

Section 3: Pulmonary and Critical Care Medicine

CHAPTER 18: OBSTRUCTIVE LUNG DISEASES

Q.1. An 80-year-old man has a 50-year pack-a-day smoking history and a 12-year history of COPD. He presents with two days of worsening dyspnea, yellow-green sputum, and cough. He has not been able to sleep for two nights and is unable to lie flat. Arterial blood gases are: pH 7.32, PO₂ of 53 mm Hg, and PCO₂ of 58 mm Hg. You admit him to the hospital. Chest radiograph does not reveal an infiltrate. Which of the following would you *not* prescribe?

- A. Intermittent positive pressure breathing treatments by face mask
- B. Nebulized albuterol
- C. High-dose inhaled corticosteroids
- D. An oral macrolide antibiotic
- E. 28% oxygen by Venturi mask

Answer: C. Inhaled corticosteroids are not useful for severe exacerbations of COPD. Oral or parenteral steroids should be administered. The other treatments are acceptable modes of initial therapy for an acute COPD exacerbation with acute, albeit mild, respiratory failure. Noninvasive mask ventilation has been shown to reduce the need for intubation in patients with COPD exacerbations. Nebulized albuterol is not more effective than use of a metered dose inhaler and reservoir but is an acceptable mode of treatment. Macrolides may be taken orally for patients who are able to take them. Antibiotics may shorten the course of an exacerbation. Venturi mask delivery of oxygen is the preferred method of delivery for patients who are acutely ill and may be at risk for hypercapnia.

Q.2. A 28-year-old man has smoked 30 cigarettes per day for 12 years. He has a chronic "smoker's cough," producing two teaspoons of gray phlegm each morning. He has done this for the past four years. He is concerned that his smoking habit is affecting his health, and he consults you for an examination and advice regarding his cough. Which of the following would you do?

- A. Perform a history and physical examination, reassure him that he is healthy, and counsel him to quit smoking
- B. Perform a pulmonary examination, obtain spirometry and a chest radiograph, inform him that he has chronic bronchitis, prescribe a nicotine inhaler to help him quit smoking, and schedule a return appointment
- C. Perform a pulmonary examination, obtain a chest radiograph, complete blood count, and urinalysis; reassure him; counsel him to cut back on his smoking and give him an influenza vaccination
- D. Perform a history and a physical examination; obtain spirometry, ECG, chest radiograph, complete blood count, biochemical profile, urinalysis, and schedule a follow-up appointment to review the results

Answer: B. The patient has chronic bronchitis by definition, but spirometry is needed to determine if the patient has evidence of airflow obstruction. A physical examination is not sensitive for diagnosing patients with mild to moderate COPD. It is good practice to inform all actively smoking patients at each visit that they should discontinue smoking. The principles of smoking cessation include a strong personalized message, prescription of adjuncts, such as nicotine replacement, and follow up to reinforce cessation.

Q.3. A 28-year-old man presents with chronic cough and sputum production. He requires about four courses of antibiotics per year. He has a history of frequent respiratory infections as a child including chronic sinusitis, which has required several surgical drainage procedures. A chest CT shows thickening and dilatation of peripheral airways in the lower lobes compatible with bronchiectasis. He is married but has no children. He works in a grain storage facility as a manager. Your evaluation would include all of the following studies except

- A. Aspergillus precipitins
- B. Serum immunoglobulin levels
- C. Nasal mucosal biopsy with electron microscopy
- D. Sweat chloride level
- E. Serum protein electrophoresis

Answer: A. This test might be useful for allergic bronchopulmonary aspergillosis (ABPA), but this man does not have a history of persistent asthma or recurrent infiltrates. ABPA can cause central bronchiectasis but does not typically cause peripheral bronchiectasis. The remaining tests might disclose other causes of bronchiectasis, such as IgA or IgG deficiency, immotile cilia syndrome, cystic fibrosis presenting in an adult, and alpha-1 antitrypsin or severe immunoglobulin deficiency, respectively.

Q.4. A 43-year-old woman has severe episodic asthma, requiring her to visit the emergency department and receive a course of oral steroids four to five times per year, and requires oral steroids approximately half the days of the year. She uses high-dose inhaled corticosteroids twice daily. She works in an electronic assembly plant soldering components to integrated circuits. She has gained approximately 30 pounds over the past five years, which she attributes to her oral steroids. She has chronic severe frontal headaches and takes Fiorinal (aspirin, butabarbital, and caffeine) approximately four times per week for treatment of these. She has had sinus drainage surgery with removal of obstructing nasal polyps but this has had only minimal effect on her headaches. She has no pets, no foreign travel, and has never smoked cigarettes. A chest radiograph is normal. Pulmonary function tests show the FEV1/FVC ratio is 0.68, and her FEV1 is 72% predicted. The most appropriate treatment for this patient would include:

- A. A 24-hour esophageal pH probe test for GERD, prescription of a proton pump inhibitor, and a chest CT to evaluate for silicosis
- B. Serum immunoglobulins with IgG subtypes, a sputum culture, a sweat chloride test, a high-resolution chest CT, and prescription of antibiotics
- C. Panel of auto-antibodies, creatinine clearance, sinus CT, nasal mucosal biopsy, and immunosuppressive therapy
- D. Bronchoscopy to evaluate for central airway obstruction, nutrition consultation for weight-loss, and prescription of alendronate for treatment of osteoporosis
- E. Daily monitoring of peak expiratory flow, prescription of nasal steroids, a leukotriene receptor antagonist, and discontinuation of the current analgesic medication

Answer: E. The patient has chronic severe asthma, and her history suggests that she has “triad” asthma with nasal polyps and aspirin sensitivity (present in Fiorinal). A first step in treating this patient would be to discontinue the aspirin-containing medication and add a second controller medication, which would most appropriately be a leukotriene receptor antagonist. Monitoring of peak flow to assess for asymptomatic deterioration in lung function, and institution of an asthma-action plan based on peak flow and clinical symptoms may permit her to avoid emergency department visits. She may also have an element of occupational asthma, and monitoring of twice-daily peak flow will help assess whether she worsens at the end of the day or throughout the course of the workweek.

Q.5. A 72-year-old man with COPD presents for routine follow-up. He has a 120-pack-a-year smoking history and quit smoking four years ago after hospitalization for respiratory failure. He complains of severe breathlessness despite completion of a pulmonary rehabilitation program. He has daily morning cough and phlegm production. Chest examination shows decreased breath sounds and distant heart sounds. There is no cyanosis, clubbing, or peripheral edema. He has an FEV1/FVC ratio of 0.43 and an FEV1 of 32% predicted. The D_LCO is 28% of predicted. The TLC is 120% predicted and the RV is 223% predicted. Arterial blood gases on room air are PaO₂ 61 mm Hg, PaCO₂ 48 mm Hg, pH 7.41. His maximum exercise capacity on a cycle ergometer is 32% of predicted, which is interpreted as a severe impairment. His BMI is 23, and he has lost 10 pounds of body weight over the past three years. A chest radiograph and chest CT show emphysema that is predominantly in the upper zones of the chest. Appropriate therapy would include

- A. Lung transplantation
- B. Noninvasive mask ventilation at night
- C. Continuous low-flow oxygen by nasal cannula
- D. Lung volume reduction surgery
- E. All-trans retinoic acid

Answer D: Lung volume reduction surgery is an appropriate option for patients with severe emphysema (FEV1 less than 40% predicted) who are very symptomatic, have low exercise capacity despite rehabilitation, and have emphysema predominantly in the upper lung zones. This patient does not qualify for lung

transplantation given his age (>60) and level of lung function (>25% predicted FEV1). He does not have sufficient hypoxemia to warrant long-term oxygen, nor does he have enough acute hypercapnia to warrant noninvasive mask ventilation. The low D_LCO suggests that this patient might desaturate with exercise. If testing shows this to be the case, then portable supplemental oxygen may improve exercise capacity.

