Question 1

• C; Laryngoscopy
Diagnose a patient with vocal cord dysfunction

• 32 y/o M with persistent asthma
• Diagnosed with asthma in high school and requires several courses of prednisone yearly
• Recent ED visit for dyspnea, wheezing, dysphonia, and upper chest and throat tightness
• Treated with albuterol, IV methylprednisolone and hospitalization

• Vocal cord dysfunction:
  • Paradoxical adduction of the VCs during inspiration, leading to a functional airway obstruction
  • Dysphonia, midchest tightness, exposure to particular triggers, difficulty breathing in, and symptoms that are only partially responsive to asthma medications
Diagnose a patient with vocal cord dysfunction

Inducers of VCD:
- Asthma
- Exercise
- Postextubation
- Inhaled irritants
- Laryngopharyngeal reflux
- Neurologic injury
- Psychological disorders and stress

Vocal cord dysfunction:
- Diagnose by laryngoscopy; visualization of the abnormal movement
- Tx with speech therapy using cognitive behavioral techniques and avoidance of irritants
Question 2

• A: Admit patient to the hospital for inpatient management
Treat an asthma exacerbation in the hospital

- 52 y/o F with hx of asthma presents with worsening wheezing, dyspnea and cough despite using albuterol inhaler QID
- Smokes 2 PPD; ran out of budesonide/formoterol 2 weeks ago
- 2 recent exacerbations; hx of intubation
- HR 140, RR 32/min and O2 sat 89% on RA
- Chest exam with poor air movement and faint wheezing
Question 3

- B; Magnesium sulfate, intravenously
Treat a patient for an acute asthma exacerbation with magnesium sulfate

• 24 y/o F being treated in the ED for an acute asthma exacerbation
• s/p continuous albuterol and ipratropium nebs and IV methylprednisolone
• HR 121, RR 28/min, O2 sat 95% on 4 L/min
• Peak flow is < 40% of her baseline
• Sitting upright, using accessory muscles and speaking in 4 word sentences
• Diffuse wheezing on exam

• IV magnesium sulfate
  • Relaxes bronchial smooth muscle tissue
  • 2014 systematic review:
    • IV infusion of 1.2 g or 2 g of mag sulfate IV over 15 to 30 min reduced hospital admissions and improves lung function

• Other key points:
  • SAMA/SABA combo > SABA alone: has been shown to reduce hospitalizations and improve lung function in mod-severe exacerbation
Treat a patient for an acute asthma exacerbation with magnesium sulfate

- **Other answers**
  - IV ketamine: theoretical bronchodilatory effect, but 2 RCTs failed to demonstrate added bronchodilator effects compared to conventional management
  - Monteleukast and theophylline may be effective long term options in outpatient setting

- **Peak flow measurement**
  - Determine personal best; PF diary
  - Normal range: 80-100% of personal best
  - Used to determine severity and response to treatment in acute setting
  - PEF <200 L/min = severe obstruction
  - Severe if ≤ 50% predicted
  - > 50 but < 70% = moderate

- **Other answers**
  - IV ketamine: theoretical bronchodilatory effect, but 2 RCTs failed to demonstrate added bronchodilator effects compared to conventional management
  - Monteleukast and theophylline may be effective long term options in outpatient setting
Question 4

• C; Surgical wedge resection
Evaluate a solitary pulmonary nodule in a patient at high risk for malignancy

• 72 y/o F with 30-PY smoking hx, quit 5 years ago
• Hx of COPD and breast CA
• Screening low dose CT shows a peripheral 9-mm solid pulmonary nodule LUL; no LAD
• PET/CT showed FDG activity

<table>
<thead>
<tr>
<th>Nodule size (mm)</th>
<th>Low (&lt;5%) cancer risk</th>
<th>High (&gt;65%) or moderate (5 to 65%) cancer risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solitary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6</td>
<td>No routine follow-up</td>
<td>Optional CT at 12 months</td>
</tr>
<tr>
<td>6 to 8</td>
<td>CT at 6 to 12 months, then consider CT at 18 to 24 months</td>
<td>CT at 6 to 12 months, then CT at 18 to 24 months</td>
</tr>
<tr>
<td>&gt;8</td>
<td>CT at 3 months, then at 9 and 24 months</td>
<td>FDG PET/CT, biopsy or resection</td>
</tr>
</tbody>
</table>
Evaluate a solitary pulmonary nodule in a patient at high risk for malignancy
Question 5

• A; Chest CT scans every 2 years for 5 years
Evaluate a subsolid solitary pulmonary nodule

- 72 y/o M found to have an 8 mm ground glass nodule in the RUL
- He undergoes f/u CT at 12 months and also 2 years
- The nodule is unchanged

- Subsolid nodule
  - Pure ground glass
  - Part-solid
- Adenocarcinoma in situ
  - Slower rate of growth
  - Observed growth rates: 400-800 days

<table>
<thead>
<tr>
<th>Pure ground glass</th>
<th>&lt;6 mm</th>
<th>No follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥6 mm</td>
<td>CT at 6-12 months to confirm persistence, then CT every 2 years until 5 years</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part solid nodule</th>
<th>&lt;6 mm</th>
<th>No follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥6 mm</td>
<td>CT at 3-6 months to confirm persistence. If unchanged and solid component remains &lt;6 mm, annual CT should be performed for 5 years</td>
<td></td>
</tr>
</tbody>
</table>
• A; Indwelling pleural catheter placement
Manage a malignant pleural effusion

- 58 y/o F with hx of breast cancer
- 6 months of progressive dyspnea and cough
- Left-sided pleural effusion; cytology positive for adenocarcinoma
- Treated for metastatic breast CA
- Requires repeat thoracentesis for drainage of pleural fluid

Consider prognosis, degree of lung re-expansion and patient performance status

- Indwelling pleural catheters with intermittent drainage provide symptom relief and 50% to 70% of patients achieve spontaneous pleurodesis after 2-6 weeks

Recent trial:
  - Non-inferior to talc pleurodesis and assoc. with ↓ LOS and ↓ SOB
Manage a malignant pleural effusion

• Other answers:
  • Pleurectomy – rarely performed as invasive, long recovery and no more effective than less invasive options
  • Repeat therapeutic thoracentesis – appropriate if < 3 month prognosis and slower reaccumulation of fluid
  • Chemical pleurodesis – obliteration of the pleural space with talc; very effective, success rate of 60% to 90%, but assoc. with increased pain and ↑ LOS

• Side effects:
  • Bleeding, catheter blockage, catheter fracture
  • Infection along tract or w/in pleural space; often can be treated with antibiotics and catheter does not need to be removed

• Another point about testing for malignant pleural effusion:
  • Sensitivity of pleural fluid is 60%
  • Increases by 15% if a 2nd sample is obtained
  • If cytology is negative and malignancy is still suspected, thoracoscopy is next step
    • Biopsy of the pleural surface: > 90% sensitivity
Question 7

• C; Transthoracic echocardiogram
Evaluate suspected pulmonary artery hypertension with transthoracic echocardiography

- 35 y/o F with 4 months of exertional dyspnea and 1 week of chest pressure
- Widened split $S_2$ with a prominent pulmonic component and neck vein distension
- Normal lung exam, labs and EKG
- CXR clear with prominent hilae

- Transthoracic echocardiogram is the initial test if suspicion for pulmonary hypertension
  - Estimates pulmonary artery pressure, right and left heart function
  - May underestimate true pulmonary artery pressures, so if pretest probability is high, may require RHC if ECHO unrevealing

- PH defined as resting mean PAP of 25 mm Hg or greater on RHC
• Evaluation of **left-heart disease**
  • More than 75% of cases of PH are directly related to LV dysfunction or MV or AV disease

