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**LEARNING OBJECTIVES**

After completing this CME activity, physicians should be better able to:
- Identify the defining characteristics of pulmonary hypertension
- Identify MRI techniques best suited for evaluation of patients with known or suspected pulmonary hypertension
- Diagnose pulmonary hypertension using various imaging techniques

**ANSWERS**

*1. Which of the following defines pulmonary hypertension?
(a) Mean pulmonary artery pressure > 25 mm Hg at rest
(b) Pulmonary capillary wedge pressure > 15 mm Hg
(c) Pulmonary vascular resistance of < 3 Wood units
(d) Right ventricular systolic pressure > 10 mm Hg

Correct answer: A

Rationale:
Pulmonary hypertension is defined as a mean pulmonary artery pressure greater than 25 mm Hg at rest. Other criteria that establish a diagnosis of pulmonary hypertension include pulmonary capillary wedge pressure less than 15 mm Hg and pulmonary vascular resistance of greater than 3 Wood units.

Please see the following reference for further study:

*2. What is the most common cause of acute pulmonary hypertension?
(a) Acute myocardial infection
(b) Acute respiratory distress syndrome
(c) Acute pulmonary thromboembolism
(d) Acute aortic dissection

Correct answer: C

Rationale:
The most common cause of acute pulmonary hypertension is acute pulmonary thromboembolism. Regional hypoxia leads to vasoconstriction in the pulmonary arterial bed. As this resistance is elevated, pulmonary blood flow decreases and pulmonary arterial pressure rises. When pulmonary arterial pressures increase dramatically, acute right heart strain and ultimately cor pulmonale can ensue.

Please see the following reference for further study:

*3. Which of the following CT findings is the most suggestive of pulmonary veno-occlusive disease in a patient with recently diagnosed pulmonary hypertension?
(a) Pulmonary vein enlargement
(b) Interlobular septal thickening
(c) Right ventricular hypertrophy
(d) Pulmonary artery intimal calcification

Correct answer: B
Rationale:

Interlobular septal thickening is the most suggestive finding of pulmonary veno-occlusive disease in a patient with newly diagnosed pulmonary hypertension. The pulmonary lymphatics and small veins are located in the interlobular septa, and obstruction at this level results in pre-obstruction venous dilation and lymphatic engorgement. Pulmonary vein enlargement is not a finding associated with pulmonary veno-occlusive disease. Because pulmonary veno-occlusive disease usually results in symptoms early in its course, right ventricular hypertrophy and pulmonary artery intimal calcification are not expecting findings as they indicate longstanding pulmonary hypertension.

Please see the following reference for further study:

*4. Which of the following magnetic resonance imaging techniques is best suited for pulmonary vascular shunt quantification?
(a) Cardiac gated steady state free procession
(b) Contrast-enhanced magnetic resonance angiography
(c) Time-of-flight magnetic resonance angiography
(d) Phase contrast magnetic resonance angiography

Correct answer:
D

Rationale:

Phase contrast magnetic resonance angiography allows measurement of both velocity and direction of blood flow and thus is best suited for quantifying pulmonary vascular shunts.

Please see the following reference for further study:

*5. What best characterizes the histopathology of chronic pulmonary hypertension?
(a) Pulmonary arterial smooth muscle hypertrophy
(b) Pulmonary venous thrombosis
(c) Lymphocytic infiltration of pulmonary arteries
(d) Panlobular emphysema

Correct answer:
A

Rationale:

Pulmonary arterial smooth muscle hypertrophy is the hallmark of chronic pulmonary hypertension. Neointimal formation and in situ arterial thrombi may also be present. Pulmonary venous thrombosis is characteristic of pulmonary veno-occlusive disease but is not associated with other causes of pulmonary hypertension. Lymphocytic infiltration of pulmonary arteries is associated with chronic pulmonary vasculitis and is not a marker of pulmonary hypertension. Panlobular emphysema most commonly is the result of alpha-1 antitrypsin deficiency and is characterized by emphysematous destruction of the entire secondary pulmonary lobule. While extensive emphysema can cause secondary pulmonary hypertension, it is not maker of pulmonary hypertension.

Please see the following reference for further study:

*6. Which of the following chest radiographic findings is most suggestive of pulmonary hypertension?
(a) Pulmonary hyperinflation
(b) Splaying of the carina
(c) Filling in of retrosternal space
(d) Left ventricular calcification

Correct answer:
C
Rationale:
Filling in of the retrosternal space on the lateral chest radiograph may reflect enlargement of the right ventricular outflow tract. Pulmonary hyperinflation is a sign of obstructive lung disease. Carinal splaying can occur with left atrial enlargement, and left ventricular calcification typically indicates remote infarction.

Please see the following reference for further study:

7. Which of the following is the reference standard imaging test for chronic pulmonary thromboembolic hypertension?
   (a) Ventilation-perfusion scintigraphy
   (b) CT pulmonary angiography
   (c) Echocardiography
   (d) MR angiography

Correct answer:
A

Rationale:
Ventilation-perfusion scintigraphy (V/Q scanning) is the most sensitive test for showing the multiple subsegmental ventilation-perfusion mismatches characteristic of CTEPH. Findings of CTEPH may also be apparent on CT and MR. Echocardiography may suggest pulmonary hypertension but often cannot identify the cause.

Please see the following reference for further study:

8. Which of the following is an independent predictor of mortality in pulmonary arterial hypertension?
   (a) Tricuspid valve regurgitant fraction
   (b) Pulmonary artery stiffness
   (c) Interventricular septal bowing
   (d) Increased right ventricular ejection fraction

Correct answer:
B

Rationale:
Pulmonary artery stiffness and its imaging surrogate, relative area change, which is defined as (maximum systolic area – minimum diastolic area)/maximum systolic area, have been shown to be independent predictors of mortality in pulmonary arterial hypertension. Tricuspid valve regurgitation and interventricular septal bowing may indicate elevated right ventricular pressure. Increased right ventricular ejection fraction indicates a better prognosis in the setting of pulmonary arterial hypertension.

Please see the following reference for further study: