PULMONARY DISEASES AND PILOT PERFORMANCE

Clayton T. Cowl, MD, MS
Immediate Past President, Civil Aviation Medical Association
Chair, Division of Preventive, Occupational & Aerospace Medicine
with Joint Appointment, Division of Pulmonary & Critical Care Medicine
Mayo Clinic
Rochester, Minnesota USA
Financial disclosures

No financial conflicts to declare regarding the material to be presented in this session.
Goals for this session

• Review some common and some esoteric pulmonary-related conditions
• Use audience response format for addressing certification dispositions
• Address topics on CAMA/FAA quiz
Case #1

- 48 year old pilot with 3-4 year history of chronic cough
- Cough rarely productive of white sputum
- Had a single episode of trace blood with sputum
- Physical exam unremarkable
- CXR, PFTs, methacholine challenge testing all normal
- Chest CT scan performed
Case 1- CT Scan
What would you do next?

A. Order a serum ACE level
B. Obtain magnetic resonance imaging (MRI) of the airways
C. Perform flexible bronchoscopy
D. Order serum ANCA
E. Add serum protein electrophoresis
What would you do next?

A. Order a serum ACE level  
B. Obtain magnetic resonance imaging (MRI) of the airways  
C. Perform flexible bronchoscopy  
D. Order serum ANCA  
E. Add serum protein electrophoresis
Tracheobronchopathia Osteochondroplastica (TO)

- Bronchoscopy because of hemoptysis
- CT shows nodularity of tracheal wall
- Cartilaginous and osseus nodules in trachea submucosa
- Spares the posterior membranous trachea
- CXR usually normal
- CT characteristic
Tracheobroncheopathia Osteochondroplastica (TO)

- TO has unknown etiology
- M>F. Usually >50 yo
- Nodules confined to areas of the airways that contain cartilage
- May contain bone marrow elements
- Biopsy difficult
- Sx: cough, dyspnea, bronchitis, but rarely hemoptysis
Tracheobroncheopathia Osteochondroplastica (TO)
Why The Other Options Are Incorrect

- Sarcoidosis and granulomatosis with polyangiitis (GPA) can involve trachea but CT suggests TO
- Serum ACE (answer A) neither sensitive nor specific
- ANCA (answer D) not warranted with clinical picture
- Amyloid usually involves posterior membranous trachea
- Serum protein electrophoresis (E) is often normal in tracheobronchial amyloidosis
- MRI (B) does not help limit the diagnostic choices
What would be your disposition for this case as an AME?

A. Certify
B. Defer
C. Deny
And now for something completely different...
Case #2

A 65-year-old private pilot has progressive shortness of breath for the last 5 years. History of childhood asthma, stopped smoking ten years previously. His physical examination is normal except for obesity (BMI 33.2 kg/m^2). SpO_2 96% breathing room air, and the chest radiograph was normal.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>% pred</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>1.28</td>
<td>40</td>
</tr>
<tr>
<td>FEV$_1$ (L)</td>
<td>0.95</td>
<td>37</td>
</tr>
<tr>
<td>FEV$_1$/FVC0.74</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>TLC (L)</td>
<td>3.66</td>
<td>68</td>
</tr>
<tr>
<td>SVC (L)</td>
<td>1.34</td>
<td>42</td>
</tr>
<tr>
<td>ERV (L)</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>RV (L)</td>
<td>2.11</td>
<td>110</td>
</tr>
<tr>
<td>DL$_{CO}$</td>
<td>17.4</td>
<td>74</td>
</tr>
</tbody>
</table>
These pulmonary function tests are most consistent with which of the following?

A. Interstitial lung disease
B. Obesity
C. Neuromuscular disease
D. Pulmonary vascular disease
<table>
<thead>
<tr>
<th></th>
<th>% pred</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>1.28</td>
<td>40</td>
</tr>
<tr>
<td>FEV$_1$ (L)</td>
<td>0.95</td>
<td>37</td>
</tr>
<tr>
<td>FEV$_1$/FVC</td>
<td>0.74</td>
<td>90</td>
</tr>
<tr>
<td>TLC (L)</td>
<td>3.66</td>
<td>68</td>
</tr>
<tr>
<td>SVC (L)</td>
<td>1.34</td>
<td>42</td>
</tr>
<tr>
<td>ERV (L)</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>RV (L)</td>
<td>2.11</td>
<td>110</td>
</tr>
<tr>
<td>DL$_{CO}$</td>
<td>17.4</td>
<td>74</td>
</tr>
</tbody>
</table>
These pulmonary function tests are most consistent with which of the following?

A. Interstitial lung disease
B. Obesity
C. Neuromuscular disease
D. Pulmonary vascular disease
Pulmonary Function Tests

*Neuromuscular Disease*

- Reduced FVC and FEV$_1$
- Normal FEV$_1$/FVC
- Reduced TLC: Can’t inhale
- Normal or increased RV: can’t exhale
- Poor effort may look like this (won’t inhale or exhale), but not reproducibly
Which of the following flow-volume curves best represents what would be seen in our patient?

A. A
B. B
C. C
D. D
What would be your disposition as you assess this airman?

A. Certify
B. Deny
C. Defer
D. Depends on the cause of PFT abnormality
Midway through the exam, Allen pulls out a bigger brain.
Case #3
What would be your disposition as you assess this airman?

A. Certify
B. Deny
C. Defer
OSA QUICK-START for the AME

The AME while performing the triage function must conclude one of six possible determinations. The AME is not required to perform the assessment or to comment on the presence or absence of OSA. (For more information on this process, an instructional video is available.)

Step 1 - Determine into which group (1-6) the airman falls.

**Applicant Previously Assessed:**
- **Group 1:** Has OSA diagnosis and is on Special Issuance. Reports to follow.
- **Group 2:** Has OSA diagnosis OR has had previous OSA assessment. NOT on Special Issuance. Reports to follow.

**Applicant Not at Risk:**
- **Group 3:** Determined to NOT be at risk for OSA at this examination.

**Applicant at Risk/Severity to be assessed:**
- **Group 4:** Discuss OSA risk with airman and provide educational materials.
- **Group 5:** At risk for OSA. AASM sleep apnea assessment required.

**Applicant Risk/Severity Extremely High:**
- **Group 6:** Deferred. Immediate safety risk. AASM sleep apnea assessment required. Reports to follow.

Step 2 – Document findings in Block 60.

Step 3 – Check appropriate triage box in the AME Action Tab.

Step 4 – Issue, if otherwise qualified.

In assessing airmen for groups 4 and 5, the AME is expected to use their own clinical judgment, using AASM information, when making the triage decision.
50/50 rule - Half of OSAS patients have hypertension, half of hypertensive patients have OSAS.

BMI > 125% of IBW

Neck size > 17.5 in
Mallampati Score

Variable reliability in predicting apnea except at the extremes, but useful to document that you did the exam

- View pharynx with mouth open at rest
- No phonation or protrusion of Tongue

**Grade 1:** Entire tonsil clearly visible
**Grade 2:** Upper half of tonsil fossa visible
**Grade 3:** Soft and Hard Palate clearly visible
**Grade 4:** Only Hard Palate visible
Definitions of Sleep Disordered Breathing Events

**Apnea**

Thermal sensor amplitude drops ≥ 90% of baseline for at least 10 seconds

**Hypopnea**

Nasal pressure amplitude drops ≥ 30% of baseline for at least 10 seconds with ≥ 4% desaturation from pre-event baseline

**RERA- Respiratory Effort Related Arousal**

Increasing respiratory effort OR flattening of nasal pressure waveform for at least 10 seconds associated with arousal

Criteria for apnea or hypopnea not fulfilled

- AASM 2007
Risks of Untreated OSAS

Apnea Index vs. Mortality

- Probability of cumulative survival in 142 patients with AI ≤ 20 (blue) vs. 104 patients (red) with AI > 20.

Effect of apnea index on mortality: Probability of cumulative survival for patients with obstructive sleep apnea and an apnea index (AI) that is either equal to or less than 20 (top line, 142 patients) or greater than 20 (bottom line, 104 patients). All the patients were men and were untreated. Survival was significantly higher in the patients with an AI ≤ 20. (Data from He, J, Kryger, MH, Zorick, FJ, et al, Chest 1988; 94:9.)

He J. Chest 1988: 94:9
Case #4

You see a pilot with the following ABG:

\[\text{pH 7.39/pCO2 43/pO2 69 (on RA)}\]

Which of the following would best represent a patient with these values

A. 23-year-old with no respiratory conditions
B. 57-year-old with pulmonary fibrosis
C. 64-year-old with moderate severity COPD
“Impaired vision, bloated abdomen, cold hands...they could be symptoms of a severe peanut allergy.”
Acute Mountain Illness

- Hypobaric hypoxia
- Acclimatization is the most effective means of prevention
- Symptoms reported at altitudes as low as 4,667 ft MSL (color vision)
- High-altitude pulmonary or cerebral edema HAPE, HACE
- Rx: Descend
Symptoms

Headache, lightheadedness, weakness, trouble sleeping and an upset stomach

Prevention

Acclimatize: when you reach an altitude above 8,000 feet, don't ascend faster than 1,000 feet per day.

Acetazolamide may be considered

Corticosteroids not shown to be beneficial for prevention
High-altitude pulmonary edema at a ski resort.

H N Hultgren, B Honigman, K Theis, and D Nicholas

Abstract

Medical records of 150 patients with high-altitude pulmonary edema seen over a 39-month period in a Colorado Rocky Mountain ski area at 2,928 m (9,600 ft) (mean age 34.4 years; 84% male) were reviewed. The mean time to the onset of symptoms was 3 +/- 1.3 days after arrival. Common symptoms were dyspnea, cough, headache, chest congestion, nausea, fever, and weakness. Orthopnea, hemoptyisis, and vomiting were rare, occurring in 7%, 6%, and 16%, respectively. Symptoms of cerebral edema occurred in 14%. A temperature exceeding 100 degrees F occurred in 20%, and 17% had a systolic blood pressure of 150 mm of mercury or higher. Blood pressures were higher in patients older than 50 years (142 mm of mercury). Rales were present in 85%, and a pulmonary infiltrate was present in 88%; both were most commonly unilateral or on the right side. The amount of infiltrate was mild. Men appeared to be more susceptible than women to high-altitude pulmonary edema. Pulse oximetry in 45 patients showed a mean oxygen saturation of 74% (38% to 93%). Treatment methods depended on severity and included a return to quarters for portable nasal oxygen, an overnight stay in the clinic for continuing oxygen, or a descent to Denver for recovery or admission to a hospital. All patients received oxygen for 2 to 4 hours in the clinic. There were no deaths or complications.
“The brain tumor’s incurable, but let me give you something for that dandruff.”
Case #5

A 59-year-old woman presents with progressive dyspnea on exertion.

PMH:
• She has had three probable episodes of pulmonary embolism (PE), the most recent of which occurred 4 years ago.
Studies

• Right heart catheterization:
  – pulmonary artery pressure of 93/30 mm Hg (mean, 52 mm Hg,) wedge pressure 9 mm Hg

• Pulmonary angiography
  – 100% occlusion of the right lower lobe pulmonary artery with webbing in arteries supplying the right middle lobe and superior lingula.
– The diagnosis of chronic thromboembolic pulmonary hypertension is made.
What is the most common hypercoagulable state associated with chronic thromboembolic pulmonary hypertension?

A. Antiphospholipid antibodies.
B. Factor V Leiden.
C. Malignancy.
D. Splenectomy.
What is the most common hypercoagulable state associated with chronic thromboembolic pulmonary hypertension?

- A. Antiphospholipid antibodies.
- B. Factor V Leiden.
- C. Malignancy.
- D. Splenectomy.
Antiphospholipid antibodies

• Chronic thromboembolic pulmonary hypertension (CTEPH)
  
  – Diagnosis:
  – RHC: mean pulmonary artery pressure is 25 mm Hg 6 months after the diagnosis of acute PE has been made.

