrous dysplasia often signifies the development of a superimposed aneurysmal bone cyst.

B. *Incorrect*. Osteoid osteoma is a benign bone forming neoplasm usually cortically based and extraarticular, with characteristic reactive sclerosis. Intracapsular, intramedullary and subperiosteal lesions also occur. Osteoid osteomas that are intra-articular incite little or no sclerosis. Intra-medullary and subperiosteal lesions provoke variable degrees of sclerosis. There is no association with ABC. Osteoblastoma, however, is associated.

C. *Incorrect*. Enchondroma is a benign cartilage forming neoplasm within the medullary canal. Such lesions on the surface of the bone are known as superiosteal or juxta-cortical chondromas. They are most common at the fingers. There is no association with ABC.

D. *Incorrect*. Plasmactyoma represents the solitary form of myeloma. While laboratory teats may be negative at the time of diagnosis, many patients will eventually develop multiple myeloma. The lesions are usually lytic, and may be expansile or non-expansile. Rarely, a plasmacytoma may be blastic. An association between plasmacytoma and aneurysmal bone cyst has not been described.
10. Which of the following tumors is characterized by a subarticular location?

A. Osteoblastoma

- B: Clear cell chondrosarcoma
- C. Chondromyxoid fibroma
- D. Aneurysmal bone cyst

Кеу: В

Rationales:

A. *Incorrect*. The most common location for osteoblastoma is in the dorsal elements of the spine where forty percent are found. The remaining are usually located in the long bones and phalanges. An epiphyseal or subarticular location is rare. Osteoblastoma is usually expansile, and may be associated with neurologic deficit. B. **Correct.** Few lesions have a propensity for the end of the bone, epiphysis or apophysis (epiphysis equivalent). Giant cell tumor of bone and chondroblastoma are oth such lesions. Approximately 5% of giant cell tumors are malignant and associated with lung metastases. Otherwise, both of these are considered benign. The malignant tumor that is found at the end of the bone, subarticular, is clear cell chondrosarcoma. This is a slow growing tumor, and symptoms may be present for over five years before diagnosis. The tumor may be lobulated and calcified, or lytic and ill defined.

C. *Incorrect*. As the name implies, chondromyxoid fibroma is a benign tumor composed of chondroid, myxoid and fibrous tissue. Three-fourths are found in the lower extremities. Approximately half involve long bones, and ninety-five percent of those are found in the metaphysis. The remaining five percent are diaphyseal.

D. *Incorrect*. Although aneurysmal bone cysts may be engrafted on epiphyseal or subarticular lesions such as giant cell tumor and chondroblastoma, the most common locations are the metaphysis of long bones and the dorsal elements of the vertebrae. Approximately one third of aneurysmal bone cysts are secondary, associated with other entities. The remaining may represent primary aneurysmal bone cysts, or may reflect complete destruction of the entire pre-existing tumor by the aneurysmal bone cyst. **References**:

Mirra JM, Picci P, Gold RH. *Bone Tumors: Clinical, Radiologic, and Pathologic Correlations*. Lea & Febiger, Philadelphia, PA, 1989

- 11. Which of the following synovial spaces normally communicate with each other?
- A. The glenohumeral joint and the subacromial bursa
- B: The pisiform recess and the radiocarpal joint
- C. The ankle joint and the peroneal tendon sheath
- D. The posterior subtalar joint and the Achilles tendon sheath

Key: B

Rationales:

A. *Incorrect*. Communication between the glenohumeral joint and the subacromial bursa (more accurately, the subacromial/subdeltoid bursal complex) indicates the presence of a full thickness rotator cuff tear. This principal is the basis for diagnosis of such tears on both conventional and MR glenohumeral arthrography.

B. **Correct**. Either space may be entered for wrist arthrography. Excessive fluid in the pisiform recess should not be considered abnormal if there is a radiocarpal joint effusion.

C. *Incorrect*. The ankle joint may normally communicate with the tendon sheaths of the flexor digitorum longus and flexor hallucis longus at the medial aspect of the ankle. Communication with the lateral tendon sheath (common peroneal) implies a tear of the calcaneofibular ligament.

D. *Incorrect*. The Achilles tendon does not have a true tendon sheath. Instead, it is surrounded by connective tissue called a paratenon. This provides for the normal gliding action of the tendon. **References**:

Arndt RD, Horns JW, Gold RH. Clinical Arthrography. 2nd ed. Williams & Wilkins, Baltimore, MD. 1985.

12. You are shown an oblique coronal T2-weighted gradient echo image of a 50-year-old man with shoulder pain. Which one of the following is the cause of the abnormality?



- A. Calcium hydroxyapatite
- B: Calcium pyrophosphate dihydrate
- C. Monosodium urate
- D. Hemosiderin

Key: A

Rationales:

A. **Correct**. There is focal signal void at the suprapinatus tendon The capsular, tendinous, ligamentous and bursal tissues about the shoulder are the most common sites of peri-articular calcific deposits. The supraspinatus tendon is the most frequent site of calcification, usually at the insertion near the greater tuberosity. Although other crystals may deposit here, most are calcium hydroxyapatite.

B. *Incorrect*. CPPD deposition may be present in synovium, cartilage, capsule, tendon, ligament and bursae. Involvement of the supraspinatous tendon is not uncommon and there may be associated HAA deposition. Deposition in cartilage, however, is more typical.

C. *Incorrect*. Monosodium urate deposition may occur in the peri-articular soft tissues including the joint capsule, tendon, ligament and bursa but is much more common in the synovium and articular cartilage. There is a predilection for the lower extremity.

D. *Incorrect.* Hemosiderin deposits within the synovium not the tendons and may be secondary to resolving hematoma or recurrent hemarthrosis as in pigmented villonodular synovitis or hemophilia. It is noted with inflammatory arthritis as well.

References:

Manaster, Disler, May. Musculoskeletal Imaging. The Requisites. 2nd ed. Mosby, St. Louis MO, 2002.Resnick, Niwayama. Diagnosis of Bone and Joint Disorders. W.B. Saunders. 2002,Philadelphia, PA. Fourth Ed.

Neuroradiology In-Training Test Questions for Diagnostic Radiology Residents



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April, 2015

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© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. Lumbar spine radiographs demonstrate a grade I anterior spondylolisthesis at L4-L5 and bilateral L4 pars interarticularis defects. Lumbar MRI at this level would MOST likely reveal which one of the following findings?

A. Stenosis of the central spinal canal and widening of neural foramina

- B: Stenosis of the central spinal canal and stenosis of the neural foramina
- C. Widening of the central spinal canal and widening of the neural foramina
- D. Widening of the central spinal canal and stenosis of the neural foramina

Key: D

Rationales:

Anterior spondylolisthesis in the lumbar spine commonly results from either degenerative facet disease or spondylolysis. With either cause, there is frequently narrowing of the neural foramina.

A. *Incorrect.* Disc herniations and other epidural masses may produce central stenosis without foraminal stenosis. There is typically no spondylolisthesis.

B. *Incorrect.* Spondylolisthesis due to degenerative facet disease frequently causes central spinal canal stenosis and foraminal stenosis.

C. Incorrect. These findings may occur with trauma but are not typical of degenerative disease. D. **Correct.** Spondylolisthesis due to spondylolysis usually results in enlargement of the central spinal canal, at least with grades I and II. When spondylolytic spondylolisthesis becomes severe (grade IV), there may also be central stenosis.

Citations:

DH Yock. *Magnetic Resonance Imaging of CNS Disease*. 2nd ed. St Louis, Mo: Mosby; 2002:592-593.

2. Which of the following is a TRUE statement concerning the salivary apparatus?

- A. Plunging ranulas are confined to the sublingual space.
- B: Wharton's duct drains the sublingual gland.
- C. Stensen's duct drains the parotid gland.
- D. Calculi most commonly occur in the parotid gland.

Key: C

Rationales:

A. Incorrect. Plunging or diving ranulas extend from the sublingual into the submaxillary space as well.

B. Incorrect. It drains the submandibular gland.

C. Correct. True.

D. Incorrect. Calculi most commonly (80-90%) occur in the submandibular gland.

References:

Diagnostic Imaging: Head and Neck. Harnsberger. Amerisys 2004. Part III :Section 4 – Ranula pages 26-29 Head and Neck Imaging 4th Edition. Som. Mosby 2003. Chapter 39 – Salivary Glands: Anatomy and Pathology pages 2005-2040

- 3. Which statement concerning the LeFort classification of facial injuries is TRUE?
- A. All types involve the pterygoid plates and nasal region.
- B: All types involve the orbital floors and zygomas.
- C. The Type III injury is characterized by a free floating palate (transmaxillary fracture).
- D. The type II injury is characterized by cranial facial dissociation.

Key: A

Rationales:

A. **Correct**. LeFort Fractures basically occur along weakness planes in the facial skeleton. These include the two structures mentioned above.