Q.6. A 52-year-old woman who is a lifelong nonsmoker enters for evaluation of recurrent episodes of pneumonia. These episodes are characterized by increasing cough with purulent sputum. She has had several of these episodes diagnosed clinically by the presence of crackles over the right lower lung field extending into the axilla. On several occasions, she has had chest radiographs that showed abnormalities over the right middle lobe and right lower lobe. A high resolution CT scan shows that this region of lung has dilated airways that are approximately twice the diameter of the accompanying blood vessel. Lung function tests show a mild restrictive ventilatory defect and mild airflow obstruction. Diagnostic tests that are indicated include all *except*

- A. Bronchoscopy
- B. Sweat chloride test
- C. Alpha-1 antitrypsin levels
- D. Sputum examination for acid-fast bacilli
- E. Serum immunoglobulin levels

Answer A: This patient has bronchiectasis. Although obstruction of the bronchus intermedius can lead to recurrent pneumonias in the right middle and lower lobes, the CT scan does not identify atelectasis. Causes for bronchiectasis may include adult presentation of cystic fibrosis (increased sweat chloride), immunoglobulin deficiency, alpha-1 antitrypsin, or prior granulomatous lung infection. In middle-aged and older women, right middle-lobe bronchiectasis may be associated with low-grade infections with atypical mycobacteria. This syndrome has been called "Lady Windemere's" syndrome after the character in the play by Oscar Wilde.

Q.7. A 66-year-old female has been smoking 1 to 2 packs of cigarettes per day for 43 years. She has exertional dyspnea, and morning cough variably productive of clear or yellow sputum. Chest x-ray reveals diffuse emphysematous changes. Pulmonary function tests reveal an FEV1 of 37% predicted, an FVC of 79% predicted, and a DLCO of 53% or predicted. Which of the following statements is true?

- A. Rotating oral antibiotics every month will reduce the number of yearly exacerbations
- B. Inhaled corticosteroids will not prevent progression of the disease
- C. Lung transplantation is a good alternative for therapy in this patient
- D. Smoking cessation does not alter the course of disease

Answer: B. This patient has emphysema, potentially with a component of chronic bronchitis depending on the duration of her sputum production, which is not stated. Smoking cessation is the only intervention that has been shown to alter the course of disease progression in emphysema. Antibiotics are frequently prescribed for acute exacerbations associated with changes in the character or volume of sputum, but are not helpful chronically. Lung transplantation is not generally considered in an individual over 60 years old.

Chapter 19: PULMONARY FUNCTION TESTING

Q.1. In which of the following disease states would you expect an increased D_LCO ?

- A. Emphysema
- B. Pulmonary hypertension
- C. Pulmonary hemorrhage
- D. Multiple pulmonary emboli

Answer: C. The presence of blood in the alveolar space acts as a "sink" for the carbon monoxide (CO) used in the diffusing capacity measurement. The D_LCO will be increased. All the other choices are associated with a decreased D_LCO .

Q.2. A 28 year-old woman has chronic, nonproductive cough for 12 months. It is worse during the day and is not affected by position. It is made worse by going outdoors, particularly on cold days, on exposure to irritants, such as cigarette smoke, and may get worse following exercise. She is obese (BMI 32) but her weight has been stable and she has no peripheral edema. A chest radiograph and echocardiogram are normal. A methacholine inhalation challenge test shows that she can tolerate the maximal concentration (25 mg/mL) without a decline in her FEV₁. Which of the following statements is *false*?

- A. She is unlikely to have gastroesophageal reflux
- B. She is likely to have sinusitis/post-nasal drip
- C. She is likely to have asthma
- D. She is likely to have both sinusitis and gastroesophageal reflux
- E. She is unlikely to respond to a course of inhaled corticosteroids

Answer: C. A negative methacholine challenge test makes active asthma unlikely if the patient is not being treated with bronchodilators prior to the test. About 70 to 90% of patients with chronic cough suffer from one or more of the following: asthma, sinusitis/post-nasal drip, or gastroesophageal reflux. Most patients with prolonged, recalcitrant cough have two or more of these diagnoses. Because she does not have asthma, she is unlikely to respond to inhaled corticosteroids.

Q.3. A 43-year-old man who has smoked one-half pack of cigarettes per day since the age of 20 has an insidious onset of dyspnea. He has pulmonary function testing that shows an FEV₁/FVC ratio of 0.63, an FEV₁ of 40% predicted, a TLC of 140% predicted, an RV of 184% predicted, a D_LCO of 24% predicted. A chest CT shows predominantly lower lobe emphysema. Which of the following statements is most likely correct?

- A. His oxygen saturation by pulse oximetry falls when he exercises
- B. His end-expiratory lung volume falls when he exercises
- C. He likely has occupational exposure to coal dust
- D. His antiphospholipid antibodies are likely positive
- E. He has the MZ phenotype of alpha-1 antitrypsin

Answer: A. When the D_LCO is less than 50%, about half of patients have exercise desaturation. The diagnosis of exclusion in this case is alpha-1 antitrypsin deficiency, evidenced by the severe emphysema in a young man with a light smoking history and the lower lobe emphysema (suggesting panacinar pathology). Most of these patients have the ZZ or SZ phenotype. Coal dust exposure has a mild effect on airway function, but is not likely to cause severe premature emphysema of the panacinar variety. Severe thromboembolic pulmonary hypertension can cause reduction in diffusing capacity, but would not lead to emphysema or a severe obstructive ventilatory defect.

Q.4. A 52-year-old man who has never smoked has been confined to bed for the past year because of massive obesity (BMI = 48). He has hypoxemia secondary to hypoventilation and has peripheral edema suggesting cor pulmonale. Which of the following sets of lung volumes are most likely present?

- A. TLC 110% predicted, FRC 120% predicted, RV 160% predicted
- B. TLC 85% predicted, FRC 62% predicted, RV 94% predicted
- C. TLC 60% predicted, FRC 65% predicted, RV 58% predicted
- D. TLC 120% predicted, FRC 80% predicted, RV 60% predicted
- E. TLC 100 % predicted, FRC 98% predicted, RV 105% predicted

Answer: B. Patients with obesity have slight reductions of TLC, but they are often in the normal range. The most striking abnormality in obesity is the disproportionate reduction in end-expiratory lung volume or FRC (functional residual capacity). Because of the low end-expiratory lung volumes, the airways at the base of the lung may be closed during normal tidal breathing, which contributes to the poor oxygenation.

Q.5. Which of the following statements is true for a patient with a negative methacholine challenge test?

- A. The patient is likely to have emphysema
- B. The patient is very likely to have active asthma
- C. The patient is very unlikely to have active asthma

D. The patient should be treated with bronchodilator therapy and retested

Answer: C. A negative methacholine challenge test essentially rules out active asthma.

CHAPTER 20: CHEST X-RAY REVIEW

Q.1. A 57-year-old male tobacco user is found to have a 2-cm calcified middle lobe nodule on a chest x-ray obtained in the setting of bronchitic symptoms. Which pattern(s) of calcification provide(s) reassurance that the lesion is likely to be benign?

- A. Complete calcification
- B. Bull's eye calcification
- C. Popcorn calcification
- D. Onion skin calcification
- E. All of the above

Answer: E. Each of these patterns of calcification suggests that a nodule is benign. However, whereas the majority of calcified nodules are benign, adenocarcinomas are occasionally calcified. Eccentric and stippled patterns of calcification are more likely to be malignant.

Q.2. A 65-year-old man presents to the emergency department in severe respiratory distress. His chest x-ray reveals fluffy bilateral alveolar infiltrates. He is intubated and admitted to the medical intensive care unit. By the next day, he has been extubated and his chest x-ray has virtually cleared. Which alveolar filling process is most consistent with this clinical course?

- A. Cardiogenic pulmonary edema
- B. Eosinophilic pneumonia
- C. Alveolar proteinosis
- D. Desquamative interstitial pneumonitis
- E. Bacterial pneumonia

Answer: A. Two alveolar-filling processes that may clear substantially within 24 hours are blood and water (cardiogenic pulmonary edema). Of the options listed, only cardiogenic pulmonary edema would clear so rapidly.

Q.3. A 61-year-old man is diagnosed with lung cancer after a chest x-ray reveals an alveolar infiltrate. This pattern is most consistent with which of the following pulmonary malignancies?

- A. Small cell carcinoma
- B. Adenocarcinoma
- C. Bronchoalveolar cell carcinoma
- D. Sarcoma
- E. Mesothelioma

Answer: C. Bronchoalveolar cell carcinoma can present as an alveolar-filling process, while the others mentioned more commonly present as a mass.

Q.4. A 57-year-old woman with hypertension, hypercholesterolemia, diabetes mellitus, and systemic lupus erythematosus presents with gradually worsening dyspnea on exertion. Her chest x-ray demonstrates bilateral pleural effusions with a cardiothoracic ratio of 22/34 cm. The most likely cause of this presentation is

- A. Viral infection
- B. Congestive heart failure
- C. Lymphoma
- D. Connective tissue disease
- E. Pancreatitis

Answer: B. Heart failure is the most common cause of bilateral pleural effusions with an enlarged heart size and is probably also the most common cause of right-sided effusions as well.

Q.5. A 43-year-old woman presents to the emergency department with a two-week history of weakness and double vision. PA and lateral chest x-rays demonstrate an anterior mediastinal mass. The most likely diagnosis is

- A. Teratoma
- B. Lymphoma
- C. Substernal thyroid
- D. Thymic cyst
- E. Thymoma

Answer: E. Symptoms of myasthenia gravis with an anterior mediastinal mass most likely represent a thymoma. The differential diagnosis of anterior mediastinal masses is remembered by the mnemonic "terrible Ts"), and includes teratoma, thymoma, thymolipoma, thymic carcinoma/carcinoid, thymic cyst, thoracic thyroid, and terrible lymphoma.

Q.6. A 64-year-old man who was previously in excellent health and taking no prescription medications, presents with gradually worsening dyspnea on exertion. His chest x-ray reveals bilateral pulmonary effusions with a cardiothoracic ratio of 17/34 cm. The most likely cause of this presentation is

- A. Viral infection
- B. Congestive heart failure
- C. Lymphoma
- D. Connective tissue disease
- E. Pancreatitis

Answer: C. Lymphoma and other malignancies are the most common causes of bilateral pleural effusions in the presence of a normal heart size.

Q.7. A 37-year-old African-American man presents with gradually worsening cough and dyspnea on exertion. His oxygen saturation is 87% on room air, he has diffuse fine rales on auscultation of his lungs, and his chest x-ray reveals bilateral hilar adenopathy and diffuse reticulonodular infiltrates. He is originally from North

Carolina and currently works as a hired hand on a dairy farm, but previously worked in the shipyards at Bethlehem Steel in Baltimore. The most likely etiology of his interstitial infiltrates is

- A. Hypersensitivity pneumonitis
- B. Sarcoidosis
- C. Silicosis
- D. Viral pneumonia
- E. None of the above

Answer: B. Although the potential causes of interstitial lung disease include over 100 processes, and the patterns of infiltrates are not specific in most instances, this patient's hilar adenopathy is most suggestive of sarcoidosis.

Q.8. A 62-year-old man presents with a persistent, nonproductive cough. He is hypertensive and being treated with lisinopril. The medication is replaced with a thiazide diuretic, but his cough persists. His primary care physician then obtains a chest x-ray that reveals bilateral upper lung field interstitial infiltrates. Which of the following processes would be least likely to be causing his infiltrates?

- A. Eosinophilic granuloma
- B. Hypersensitivity pneumonitis
- C. Sarcoidosis
- D. Scleroderma
- E. Silicosis

Answer: D. Scleroderma is more likely to present with lower lung field interstitial disease.

Q.9. A 64-year-old man presents with the acute onset of dyspnea, and both abdominal and back pain. He has been drinking heavily and began vomiting this morning. By examination and chest x-ray he is found to have a left-sided pleural effusion. His laboratory evaluation is notable for an AST of 231 IU/L and ALT of 115 IU/L. Which of the following is least likely to be the correct diagnosis?

- A. Thoracic aortic aneurysm dissection
- B. Boerhaave's syndrome
- C. Hepatic hydrothorax
- D. Pancreatitis
- E. None of the above

Answer: C. The patient's age and alcohol abuse place him at risk for thoracic aortic aneurysm dissection, Boerhaave's syndrome, and pancreatitis. Additionally, these agents tend to present with left-sided pleural effusions whereas hepatic hydrothorax presents with right-sided pleural involvement.

Q.10. A 50-year-old man has a history of several severe episodes of pneumonia as a child, and the subsequent development of recurrent purulent sputum production. He once again presents with the latter, and a chest x-ray reveals increased bilateral lower lung field markings suggestive of "tram tracks." The most likely diagnosis is

- A. Asbestosis
- B. Aspiration pneumonia
- C. Bronchiectasis
- D. Dermatomyositis, with Jo-1-associated lung disease
- E. Sarcoidosis

Answer: C. While all of these processes may be manifested as lower lung field changes radiographically, the "tram track" appearance is a classic finding seen with bronchiectasis.

CHAPTER 21: INTERSTITIAL LUNG DISEASE

Q.1. "Shrinking lung syndrome" is often found in which of the following diseases?

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

E. Sarcoidosis

Answer: B. "Shrinking lung syndrome" is found in systemic lupus erythematosus as a result of smaller lung volumes with relatively normal parenchyma due to diaphragmatic weakness.

Q.2. In which of the following collagen vascular diseases can the associated interstitial lung disease precede the joint manifestations?

- A. Rheumatoid arthritis
- B. Systemic lupus erythematosus
- C. Sarcoidosis
- D. Scleroderma

Answer: A. In up to 20% of cases of rheumatoid arthritis-associated interstitial lung disease, the lung disease precedes any joint manifestations.

Q.3. Which of the following are not characteristic of rheumatoid arthritis-associated lung disease?

- A. Necrobiotic nodules
- B. Pleural effusions
- C. Granulomas
- D. Bronchiolitis obliterans

Answer: C. Granulomas are most characteristic of sarcoidosis and extrinsic allergic alveolitis, not rheumatoid arthritis. Necrobiotic nodules, pleural effusions and plaques, bronchiolitis obliterans, and parenchymal fibrosis are associated with rheumatoid arthritis.

Q.4. Which of the following interstitial lung diseases responds poorly to corticosteroid treatment?

- A. Acute eosinophilic pneumonia
- B. Allergic bronchopulmonary aspergillosis

- C. Idiopathic pulmonary fibrosis
- D. Bronchiolitis obliterans with organizing pneumonia (BOOP)
- E. Sarcoidosis

Answer: C. Idiopathic pulmonary fibrosis is a progressive fibrotic disorder of the lungs that occurs most frequently in individuals over 60 years of age. To date there is no cure or effective treatment for this disease and response to steroids is less than 10%. The remaining diseases all have a significant response to corticosteroids although relapse is common in BOOP and sarcoidosis.

Q.5. A 53-year-old male presents with progressive exertional dyspnea. Pulmonary function tests reveal an FVC of 2.84 L (87% predicted), FEV₁ of 1.9 L (41% predicted), and an FEV₁/FVC ratio of 0.42. Chest radiograph is clear. Which of the following diseases is most likely to cause this patient's lung disease?

- A. Systemic lupus erythematosus
- B. Idiopathic pulmonary fibrosis
- C. Wegener's granulomatosis
- D. Rheumatoid arthritis
- E. Churg-Strauss syndrome

Answer: D. Pulmonary function tests in this patient suggest obstructive lung disease. Of the potential etiologies on the list, only rheumatoid arthritis (bronchiolitis obliterans) and Churg-Strauss syndrome are obstructive diseases. More than 90% of patients with Churg-Strauss have abnormal chest radiographs, so the most likely etiology from this list is rheumatoid arthritis causing bronchiolitis obliterans.

CHAPTER 22: VENOUS THROMBOEMBOLIC DISEASE

Q.1. Clinical risk factors for DVT include all of the following except

- A. Female sex if premenopausal
- B. Recent surgery

- C. Trauma
- D. Homocystinuria
- E. Increasing age

Answer: A. Although pregnancy is a risk factor for DVT/PE, nonpregnant women do not appear to be at increased risk.

Q.2. Which combination provides the most confident diagnosis of proximal leg DVT?

- A. In the presence of leg pain, increased thigh circumference, positive Homans' sign, and known risk factors
- B. With negative B-mode compression ultrasonography (US), high clinical suspicion, and positive venography
- C. With positive B-mode compression US and low clinical suspicion
- D. With abnormal Doppler ultrasound, high clinical suspicion, and negative B-mode compression US
- E. With abnormal impedance plethysmography, known risk factors, and absent symptoms

Answer: B. Venography is considered the gold standard diagnostic test for DVT. Symptoms and examination findings are very nonspecific for DVT and thus can never be used to make the diagnosis alone. Doppler ultrasonography is less specific when compared with compression US. Compression US is not 100% sensitive even in the presence of a high clinical suspicion. Thus the combination of a negative compression US and high clinical suspicion should prompt either repeat compression US at seven days or immediate venography. Although reasonably accurate, impedance plethysmography is less specific than compression US in the asymptomatic patient.

Q.3. An active 35-year-old woman with lifelong asthma and multiple asthma admissions develops severe dyspnea associated with a cough and pleuritic chest pain over several hours. For the last 24 hours she has suffered from a sore throat, runny nose, and low-grade fever. She is taking an oral contraceptive but has no family history of DVT or PE. Examination reveals expiratory wheezing, her chest x-ray is clear, and an arterial blood gas reveals a respiratory alkalosis. A V/Q scan performed

in the ER is read as high probability for PE, showing two segmental mismatches. Based on these data, what would you do?

- A. Start unfractionated heparin to increase PTT to 2.5 times control and begin warfarin for a six-month course
- B. Begin thrombolytic therapy with plan to convert to heparin and warfarin
- C. Perform venous ultrasonography; if negative, schedule a pulmonary angiogram
- D. Measure D-dimer; if elevated, begin full-dose unfractionated heparin IV
- E. Perform no additional workup or treatment

Answer: C. The patient has a single risk factor for DVT/PE with the use of an oral contraceptive but also has an alternative explanation for her respiratory symptoms and signs. Under these circumstances, the clinical suspicion for PE is low and thus the V/Q scan should be interpreted with caution. A high-probability pattern under these circumstances is significantly less specific when compared with the same pattern associated with a high clinical suspicion. The presence of a positive compression ultrasound would confirm DVT and prompt treatment, thus avoiding a pulmonary angiogram. If negative, the only way of effectively ruling out PE is to perform additional testing.

Q.4. A 33-year-old woman was diagnosed with a large proximal leg DVT and PE seven days after giving birth by an uncomplicated cesarean section to her first child. She had no previous history of DVT or PE. Her blood pressure was 118/78 mm Hg, pulse 104/min, respiratory rate 23/min, and temperature 38.1°C. Her room air saturation was 92%. Given the circumstances, an appropriate course of therapy would be to

- A. Start unfractionated heparin and begin warfarin for a three-month course
- B. Administer thrombolytic therapy followed by heparin and coumadin
- C. Start unfractionated heparin and begin warfarin for a six-month course
- D. Place an inferior vena cava filter before starting anticoagulation with heparin
- E. Start unfractionated heparin and warfarin but let Factor V Leiden and prothrombin 20210A testing determine total duration of therapy

Answer: A. The patient has significant risk factors for DVT (puerperium and abdominal surgery). The presence of major reversible risk factors for DVT indicates that three months of anticoagulation is adequate treatment. Thrombolytic therapy is not indicated for the PE because she does not have hemodynamic compromise or refractory hypoxemia. Although some experts might suggest thrombolytic therapy for extensive proximal DVT, this is controversial. In this case, she is within ten days of childbirth and thus has a significant relative contraindication to thrombolytic therapy even if she was hypotensive from a massive PE. She does not have a contraindication for anticoagulation, however, so that an inferior vena caval filter is not indicated. The presence or absence of the Factor V Leiden or prothrombin 20210A defects does not factor into the choice of anticoagulation duration following a first DVT/PE provoked by major reversible risk factors.

Q.5. A 45-year-old man arrived in the emergency room with complaints of two days of swelling and tenderness of the left arm. He had no respiratory complaints. He was recovering from a course of chemotherapy for a recently diagnosed lymphoma. On examination, he had a low-grade fever and his left arm was mildly erythematous and edematous up to the shoulder. The site of a tunneled left subclavian catheter was unremarkable. The remainder of the examination, including stool occult blood, was normal. A chest x-ray was normal except for a small right pleural effusion. Blood work was obtained revealing a leukocyte count of 2000 cells/mm^3 ; the platelet count was $80,000/\text{mm}^3$. The emergency room resident ordered a compression US of the left arm, which was performed in the emergency room and found to be unremarkable. As the admitting physician, the next step should be

- A. Draw blood cultures, apply heat, and elevate the arm
- B. Contact interventional radiology to pull the intravenous catheter
- C. Start intravenous unfractionated heparin by weight-based protocol
- D. Admit to inpatient service, order an MRI of the left shoulder
- E. Admit to inpatient service, order a venogram of left arm

Answer: C. The patient has significant risk factors for upper extremity DVT (cancer and central venous catheter) and compatible exam findings. Thrombocytopenia does not provide protection against the development of DVT. Although the symptoms and signs exhibited here could be consistent with cellulitis,

upper extremity DVT can be complicated by pulmonary emboli and thus has to be ruled out. In the presence of significant upper extremity DVT risk and no contraindication to anticoagulation, full-dose anticoagulation should be initiated if definitive testing cannot be immediately performed. Compression ultrasound of the upper extremity is sensitive and specific enough to be the initial test of choice for upper extremity DVT. Nevertheless, subclavian vein thrombosis can be missed if present behind the clavicle. Venography and MRI are reasonable secondary studies.

Q.6. An 80-year-old man was admitted to the hospital with a diagnosis of bilateral pneumonia. His physical examination was remarkable for mild respiratory distress with a respiratory rate of 30/min, a blood pressure of 110 systolic, heart rate of 110/min, and a temperature of 38.2° C. His room air arterial oxygen saturation was 82%. Because of a previous history of DVT, a spiral CT scan of the chest was obtained. A "saddle" embolus was seen draped across the main pulmonary arteries. A reasonable course of action would be to

- A. Check stool for blood and administer tissue plasminogen activator if negative
- B. Treat with unfractionated intravenous heparin and monitor closely
- C. Obtain an echocardiogram and place an emergent IVC filter
- E. Consult with interventional radiology regarding catheter embolectomy
- F. Consult with cardiac surgery regarding surgical embolectomy

Answer: B. This elderly man has a proximal pulmonary embolus with or without a pulmonary infection. He is mildly hypoxemic but is hemodynamically stable and thus does not meet criteria for immediate use of thrombolytic therapy. Many of the proximal pulmonary emboli that resulted in high probability V/Q scan patterns in the pre-CT era likely had a "saddle" configuration that was simply not visualized. Despite this, hemodynamically stable patients have been repeatedly shown to do well on heparin anticoagulation regardless of the appearance of the clot in the pulmonary circulation. Although some investigators advocate echocardiography as a means of determining prognosis and therefore intensity of therapy in hemodynamically stable patients with pulmonary embolism, this remains controversial. In the absence of shock or a contraindication to anticoagulation there is no indication here for an embolectomy procedure.

Q.7. A 50-year-old man presents with a swollen, painful left leg, positive venous compression US, and a negative spiral CT lung scan. He had a venous compression US one week before that was negative in the same location. He has a history of CHF and hypertension and was treated (four months of coumadin) for a pulmonary embolus diagnosed by angiogram five years before. You suggest

- A. Initiation of full-dose IV heparin followed by coumadin with several days of overlap without further testing
- B. Initiation of full-dose IV heparin awaiting venography to settle the conflicting results of the two US tests
- C. Initiation of full-dose IV heparin awaiting V/Q scan to be certain that the spiral CT is not falsely negative.
- D. Initiation of full-dose IV heparin awaiting pulmonary angiogram to confirm the negative spiral CT scan.
- E. Sending a hypercoagulability workup to help determine the duration of therapy of DVT or PE are confirmed.

Answer: A. The presence of a positive compression US in a symptomatic leg is highly accurate for the diagnosis of DVT. The recent negative study rules out that the abnormality is from a previous DVT. Thus, no further workup is necessary to confirm the diagnosis. The presence or absence of a pulmonary embolism or an identifiable thrombophilia does not alter the fact that this patient needs life-long anticoagulation because of recurrent venous thrombosis.