• Evaluation of **lung disease**
  • COPD, ILD, OSA

• Evaluation for **chronic thromboembolic disease**
  • Important to identify, as it is the only curable etiology of PH
  • Up to 9% of patients who survive acute PE exhibit features of chronic proximal thrombosis and remodeling of the distal pulmonary arteries
Question 8

• D; Supplemental oxygen
Treat pulmonary hypertension secondary to chronic hypoxemia

• 62 y/o F with exertional dyspnea x 6 months
• Former smoker with severe COPD
• On LAMA/LABA, inhaled corticosteroid
• O2 sat 89%, diminished breath sounds and prominent pulmonic sound
• ABG: 7.41/43/55
• CXR: hyperinflation, ECHO: RVSP 58 mm Hg
• PSG with AHI of 2 and a mean O2 sat of 87%

• Pulmonary hypertension in the setting of advanced COPD, Group 3
• Maximum inhaler therapy for her COPD
• Oxygen indicated if:
  • Hypoxemia during daytime rest
  • In the setting of cor pulmonale or secondary polycythemia
  • Hypoxemia during sleep

• Other answers:
  • BiPAP: indicated in the setting of hypercapnia with COPD
  • Prednisone: for acute exacerbation of COPD
  • Vasodilator: not indicated for PH Group 2
Question 9

• D; Observation
Manage an asymptomatic patient with stage I pulmonary sarcoidosis

- 24 y/o F seen in follow-up
- CXR with incidental findings of bilateral hilar adenopathy
- Normal vital signs and asymptomatic

Pulmonary sarcoidosis:
- **Stage I**: hilar LAD with normal lung parenchyma
- **Stage II**: hilar LAD with abnormal lung parenchyma
- **Stage III**: no LAD with abnormal lung parenchyma
- **Stage IV**: parenchymal changes with fibrosis and architectural distortion

Majority of patients with stage I pulmonary sarcoidosis have spontaneous resolution of the hilar LAD
Manage an asymptomatic patient with stage I pulmonary sarcoidosis

• Sarcoidosis:
  • Granulomatous disease that can affect multiple organ systems
  • > 90% have lung involvement
  • Patients are often asymptomatic and incidental CXR findings
  • Diagnose with bronchoscopic biopsy, except:

| Asymptomatic bilateral hilar lymphadenopathy | No evidence of fevers, malaise, or night sweats to suggest a malignancy |
| Lófgren syndrome | Bilateral hilar lymphadenopathy, migratory polyarthritis, erythema nodosum, and fever |
| Heerfordt syndrome | Anterior uveitis, parotiditis, fever (uveoparotid fever), and facial nerve palsy |

• Organ involvement:
  • Skin
  • Lymph node
  • Eye
  • Liver

![Number and percentage of patients with specified organ involvement table]

- Lungs: 699, 95%
- Skin: 117, 15.9%
- Lymph node: 112, 15.2%
- Eye: 87, 11.8%
- Liver: 85, 11.5%
- Erythema nodosum: 61, 8.3%
- Spleen: 49, 6.7%
- Neurologic: 34, 4.6%
- Parotid/salivary: 29, 3.9%
- Bone marrow: 29, 3.9%
- Calcium: 27, 3.7%
- ENT: 22, 3%
- Cardiac: 17, 2.3%
- Renal: 5, 0.7%
- Bone/joint: 4, 0.5%
- Muscle: 3, 0.4%

ENT: ear, nose, and throat.
* Total n = 736.
† Excluding erythema nodosum.
Manage an asymptomatic patient with stage I pulmonary sarcoidosis

- Treat with glucocorticoids
- Decision to treat should be based on symptoms and organ involvement

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hilar lymphadenopathy with normal lung parenchyma</td>
<td>&gt;90% will have spontaneous resolution without treatment</td>
</tr>
<tr>
<td>II</td>
<td>Hilar lymphadenopathy with abnormal lung parenchyma</td>
<td>Approximately 50% rate of spontaneous improvement without treatment</td>
</tr>
<tr>
<td>III</td>
<td>No lymphadenopathy with abnormal lung parenchyma</td>
<td>Approximately 20% rate of spontaneous improvement without treatment</td>
</tr>
<tr>
<td>IV</td>
<td>Parenchymal changes with fibrosis and architectural distortion</td>
<td></td>
</tr>
</tbody>
</table>
Question 10

• B; Epinephrine
Treat a patient who has anaphylaxis with epinephrine

• 18 y/o F with lip swelling after attending a picnic
• Hx of allergies to peanut/tree nut with lip swelling
• BP 110/64 mm Hg, HR 109, RR 19, O2 sat 100% on RA
• On exam, bilateral lip swelling, upper > lower lip, no tongue swelling or stridor, lungs CTA
• Urticaria present on hands and trunk

• Presentation
  • Flushing, urticaria and angioedema – 85%
  • Wheeze, stridor and respiratory distress – 70%
  • Hypotension and tachycardia – 45%
Treat a patient who has anaphylaxis with epinephrine

<table>
<thead>
<tr>
<th>Promptly and simultaneously, give:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IM epinephrine (1 mg/mL preparation):</strong> Give epinephrine 0.3 to 0.5 mg intramuscularly, preferably in the mid-outer thigh. Can repeat every 5 to 15 minutes (or more frequently), as needed. If epinephrine is injected promptly IM, most patients respond to one, two, or at most, three doses. If symptoms are not responding to epinephrine injections, prepare IV epinephrine for infusion.</td>
</tr>
<tr>
<td><strong>Place patient in recumbent position,</strong> if tolerated, and elevate lower extremities.</td>
</tr>
<tr>
<td><strong>Oxygen:</strong> Give 8 to 10 L/minute via facemask or up to 100% oxygen, as needed.</td>
</tr>
<tr>
<td><strong>Normal saline rapid bolus:</strong> Treat hypotension with rapid infusion of 1 to 2 liters IV. Repeat, as needed. Massive fluid shifts with severe loss of intravascular volume can occur.</td>
</tr>
<tr>
<td><strong>Albuterol (salbutamol):</strong> For bronchospasm resistant to IM epinephrine, give 2.5 to 5 mg in 3 mL saline via nebulizer. Repeat, as needed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjunctive therapies:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1 antihistamine</strong>: Consider giving diphenhydramine 25 to 50 mg IV (for relief of urticaria and itching only).</td>
</tr>
<tr>
<td><strong>H2 antihistamine</strong>: Consider giving ranitidine 50 mg IV.</td>
</tr>
<tr>
<td><strong>Glucocorticoid</strong>: Consider giving methylprednisolone 125 mg IV.</td>
</tr>
<tr>
<td><strong>Monitoring:</strong> Continuous noninvasive hemodynamic monitoring and pulse oximetry monitoring should be performed. Urine output should be monitored in patients receiving IV fluid resuscitation for severe hypotension or shock.</td>
</tr>
</tbody>
</table>
Question 11

• B; Evaluate for lung volume reduction surgery
Evaluate a patient with upper-lobe emphysema and significant exercise limitations for lung volume reduction surgery

- 58 y/o M with severe COPD and chronic exertional dyspnea
- Meds: LABA/anticholinergic, inhaled corticosteroid and SABA
- Uses supplemental O2
- Severe airflow obstruction on spirometry
- CT chest with heterogenous emphysema and without nodules
- ECHO shows DD, no pulmonary HTN

- LVRS
  - Improves the mechanical efficiency of respiratory muscles
  - Increases the elastic recoil of the lungs to improve expiratory flow
  - Reduce exacerbations
Evaluate a patient with upper-lobe emphysema and significant exercise limitations for lung volume reduction surgery

- National Emphysema Treatment Trial (NETT)
  - Carefully selected patients with upper-lobe predominant emphysema and significant exercise limitation despite participation in a pulmonary rehabilitation program had improved quality of life and survival with lung volume reduction surgery

- Candidates for LVRS:
  - Age < 75 y/o
  - Severe dyspnea despite optimal medical therapy and pulmonary rehab
  - > 6 months of smoking cessation
  - FEV1 < 45% predicted
  - DLCO not < 20% predicted
  - Lung volume measurements showing air trapping; increased RV/TLC ratio
  - CT with hyperinflation and heterogenous distribution of emphysema; predominately upper lobe emphysema
  - 6-minute walk > 140 meters
Question 12

• B; CT pulmonary angiography
Diagnose pulmonary embolism as a potential trigger for acute COPD exacerbations

• 66 y/o M with hx of COPD presenting with 1 week of increasing dyspnea on exertion, wheezing and non-productive cough
• Started on treatment with antibiotics and steroids
• Increase in albuterol use and nocturnal awakenings
• No URI symptoms
• Labs: normal CBC, BMP, BNP and ABG
• EKG: sinus tachycardia
• CXR: hyperinflation but no infiltrates

• COPD exacerbation triggers:
  • Respiratory infections - 70%
  • Environmental pollution
  • Other medical conditions:
    • Myocardial ischemia
    • Heart failure
    • Aspiration
    • Pulmonary embolism

• PE and COPD exacerbation
  • Meta-analysis of 5 studies, 550 patients having a COPD exacerbation
  • Prevalence of PE 20%
  • Limitation: unable to determine if the PE was the cause, result or a bystander
Question 13

• B; Endobronchial ultrasound and mediastinal lymph node biopsy
Evaluate potential lung cancer with the optimal diagnostic procedure

- 63 y/o M with 60-PY smoking hx and cough
- Physical exam and labs, including Na and Ca are normal
- CXR shows a 2-cm nodule RUL
- CT and PET show PET positivity if the lung lesion and in the mediastinal lymph nodes

Other answers:
- CT-guided needle biopsy: highly accurate for diagnosis, but increased risk of procedural complications and likely would require a 2nd procedure to stage
- Sputum cytology: lower sensitivity than EBUS, does not produce sufficient material for molecular studies and would not provide staging
- Thoracoscopic lung biopsy with LN dissection: more invasive, costly and with increased complication risk
Evaluate potential lung cancer with the optimal diagnostic procedure

- Endobronchial ultrasound-guided transbronchial needle aspiration is the procedure of choice for diagnosing and staging mediastinal and hilar lymphadenopathy in patients with suspected thoracic malignancy.
- Initial diagnostic testing should aim at identifying LN involvement or metastatic disease.
- EBUS–guided aspiration can access most mediastinal and some hilar LN stations.
Question 14

- E; Supervised weight loss program
Manage obesity related asthma with a supervised weight loss program

- 58 y/o M seen in f/u of an asthma exacerbation
- 30-year hx of asthma and 2 prior exacerbations over the past 12 months
- No environmental triggers, allergies, atopy, reflux symptoms, sinus symptoms, snoring or recent respiratory infections
- Recent sleep study negative for OSA
- VS normal, 97% on RA, BMI 36
- Scattered expiratory on exam
- Labs, including IgE level is normal
- CT of the sinuses normal

- Common comorbidities that can improve asthma control if managed:
  - GERD
  - Sinus disease
  - Obstructive sleep apnea
  - Vocal cord dysfunction
  - Obesity
- Incidence of asthma is 1.47 times greater in obese patients
- Weight loss improves asthma control, lung function and quality of life; additionally, reduces asthma medication use
Question 15

• D; Restart previous medications
Treat asthma during pregnancy

- 24 y/o pregnant F with a hx of asthma
- Stopped her asthma medications (albuterol and budesonide) 4 weeks ago due to concern for the fetus
- 4 weeks of exertional dyspnea and chest tightness 3-4 times per week
- VS normal, O2 sat 97% on RA
- Occasional expiratory wheezing on exam
- Mild airflow obstruction on spirometry

- Risks of untreated asthma > risks of asthma medications
  - Maternal asthma ↑ the risk of perinatal mortality, preterm birth, low-birth-weight infants, and preeclampsia
- Mild persistent asthma with symptoms more than 2 times per week
  - Low-dose inhaled glucocorticoid – budesonide preferred in pregnancy
Classifying Asthma Severity in Children 12 Years and Older and Adults

Classifying severity for patients who are not currently receiving long-term control medication

<table>
<thead>
<tr>
<th>Components of severity</th>
<th>Intermittent</th>
<th>Persistent</th>
<th>Daily</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impairment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤ 2 days per week</td>
<td>&gt; 2 days per week but not daily</td>
<td>Daily</td>
<td>Continuous</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>≤ 2 times per month</td>
<td>3 to 4 times per month</td>
<td>Daily</td>
<td>Continuous</td>
</tr>
<tr>
<td>Short-acting beta₂-agonist use for symptom control (not prevention of EIB)</td>
<td>≤ 2 days per week but not &gt; 1 time per day</td>
<td>&gt; 2 days per week</td>
<td>Daily</td>
<td>Continuous</td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>None</td>
<td>Minor Limitation</td>
<td>Some</td>
<td>Severe</td>
</tr>
<tr>
<td>Lung function</td>
<td>Normal FEV₁ between exacerbations</td>
<td>FEV₁, ≥ 80% predicted</td>
<td>FEV₁/FVC normal</td>
<td>FEV₁/FVC &lt; 80% Predicted</td>
</tr>
</tbody>
</table>

Stepwise Approach for Managing Asthma in Children 12 Years and Older and Adults

**Step 1:** Preferred: Inhaled SABA, as needed

**Step 2:** Preferred: Low-dose ICS
Alternative: Cromolyn, LTRA, or theophylline

**Step 3:** Preferred: Low-dose ICS plus LABA
Alternative: Medium-dose ICS plus LABA

**Step 4:** Preferred: Medium-dose ICS plus LABA
Consider omalizumab (Xolair) for patients who have allergies

**Step 5:** Preferred: High-dose ICS plus LABA
Consider omalizumab (Xolair) for patients who have allergies

**Step 6:** Consider systemic corticosteroid

Each step: Patient education, environmental control, and management of comorbidities

Steps 2 through 4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma.

Quick-relief medication for all patients:

Inhaled SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms (up to three treatments at 20-minute intervals, as needed). Short course of oral systemic corticosteroids may be needed.

Use of inhaled SABA for more than two days a week for symptom relief (not prevention of exercise-induced broncospasm) generally indicates inadequate control and the need to step up treatment.
• C; Discontinue ibuprofen, begin prednisone
Recognize the role of NSAIDs in poor control of asthma

- 37 y/o M with 1 month of cough and wheezing, increasing nasal congestion and rhinorrhea
- Increase in use rescue inhaler
- Recent traumatic ACL tear
- Hx of sinusitis, but no GERD
- Meds: albuterol, budesonide/formoterol and ibuprofen
- VS normal, 97% on RA
- Conjunctival injection and nasal polyps, wheezing
- IgE 265, WBC 4K with 10% eosinophils
- Aspirin-exacerbated respiratory disease
  - Asthma and rhinosinusitis precipitated by exposure to aspirin or other NSAIDs
  - Onset in adulthood
  - Eosinophilia, inflammatory sinusitis with polyposis
  - Persistent, often severe asthma
- Life-threatening bronchospasm, rhinorrhea, conjunctival injection and flushing
- Treatment: discontinue NSAIDs, use leukotriene-receptor antagonists and usual stepped up asthma care
Question 17

• B; Dexamethasone
Treat high-altitude cerebral edema with dexamethasone

• 31 y/o M on a 3500-meter trek in the French Alps
• Confused and irritable
• He took prophylactic acetazolamide, which he stopped due to nocturia
• HR 128/min, RR 22/min
• Ataxic gait
• Placed on supplemental O2 and started on descent