B. *Incorrect*. The LeFort type I injury specifically does not involve the orbits with the blow and fracture line occurring at the level of the maxilla. The fracture includes the entire palate, maxillary and alveolus teeth and portions of the pterygoid plates. The zygoma is not included in the classification of LeFort fractures.

C. Incorrect. This describes the Type I injury.

D. Incorrect. This describes the Type III injury.

References:

Som PM, Curtin HD Head and Neck Imaging, Third Edition, Mosby, St. Louis 1996Grossman R, Yousem D. Neuroradiology, The Requisites Second Edition, Philadelphia, Mosby, 2003

4. Which statement is TRUE concerning diastematomyelia?

A. It is the most commonly encountered neural tube defect.

B: It is commonly seen in infants of mothers with diabetes mellitus.

C. There is duplication of the spinal cord with sensory and motor roots originating from each cord.

D. The spinal cord is split, separated by bone, cartilage, or a fibrous septation.

Key: D

Rationales:

A. *Incorrect*. Meningoceles and myelomeningoceles are the most commonly encountered neural tube defects.

B. *Incorrect*. Caudal Regression Syndrome is commonly seen in infants of diabetic mothers. Diastematomyelias are associated with other spinal anomalies including Chiari II and myelomeningoceles.

C. Incorrect. This is actually the definition of diplomyelia which is a much more rare anomaly

D. **Correct**. Diastematomyelia involves a split of the cord into two separate components. As mentioned, the division may be the result of bone, cartilaginous or fibrous septation. The separate halves so to speak may be enclosed in a single dural sac or the split may involve the dura as well. **References**:

Davis P, Hoffman Jr. J et al., Spinal Abnormalities in Pediatric Patients: MR Imaging Findings Compared with Clinical, Myelographic and Surgical Findings, Radiology 1988; 166:679-685Grossman R, Yousem D. Neuroradiology, The Requisites Second Edition, Philadelphia, Mosby, 2003

5. Tolosa-Hunt syndrome is MOST closely related to:

- A. orbital pseudotumor.
- B: Wegener's granulomatosis.
- C. post-transplant lymphoproliferative disorder.
- D. sarcoidosis.

Key: A

Rationales:

A. **Correct**. Tolosa Hunt syndrome is an idiopathic inflammatory process involving the orbital apex and/or the cavernous sinus. It is histologically identical to orbital pseudotumor. Commonly presenting with retroorbital pain and multiple cavernous sinus cranial nerve palsies, it is rapidly responsive to steroid therapy.

B. Incorrect. Wegener's granulomatosis is a necrotizing granulomatous inflammatory process which may involve the orbit and paranasal sinuses. It is either transiently responsive or nonresponsive to steroid therapy. Antineutrophil cytoplasmic antibodies (ANCA) are sensitive indicators of the entity.
C. Incorrect. Posttransplant lymphoproliferative disorder occurs in a small percentage of patients following organ transplantation. It likely is incited by Ebstein Barr virus infection which leads to a proliferation of the B cell population. In these immunosuppressed patients, this proliferation is unopposed secondary to a deficiency in the T cell population. A spectrum of disease results which ranges from adenopathy and lymphoid tissue hypertrophy to lymphoma.

D. *Incorrect*. Sarcoidosis is a granulomatous disease of unknown etiology. CNS involvement occurs in a minority of cases. It can present in a number of ways including dural based mass, leptomeningeal mass/enhancement, and intraaxial mass. Orbital involvement including uveitis and orbital masses can also occur.

References:

Grossman and Yousem, Neuroradiology Requisites 2nd edition, Mosby, Philadelphia 2003 Som and Curtin, Head and Neck Imaging 3rd edition, Mosby, Philadelphia 1996 Rationale:

- 6. Regarding sinonasal mucoceles, which of the following is TRUE?
- A. Most commonly found in the sphenoid sinus
- B: May have an enhancing rim rather than interior enhancement
- C. Most commonly have decreased signal on T1WI and T2WI
- D. Associated with smaller than normal sinus

Кеу: В

Rationales:

A. Incorrect: Frontal and Ethmoid Sinuses are more common

- B. Correct: Mucoceles have an enhancing rim whereas tumors have more solid enhancement.
- C. *Incorrect*: Mucoceles typically have increased T1 signal on MR
- D. Incorrect: Mucoceles are associated with an expanded enlarged sinus

References:

Grossman and Yousem. The Requisites. Neuroradiology, pp 510, 628, 2nd edition, Mosby, Philadelphia, PA, 2003.

7. Which of the following is the MOST common type of vascular malformation involving the spine?

- A. Dural arteriovenous fistula
- B: Glomus arteriovenous malformation
- C. Juvenile arteriovenous malformation
- D. Aneurysm

Key: A

Rationales:

A. **Correct**. This is the most common vascular malformation in the spine. These lesions typically present with paraplegia. MR shows spinal cord edema, with variable visualization of enlarged vessels.

Angiography demonstrates an enlarged draining vein on the surface of the cord. Patients present with progressive lower extremity weakness due to venous hypertension.

B. *Incorrect*. These uncommon lesions are similar to parenchymal AVM's seen in the brain. They usually present after hemorrhage.

C. *Incorrect*. These unusual lesions are extensive AVM's which are both intra and extra dural. They are extensive lesions which involve skin, muscle and bone in addition to spinal cord.

D. Incorrect. Aneurysms are rare in the spine, with only scattered case reports.

References:

"Modified classification of spinal cord vascular lesions." Spetzler, et al. J Neurosurg. 2002 Mar; 96 (2 Suppl):145-56.

8. A middle-aged woman presents with numbness of the hands. You are shown sagittal and axial T2-weighted images of the cervical spine. Which of the following is the MOST likely diagnosis?



- A. Acute disseminated encephalomyelitis (ADEM)
- B: Lupus myelitis
- C. Foix Alajouanine syndrome
- D. Subacute combined degeneration

Key: D

Findings:

Bilateral increased signal intensity within the dorsal columns of the cervical spinal cord on T2WI extending over multiple spinal segments.

Rationales:

A. *Incorrect*: ADEM can enlarge the spinal cord but is usually seen in the cerebrum. Its appearance can mimic MS.

B. *Incorrect.* Myelopathy is a rare complication of systemic lupus erythematosis occurring in approximately 1 % of patients. It is thought that the underlying process is vacuolar degeneration caused by ischemia related to vasculitis or an autoimmune phenomenon. As in this case, it may present as increased signal intensity on T2WI extending over multiple spinal segments. However, given the rarity of this entity and absence of a history of SLE, an alternative diagnosis should be sought.

C. Incorrect. Foix Alajouanine syndrome is a myelopathy associated with a spinal dural arteriovenous fisula. The entity tends to occur in males in their 40's and 50's. It begins with insidious onset of lower extremity weakness or sensory deficits and may progress to paralysis if untreated. The underlying pathology is chronic venous hypertension secondary to the vascular malformation. MR findings include a normal or enlarged spinal cord with increased signal intensity on T2WI. The spinal cord may enhance and prominent vessels are often seen on the dorsal surface of the spinal cord. These findings most commonly occur within the lower thoracic spinal cord or conus medullaris.

D. *Correct*. Subacute combined degeneration is secondary to vitamin B12 deficiency and produces a myelopathy predominantly affecting the cervical and upper thoracic spinal cord. Paresthesias of the hands and feet, lower extremity weakness, and loss of position and vibratory sensation are presenting symptoms. Pernicious anemia is the most common cause of subacute combined degeneration in the US. It results from inability to absorb B12 from the GI tract secondary decreased levels of intrinsic factor. Intrinsic factor is produced by the gastric parietal cells which are lost in pernicious anemia. The intrinsic factor/B12 complex binds to the mucosa of the terminal ileum where the B12 is absorbed. Therefore, diseases involving the terminal ileum such as Crohn's disease and tropical sprue may also produce subacute combined degeneration. Gastrectomy and resection of the terminal ileum are additional causes. The MR findings are increased signal intensity within the dorsal columns bilaterally. Many entities may produce increased signal intensity within the dorsal columns bilaterally. Many entities may produce increased signal intensity within the dorsal columns on T2WI but the history in this case should lead to the correct diagnosis.

References:

Grossman and Yousem, Neuroradiology Requisites 2nd edition, Mosby, Phildaelphia 2003 Bowen, Case Review Spine Imaging, Mosby, Philadelphia 2001 9. You are shown T2-weighted and T1-weighted sagittal images and a T1-weighted axial MR images from a 1-year-old girl with a sacral mass. The patient has not had surgery. What is the BEST diagnosis?



- A. Myelomeningocele
- B: Lipomyelocele
- C. Dermoid
- D. Neurenteric cyst

Кеу: В

Rationales:

A. *Incorrect*. Myelomeningocele has a defect in the posterior elements (dysraphism) with a cyst. This is an open neural tube defect. The spinal cord is tethered to the cyst. No cyst is seen is this case. This lesion is typically seen in the setting of the Chiari II malformation with hydrocephalus and low-lying cerebellum.