  – Statistics:
  – 2% to 4% of patients who suffer acute PE develop CTEPH

  – Many patients with CTEPH have neither a history of acute PE nor of symptoms compatible with that diagnosis.
Risk Factors for CTEPH

Factors specific to prior acute PE:
- Recurrent or unprovoked embolism
- Large perfusion defects when a PE is detected
- Young or old age when a PE is diagnosed
- Pulmonary artery systolic pressure > 50 mm Hg at initial presentation of PE

Chronic medical conditions:
- Infected surgical cardiac shunts, or infected pacemaker or defibrillator leads
- Postsplenectomy
- Chronic inflammatory disorders
- Thyroid-replacement therapy
- Malignancy

Thrombotic factors:
- Lupus anticoagulant or antiphospholipid antibodies
- Increased levels of factor VIII
- Dysfibrinogenemia

Genetic factors:
- ABO blood groups other than O
- HLA polymorphisms
- Abnormal endogenous fibrinolysis
Thrombophilia: a risk factor for CTEPH

- Antiphospholipid antibody syndrome is the most common hypercoagulable state associated with CTEPH.
  - Antiphospholipid antibody syndrome occurs in up to 20% of patients (choice A is correct).
  - Abnormalities in fibrinogen sialylation and fibrinogen fragmentation have also been noted among this patient population.
  - The frequency of factor V Leiden mutation, protein S or C deficiency, and the prothrombin 20210G mutation have not been found to be more common in patients with CTEPH than in the general population (choice B is incorrect).
  - Both malignancy and splenectomy are defined risk factors for CTEPH, but are recognized far less frequently than antiphospholipid antibodies (choices C and D are incorrect).
Decision Considerations
Disease Protocols - Thromboembolic Disease

An applicant with a history of thromboembolic disease must submit the following if consideration for medical certification is desired:

1. Hospital admission and discharge summary
2. Current status report including:
   - Detailed family history of thromboembolic disease
   - Neoplastic workup, if clinically indicated
   - PT/PTT
   - Protein S & C
   - Leiden Factor V
   - If still anticoagulated with warfarin (Coumadin), submit all (no less than monthly) INRs from time of hospital discharge to present

For applicants who are **just beginning warfarin (Coumadin)** treatment the following is required:

- Minimum observation time of 6 weeks after initiation of warfarin therapy;
- Must also meet any required observation time for the underlying condition; AND
- 6 INRs, no more frequently than 1 per week
“Off hand, I'd say you're suffering from an arrow through your head, but just to play it safe, I'm ordering a bunch of tests.”
Case #4

- 31 year-old woman referred for an abnormal CXR
- Recurrent seizures experienced since age 17
- Bilateral kidney hemorrhages since age 26
- Spontaneous left pneumothorax at age 28
- Denies dyspnea, hemoptysis, chest pain
- Lifetime non-smoker
- Noted “reddish bumps” on right side of face and a “white birth mark” across forearm
# Case #3 PFTs

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pred</th>
<th>Pre</th>
<th>%Pred</th>
<th>Post</th>
<th>%Pred</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>3.5</td>
<td>2.3</td>
<td>66%</td>
<td>2.2</td>
<td>61%</td>
<td>-4%</td>
</tr>
<tr>
<td>FEV1</td>
<td>2.8</td>
<td>2.0</td>
<td>71%</td>
<td>2.0</td>
<td>71%</td>
<td>0%</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>79</td>
<td>85</td>
<td>107%</td>
<td>90</td>
<td>113%</td>
<td>+6%</td>
</tr>
<tr>
<td>TLC</td>
<td>5.1</td>
<td>4.1</td>
<td>81%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RV</td>
<td>1.6</td>
<td>1.8</td>
<td>114%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRC(Box)</td>
<td>2.9</td>
<td>2.2</td>
<td>74%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RV/TLC</td>
<td>30.8</td>
<td>43.3</td>
<td>140%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLCO</td>
<td>17.6</td>
<td>16.7</td>
<td>95%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Which of the following is the most likely diagnosis?