• High-altitude cerebral edema
  • Hypoxia and hypocapnia alter cerebral blood flow and O2 delivery
  • Vascular leak leads to brain swelling
  • Confusion, irritability, ataxic gait, come, death
  • Treatment: descent, dexamethasone, supplemental O2
Table 2. Lake Louise Criteria for Altitude Illness

<table>
<thead>
<tr>
<th>Condition</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute mountain sickness</td>
<td>Headache and at least one of the following symptoms: fatigue or weakness;</td>
</tr>
<tr>
<td></td>
<td>dizziness or lightheadedness; gastrointestinal symptoms (nausea or vomiting,</td>
</tr>
<tr>
<td></td>
<td>anorexia); difficulty sleeping</td>
</tr>
<tr>
<td>High-altitude cerebral edema</td>
<td>Change in mental status or ataxia in a person with acute mountain sickness</td>
</tr>
<tr>
<td>High-altitude pulmonary edema</td>
<td>At least two of the following symptoms: dyspnea at rest; cough; weakness or</td>
</tr>
<tr>
<td></td>
<td>decreased exercise performance; chest tightness or congestion</td>
</tr>
<tr>
<td></td>
<td>and</td>
</tr>
<tr>
<td></td>
<td>At least two of the following signs: crackles or wheezing in at least one lung field;</td>
</tr>
<tr>
<td></td>
<td>central cyanosis; tachypnea; tachycardia</td>
</tr>
</tbody>
</table>

*—Signs and symptoms occurring in the setting of a recent gain in altitude.

Information from references 12 and 13.

Table 3. Medications for the Prevention and Treatment of Altitude Illness

<table>
<thead>
<tr>
<th>Medication</th>
<th>Indication</th>
<th>Typical dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetazolamide</td>
<td>Prevention and treatment of acute mountain sickness (first-line therapy)*</td>
<td>125 mg twice daily (prophylaxis)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250 mg twice daily (treatment)</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>Prevention of acute mountain sickness†</td>
<td>4 mg every 6 to 12 hours</td>
</tr>
<tr>
<td></td>
<td>Treatment of acute mountain sickness‡</td>
<td>4 mg every 6 hours</td>
</tr>
<tr>
<td></td>
<td>Prevention of high-altitude cerebral edema†</td>
<td>4 mg every 6 hours</td>
</tr>
<tr>
<td></td>
<td>Treatment of high-altitude cerebral edema‡</td>
<td>8 mg, then 4 mg every 6 hours</td>
</tr>
<tr>
<td>Nifedipine (Procardia)</td>
<td>Prevention and treatment of high-altitude pulmonary edema†</td>
<td>20 mg every 8 to 12 hours</td>
</tr>
<tr>
<td>Salmeterol (Serevent)</td>
<td>Prevention and treatment of high-altitude pulmonary edema‡</td>
<td>125 mcg every 12 hours</td>
</tr>
<tr>
<td>Sildenafil (Viagra)</td>
<td>Prevention and treatment of high-altitude pulmonary edema‡</td>
<td>20 mg every 6 to 8 hours</td>
</tr>
<tr>
<td>Tadalafil (Cialis)</td>
<td>Prevention and treatment of high-altitude pulmonary edema‡</td>
<td>10 mg every 12 hours</td>
</tr>
</tbody>
</table>

*—U.S. Food and Drug Administration (FDA)-approved indication.
†—Not an FDA-approved indication.
‡—Descent is mandatory.