B. **Correct**. In a lipomyelocele there is a dysraphic defect. The spinal cord is tethered to a lipoma within the spinal canal. In a lipomyelomeningocele, there is an cyst associated with the lipoma and enlargement of the spinal canal. This is not an open neural tube defect. Patients may become symptomatic later in life due to the tethered cord; complications include scoliosis, bladder dysfunction, and leg weakness and pain.

C. *Incorrect*. Dermoid cysts of the spine typically occur in the sacrum. In addition to lipid material, they typically show mixed fluid signal on MR. If a dermoid ruptures into the subaracnoid space, it results in chemical (aseptic) meningitis. Dermoids can also be associated with dermal sinuses. The large dysraphic defect in this case is atypical for dermoid.

D. *Incorrect*. Neurenteric cyst is usually seen in the thoracic spine. It may be associated with a vertebral segmentation anomaly rather than dysraphism. It may produce mass effect on the spinal cord. **References**:

Barkovich, Pediatric Neuroimaging, 3rd Ed. Pp. 627, 641, 657, 669 Lippincott, Williams & Wilkins 2000

10. An 8-year-old girl presents for evaluation of sensorineural hearing loss. You are shown an axial CT image. Which of the following is the MOST likely diagnosis?



- A. Cock's deformity
- B: Enlarged vestibular aqueduct syndrome
- C. Michel's aplasia
- D. Mondini malformation

Key: B

Findings:

Bilateral enlargement of the vestibular aqueduct.

Rationales:

A. *Incorrect*. Cock's deformity is the second most common cohlear malformation occurring at 4-5 weeks gestation. The cochlea and vestibule form a common cavity. The semicircular canals may or may not be involved.

B. **Correct.** Enlarged vestibular aqueduct syndrome is the most common cause of congenital sensorineural hearing loss. The midportion of the normal vestibular aqueduct should measure 1.5mm or less in diameter. The incidence of associated cohlear abnormality is near 100%. The condition is bilateral in approximately 90% of cases.

C. *Incorrect.* Michel's aplasia is used to describe total aplasia of inner structures. This is due to a defect in otic placode development during the third gestational week.

D. *Incorrect.* Mondini malformation is the most common cochlear congenital anomaly. Occurring during the 7th to 8th gestational weeks, it consists of incomplete development of the cochlea. While the basal turn is relatively normal, the middle and apical turns often form a common cavity.

References: Grossman and Yousem, <u>Neuroradiology Requisites</u> 2nd edition, Mosby, Philadelphia 2003 Yousem and da Motta, <u>Case Review Head and Neck I</u>maging, 2nd edition, Mosby, Philadelphia 2006

Nuclear Radiology In-Training Test Questions for Diagnostic Radiology Residents



QUALITY IS OUR IMAGE

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

© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. You are shown anterior whole body Tc-99m MDP bone scan in an 84-year-old woman with head and neck pain and a history of papillary thyroid carcinoma. What is the MOST likely explanation for the scintigraphic findings?



- A. Poor bone uptake due to osteoporosis
- B: Metastatic calcification due to hyperparathyroidism
- C. Poor labeling of the MDP
- D. Metastatic papillary thyroid cancer

Key: C

Findings:

There is marked increased activity in the stomach, thyroid, and salivary glands, with some activity seen in bowel and bladder.

Rationales:

A. *Incorrect.* Patients with severe osteoporosis may demonstrate relatively decreased activity in the skeletal system, with increased soft tissue activity. Diffusely increased skeletal uptake may also occur. However, osteoporosis would not show localization in the sites mentioned above.

B. *Incorrect.* Metastatic calcifications can result in increased activity in the stomach, lungs, kidneys, and other soft tissue locations. However, it would not demonstrate increased activity in salivary glands or thyroid.

C. **Correct.** Free Technetium-99m pertechnetate, which occurs when there is poor labeling of the MDP, will localize in the locations mentioned above, the stomach, thyroid, and salivary glands. This condition can be confirmed by performing thin-layer paper chromatography on the radiopharmaceutical. D. *Incorrect.* Metastatic papillary thyroid cancer may show areas of increased or decreased activity in the skeleton on a bone scan. Soft tissue metastases in the thyroid bed, cervical lymph nodes, lungs or mediastinum may be seen on a whole body I-131 or I-123 scan, but are not normally visualized on a bone scan. Thus, metastatic papillary thyroid carcinoma would not demonstrate the distribution of radiotracer seen above.

2. You are shown representative coronal, transaxial and sagittal images from an F-18 FDG (fluorodeoxyglucose) PET scan. What is the MOST likely diagnosis?



- A. Lymphoma
- B: Bronchogenic carcinoma
- C. Esophageal carcinoma
- D. Normal variant

Key: C

Rationales:

A. *Incorrect*. The abnormal uptake in this case is located in the posterior mediastinum, where adenopathy due to lymphoma may occur. However, the linear configuration of the activity is characteristic of esophageal activity, rather than the typical focal rounded appearance of adenopathy. Furthermore, no other sites of adenopathy are present. The findings are characteristic of an esophageal neoplasm, making squamous cell carcinoma or adenocarcinoma far more likely than lymphoma.

B. *Incorrect*. As discussed above, the linear uptake located in the posterior mediastinum is characteristic in appearance for an esophageal neoplasm. There are no focal pulmonary nodules or foci of mediastinal or hilar adenopathy, as would be anticipated in the presence of bronchogenic carcinoma.

C. **Correct**. The linear pattern of increased FDG uptake in the posterior mediastinum, in the expected location of the esophagus, is characteristic in appearance for an esophageal neoplasm, most likely representing squamous cell carcinoma of the esophagus.

D. *Incorrect*. Mildly increased uptake near the gastroesophageal junction may be seen as a normal variant, or in patients with gastroesophageal reflux. Mild diffuse esophageal uptake may also occur in esophagitis. The uptake in this case is far more intense than would be anticipated as a normal variant, and the location of the activity remote from the gastroesophageal junction is not consistent with a normal variant.

3. You are shown representative coronal, transaxial and sagittal tomographic radionuclide images. Which one of the following radiotracers was MOST likely utilized for this study?



- A. Tc-99m methylene diphosphonate
- B: Tc-99m sulfur colloid
- C. F-18 fluorodeoxyglucose
- D. F-18 sodium fluoride

Key: C

Rationales:

A. *Incorrect*. The normal biodistribution of Tc-99m methylene diphosphonate (MDP) includes the axial and appendicular skeleton, kidneys and bladder. The liver, spleen, mediastinum, and brain, which are visualized in this case, are not seen on a normal bone scintigram.

B. *Incorrect*. The normal biodistribution of Tc-99m sulfur colloid includes intense liver and spleen activity. Less intense activity is identified in the central bone marrow (skull, ribs, sternum, vertebral bodies, pelvis, proximal humeri and femora). The most intense activity in this study is osseous. Moderate activity is seen within the spleen and low level activity in the liver, mediastinum and brain. This biodistribution is not typical for sulfur colloid.

C. **Correct**. The normal biodistribution of F-18 fluorodeoxyglucose (FDG) is accumulation in the brain, myocardium, blood vessels, pharynx, liver, spleen, bone marrow, kidneys, ureters, urinary bladder, and GI tract. Intense marrow uptake is seen in this patient with lymphoma after administration of granulocyte colony stimulating factor (G-CSF), which is given to support bone marrow function following therapy. Normal marrow uptake is usually less intense than hepatic uptake. While this distribution is not normal, it is more characteristic of FDG than any of the other tracers listed.

D. *Incorrect*. The normal biodistribution of F-18 sodium fluoride is osseous, with uptake dependent on regional blood flow and osteoblastic activity by chemisorption. Hydroxyl groups are exchanged to form fluoroapatite in the hydroxyapatite crystals. Because of the superior spatial resolution and three-dimensional localization afforded by PET imaging, there is a high sensitivity for the detection of metabolically active skeletal lesions using F-18 sodium fluoride.

References:

Mettler, FA and Guiberteau, MJ Essentials of Nuclear Medicine Imaging, 4th ed. p. 287-9

Mettler, FA and Guiberteau, MJ Essentials of Nuclear Medicine Imaging, 4th ed. p, 326

Wahl, RL. Principles and Practice of Positron Emission Tomography, Lippincott Williams & Wilkins, Philadelphia 2002 p.111-136.

Wahl, RL. Principles and Practice of Positron Emission Tomography, Lippincott Williams & Wilkins, Philadelphia 2002 p. 246-247.

4. What is the basic principle underlying the C-14 urea breath test for Helicobacter pylori infection in patients with peptic ulcer disease?

A. Absence of urease in mammalian cells

B: Chemical breakdown of C-14 urea by gastric acid

C. Formation of C-14 labeled glucose

D. Renal excretion of C-14 urea absorbed from the stomach

Key: A

Rationales:

A. **Correct**. The basis of this study is that the Helicobacter pylori bacteria present in the stomach in patients with this infection contain the enzyme urease, necessary for the breakdown of urea. This metabolism of C-14 labeled urea results in the formation of C-14 labeled CO2 gas, which is then detected using a liquid scintillation counter. In the absence of the bacterial infection, the cells of the gastric mucosa, which lack the enzyme urease (like all mammalian tissue), are unable to break down the urea, and thus no C-14 labeled CO2 gas is formed, resulting in a negative study.

B. *Incorrect*. The study has nothing to do with the presence or absence of gastric acid. Only the presence of the enzyme urease, found in the Helicobacter pylori organisms, but not in the gastric cells, can break down the C-14 urea to form C-14 labeled CO2 gas.

C. *Incorrect*. The physiology of the study is as described above. In no way is the formation of glucose or other aspects of carbohydrate metabolism involved.

D. *Incorrect*. Again, the metabolism of C-14 labeled urea by bacterial urease is the basis of the study. Renal excretion is not involved, and no urine collections are performed. The study is performed by having the patient ingest the radiopharmaceutical, followed by collection of two breath samples, which are analyzed in a liquid scintillation counter for the presence of C-14 labeled CO2 gas.

5. In nuclear medicine, what is the primary benefit for the use of a narrow energy window?

- A. Enhances count rate
- B: Reduces dead time losses
- C. Diminishes background radiation in image
- D. Reduces scatter radiation in image

Key: D

Rationales:

A. Incorrect. A narrow window would reduce the image count rate.

B. *Incorrect*. While the count rate for generating the image would be reduced, the actual detected photon count rate would not be changed and the dead time losses would not be reduced.

C. *Incorrect*. Background radiation counts would be reduced, but this is a minor component compared with the scatter radiation coming from the patient.

D. **Correct.** Gamma rays are emitted at very specific energies. If the detected photon has a lower energy, it may be assumed that the photon was from a Compton scatter interaction and is not coming directly from the location of the radionuclide tracer.

6. Which of the following factors contributes MOST to the specificity of Tc-99m sestamibi scintigraphy for the detection of parathyroid adenomas?

A. Size of the parathyroid adenoma

B: Greater hypercellularity of parathyroid adenomas compared to thyroid adenomas

C. Greater avidity of the radiopharmaceutical for parathyroid tissue than for thyroid tissue

D. Longer retention of the tracer in parathyroid tissue than in thyroid tissue

Key: D

Rationales:

A. *Incorrect*. Size of the adenoma affects *sensitivity*, not specificity. Parathyroid adenomas must attain a size greater than ~500mg to be generally detectable, although this is usually the threshold at which they are clinically (not chemically) manifest.

B. Incorrect. This is frequently untrue and unrelated.

C. Incorrect. There is no in vitro evidence supporting this statement.

D. **Correct**. Slow Tc-99m sestamibi wash-out is the hallmark of a parathyroid adenoma (or carcinoma). This phenomenon is specific for hypercellular parathyroid neoplasms and is not a characteristic of thyroid neoplasms.

References:

Taillefer R., Boucher Y., et al. Detection and localization of parathyroid adenomas in patients with hyperthyroidism using a single radionodule imaging procedure with technetion 99m – sestamibi (double-phase study). J. Nuclear Med. 1992; 33: 1801 – 1807.

7. An 8-year-old patient with suspected lower extremity osteomyelitis presents with normal plain radiographs. Which one of the following is the MOST appropriate next imaging study?

A. Tc-99m methylene diphosphonate (MDP) three-phase bone scintigraphy

B: Ga-67 citrate scintigraphy

C. In-111-labeled WBC scintigraphy

D. Tc-99m sulfur colloid bone marrow scintigraphy

Key: A

Rationales:

A. **Correct**. A three-phase bone scan is almost always a good choice for the initial evaluation of possible osteomyelitis, especially if the plain radiographs are normal (and there is no other underlying bone pathology which would be likely to cause increased bone uptake of the tracer and limit the usefulness of the exam). It is both highly sensitive and has a very high negative predictive value for osteomyelitis. The radiopharmaceutical is readily available, the exam is easily performed, and the radiation dose is lower than for Ga-67 or In-111 labeled WBC imaging. The normal increased radiopharmaceutical activity at the growth plates is a potential limitation in pediatric patients, but this would also be a limitation with Ga-67 citrate imaging.

B. *Incorrect*. A three-phase bone scan is the most appropriate next study. In some settings, Ga-67 citrate may be used in addition to bone scan to improve diagnostic accuracy, with the gallium scan performed after the bone scan.

C. *Incorrect.* In-111 WBCs are generally avoided in pediatric patients if there is a good alternative, because of the high radiation-absorbed dose to the spleen. A three-phase bone scan is a better choice. D. *Incorrect.* A bone marrow scan can be used in conjunction with radiolabelled WBC imaging to improve diagnostic accuracy in the evaluation of osteomyelitis, but it has no role as an *initial* imaging agent in this setting.

References:

Zeissman HA, O'Malley JP, Thrall JH: Nuclear Medicine-The Requisites. 3rd ed. Mosby. 2006. Treves, ST: Pediatric Nuclear Medicine. 2nd ed. Springer-Verlag. 1995.

8. You are shown an anterior image of the neck from a thyroid scintigram obtained in a 27-year-old woman presenting with elevated serum T4 and T3 levels, a serum TSH<0.1 mIU/L and 24 hour I-123 thyroid uptake of 50%. The MOST likely diagnosis is:



- A. Graves' disease.
- B: toxic nodular goiter.
- C. subacute thyroiditis.
- D. factitious hyperthyroidism.

Key: A

Findings: Thyromegaly with diffusely prominent uptake throughout the thyroid gland, without focal nodules is demonstrated.

Rationales:

A. **Correct**. This is a classic diagnostic picture of elevated T4/T3, suppressed TSH, elevated I-131 thyroid uptake and a homogeneous gland distribution (typically, scan is normal.)

B. *Incorrect*. While the clinical presentation given is consistent with TNG, the thyroid scan appearance is not. TNG is associated with an irregularly irregular thyroid tracer distribution, with one or more focal hyperfunctioning nodules and areas of suppressed normal thyroid tissue. In addition, an I-131 thyroid

uptake of 50% is much higher than typically seen in TNG, where the uptake may be only mildly elevated or even within normal limits.

C. Incorrect. Like Graves ' disease, this is a chronic autoimmune thyroid disease, which may present with painless, diffuse gland enlargement, elevated T4/T3 levels and a suppressed TSH, especially early in the course of the disorder. However, in such cases, the iodine uptake is typically suppressed, with an associated organification defect. Graves' disease and Hashimoto's thyroiditis may also co-exist in the same patient. Late in the course of Hashimoto's disease, it more often produces hypothyroidism, and may present with a multinodular goiter.

D. *Incorrect.* Also known as iatrogenic hypothyroidism or thyrotoxicosis factitia, and most commonly seen in health care workers with ready access to medications, exogenous thyroid hormone (T4, T3,dessicated thyroid) will produce an elevated serum T4 level, associated with a suppressed TSH level and either a normal scan or more commonly, poor visualization or non-visualization of the gland. An elevated thyroid uptake value is incompatible with this diagnosis.

Pediatric Radiology In-Training Test Questions for Diagnostic Radiology Residents



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1. Which statement is CORRECT concerning vascular rings?

A. A double aortic arch usually presents during puberty

- B: The double aortic arch encircles the trachea anterior to the esophagus
- C. Symptomatic pulmonary sling is associated with a right aortic arch
- D. A left aortic arch with an aberrant right subclavian artery is typically asymptomatic

Key: D

Rationales:

A. *Incorrect.* Double aortic arch is a true vascular ring resulting in compression of both trachea and esophagus. Symptoms often begin at birth and can include stridor, wheezing, vomiting, and dysphagia.
B. *Incorrect.* Double aortic arch typically encircles both the trachea anteriorly and esophagus posteriorly by its right and left arches. Lateral radiographs will demonstrate anterior bowing of the trachea. On barium swallow posterior indentation of the esophagus is present.

C. *Incorrect.* Anomalous origin of the left pulmonary artery is often an isolated finding though it may be part of a more complex anomaly. The left pulmonary artery arises from the right pulmonary artery crossing over the proximal portion of the right mainstem bronchus.

D. **Correct.** This most common congenital vascular anomaly is frequently found due to interruption of the right embryonic arch between the right common carotid and right subclavian arteries. The right ductus arteriosus usually involutes so no true vascular ring exists.

Citations:

Goo H, Perk T, Ok J et al. CT of congenital heart disease: Normal anatomy and typical pathologic conditions. *Radiographics.* 2003;23:S147-65

Ebel D, Blickman H, Willich E, Richter E, Glass RBJ. *Differential Diagnosis in Pediatric Radiology*. New York, NY: Thieme; 1999.

- 2. Concerning holoprosencephaly, which one is TRUE?
- A. The fornix and septum pellucidum are absent in all forms.
- B: The posterior portion of the corpus callosum is absent in lobar form.
- C. 10% of cases are associated with cytogenetic abnormalities.
- D. Cebocephaly is most common in patients with lobar form.

Key: A

Rationales:

A. **Correct**. While the severity of holoprosencephaly varies from severe alobar to lobar, by definition, all forms of holoprosencephaly do not have a fornix or septum pellucidum, and may have hypoplasia of the pituitary and optic nerves.

B. *Incorrect*. The cerebral vesicles cleave in a dorsofrontal direction. In patients with lobar and Semilobar holoprosencephaly, the posterior portion of the corpus callosum is present while the Anterior portion is absent; the entire corpus callosum may be present in lobar Holoprosencephaly.

C. *Incorrect*. Up to 40% of cases are linked to chromosomal anomalies, 20% with syndromes, with only 40% cases isolated.

D. *Incorrect*. Severe facial anomalies, such as cyclopia, cebocephaly and ethmocephaly, are most likely in patients with alobar holoprosencephaly. However, a normal face does not exclude a severe form of holoprosencephaly.

References:

Garel C, MRI of the fetal brain. Pringer Verley New York 2004

Bullen PF, Rendin, JM, Robson SL Investigation of epidemiology and prenatal diagnosis of holoprosencephaly. 2001 Am J OB Gyn 184: 1246-1262.

3. Concerning Tetralogy of Fallot, which one is CORRECT?

A. A right-sided aortic arch is present in approximately 60% of cases.

B: The four features consist of ASD, VSD, overriding aorta and right ventricular outflow tract obstruction.

- C. Radiographs typically demonstrate marked cardiomegaly.
- D. Right-sided obstruction may include infundibular, valvular and peripheral pulmonic stenoses.

Key: D

Rationales:

A. *Incorrect*. Tetralogy of Fallot is one of the most frequent lesions to be associated with a right-sided aortic arch. This occurs however in approximately 20 - 30% of cases. Other cardiac lesions associated with a right-sided aortic arch include truncus arteriosus (30%), tricuspid atresia (10 - 15%) and double outlet right ventricle (12%).

B. *Incorrect*. ASD is not one of the four cardinal features in Tetralogy of Fallot. Right ventricular hypertrophy is the fourth feature in addition to VSD, overriding aorta and right ventricular outflow obstruction. ASD occurs in approximately 15% of cases; when present the entity is termed Pentalogy of Fallot.

C. *Incorrect*. Although the "boot shaped" heart is the classically described configuration in Tetralogy of Fallot, preoperatively the heart is usually normal in size, or only mildly enlarged. The "boot-shaped heart" is produced by the combination of a concave main pulmonary artery segment and an elevated cardiac apex, indicative of right ventricular hypertrophy without dilatation and cardiac enlargement.

D. **Correct**. Right-sided obstruction is often at multiple levels. Typically there is infundibular obstruction without or with valvular stenosis, or even atresia. Peripheral pulmonary artery coarctation, unilateral hypoplasia or absence of a pulmonary artery also occurs, most often on the left side. Conversely there may be complete absence of the pulmonary valve leaflets with marked pulmonic regurgitation and very large central pulmonary arteries.

4. Concerning Ewing sarcoma of bone, which one is CORRECT?

A. It is most common in children under 5 years of age.

B: It is the most common primary bone malignancy in childhood.

C. The more aggressive tumors produce more osteoid.

D. Histologically it is identical to primitive neuroectodermal tumor (PNET).

Key: D

Rationales:

A. *Incorrect*. Although Ewing sarcoma can occur in a child under 5 years of age, it is relatively rare in this age group. Ewing sarcoma is most common in the second decade of life.

B. *Incorrect*. Ewing sarcoma is the second most common primary bone malignancy in childhood. Osteosarcoma is considerably more common.

C. *Incorrect*. Ewing sarcoma does not produce osteoid. Osteoid is produced by osteosarcoma. A sclerotic response may be seen within the host bone and up to 15% of Ewing sarcomas will thus appear sclerotic at presentation; however, the tumor itself does not produce osteoid.

D. **Correct**. Ewing sarcoma and PNET are histologically identical. Moreover, they are cytogenetically identical and now considered by pathologists to be the same tumor.

References:

Eggli KD, Quiogue T, Moser RP Jr. Ewing's sarcoma. Radiol Clin North Am 1993; 31:325-337

Kennedy JG, Frelinghuysen P, Hoang BH. Ewing sarcoma: current concepts in diagnosis and treatment. Curr Opin Pediatr 2003; 15:53-57

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

Reinus WR, Gilula, LA. Radiology of Ewing's sarcoma; intergroup Ewing's sarcoma study (IESS). Radiographics 1984; 4:929-944

Saifuddin A, Whelan J, Pringle JA, Cannon SR. Malignant round cell tumours of bone: atypical clinical and imaging features. Skel Radiol 2000; 29:646-651

5. Concerning a duplex renal collecting system, which of the following would be a typical association?

- A. Larger than normal kidney
- B: Simple ureterocele
- C. Upper moiety reflux
- D. Male urinary incontinence

Key: A

Rationales:

A. **Correct**. Kidneys with duplicated collecting systems tend to be larger than those with non-duplicated collecting systems.

B. *Incorrect*. Ectopic ureteroceles are associated with duplex collecting systems. Simple ureteroceles are uncommon in childhood and are associated with non-duplex systems.

C. *Incorrect*. Although reflux can occur in either moiety in uncomplicated duplications, a complicated duplex typically demonstrates obstruction of the upper moiety, and secondary reflux in the lower moiety.

D. *Incorrect*. The insertion of the ectopic ureter is related to the course of the embryonic mesonephric duct. Urinary incontinence is seen only in females since the ectopic ureter in girls can insert beyond the bladder sphincter, along the course of the mesonephric duct. This does not happen in boys, in whom insertion always occurs proximal to the external sphincter, again outlining the course of the embryonic mesonephric duct. **References:**

Kirks DR (Ed.) 1998. Practical Pediatric Imaging, 3rd Ed. Lippincott, Philadelphia Siegel MJ, 1995. Pediatric Sonography, 2nd Ed. Raven Press, New York

6. Which of the following is TRUE concerning tracheoesophageal fistulas?

A. Prenatally the stomach is not filled with fluid in approximately 80% of patients.

- B: Most common presentation is a fistula from the proximal pouch to the trachea.
- C. The side of the aortic arch must be identified preoperatively.

D. It is an isolated anomaly in most patients.

Key: C

Rationales:

A. *Incorrect*. Majority will have some fluid in the stomach due to the distal fistula allowing fluid to course from the trachea into the distal esophageal segment.

B. Incorrect. 87% present with tracheoesophageal fistula to the distal esophageal segment.

C. **Correct**. Right arch occurs in 4% of cases. This is important in determining the side of thoracotomy for repair, on the side opposite the arch.

D. Incorrect. Increased incidence of cardiac, duodenal, anorectal, renal and musculoskeletal anomalies in 50-70% of patients, and VACTERL association

References:

Hertsberg BS: Sonography of the fetal gastrointestinal tract: anatomic variants, diagnostic pitsfalls, and abnormalities AJR 1994;162:1175

Quan L, Smith DW: the VACTER association: vertebral defect, anal atresia, TE fistula, radial and renal dysplasia a spectrum of associated defects. J Pediatr 1973; 82:104.

7. Regarding colonic abnormalities in children, which one of the following is CORRECT?

A. Microcolon resolves spontaneously

B: Colonic atresia is more common than ileal atresia

C. Small left colon syndrome is part of the VACTERL association

D. Meconium ileus presents with a large plug in a normal-sized colon

Key: A

Rationales:

A. **Correct**. Microcolon refers to an unused colon, and is seen in infants with long-standing distal obstruction, such as is seen in ileal atresia, meconium ileus, or the distal portion of the colon in colonic atresia. Once the obstruction has been relieved, the colon returns to normal size.

B. *Incorrect*. Colonic atresia is the least common of the intestinal atresias (other than pyloric atresia) representing only 8% of intestinal atresias in a population of 277 neonates in a published series.
C. *Incorrect*. Anal atresia is part of the VACTERL association, along with vertebral anomalies, cardiac abnormalities, esophageal atresia/distal fistula complex, renal anomalies and limb anomalies typically affecting the radius. Colonic atresia typically occurs in isolation, or in conjunction with other GI atresias.
D. *Incorrect*. Meconium ileus consists of particularly thick and tenacious meconium inspissated within the distal small bowel, resulting in distal small bowel obstruction and microcolon. Meconium ileus can be complicated in utero by intrauterine bowel perforation, meconium peritonitis or meconium cyst.

References:

Dalla Vecchia et al. Intestinal atresia and stenosis. Arch Surg 1998; 133:490-497 Heinen F et al. Pyloric atresia. www.thefetus.net, 1000-08-28-10 Rationale:

8. Regarding Tetralogy of Fallot, which one of the following is CORRECT?

A. Most patients have a right-sided aortic arch.

B: A normal-sized heart is a common presurgical finding on chest radiographs.

