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Self Assessment Module Questions, Answers and References

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Pulmonary Hypertension: Classification and Imaging

SAM Questions

1. The definition of PAH is:
   A) Resting mPAP ≥ 25 mmHg, pulmonary artery occlusion (wedge) pressure > 15 mmHg and pulmonary vascular resistance (PVR) > 3 Wood units at right heart catheterization
   B) Resting mPAP ≥ 20 mmHg, pulmonary artery occlusion (wedge) pressure > 15 mmHg and pulmonary vascular resistance (PVR) ≤ 3 Wood units at right heart catheterization
   C) Resting mPAP ≥ 25 mmHg, pulmonary artery occlusion (wedge) pressure ≤ 15 mmHg and pulmonary vascular resistance (PVR) > 3 Wood units at right heart catheterization
   D) Resting mPAP ≥ 20 mmHg, pulmonary artery occlusion (wedge) pressure ≤ 15 mmHg and pulmonary vascular resistance (PVR) ≤ 3 Wood units at right heart catheterization
   E) Resting mPAP <20 mmHg, pulmonary artery occlusion (wedge) pressure ≤ 15 mmHg and pulmonary vascular resistance (PVR) ≤ 3 Wood units at right heart catheterization

   CORRECT ANSWER: C.
   A) The pulmonary wedge pressure is ≤ 15 mmHg in pulmonary arterial hypertension.
   B) These parameters are seen in group 2 pulmonary hypertension with left heart disease.
   D) These parameters are seen in group 2 pulmonary hypertension with left heart disease with the exception of a pulmonary wedge pressure greater than 15 mmHg.
   E) These parameters reflect values seen in the normal population.

   REFERENCES:
   [Link to article]

2. Pulmonary arterial hypertension can be reliably predicted on CT when:
   A) Diameter of distal main pulmonary artery ≥ 29 mm and segmental artery to bronchus ratio > 1:1 in three of four pulmonary lobes

   REFERENCES:
   [Link to article]
B) Ratio of distal main pulmonary artery diameter to aortic diameter > 1:1 in patients > 50 years old
C) Abrupt narrowing and tapering of central pulmonary vessels is present
D) Right atrium is enlarged and right ventricle is small
G) Rightward bowing of the interventricular septum and dilatation of the tricuspid valve annulus is present

CORRECT ANSWER: A
B. PAH can be reliably predicted on CT when the ratio of the distal main pulmonary artery to aortic diameter is > 1:1 in patients less than 50 years old, not greater than 50 years old.
C). A CT feature of pulmonary arterial hypertension is abrupt narrowing and tapering of the peripheral pulmonary vessels, not the central pulmonary vessels.
D). Other features suggestive of but not reliably predictive of PAH include right atrial enlargement and right ventricular hypertrophy.
E). Leftward, not rightward bowing of the interventricular septum and dilatation of the tricuspid valve annulus may also be seen.

REFERENCES:

3. The characteristic delayed contrast enhancement pattern seen on cardiac MRI in pulmonary hypertension includes:
A) Anteroseptal and inferoseptal RV attachments more prominent at base of heart
B) Anteroseptal and inferoseptal RV attachments more prominent at apex of heart
C) Septal enhancement without IVS bowing
D) Diffuse mid-myocardial enhancement
E) Nodular septal enhancement

CORRECT ANSWER: A
B) Correct answer is more prominent at the base of the heart.
C) If septal enhancement is seen, it is usually with the presence of IVS bowing.
D) Diffuse mid-myocardial enhancement is a pattern seen more commonly with myocarditis rather than pulmonary arterial hypertension.
E) Nodular septal enhancement is not the pattern seen in PH.