Information from references 3, 7, and 16 through 29.
Question 18

• D; Obtain methacholine challenge testing
Diagnose cough-variant asthma

- 62 y/o F with 1 year of cough
- No environmental exposures
- Triggered by temperature changes, exercise, laughter, strong scents
- No sputum, rhinitis, postnasal drip, wheezing, GERD
- Recently treated with intranasal fluticasone and antihistamines without improvement
- VSS, O2 sat 97% on RA
- Labs, CXR and PFTs normal

- Cough-variant asthma
  - Asthma with primary symptom of cough
  - Diagnosis requires documentation of bronchial hyperactivity, as most patients will have normal baseline
  - Often co-exists with GERD or upper airway cough syndrome
• Indications for methacholine challenge test:
  • Diagnosis of asthma
  • Assessment of response to therapy
  • Identification of specific asthma triggers

**TABLE 1**

**Contraindications to methacholine challenge testing:**
*American Thoracic Society guidelines*

**Absolute contraindications**
- Severe airflow limitation: forced expiratory volume in 1 second (FEV₁) < 50% of predicted or < 1.0 L
- Heart attack or stroke in last 3 months
- Uncontrolled hypertension: systolic blood pressure > 200 mm Hg or diastolic pressure > 100 mm Hg
- Known aortic aneurysm

**Relative contraindications**
- Moderate airflow limitation: FEV₁ < 60% of predicted or < 1.5 L
- Inability to perform spirometry of acceptable quality
- Pregnancy
- Nursing mothers
- Current use of cholinesterase inhibitor medication (for myasthenia gravis)
Question 19

- A; Complicated parapneumonic effusion
Diagnose a complicated parapneumonic effusion

• 43 y/o M with 1 week of cough, dyspnea, chest pain and night sweats
• T 38.8, BP 134/82 mm Hg, HR 142/min, RR 30/min, O2 sat 88% on RA
• WBC count 29,000
• CXR: large right pleural effusion with compressive atelectasis or consolidation and RUL consolidation
• Broad spectrum antibiotics started
• Thoracentesis: 100 mL serous fluid with pH 7.0, LDH 2310, total protein 5.2, glucose 42, gram stain negative

• Complicated parapneumonic effusion
  • pH < 7.2 and glucose < 60
  • Gram stain typically negative and cultures are usually sterile
  • Thoracostomy tube drainage recommended

• Empyema
  • Frank pus or a positive gram stain
  • Thoracic surgery consult, as usually requires thoracoscopic or open debridement and drainage

• Uncomplicated parapneumonic effusion
  • pH > 7.2 and glucose > 60
  • Usually resolve with antibiotic therapy alone
Diagnose a complicated parapneumonic effusion

- Pleural fluid acidosis (pH < 7.3)
  - Complicated parapneumonic effusions
  - Tuberculous pleuritis
  - Rheumatoid and lupus pleuritis
  - Esophageal rupture
  - Malignancy

- Low pleural fluid glucose (< 60 mg/dL)
  - Increased utilization within the pleural space – bacteria, malignant cells
  - Decreased transport into pleural space – rheumatoid pleurisy, lupus pleuritis

*** Lowest glucose concentrations found in rheumatoid pleurisy and empyema
Question 20

• A: Continue antibiotic therapy for a total of 7 days
Treat ventilator-associated pneumonia for 7 days

- 67 y/o F with ventilator-associated pneumonia
- Transferred out of the ICU 3 days prior for respiratory failure 2/2 GBS, intubated
- 1 day prior diagnosis of VAP was made and antibiotics started
- Sputum culture grew MSSA and de-escalated to oxacillin; blood cultures negative
- T 37.6, BP and HR within normal limits, RR 15/min and O2 sat 97% on 40% FiO2
- CXR: RML/RLL infiltrates without effusions

- Ventilator-associated pneumonia
  - Pneumonia developing 48 hours after intubation
  - Early onset (< 5 days after hospitalization or intubation) associated with more antimicrobial-sensitive organisms
  - Late onset (> 5 days after hospitalization or intubation) more likely to have MDROs
  - Treat for 7 days as long as there is clinical improvement
  - Consider complications (effusion, empyema, superinfection, antibiotic resistance) if failure to respond