C. The ventricular septal defect may close if surgery is delayed.

D. The Fontan procedure is most appropriate for surgical repair.

Кеу: В

Rationales:

A. *Incorrect.* A right-sided aortic arch is present in approximately 25% of patients with Tetralogy of Fallot. The majority of patients have a left-sided arch.

B. **Correct**. Patients with Tetralogy of Fallot have a pressure overload on the right ventricle, resulting in right ventricular hypertrophy, but little cardiac enlargement as a result. The apex is typically elevated, with concavity at the hypoplastic pulmonary artery, leading to the typical description of "coeur en sabot" or boot-shaped heart.

C. Incorrect. The ventricular septal defect in patients with Tetralogy results from a malalighment of the stenotic infundibular portion of the interventricular septum. This type of defect does not close.
 D. Incorrect. The Fontan procedure is performed in patients with single ventricle anatomy, which is not the case in patients with Tetralogy of Fallot. Surgical repair of these patients most often consists of enlargement of the infundibular portion of the septum via a pericardial patch.

9. Concerning fibromatosis colli, which of the following is CORRECT?

- A. CT is the preferred imaging modality
- B: The chin points towards the opposite side
- C. Biopsy is required to exclude rhabdomyosarcoma
- D. Birth history is usually normal

Key: B

Rationales:

A. *Incorrect*. The preferred modality for imaging fibromatosis colli is ultrasound. Both CT and MR may demonstrate the abnormality; however, neither provides additional information to ultrasound. On ultrasound, enlargement of the sternocleidomastoid muscle is clearly demonstrated and the lesion is readily distinguished from tumor. CT is less desirable due to radiation. MR is less desirable due to potential need for sedation.

B. **Correct**. With fibromatosis colli, there is a contracture of the sternocleidomastoid muscle. The mastoid attachment of the muscle pulls down on the affected side, tilting the head down on the affected side, and pointing the chin towards the contralateral side.

C. *Incorrect*. Particularly with the appropriate clinical history (i.e. torticollis or head tilt), the imaging findings of fibromatosis colli are diagnostic and biopsy is not needed to exclude rhabdomyosarcoma. In fibromatosis colli, the muscle is enlarged. If a discrete mass is identified distorting the muscle or outside of the muscle and displacing it, then consideration for other processes besides fibromatosis colli should be raised.

D. *Incorrect.* In many of these patients, there is a history of complications during delivery, such as breech presentation or forceps extraction.

References:

Effmann EL. Neck and upper airway. In: Kuhn JP, Slovis TL, Haller JO, eds. Caffey's Pediatric Diagnostic Imaging, 3rd edition, Mosby, Philadelphia, 2004, pp 777-809.

Crawford SC, Harnsberger HR, Johnson L, et al. Fibromatosis colli of infancy: CT and sonographic findings. AJR 1988; 151-1183-1184.

Chan YL, Cheng JCY, Metrewelli C. Ultrasonography of congenital muscular torticollis. Pediatr Radiol 1992; 22:356-360.

Rationale:

10. You are shown a chest radiograph obtained during a contrast injection into the left central line in an infant with congenital heart disease. What surgical procedure is outlined by the contrast injection?



- A. Blalock-Hanlon
- B: Blalock-Taussig
- C. Glenn
- D. Rastelli

Key: C

Rationales:

A. *Incorrect*. This term refers to an atrial septectomy, performed to promote admixture of blood at the atrial level. This procedure is not illustrated in the test case, and this answer is false.B. *Incorrect*. This operation refers to a shunt between the subclavian artery and the ipsilateral

pulmonary artery in order to provide pulmonary blood flow. This is not illustrated in the test case, and this choice is incorrect

C. **Correct**. A Glen shunt refers to anastomosis of the superior vena cava to the pulmonary artery. A bidirectional Glen refers to a shunt in which the superior caval flow enters into both pulmonary arteries and into both lungs; a unidirectional Glen shunt refers to flow directed solely to the ipsilateral pulmonary artery and lung. The test case demonstrates injection of contrast into the superior vena cava and hence into both pulmonary arteries. This constitutes the bidirectional Glenn shunt.

D. *Incorrect*. Rastelli procedure refers to a conduit between the right ventricle and the pulmonary artery. This is not shown in the test case and this choice is incorrect.

References:

Pelech AN, Neish SR. Sudden death in congenital heart disease. Pediatr Clin N Am 51 (2004) 1257-1271

Physics In-Training Test Questions for Diagnostic Radiology Residents



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April, 2015

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© 2015 by American College of Radiology. All rights reserved. 1891 Preston White Drive -- Reston, VA 20191-4326 -- 703/648-8900 -- www.acr.org 1. What is the primary benefit of using rotating anode x-ray tubes rather than stationary anode tubes?

- A. Decreased radiation exposure
- B: Reduced voltage ripple
- C. Ability to use higher kVp
- D. Ability to use higher mAs

Key: D

Rationales:

A. Incorrect.

B. *Incorrect.* The voltage ripple is dependent on the high voltage circuit, not the x-ray tube.

C. *Incorrect.* The maximum kVp is dependent on the high voltage circuit and the cathode-anode spacing (to prevent HV arcing), not stationary versus rotating anode.

D. **Correct.** Rotating anode tubes allow for very high mA for relatively short exposure times by spreading the heat over a larger surface area. This permits high-intensity short exposures.

Citations:

A. Wolbarst, Physics of Radiology (1993) E, Chapter 10

J.T. Bushberg, et al., The Essential Physics of Medical Imaging (2002), Chapter 5

2. Concerning the inverse square law in chest fluoroscopy, how much does the entrance dose change if the source-to-image distance (SID) is increased from 90 cm to 120 cm while maintaining a similar source-to-skin distance (SSD)?

A. Increases by a factor of approximately 1.3

B: Remains unchanged

C. Decreases by a factor of approximately 2

D. Increases by a factor of approximately 1.8

Key: D

Rationales:

A. Incorrect. See correct answer.

B. Incorrect. See correct answer.

C. Incorrect. See correct answer.

D. **Correct**. According to the inverse square law, if the exposure-rate from a source is X_1 at distance d_1 , the exposure rate X_2 at another distance d_2 will be $X_2=X_1(d_1/d_2)^2$. Therefore, Increasing the SID requires an increased output from the X-ray tube. Using the inverse square law, you have two equations, $(X_{patient90}/X_{90})=(d_{90}/d_{65})^2$ and $(X_{patient120}/X_{120})=(d_{120}/d_{65})^2$. A constant dose rate is necessary at the image intensifier at any SID since auto brightness control is being used so $X_{90}=X_{120}$. So when you plug this into the equations and rearrange, you get $(X_{patient120}/X_{patient90})=(120/90)^2 \approx 1.8$.

References:

The Essential Physics of Medical Imaging by Bushberg JT et. al., Second Edition, Chapter 23: Radiation Protection.

3. Regarding image intensifier design, which of the following results from the combination of a curved input screen and flat output screen?

- A. Pincushion distortion
- B: Increased contrast ratio
- C. Reduced radiation dose
- D. Increased brightness gain

Key: A

A. **Correct**. Mapping of an image from a curved input screen to a flat output screen results in increased magnification at the image periphery as compared to the image center

B. Incorrect. The shape of the input and output screens does not affect veiling glare

C. Incorrect. The shape of the input and output screens does not affect radiation dose

D. Incorrect. Brightness gain depends on electronic gain and minification gain

References:

Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging, 2nd Edition, p. 235

4. Concerning ultrasound interaction with matter, an ultrasound beam reflected from small (2 mm) kidney stones would:

A. be specular reflection.

B: be non-specular reflection.

C. provide a strong echo.

D. produce reverberation artifacts.

Кеу: В

Rationales:

A. *Incorrect*. A specular reflector is a smooth boundary between two media, where the dimensions of the boundary are much larger than the wavelength of the incident ultrasound energy. As the wavelength becomes smaller, the boundary becomes rough, resulting in a nonspecular reflector surface. Since the kidney stones are small, the resulting reflection would be non-specular.

B. **Correct.** A specular reflector is a smooth boundary between two media, where the dimensions of the boundary are much larger than the wavelength of the incident ultrasound energy. As the wavelength becomes smaller, the boundary becomes rough, resulting in a nonspecular reflector surface. Since the kidney stones are small, the resulting reflection would be non-specular.

C. *Incorrect*. Since the resulting reflection is non-specular, sound is reflected in all directions and the amplitudes of the returning echoes are significantly weaker then echoes from tissue boundaries.

D. *Incorrect*. Reverberation artifacts are generally produced by large objects producing multiple reflections within the object.

References:

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

5. Portable radiographs taken with a film-screen system using a fixed radiographic grid tend to have less contrast than the radiographs taken in the radiography rooms. Which of the following factors is the MOST likely cause for the reduced contrast?

A. Use of lower kVp

B: Use of higher mAs

C. Use of Lower grid ratio

D. Use of higher speed film-screen system

Key: C

Rationales:

A. Incorrect. Lower kVp would increase contrast.

B. *Incorrect*. Higher mAs would darken film, but not change contrast.

C. **Correct**. Lower grid ratio radiographic grid is used to minimize cutoff from poor alignment, however the lower grid ratio yields less cleanup of the scatter radiation.

D. Incorrect. Higher speed film-screen does not necessarily reduce contrast.

References:

A. Wolbarst, Physics of Radiology (1993), Chapter 20J.

T. Bushberg, et al., The Essential Physics of Medical Imaging (2002), Chapter 6

6. What is the primary source of radiation exposure to the fetus from a chest CT scan in a pregnant patient?

A. Primary x-ray radiation

B: Internal scatter radiation

C. External scatter radiation

D. Leakage radiation

Key: B

Rationales:

A. Incorrect

B. Correct.

C. *Incorrect*. External scatter radiation drops drastically from the edge of scan field, i.e., chest. The exposure is minimal from external scatter.

D. Incorrect.

Ultrasound In-Training Test Questions for Diagnostic Radiology Residents



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- 1. What is the MOST common ultrasound finding in acute pyelonephritis?
- A. Perirenal fluid collection
- B: Normal-appearing kidney
- C. Loss of corticomedullary differentiation
- D. Poorly marginated, hypoechoic mass

Кеу: В

Rationales:

A. *Incorrect.* A perirenal fluid collection may be seen as a complication of acute pyelonephritis, but in most cases there are no complications and the ultrasound findings are normal.

B. **Correct.** A normal appearance is the most common ultrasound finding.

C. *Incorrect.* Pyelonephritis may alter the echo texture of the renal parenchyma, but in most cases the ultrasound findings are normal.

D. *Incorrect.* Pyelonephritis may produce areas of increased as well as decreased echogenicity which may simulate a mass, but in most cases the ultrasound findings are normal.

Citations:

Middleton WD, Kurtz AB, Hertzberg BS. *Ultrasound: The Requisites*, 2nd ed. St. Louis, Mosby, 2004. Rumack CM, Wilson SR, Charboneau JW. *Diagnostic Ultrasound*, 2nd Ed. Mosby Yearbook Inc., St. Louis, MO. 1998.



You are shown a single image from a 2nd trimester OB ultrasound. What is the MOST likely diagnosis?

- A. Incompetent cervix
- B: Placenta previa
- C. Placental abruption
- D. Nabothian cyst

Key: A

Findings: Single longitudinal image of lower uterine segment from 2nd trimester OB examination reveals shortening of the cervix and hour glass herniation of membranes through cervical os. **Rationales:**

A **Correct**. The above findings on a 2nd trimester ultrasound are consistent with cervical incompetence. B. *Incorrect*. The placenta does not overly the cervix; therefore, there is no placenta previa.

C. Incorrect. There are no subchorionic or retroplacental fluid collections to suggest placental abruption.

D. *Incorrect*. A Nabothian cyst arises from the cervix. The visualized fluid collection of vagina clearly communicates with the endometrial cavity via the cervical os.

3. A 28-year-old man presents with mild renal function impairment on routine medical checkup. You are shown a longitudinal sonogram of the right kidney. What is the MOST likely diagnosis?



- A. Medullary sponge kidney
- B: Acute pyelonephritis
- C. Human immunodeficiency virus-associated nephropathy
- D. Autosomal recessive polycystic kidney disease

Key: C

Rationales:

A. *Incorrect*. Medullary sponge kidney (MSK) is secondary to dilatation or ectasia of the distal collecting ducts and is difficult to identify by ultrasound. When complicated by nephrocalcinosis multiple echogenic foci can be seen in the medullary pyramids.

B. *Incorrect*. Pyelonephritis is rare in adult males. Majority of kidneys with acute pyelonephritis are normal on Sonography and if abnormality is present it is usually a focal lesion and not diffuse increased echogenicity.

C. **Correct**. The cortical echogenicity is increased, cortico-medullary differentiation is decreased and renal sinus fat is decreased. The renal size may be enlarged.

D. *Incorrect.* Autosomal recessive polycystic kidney disease is bilateral and usually diagnosed in utero in early second trimester. These children generally succumb to their renal failure. If they survive to adulthood the kidney will demonstrate increased echogenicity with large renal cysts. **References**:

Thurston W, Wilson SR. The urinary tract. In Rumack CM, Wilson SR and Charboneau JW (eds): Diagnostic Ultrasound 3rd edition. Elsevier Science 2005. Pages 321-394.

Babcock BS, Patriquin HB. The pediatric kidney and adrenal glands. In Rumack CM, Wilson SR and Charboneau JW (eds): Diagnostic Ultrasound 3rd edition. Elsevier Science 2005. Pages 1905- 1940.

Di Fiori JL, Rodrigue D, Kaptein EM, Ralls PW. Diagnostic sonography of HIV-associated nephropathy: new observations and clinical correlation. AJR Am J Roentgenol. 1998 Sep; 171(3):713-6. Atta MG, Longenecker JC, Fine DM, Nagajothi N, Grover DS, Wu J, et al. Sonography as a predictor of human immunodeficiency virus-associated nephropathy. J Ultrasound Med. 2004 May;23(5):603-10.

4. Which statement is TRUE concerning cavernous transformation of the portal vein?

A. It typically occurs with acute portal vein thrombosis.

B: It is strongly associated with a biliary cystadenoma.

C. It represents recanalization of a previously thrombosed portal vein.

D. It represents the development of multiple periportal collaterals.

Key: D

Rationales:

A. *Incorrect*. Occurs with longstanding portal vein thrombosis and may take up to 12 months to develop. B. *Incorrect*. No known association between biliary cystadenoma and cavernous transformation of portal vein.

C. *Incorrect*. Cavernous transformation of portal vein represents development of periportal collaterals in the setting of chronic portal vein thrombosis.

D. **Correct**. Cavernous transformation of portal vein represents development of periportal collaterals in the setting of chronic portal vein thrombosis.

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.

- 5. Which statement is TRUE concerning partial molar pregnancies?
- A. Fetal tissue is not typically present.
- B: The majority are diploid.
- C. Focal molar placental degeneration is present.
- D. The beta-hCG is negative.

Key: C

Rationales:

A. *Incorrect*. Fetal tissue is typically present in the case of molar pregnancies, however, multiple anomalies are usually present due to the triploid karyotype present in most cases.

B. *Incorrect*. 90% of partial moles are triploid with majority inheriting two chromosomal sets of paternal origin and one set of maternal origin.

C. **Correct**. Focal areas of molar degeneration are present interspersed throughout areas of normal placenta in the case of partial molar pregnancy. This results in a thickened and enlarged placenta with multiple cystic areas.

D. *Incorrect*. The Beta hCG is positive.

References:

Ultrasonography in Obstetrics and Gynecology by Peter W. Callen. Publisher – W B Saunders. 2000. 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. 6. A 30-year-old woman undergoing a thyroid ultrasound is found to have multiple nodules. Which one of the following nodules should be biopsied?

A. 2.0-cm cystic nodule with echogenic foci demonstrating comet-tail artifact

- B: 2.5-cm homogeneous nodule with peripheral eggshell-like calcification
- C. 1.0-cm heterogeneous mass with a "honeycomb" cystic appearance
- D. 1.5-cm hypoechoic mass with microcalcifications

Key: D

Rationales:

A. Incorrect. This is a colloid nodule and does not require biopsy.

- B. Incorrect. Thin peripheral calcification indicates a high probability of benign lesion.
- C. Incorrect: "Honeycomb" cystic features indicate a very high probability of a benign process
- D. Correct. Malignancy is likely in a nodule with microcalcifications.

7. Which sonographic characteristic of a complex renal cyst requires follow-up with a CT scan and not ultrasound?

- A. Internal echoes
- B: Few thin septations (< 1 mm)
- C. Thickened wall
- D. Thin peripheral calcification or milk of calcium

Key: C

Rationales:

A. *Incorrect*. This can be followed up with ultrasound if no other malignant features are present.

B. Incorrect. This can be followed with ultrasound.

C. Correct. This is a malignant finding and CT scan should be performed.

D. Incorrect. This can be followed with ultrasound.

References:

Rumack et al, 3rd Edition, p. 367

- 8. Gastroschisis is associated with:
- A. chromosomal abnormalities.
- B: cardiac abnormalities.
- C. gastrointestinal tract atresias.
- D. limb reduction defects.

Key: C

Rationales:

Gastroschisis is commonly associated with gastrointestinal tract atresias, but not with the other abnormalities listed as possibilities.