Q.8. A 43-year-old woman with Factor V Leiden is noncompliant with her chronic anticoagulation and presents with a newly swollen right leg and marked new dyspnea at rest. Her blood pressure is 100/61 mm Hg with a pulse of 115/min and a respiratory rate of 23/min. Her room air arterial saturation is 85%, which increases to 95% on 4 L O₂ by nasal cannula. V/Q scan shows multiple segmental defects that are ventilated but not perfused. Thrombolytic therapy would be indicated if

- A. Her baseline systolic blood pressure is 150 mm Hg and no further improvement occurs over the next two hours
- B. Her room air saturation remains less than 90% despite initiation of a fluid bolus and IV heparin

- C. Leg studies demonstrate a venous clot extending into the pelvis
- D. The summation of all of the perfusion defects is greater than 50% of the total perfusion for both lungs
- E. It is discovered that the patient is homozygous for Factor V Leiden

Answer: C. Indications for thrombolytic therapy include refractory hypotension, severe hypoxemia refractory to high concentrations of inspired O₂, and extensive iliofemoral DVT. Thrombolytic therapy for extensive DVT has been shown to significantly reduce the postphlebotic syndrome compared to heparin treatment. None of the other clinical features in this patient warrants thrombolytic therapy.

Q.9. A 35-year-old woman with no history of medical illness presented to the emergency department with complaints of wheezing, shortness of breath, and cough for one day. On physical examination she is tachycardic and has occasional expiratory wheezes on lung exam. Her room air blood gas is pH: 7.40, pCO₂: 38, PaO₂: 89. Her CXR is normal. EKG was sinus tachycardia but no S-T wave changes. Which of the following would be the best next step?

- A. Tell her she does not have a pulmonary embolism and treat her for presumed reactive airway disease
- B. Arrange for a ventilation/perfusion (V/Q) scan
- C. Order lower extremity Dopplers
- D. Start coumadin

Answer: B. This is a moderate to high probability history for a pulmonary embolism. A normal Alveolar-to-arterial oxygen gradient does not rule out a pulmonary embolism. The patient should be evaluated for a pulmonary embolism and the best first choice would be a ventilation/perfusion scan. If this were negative and clinical suspicion was high then a lower extremity Doppler should be performed. Coumadin would only be started after heparin.

Q.10. A patient tells you she had been placed on coumadin 10 years ago for a DVT and developed a large necrotic skin ulcer from the medication. She doesn't recall any further testing being done at that time. What lab test would you consider sending?

- A. Protein C
- B. Antithrombin III
- C. Homocysteine level
- D. Antiphospholipid antibody

Answer: A. Protein C and protein S are associated with causing warfarin-induced skin necrosis. Proteins C and S decline when warfarin is started during an active thrombotic state; this decline causes an increase in thrombogenic potential. If protein C and S levels are low to begin with, the risk for this is greater. Heparin will counteract this temporary procoagulant effect.

CHAPTER 23: SELECTED TOPICS IN PULMONARY MEDICINE

Q.1. A 33-year-old nonsmoking woman presents with six months of worsening dyspnea on exertion and fatigue. She denies any other symptoms and has no prior medical history. On physical examination she has clear lung fields, a prominent P₂, elevated jugular veins, and mild pedal edema. A chest x-ray shows plump pulmonary arteries bilaterally without any other abnormalities. Which of the following test results is most likely to be found in her diagnostic workup?

- A. Echocardiography showing an estimated right ventricular systolic pressure (RVSP) of 30 mm Hg
- B. Ventilation-perfusion scanning showing delayed washout on the ventilation images
- C. High-resolution chest CT scan showing patchy ground glass infiltrates and subpleural honeycombing
- D. Pulmonary angiography demonstrating vascular webs and bands in the pulmonary arteries
- E. Pulmonary function testing demonstrating normal lung volumes and a severely decreased diffusing capacity

Answer: E. This patient has the signs and symptoms of pulmonary hypertension. Typically, such patients do not present until the mean PA pressure has risen into the moderate to severe range. A is incorrect because an RVSP (i.e., systolic PA pressure)

of 30 mm Hg is at the upper limit of the normal range. Delayed washout on a ventilation scan (B) is seen in chronic obstructive pulmonary disease (poorly emptying lung zones), and there is nothing to suggest this as the underlying etiology for this patient's pulmonary hypertension. Similarly, both her pulmonary exam and chest x-ray demonstrate clear lung fields, so one would not expect to find changes consistent with idiopathic pulmonary fibrosis on a chest CT scan (C). Her most likely diagnosis, given her age and gender, is primary pulmonary hypertension, although further workup is needed to confirm this. Vascular webs and bands on pulmonary angiography are seen in chronic thromboembolic pulmonary hypertension, and this would be less likely than PPH in this patient. E is the best answer because it is a direct statement about the typical findings on pulmonary function testing in most patients with pulmonary hypertension.

Q.2. Which of the following is/are normally observed during sleep in a patient with obstructive sleep apnea?

- A. Audible snoring during apneic episodes
- B. Paradoxical movements of the chest and abdomen
- C. Bradycardia during apneic episodes and tachycardia during the immediate postapneic periods
- D. A and B
- E. B and C

Answer: E. Paradoxical movements of the chest and abdomen occur during obstructive apneic episodes. The most common arrhythmia during an apnea is sinus bradycardia, and there is often a rebound tachycardia in the postapnea arousal period. Since there is no airflow during an apnea, no snoring can occur; rather, the snore occurs in the postapneic period when the obstruction has been overcome.

Q.3. All of the following are predisposing factors to obstructive sleep apnea except

- A. Increasing age
- B. Craniofacial abnormalities
- C. Hypertension

- D. Hypothyroidism
- E. Benzodiazepine use

Answer: C. This question tests one's knowledge of cause and effect. Hypertension is seen in many patients with sleep apnea, but it is felt to be the result of the disease as opposed to a predisposing factor. All of the other answers are well-established risk factors for developing obstructive sleep apnea.

Q.4. Which of the following statements about solitary pulmonary nodules (SPNs) is *false*?

- A. The majority of SPNs are benign
- B. Transthoracic needle aspiration of an SPN has a much higher diagnostic yield for malignancy than bronchoscopic biopsy
- C. Most benign SPNs have an infectious cause
- D. An eccentric calcification pattern rules out a benign process
- E. Typical characteristics of benign SPNs include size less than 2 cm and lack of cavitation

Answer: D. An eccentric calcification pattern may be seen with either benign or malignant lesions. All of the other statements are true.

Q.5. A 30-year-old man comes to clinic for a preoperative evaluation. He is to undergo reconstructive surgery on his left shoulder, which he injured playing football. A chest x-ray is obtained preoperatively, demonstrating a 1.7-cm nodule in his left midlung field. He is a nonsmoker and denies cough, fever, dyspnea, and weight loss. PPD testing last year was nonreactive. He has no known occupational exposures, has lived his entire life in suburban Phoenix, Arizona, and is a music teacher. Past medical history is unremarkable. Physical examination is normal. What is the most likely cause of the patient's lung nodule?

- A. Testicular cancer
- B. Coccidioidomycosis
- C. Histoplasmosis

D. Tuberculosis

E. Lymphoma

Answer: B. When evaluating the patient with a solitary lung nodule, key features of the history include age (younger than 35 years is associated with low risk of malignancy); occupational history (e.g., asbestos exposure, silica exposure); tobacco history (increases risk of malignancy); and travel or residential history.

Histoplasmosis infection is endemic to the Mississippi and Ohio River valleys, as is blastomycosis (which is less common than histoplasmosis). Coccidioidomycosis is endemic to the southwestern United States. Healed tuberculosis infection may also present as a pulmonary nodule. In this asymptomatic male with a negative TB test and who lives in the southwestern United States, coccidioidomycosis is the most likely cause of his pulmonary nodule. Note that appropriate evaluation of this patient will require follow-up imaging.

Q.6. A 68-year-old man presents to the emergency room with hemoptysis. In the past 24 hours, he has coughed up approximately 800 mL of bright red blood. Initial management may include each of the following *except*

A. Chest x-ray

B. Avoidance of cough suppressant medications

C. Placing the patient with the bleeding lung in the dependent position

D. Fluid resuscitation

E. Intubation with double-lumen tube

Answer: B. Several different definitions of massive hemoptysis appear in the medical literature, but the most widely accepted one is coughing up more than 600 mL of blood in 24 hours. This patient's hemoptysis of 800 mL of bright red blood is unquestionably massive. A chest x-ray should be obtained in all patients with hemoptysis, regardless of the quantity of blood. With massive hemoptysis, fluid resuscitation is important to avoid hypotension and hypoperfusion. Interventions that protect the nonbleeding lung from spillage of blood should also be considered. The simplest intervention is to position the bleeding lung in the dependent position, but some patients may require intubation with a double-lumen endotracheal tube. While the cough reflex is important to help clear the airways of blood, gentle cough

suppression is generally recommended, as a vigorous cough can be traumatic and result in potentiation of bleeding.