REFERENCE:
Kovacs G et al. The Emerging Role of Magnetic Resonance Imaging in the Diagnosis and Management of Pulmonary Hypertension; Respiration 2008; 76: 458 to 470

4. Cardiac MRI Features of PH include:
A) RV dilatation and hypertrophy with increased right ventricular ejection fraction
B) RV wall thinning with rightward IVS flattening or bowing
C) RV dilatation and wall hypertrophy with leftward IVS flattening or bowing
D) RV/LV diameter < 1 at the mid-ventricular level
E) Collapse of RA, IVC and hepatic veins
CORRECT ANSWER: C
A) RV dilatation and hypertrophy are correct but there is actually decreased, not increased right ventricular ejection fraction.
B) Right ventricular hypertrophy and leftward interventricular septal flattening or bowing are features, not right ventricular wall thinning.
D) The RV/LV diameter is > 1 at the midventricular level
E) The right atrium, IVC and hepatic veins are dilated, not collapsed.

REFERENCES:
Bradlow et al. Cardiovascular magnetic resonance in pulmonary hypertension. Journal of Cardiovascular Magnetic Resonance 2012; 14:6
Marc V. Gosselin, MD
Pulmonary Thromboembolic Disease: Challenging Conventional Wisdoms

SAM Questions

1. For a Pregnant Patient, which Scenario is the Best Way to Evaluate for PE?
   A. V/Q scan if the Chest Radiograph is Normal
   B. V/Q scan if the Chest Radiograph is Abnormal
   C. CT Angiogram if the Chest Radiograph is Normal
   D. Doppler Ultrasound to look for DVT
   E. All Suspected PE’s should be imaged with CT Angiograms

   ANSWER: A

   Ridge et al. AJR: 193 Nov 2009

2. What is the Estimated Mortality Incidence from ALL PE’s
   A. 3 per 100,000 persons
   B. 2 per 1,000 persons
   C. 5%
   D. 12%
   E. 18-30%

   ANSWER: A


3. What is the Most Likely Mechanism for Rapid Symptomatic Improvement of a Pulmonary Embolus with IV Anticoagulation?
   A. The High concentrations break up the Pulmonary clot/emboli quickly
   B. It Improves hemodynamic flow by raising the Pulmonary Artery blood pressure
   C. Induces a Pulmonary Vasodilation effect
   D. Prevents DVT from releasing more Emboli
   E. It Increases Right Ventricular Contractility

   ANSWER: C

SAM Questions:

1) Which of the following is the most common manifestation of Granulomatosis with Polyangiitis (GPA) in the large airways?
   (Coding: M-C02B.E, Pr-C02B.G, A-C02B.C, P-C02B.E)
   
   A. Left upper lobe collapse
   B. Right bronchopleural fistula
   C. Subglottic stenosis
   D. Tracheobronchomalacia
   E. Tracheoesophageal fistula

   Correct answer: C. Subglottic stenosis.

   Granulomatosis with Polyangiitis (GPA, formerly known as Wegener Granulomatosis) is a c-ANCA-positive multisystem vasculitis characterized by necrotizing granulomatous inflammation. Airway involvement may lead to ulceration, scarring and narrowing or, less commonly, fistula formation. Subglottic stenosis is the most common manifestation of GPA in the large airways (option C is correct). Less commonly, involvement of the main, lobar or more distal bronchi can result in atelectasis (option A is incorrect). While airway involvement more commonly results in relatively fixed areas of ulceration and narrowing, tracheobronchomalacia has been reported in patients with GPA (option D is incorrect). Fistulas to either the esophagus or pleural space are rare manifestations (options B and E are incorrect).


2) Which of the following statements regarding bronchial carcinoid tumors is TRUE?
   (Coding: M-C02B.E, Pr-C02B.A, A-C02B.C, P-C02B.C)
   
   A. 80% occur in airways distal to segmental bronchi.
   B. Less than 5% show calcification on CT.
   C. Mean age at presentation is > 65 years.
   D. The “iceberg” sign describes the CT appearance of some carcinoid tumors of the lobar and segmental airways.
   E. Typical carcinoid tumors usually show evidence of metastatic disease (lymph nodes, bone) at presentation.