9. How is the amniotic fluid index calculated?

- A. Greatest single vertical measurement of a fluid pocket in any quadrant
- B: Greatest vertical measurement of a fluid pocket in each of 4 quadrants summed
- C. Average of the greatest single measurement of the fluid pockets in 4 quadrants
- D. Subjective assessment of amniotic fluid volume in 4 quadrants

Key: B

Rationales:

- A. *Incorrect*. Measuring the greatest single vertical fluid pocket in any quadrant is known as the maximum vertical pocket (MVP) measurement and can be used as a method of assessing amniotic fluid.
- B. Correct. This is the correct method for determining the amniotic fluid index.
- C. *Incorrect*. Amniotic fluid index does not involve subjective assessment of amniotic fluid or grading scale, and divides the uterus in quadrants rather than halves.

D. *Incorrect*. Although the amniotic fluid index does use the deepest amniotic fluid pocket measurement in 4 quadrants summed, dividing by 4 would merely give the average of the fluid pocket measurements.

References:

Ultrasonography in Obstetrics and Gynecology by Peter W. Callen. Publisher – W B Saunders. 2000, Page 641-644.2.

Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound. 3rd ed. Mosby Yearbook Inc., St. Louis, MO. 2005, Page 1396-1397.

10. A didelphic uterus appears on ultrasound as:

A. two separate unfused uterine horns and a single uterine body.

B: two separate unfused uterine horns and two separate unfused uterine bodies.

- C. a normal uterine contour of uterine horns and body but with two separated endometrial canals.
- D. a single normal uterine horn and body with secondary rudimentary uterine horn present.

Key: B

- A. *Incorrect.* Two separate unfused uterine horns and singe uterine body describes a bicornuate uterus. Bicornuate uterus can have fusion of the entire uterine body or just the lower uterine segment.
- B. **Correct**. Didelphic uterus has two separate unfused uterine horns and bodies. Clinically, patient also can have two separate cervices and septated vagina.
- C. *Incorrect*. Normal uterine contour with regards to uterine horns and body but with two separated endometrial canals describes a septated uterus. The septation can be thick or thin.
- D. *Incorrect*. Single normal uterine horn and body with second rudimentary uterine horn present describes a unicornuate uterus.

References:

Ultrasonography in Obstetrics and Gynecology by Peter W. Callen. Publisher – W B Saunders. 2000, Page 824-828.

Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound. 3rd ed. Mosby Yearbook Inc., St. Louis, MO. 2005, Page 534-538.

11. Concerning renal calculi, which of the following is TRUE?

A. Ultrasound should be the initial imaging test in all patients with acute renal colic.

B: Transvaginal or transperineal scanning may be useful in detecting distal ureteral calculi not demonstrated by the transabdominal approach.

C. Color and power Doppler twinkling artifacts are demonstrated in less than 50% of renal calculi.

D. Asymmetry of ureteral jets is seen only with high-grade ureteral obstruction.

Кеу: В

Rationales:

- A. *Incorrect*. Unenhanced helical CT is the accepted initial imaging test in patients with renal colic. Ultrasound would be the initial test in pregnant patients.
- B. **Correct.** Better visualization of the distal ureters, especially in obese patients, is possible with a transvaginal or transperineal approach.

C. Incorrect. It has been shown that most (83%) of renal calculi will demonstrate this artifact.

D. *Incorrect*. Asymmetry of the ureteral jets can also be seen with low-grade obstruction.

References:

Thurston W, Wilson SR. The Urinary Track. In: Rumack CM, Wilson SR, and Charboneau JW (eds.) Diagnostic Ultrasound. Elsevier Mosby, St. Louis, 2005, Page 345-350.

- 12. Concerning portal hypertension, which of the following is TRUE?
- A. Flow may be reversed in the right portal vein, and normal in the left portal vein.
- B: A normal appearing liver by ultrasound excludes portal hypertension.
- C. Spleen size correlates well with the portal pressure.
- D. When secondary to cirrhosis the hepatic artery will be visibly decreased in size on color Doppler.

Key: A

- A. **Correct**. If there is a large peri-umbilical vein collateral, the flow will be normal in direction (antegrade) in the left portal vein as the peri-umbilical collateral originates from the left portal system.
- B. *Incorrect*. Portal hypertension may be present in patients with livers that have a normal appearance by ultrasound.
- C. *Incorrect*. The size of the spleen does not correlate well with the portal pressure.
- D. *Incorrect*. The hepatic artery is typically enlarged in cirrhosis. Increased hepatic arterial blood flow is an attempt to compensate for the decreased portal vein blood flow caused by elevated resistance in the hepatic sinusoids.

References:

Pellerito JS. Ultrasound Assessment of the Splanchnic (Mesenteric) Arteries. In Zwiebel, Pellerito (eds.) Introduction to Vascular Ultrasound 5th ed. Elsevier Saunders, Philadelphia, PA. 2005, Page 585-590.

13. Concerning omphalocele, which of the following is TRUE?

A. It is a defect in the anterior abdominal wall with extrusion of abdominal contents adjacent to the umbilical cord.

B: The incidence of associated anomalies > 75%.

C. An increase in incidence is associated with increased paternal age.

D. Its prevalence is approximately twice that of gastroschisis.

Кеу: В

Rationales:

- A. *Incorrect*. An omphalocele is a defect in the anterior abdominal wall with extrusion of abdominal contents into the base of the umbilical cord.
- B. **Correct**. Associated anomalies have been reported to be as high as 88%, with chromosomal anomalies in up to 60%

C. Incorrect. Omphaloceles increase in frequency with an increase in maternal age.

D. *Incorrect.* The incidence of omphaloceles is similar to that of gastroschisis, 2.5 in 10,000 births. **References**:

Callen PW. Ultrasonography in Obstetrics and Gynecology, Fourth Edition, 2000, Page 498-499.

14. You are shown longitudinal and transverse gray scale images of the uterus of a 32 year-old woman with positive pregnancy test. These findings are most consistent with which ONE of the following types of pregnancy?



- A. Normal intrauterine
- **B: Heterotopic**
- C. Cornual (Interstitial)
- D. Fimbrial

Key: C

Rationales:

- A. *Incorrect*. Normal intrauterine pregnancy implants eccentrically within the endometrium and not at the interstitial portion of the fallopian tube. The implantation in this case is at the interstitial portion of the fallopian tube as the overlying myometrium is very thin (<5mm).
- B. *Incorrect*. For heterotopic pregnancy, one has to demonstrate both intra and extra uterine pregnancy present at the same time.
- C. *Correct.* Cornual pregnancy (interstitial pregnancy) accounts for less than 2 % of pregnancies and is important to recognize as these patients present very late. A major complication is a ruptured uterus. Sonographically it is identified by eccentric location and usually an echogenic band can be seen connecting the ectopic pregnancy with the endometrial stripe, called interstitial line (sign).
- D. *Incorrect.* Fimbrial pregnancy is an ectopic pregnancy outside the uterus in the fimbrial portion of the fallopian tube.

References:

Paspulati RM and McElroy TM. Ectopic Pregnancy. In :Dogra V, Rubens DJ(eds): Ultrasound Secrets. 1st Edition. Philadelphia; Hanley and Belfus; 2004, Page 75-80.

15. You are shown a longitudinal image of the left kidney. Which of the following is the MOST likely diagnosis?



- A. Normal examination
- B: Emphysematous pyelonephritis
- C. Xanthogranulomatous pyelonephritis
- D. Medullary nephrocalcinosis

Key: D

Rationales:

- A. *Incorrect*. The pyramids are echogenic, characteristic of medullary nephrocalcinosis. Normal pyramids are isoechoic to slightly hypoechoic with respect to the adjacent cortex
- B. *Incorrect.* On ultrasound the gas will produce echogenic foci with distal dirty shadowing which obscures visualization of deeper structures. This is not seen on these images.
- C. *Incorrect*. This is usually associated with obstructive nephropathy, which is not seen here. XGP is suggested with parenchymal thinning, debris in a dilated collecting system, perinephric fluid collection and stones. These are not the findings in this case.
- D. **Correct**. Hyperparathyroidism is one of the etiologies of medullary nephrocalcinosis. The sonographic findings include medullary pyramids that are more echogenic than the adjacent cortex, as seen on these images.

References:

Thurston W, Wilson SR. The Urinary Track. In: Rumack CM, Wilson SR, and Charboneau JW (eds.) Diagnostic Ultrasound. Elsevier Mosby, St. Louis, 2005, Pages 337-338, and 350.

16. You are shown a midline image in the transverse plane from an abdominal ultrasound in a 40year-old woman. What structure corresponds to the arrow?



- A. Common bile duct
- B: Pancreatic duct
- C. Left renal vein
- D. Splenic vein

Key: C

Rationales:

- A. *Incorrect*. The common bile duct, in the transverse plane, can be seen as a circular structure in the lateral aspect of the head of the pancreas.
- B. *Incorrect*. The pancreatic duct is at least partially seen in 86% of patients. In the transverse plane it can be seen in the central portion of the body of the pancreas.
- C. **Correct**. In the transverse plane the left renal vein can be seen crossing anterior to the aorta on its way to the IVC.
- D. *Incorrect*. In the transverse plane, the splenic vein is posterior inferior to the pancreas and courses from the splenic hilum to join the superior mesenteric vein to form the portal vein.

References:

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