Q.7. Which of the following vascular structures is the source of the hemoptysis seen in patients with bronchiectasis?

- A. Bronchial artery
- B. Bronchial vein
- C. Pulmonary capillaries
- D. Pulmonary artery
- E. Pulmonary vein

Answer: A. In the setting of chronic inflammation, such as occurs with bronchiectasis, bronchial arteries locally increase in size and number. These are susceptible to rupture, especially with coexistent infection or coughing. Bleeding can be significant because the vessels are under the high pressure of the systemic circulation. In contrast, the pulmonary arterial circulation rarely results in bleeding because of its low-pressure characteristics and because of autoregulation to divert blood flow away from diseased portions of the lung (hypoxic pulmonary vasoconstriction). The pulmonary capillaries are not the source of bleeding in bronchiectasis. They are the origin of bleeding in diffuse alveolar hemorrhage, which can occur in a variety of conditions, including collagen vascular diseases.

Q.8. A 47-year-old man comes to clinic after undergoing sleep study for evaluation of daytime hypersomnolence. Results of the sleep study showed an Apnea-Hypopnea Index of 17 events per hour. Past medical history is otherwise unremarkable. On physical examination, vital signs were notable for blood pressure of 142/98. Body mass index was 31.1 kg/m². Examination was otherwise notable for a 2/6 systolic murmur at the right sternal border that increased with inspiration. A loud pulmonic component of the second heart sound was noted. There was trace pedal edema. Based on the condition diagnosed by his sleep study, this patient is at risk for which of the following medical complications?

- A. Peripheral vascular disease
- B. Cognitive impairment

- C. Elevated cholesterol
- D. Aspiration pneumonia

Answer: B. This patient has obstructive sleep apnea, based on his history, physical findings, and positive sleep study. Normal individuals have five or fewer apneic events an hour while sleeping; this patient has 17 events per hour (suggestive of mild sleep apnea). His daytime hypersomnolence and systemic hypertension are manifestations of sleep apnea. His physical examination is suggestive of pulmonary hypertension, and pedal edema suggests congestive heart failure. Other complications of obstructive sleep apnea include myocardial infarction and stroke, coronary artery disease, and nocturnal arrhythmias. Noncardiovascular complications include cognitive impairment (choice B), as well as motor vehicle and work-related accidents, along with sexual dysfunction and impaired quality of life. Peripheral vascular disease and elevated cholesterol have not been shown to result from obstructive sleep apnea, nor has aspiration pneumonia.

Q.9. A 44-year-old man undergoes chest x-ray for a pre-employment physical examination, and a 2-cm nodule is noted in the left lower lung field. No prior films are available. The next step in evaluating this individual is

- A. Obtain repeat CXR in three months
- B. Obtain CT scan now
- C. Obtain PET scan now
- D. Management determined based on calcification pattern of nodule

Answer: B. The initial step in evaluating a patient with a solitary pulmonary nodule is to obtain old films, if available. Old films will provide information on doubling time for pulmonary nodules. Absent old films, a CT scan should be obtained on any pulmonary nodule found on CXR. The calcification pattern is then used to guide evaluation; benign patterns should be followed with repeat CT scans every three to six months over the next two years. Concerning calcification patterns should be followed with biopsy or resection in individuals with elevated risk of malignancy (such as tobacco history, age under 35, and concerning doubling time). PET scanning has been used to evaluate nodule activity, but hasn't been fully studied on its impact on diagnosis and management of solitary pulmonary nodules.

Q.10. A 32-year-old woman presents for evaluation of syncope. She was walking up a flight of stairs, feeling very dyspneic, and had a witnessed, brief (10 seconds) loss of consciousness. She has a one-year history of progressive dyspnea. Past history is notable for obesity, treated with prescription weight loss pills. You are concerned that this patient has pulmonary hypertension. Which of the following is a common physical or laboratory finding in individuals with pulmonary hypertension?

- A. Opening snap to second heart sound
- B. Diminished pedal pulses
- C. Chest x-ray showing prominent aortic knob
- D. Pulmonary function tests showing decreased diffusing capacity

Answer: D. The evaluation of the patient with suspected pulmonary hypertension includes components of the history, physical examination, and laboratory findings to confirm the diagnosis. The most common complaint of the patient with pulmonary hypertension is exertional dyspnea. Syncope is a late finding, and portends a poor prognosis. Some patients with pulmonary hypertension also describe chest pain. On physical examination, a prominent pulmonic component of the second heart sound is heard. An opening snap, typical of mitral stenosis, is not seen with primary pulmonary hypertension. Other cardiac findings include a left parasternal heave, a right-sided systolic murmur, and pedal edema may also be seen (diminished pedal pulses is not a typical finding). On chest x-ray, the classic finding is enlarged pulmonary arteries with rapid tapering, described as a "pruned tree." Other etiologies of secondary pulmonary hypertension, such as bullous lung disease, may be evident on CXR. Echocardiography is typically performed, to demonstrate elevated pulmonary artery pressures. Pulmonary function tests are also performed, which will typically show a decreased diffusing capacity (choice D).

Q.11. Which of the following features of a solitary pulmonary nodule is supportive of a malignant diagnosis?

- A. Popcorn calcification pattern
- B. Smooth edge, with well-defined borders
- C. Doubling time of 12 months

- D. Lack of cavitation
- E. Diffuse calcification throughout the nodule

Answer: C. The doubling time of malignant lesions is between 25 and 450 days. Thus, a doubling time of 12 months (365 days) supports a malignant diagnosis. All of the other answers describe typical features of benign lesions.

Q.12. A 49-year-old man with a 50 pack per year history of smoking presents with 10 days of hemoptysis. He states that he has never coughed out more than a few teaspoonfuls of blood at a time. A chest x-ray reveals a spiculated 3.5-cm mass in the left perihilar region. Which of the following vascular structures is the most likely source of this patient's hemoptysis?

- A. Bronchial artery
- B. Bronchial vein
- C. Pulmonary artery
- D. Pulmonary capillary bed
- E. Pulmonary vein

Answer: A. This patient most likely has a bronchogenic carcinoma, on the basis of his smoking history, the size of the lung lesion (>3 cm), and its spiculated border. It is the probable cause of the hemoptysis. The vast majority of cases of hemoptysis, including in the setting of lung malignancy, originate from the bronchial arterial circulation.

CHAPTER 24: CRITICAL CARE MEDICINE

Q.1. A 50-year-old woman with severe COPD presents with respiratory distress after two days of progressive dyspnea and a cough productive of whitish yellow sputum. After treatment with bronchodilators, supplemental oxygen, and corticosteroids in the emergency room, she remains in respiratory distress with use of accessory muscles. All of the following findings would support the use of noninvasive ventilation except

- A. A respiratory rate of 30
- B. A respiratory rate of 25

- C. A systolic blood pressure of 100
- D. A systolic blood pressure of 60 with confusion
- E. A confused but responsive patient

Answer: D. The use of noninvasive ventilation for patients with COPD and hypercapnic respiratory failure has been shown to decrease the need for endotracheal intubation, shorten ICU stay, and decrease mortality rates. Thus, all potential patients should be screened for use. Contraindications to use include the presence of shock, inability to tolerate the mask, massive hemoptysis, and obtundation. Confusion by itself is not a contraindication to the use of noninvasive ventilation.

Q.2. All of the following statements about ARDS are true except

- A. Sepsis is the most common etiology of ARDS
- B. Most patients with ARDS die from intractable hypoxemia
- C. Mortality in ARDS is related to the number of organ system failures
- D. Low tidal volumes improve survival from ARDS

Answer: B. Sepsis, pneumonia, trauma, and aspiration are common causes of ARDS, with sepsis being the most common. Mortality in ARDS is related to the underlying illness and also increases with increasing number of organ system failures. Patients with ARDS are at increased risk of developing secondary infections, especially catheter-related bacteremias and ventilator-associated pneumonia. Patients who do not survive most commonly die either from sepsis or from multiple organ system failure rather than intractable hypoxemia. A recent multicenter trial showed that a low tidal volume strategy improved survival compared with a high tidal volume strategy.