   Correct answer: D. the “iceberg” sign describes the CT appearance of some carcinoid tumors of the lobar and segmental airways.

Bronchial carcinoid tumors are lesions of neuroendocrine cell origin with varying malignant potential. There are two recognized histopathologic forms: typical and atypical carcinoid tumors. Typical carcinoid tumors infrequently show metastases at presentation (option E is incorrect). Atypical carcinoid tumors, on the other hand, more frequently show metastases to lymph nodes and bone. Reported mean age at presentation varies but rarely exceeds 50 years (option C is incorrect). Most reports suggest that the majority (>80%) of bronchial carcinoid tumors occur in the main, lobar and segmental bronchi (option A is incorrect). In most series, between 25 and 37% of bronchial carcinoid tumors show calcification at CT (option B is incorrect). The “iceberg” or “tip of the iceberg” sign on CT refers to the observation that the endoluminal portion of a carcinoid tumor in the central airways is often much smaller than the extraluminal portion (option D is correct).


3) Which of the statements concerning tracheobronchomalacia is TRUE?
(Coding: M-C02B.E, Pr-C02B.G, A-C02B.C, P-C02B.K)

A. Characterized on pulmonary function testing by abnormal airflow on inspiration.
B. Diagnosis suggested by > 70% cross-sectional area reduction of trachea on expiratory CT scans.
C. Manifests on CT with abnormal thinning of airway walls.
D. Affected patients are usually asymptomatic.
E. Strongly associated with scleroderma

Correct answer: B. Diagnosis suggested by > 70% cross-sectional area reduction of trachea on expiratory CT scans.

Tracheobronchomalacia is a condition characterized by abnormal collapsibility of the intrathoracic trachea or proximal bronchi. Airway walls may be normal or thickened (Option C is incorrect). Affected patients usually present with complaints of chronic cough or dyspnea (option D is incorrect). Associated conditions include chronic obstructive pulmonary disease, long-term corticosteroid therapy and inflammatory conditions of the airway such as relapsing polychondritis. Scleroderma has no reported association with tracheobronchomalacia (option E is incorrect). Pulmonary function testing shows expiratory airflow abnormalities with blunting of the expiratory curve of the flow-volume loop (option A is incorrect). Diagnosis is suggested by a significant cross-sectional area reduction of the airway on expiratory CT. While there is a significant overlap between normal subjects and those with TBM, cross sectional area reductions of greater than 50 to 70% suggest disease (option B is correct).

Ferretti GR, Jankowski A, Perrin MA, Chouri N, Arnol N, Aubaud L, Pepin JL. Multi-


4) Which of the statements concerning blunt central airway injury is TRUE?
(Coding: M-C02B.E, Pr-C02B.M, A-C02B.C, P-C02B.H)

A. Diagnosis is suggested by persistent pneumothorax despite adequate tube thoracostomy drainage.
B. Most injuries occur in the proximal trachea.
C. The left-sided airways are more commonly injured than the right-sided airways.
D. The “fallen lung sign” refers to a vascular pedicle injury that occurs in association with a bronchial laceration.
E. Chest radiography is considered the diagnostic standard for diagnosis of airway trauma.

Correct answer: A. Diagnosis is suggested by persistent pneumothorax despite adequate tube thoracostomy drainage.

Airway injuries in the setting of blunt thoracic trauma usually occur within 2.5-cm of the tracheal carina and are more common in the proximal bronchi than the distal trachea (option B is incorrect). For reasons unknown, injuries are slightly more common on the right (option C is incorrect). Diagnosis is suggested by persistent pneumothorax despite adequate tube thoracostomy drainage or by extensive pneumomediastinum (option A is correct). The “fallen lung” sign refers to the appearance of the lung in cases of complete bronchial fracture. In this setting the lung falls away from the hilum and assumes a dependent position. The vascular pedicle remains intact, however, and tethers the “fallen lung” to the mediastinum (option D is incorrect). While chest radiography may suggest the diagnosis, the findings are by no means definitive and must be confirmed either by multi-detector CT or direct airway examination (option E is incorrect).