Q.3. Which of the following patients would be a candidate for the use of activated protein C?

- A. An 85-year-old with pneumonia causing septic shock, an APACHE II score of 30, and acute renal failure

- B. A 43-year-old with HIV, a CD4 count of 300, and pneumococcal bacteremia with an APACHE II score of 26
- C. A 50-year-old with diabetes, ESRD, catheter-associated bacteremia causing shock, and an APACHE II score of 29
- D. A 68-year-old postsurgical patient who meets sepsis criteria with a systolic blood pressure of 70 and an APACHE II score of 23
- E. A and B

Answer: E. Activated protein C was approved by the FDA for the treatment of patients with severe sepsis with APACHE II scores greater than 25 (APACHE II is a severity of illness scoring system). A recent trial of less severely ill patients with severe sepsis (APACHE II scores <25) did not show a benefit in the use of this drug. The major complication of this drug is intracerebral bleeding, and contraindications to its use for patients who meet criteria include factors that would increase risk of bleeding (hemorrhagic stroke within three months, severe head trauma, and presence of an epidural catheter). Patients with ESRD were not enrolled into the original PROWESS trial because of concerns for increased risk of bleeding, and thus would not be good candidates for the use of APC. Patient A and B meet inclusion criteria and do not meet exclusions criteria. Neither age nor the presence of HIV is a contraindication to the use of APC (although the presence of HIV with a low CD4 count was an exclusion criterion for the original trial).

Q.4. A 70-year-old patient who collapsed in a nursing home is brought to the emergency department. His temperature is 36.0° C, pulse 100, and blood pressure is initially 75/40. He is obtunded and requires intubation for airway protection. Initial laboratory data shows blood glucose of 800. His initial creatinine kinase is 300 with an MB index of 5%. His urinalysis shows pyuria. A pulmonary artery catheter is placed in the intensive care unit and the following values are obtained: Cardiac index, 2.3 L/min/m²; pulmonary artery occlusion pressure, 6 mm Hg; Systemic vascular resistance (indexed to BSA), 3000 mm Hg min/L·m². These readings suggest that his condition is most consistent with

- A. Septic shock
- B. Hypovolemic shock
- C. Cardiogenic shock

D. Anaphylaxis

Answer: B. These readings are consistent with hypovolemic shock. In a patient such as this with potential hypovolemia, sepsis, and cardiogenic shock, a pulmonary catheter may be used to differentiate these states. This patient has predominant hypovolemic shock likely from his hyperosmolar nonketotic state. Despite the presence of a urinary tract infection, the PA catheter readings do not show the high cardiac output and low SVR typical of septic shock. Cardiogenic shock typically has a low cardiac output with high filling pressures and a high SVR. Treatment in this case should include aggressive fluid resuscitation.

CHAPTER 25: PLEURAL DISEASE

Q.1. All of the following patients are at risk of spontaneous pneumothorax except

- A. A 24-year-old woman with cystic fibrosis
- B. A 40-year-old man with AIDS and a CD4 count of 140
- C. A 68-year-old woman taking nitrofurantoin chronically
- D. A 59-year-old man with COPD
- E. A 30-year-old man presenting with status asthmaticus

Answer: C. Obstructive lung diseases, including COPD and asthma, increase the risk of pneumothorax because of air trapping. Cystic fibrosis causes combined obstructive and restrictive physiology, and it too is associated with an increased risk of pneumothorax. Patients with AIDS are at risk for *Pneumocystis carinii* (*jiroveci*) pneumonia (PCP), which may present with pneumothorax. Chronic nitrofurantoin therapy is associated with the development of interstitial changes (alveolitis/fibrosis), and in the acute setting it can cause a hypersensitivity pneumonitis characterized by pulmonary infiltrates with eosinophilia. Nitrofurantoin has not been associated with pneumothorax.

Q.2. Which of the following would most likely cause a transudate?

- A. Tuberculosis
- B. Chest trauma

- C. Coronary artery bypass grafting with a left internal mammary artery
- D. Constrictive pericarditis
- E. Bacterial pneumonia

Answer: D. A transudate usually implies that there is no active pleuropulmonary disease. Constrictive pericarditis causes a transudate by a mechanism similar to simple congestive heart failure. Tuberculosis and bacterial pneumonia are well-known causes of exudates. Use of the left internal mammary artery for bypass grafting often results in an inflammatory response in the pleura. Chest trauma most commonly causes a bloody effusion or a frank hemothorax, but it does not cause a transudate.

Q.3. A 63-year-old man presents to the emergency room with progressively worsening shortness of breath over the past three weeks. He also reports episodic night sweats and unintentional weight loss of 10 pounds over the past two months. His past medical history is notable for hypertension, atrial fibrillation, and rheumatoid arthritis. He has been on a stable medication regimen for the past year, including lisinopril, amiodarone, warfarin, and methotrexate. On physical examination, he has BP 135/85, HR 76, RR 24, temperature 99.0°F, decreased breath sounds over the lower third of the right hemithorax with associated dullness to percussion, and normal heart sounds with a regular rate and rhythm. Ulnar deviation of the fingers is present, but there is no active synovitis. A chest x-ray shows a right-sided pleural effusion, and this is confirmed on a contrast chest CT scan. The CT scan also reveals bulky mediastinal adenopathy in the subcarinal, precarinal, and right paratracheal regions. No old radiographic studies are available for comparison, but the patient thinks he may have previously been told of "fluid around the lung" several years ago. A thoracentesis is performed and reveals milky-appearing pleural fluid with the following features: 1100 WBCs/mm³ (20% neutrophils, 70% lymphocytes, 10% monocytes); 110 RBCs/mm³; glucose 35 mg/dL; protein 4.0 g/dL; LDH 800 U/L; triglycerides 40 mg/dL; cholesterol 320 mg/dL. Which of the following is the most likely cause of the pleural effusion?

- A. Chronic rheumatoid pleurisy
- B. Complicated parapneumonic effusion

- C. Chylothorax secondary to interruption of thoracic duct by non-Hodgkin's lymphoma
- D. Methotrexate-induced pleural effusion
- E. Amiodarone-induced pleural effusion

Answer: A. This man presents with symptoms and signs suggestive of lymphoma, including weight loss, night sweats, and bulky mediastinal adenopathy. He also has a milky pleural effusion that raises the possibility of a chylothorax. While lymphoma is the most common cause of a chylothorax, the pleural fluid chemistries actually indicate that this is a pseudochylothorax caused by an elevated cholesterol level. A chylothorax must have an elevated triglyceride level, and if the triglycerides are less than 50 mg/dL, it is definitively ruled out. A pseudochylothorax is usually seen in long-standing effusions, with three primary causes: old tuberculosis, chronic rheumatoid pleurisy, and nephrotic syndrome. The cause of this patient's effusion is his rheumatoid arthritis. The lymphocyte predominance is found on the cell count for chronic rheumatoid pleurisy, and the exudative pleural fluid chemistries are consistent as well. In particular, the low glucose and the very high LDH are classic for rheumatoid pleurisy. A complicated parapneumonic effusion shows similar chemistries, but it does not cause elevated cholesterol, and the WBC should be higher with a neutrophil predominance. Methotrexate and amiodarone can each cause interstitial lung disease. Rare cases of pleural effusion have been reported with each drug, but they do not show high levels of cholesterol.

Q.4. A 55-year-old man with an extensive smoking history (two packs of cigarettes per day for the past 40 years) presents with the acute onset of shortness of breath and left-sided chest pain. A chest x-ray reveals a large left-sided pneumothorax, and a chest tube is promptly inserted without difficulty. His follow-up chest x-ray shows re-expansion of the lung with only a small residual pneumothorax. By the third hospital day, the x-ray shows no evidence of pneumothorax, with mildly hyperinflated lungs and no gross evidence of bullae. There is no air leak through the chest tube. The patient's history is notable for a similar episode of left-sided pneumothorax two years ago. The pulmonary consultant recommends that pleurodesis be performed. Which of the following is the most appropriate next step?