5) Which of the statements concerning allergic bronchopulmonary aspergillosis (ABPA) is TRUE? (Coding: M-C02B.E, Pr-C02B.G, A-C02B.C, P-C02B.D)

A. Affected patients are commonly asymptomatic.
B. Mucus plugs are of high attenuation on CT in greater than 75% of patients.
C. Central bronchiectasis is one of the radiologic hallmarks of the disease.
D. *A. clavatus* is the most common causative organism
E. Disease usually occurs in the setting of profound neutropenia.

Correct answer: C. Central bronchiectasis is one of the radiologic hallmarks of the disease.

Allergic bronchopulmonary aspergillosis (ABPA) results from airway colonization and infection by various mycoses, most commonly *A. fumigatus* (option D is incorrect). Affected patients usually have severe and refractory asthma; chronic cough, hemoptysis and expectoration of mucus plugs are other common complaints (option A is incorrect). Other than a history of atopy, affected patients are otherwise immunologically normal (option E is incorrect). Central bronchiectasis and large mucus plugs are the two radiologic hallmarks of the disease (option C is correct). These findings are more common in the upper lobes and are frequently asymmetric. The mucus plugs are of high attenuation on CT in up to 40% of affected patients (option b is incorrect). This high attenuation is attributed to inspissation of mucus and secretion of calcium oxalate crystals by the fungus.

HRCT: Approach to Fibrotic Lung Disease

SAM Questions

1) Which of the following HRCT findings is inconsistent with a UIP pattern of lung fibrosis?

A. subpleural, basal predominance
B. reticular opacities
C. honeycombing
D. traction bronchiectasis
E. air trapping on expiratory scans

ANSWER: E. air trapping on expiratory scans

Discussion: Criteria for a definite diagnosis of usual interstitial pneumonia (UIP) include a subpleural and basal predominance, reticular opacities with or without traction bronchiectasis, honeycombing, and an absence of inconsistent features. A common HRCT finding considered inconsistent with this diagnosis is air trapping on expiratory scans. It is typical of hypersensitivity pneumonitis, rather than UIP and idiopathic pulmonary fibrosis.


2) The HRCT finding most helpful in making the diagnosis of nonspecific interstitial pneumonia (NSIP) is:

A. ground-glass opacity
B. reticulation
C. subpleural sparing
D. honeycombing
E. an upper or midlung predominance

ANSWER: C. subpleural sparing

Discussion: NSIP occurs in cellular and fibrotic forms. It may show ground-glass opacity, reticulation, and traction bronchiectasis with a basal and subpleural distribution. Honeycombing is uncommon and, if present, it is of minimal extent. Subpleural sparing, with lung immediately beneath the pleural surface being less abnormal than other peripheral lung, is a finding present in up to 50% of cases, and strongly predicts this diagnosis.


3) The most likely cause of patchy pulmonary fibrosis having a mid lung predominance, involving both central and peripheral lung, and associated with air trapping is

A. silicosis
B. sarcoidosis
C. hypersensitivity pneumonitis
D. NSIP
E. UIP

ANSWER: C. hypersensitivity pneumonitis

Discussion: Chronic hypersensitivity pneumonitis is characterized on HRCT by patchy fibrosis involving the mid or upper lung zones, both central and peripheral lung regions, and is often associated with mosaic perfusion or air trapping. It results in reticulation and traction bronchiectasis with a patchy distribution, and honeycombing may be present.

Reference:
Silva CIS, Müller NL, Churg A. Hypersensitivity pneumonitis: spectrum of high-resolution CT and pathologic findings. AJR Am J Roentgenol 2007;188:334-344