- A. Quantitative V/Q scan of the lungs

- B. CT scan of the chest
- C. Administration of doxycycline through the chest tube to perform chemical pleurodesis
- D. Administration of talc through the chest tube to perform chemical pleurodesis
- E. Removal of the chest tube; pleurodesis is not indicated

Answer: B. This patient's risk factor for the development of a pneumothorax is his smoking history. Since this is his second pneumothorax, intervention is indicated to prevent recurrence. He likely has COPD, given the smoking history and the hyperinflated lungs. Small blebs and bullae are frequently present in such patients, and these should be resected to prevent future recurrence of pneumothorax. In combination with the bleb resection, surgical pleurodesis is usually performed by mechanically abrading the pleural surface. Thus, a chest CT scan should be done to visualize any blebs and bullae that are not seen on chest x-ray. If no lung abnormalities are seen on CT scan, either a chemical or a surgical pleurodesis can be performed. Doxycycline is the agent of choice for chemical pleurodesis; talc, while effective, is no longer used because of the risk of acute respiratory distress syndrome. A quantitative V/Q scan is sometimes done to assess the percentage of blood flow to different regions of the lungs in a patient needing a lobectomy or a pneumonectomy. This test has no role in the management of this patient.

Q.6. A thoracentesis yields yellow serous fluid with the following characteristics: glucose 60 mg/dL; protein 3.0 g/dL; LDH 160 U/L. Serum chemistries show glucose 92 mg/dL, total protein 6.8 g/dL, and LDH 220 U/L. How should this fluid be classified?

- A. Exudate
- B. Transudate
- C. Both an exudate and a transudate
- D. Neither an exudate nor a transudate
- E. Fluid cannot be classified without additional information

Answer: A. Chemistries should always be obtained on pleural fluid to determine if it is a transudate or an exudate. Differentiation between these two entities is determined by the levels of protein and LDH in the fluid and in the serum. In order to

be classified as a transudate, all three of the following criteria must be met: ratio of pleural fluid protein to serum protein less than 0.5, ratio of pleural fluid LDH to serum LDH less than 0.6, and pleural fluid LDH less than $\frac{2}{3}$ top normal serum LDH. If any one of these criteria is not met, the fluid should be classified as an exudate. For this fluid, the protein ratio is 0.44, but the LDH ratio is 0.73. The upper limit of normal for serum LDH is approximately 250 U/L, so the pleural fluid LDH of 160 U/L is slightly less than $\frac{2}{3}$ of that number. Based on the LDH ratio, the fluid is classified as an exudate. The pleural fluid glucose is not used to differentiate between transudates and exudates.

Q.7. You are performing a thoracentesis on a 44-year-old woman who presented with dyspnea, and was noted to have a moderate right-sided pleural effusion. On thoracentesis, pleural fluid showed a protein of 3.4 g/dL and LDH 179 IU/L (her serum protein was 6.0 g/dL and LDH 220 IU/L). Possible causes of the effusion in this woman include:

- A. Cirrhosis
- B. Lupus pleuritis
- C. Constrictive pericarditis
- D. Nephrotic syndrome

Answer: B. This patient has an exudative pleural effusion, with the ratio of pleural fluid to serum protein greater than 0.5, and the LDH ratio greater than 0.6. If either of these is present (and in this case, both are), an exudative pleural effusion is present (alternatively, if the LDH in pleural fluid is more than $\frac{2}{3}$ the top normal LDH, regardless of the serum LDH, an exudative effusion is diagnosed). The differential diagnosis of exudative pleural effusions includes parapneumonic effusions, tuberculosis, malignancy, pulmonary embolus, rheumatoid arthritis, lupus pleuritis (as seen here), asbestosis, and chylothorax. Cirrhosis, constrictive pericarditis, and nephrotic syndrome all are causes of transudative pleural effusions.

Q.8. You are managing a patient who presented with a symptomatic, unilateral pleural effusion. The patient underwent thoracentesis and an exudative effusion was diagnosed. Culture of the pleural fluid was negative; cell counts showed 25,000 RBC, 3000 WBC (80% lymphocytes), pH 7.30. Pleural fluid glucose was low, but amylase

and triglyceride studies were all normal. Three successive samples for cytopathology were negative. The next step in management should be

- A. Pleurodesis with talc
- B. Pleural biopsy
- C. Daily thoracentesis until effusion resolves
- D. Diuretics

Answer: B. This patient has features suggestive of a tuberculous effusion. Tuberculosis may result in an exudative pleural effusion, and a lymphocyte predominant pleocytosis, often with a low pleural fluid glucose. Three cytopathologic examinations have made malignancy less likely (although three cytopathologic examinations of pleural fluid is only 80% sensitive for diagnosis of malignancy), and other causes of exudative effusions (chylothorax, parapneumonic effusion, lupus, and rheumatoid arthritis, among others) seem unlikely. Rather than focusing management on resolution of the effusion, further diagnostic studies should be performed, and pleural biopsy is used to diagnose tuberculosis as the cause of an exudative pleural effusion.

Q.9. A 34-year-old man presents with mild dyspnea in the absence of other symptoms. Past history is notable only for tobacco use (a pack a day for the past 14 years). On examination, he is tachycardic, slightly tachypneic, and hyper-resonance is noted over the right upper lung field. You obtain a chest x-ray, and a 10% pneumothorax is noted. Appropriate management to treat the pneumothorax would be:

- A. Observation only
- B. Administration of 100% oxygen
- C. Chest tube placement
- D. Pleurodesis with tetracycline

Answer: B. This patient is presenting with a spontaneous pneumothorax. In the absence of other causative disorders, this is most likely a primary pneumothorax. Primary pneumothorax is uncommon, but when seen is often in a tall, thin male under the age of 40, who smokes (not unlike the patient described here). Treatment is in part determined by the extent of the pneumothorax. If the pneumothorax

involves less than 15% of the lung volume, administration of 100% oxygen and observation is appropriate. Larger pneumothoraces should be treated with either a chest tube or placement of a catheter to withdraw air. Catheter placement is typically tried in younger adults, and is often not successful.

Q.10. A 53-year-old woman with metastatic ovarian cancer presents with a recurrent pleural effusion. This is her third hospitalization this year for recurrent pleural effusion. Thoracentesis is performed, no infection is found, and she is diagnosed with recurrent malignant pleural effusion. Which of the following treatment options should *not* be used for management of her recurrent effusion?

- A. Pleurodesis with talc
- B. Pleurodesis with doxycycline
- C. Pleurodesis with bleomycin
- D. Surgical pleurodesis

Answer: A. Pleurodesis is used for management of recurrent pulmonary effusions, and may be done chemically or surgically. Although used in the past, use of talc for pleurodesis may result in the adult respiratory distress syndrome, and is no longer used. Due to its low cost, doxycycline is the agent of choice for chemical pleurodesis, but bleomycin (a more expensive alternative) is used as well. Surgical abrasion may also be used, but requires thoracotomy.

Q.11. The following pairs consist of findings on thoracentesis and possible etiologies. Three of the pairs consist of findings on thoracentesis that are incorrectly paired with possible etiologies. In one pair, findings on thoracentesis are correctly paired with a possible etiology. Identify the correct pair.

- A. pH less than 7.20: rheumatoid pleurisy
- B. RBC count greater than 100,000: lupus pleuritis
- C. Glucose less than 60 mg dL: pancreatitis
- D. Triglycerides greater than 110 mg/dL: cirrhosis

Answer: A. Rheumatoid pleurisy, complicated parapneumonic effusions, esophageal rupture, and malignant pleural effusions may all be associated with

pleural fluid pH less than 7.20 (pH <7.00 is diagnostic of empyema in the proper clinical setting). Pleural fluid with RBC greater than 100,000 is usually seen with trauma, malignancy, or pulmonary embolus with infarction, but is not described with lupus pleuritis. A low pleural fluid glucose (<60 mg/dL) is seen with parapneumonic effusions, empyema, rheumatoid pleurisy, malignant effusions, and tuberculous effusions, but is not described with pancreatic causes. Triglycerides greater than 110 mg/dL in the pleural fluid, which defines chylothorax, often are seen with lymphoma or interruption of the thoracic duct but are not described with cirrhosis.