A. Langerhans cell histiocytosis
B. Neurofibromatosis
C. Idiopathic pulmonary fibrosis
D. Tuberous sclerosis
E. Lymphangioleiomyomatosis
Which of the following is the most likely diagnosis?

A. Langerhans cell histiocytosis
B. Neurofibromatosis
C. Idiopathic pulmonary fibrosis
D. Tuberous sclerosis
E. Lymphangioleiomyomatosis
Tuberous Sclerosis (TS)

- Skin and neurologic involvement (tubers) suggests TS
- Name from root-like CNS growth that hardens (sclerotic)
- Autosomal dominant
- Tuberin is gene product of TSC-2
- Germ like mutation in one of two tumor suppressor genes
  - TSC-1 or TSC-2
Tuberous Sclerosis

- Skin involvement common
  - hypomelanotic nodules (ash leaf spots)
  - forehead plaques (Shagreen patches)
  - facial angiofibromas (adenoma sebaceum)
- Renal angiolipomas also seen in LAM
- Sirolimus seems to decrease angiomyolipomas
- Clinical trials ongoing
Why The Other Options Are Incorrect

• Kidney involvement and seizures are not reported in Langerhans Cell Histiocytosis (option A)
• Neurofibromatosis (option B) can cause seizures -- but lung involvement radiographically is upper lobe bullae or lower lobe fibrosis, not thin-walled cysts
• IPF (option C) more sub-pleural and honeycombing seen in late stage, not cystic (plus, DL$_{CO}$ typically normal)
• LAM (option E) has identical CT appearance and similar genetic abnormalities (TSC-2) but:
  • no true neurologic involvement (meningiomas)
  • no skin involvement
  • angiomyolipomas definitely occur and may be Rx target
Case #5

- 45 year old man with COPD
- Has 45 pack-year smoking history, quit 1 year ago
- No cough or sputum production but had progressive DOE x 8 years
- Born, raised and resides in Missouri
- Physical exam revealed decreased breath sounds and a 0.5 cm right thyroid nodule
# Spirometry

<table>
<thead>
<tr>
<th></th>
<th>Pre-BD</th>
<th>Percent Predicted</th>
<th>Post-BD</th>
<th>Percent Predicted</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1 L</td>
<td>1.6</td>
<td>64%</td>
<td>2.0</td>
<td>78%</td>
<td>25%</td>
</tr>
<tr>
<td>FVC L</td>
<td>3.2</td>
<td>90%</td>
<td>3.3</td>
<td>93%</td>
<td>3%</td>
</tr>
<tr>
<td>FEV1 FVC</td>
<td>50%</td>
<td></td>
<td>61%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Radiologic Studies

- CXR suggested a possible solitary pulmonary nodule
- CT scan performed. Representative images shown
Which of the following is the most likely cause for the CT abnormalities?

A. Hydatid disease
B. Brucellosis
C. Histoplasmosis
D. Cat scratch disease
E. Blastomycosis
Which of the following is the most likely cause for the CT abnormalities?

A.  Hydatid disease
B.  Brucellosis
C.  Histoplasmosis
D.  Cat scratch disease
E.  Blastomycosis
Histoplasmosis

- CT shows calcified hilar node, parenchymal node, and splenic nodule
- This combination in a patient from Missouri would be most consistent with previous infection with histoplasmosis
- Other possibilities include TB, sarcoidosis (but splenic calcification rare)
Histoplasmosis

- Common infection in central USA (Mississippi and Ohio River valleys) and St. Lawrence River valley
- Grows in soil/material contaminated with bat or bird droppings
- Spores airborne with disturbed soil
- Majority have asymptomatic illness
- Pneumonia with large inoculum
- This patient had no recollection of an acute illness
Why The Other Options Are Incorrect

• Hydatid disease (option A) is a common cause of splenic calcification although tend to be larger. Calcified pulmonary cysts are very rare and calcified nodes not described in this condition.

• No history of exposure to domesticated animals or acute respiratory illness suggestive of brucellosis (option B). Can cause splenic calcifications but not mediastinal calcifications.

• Chronic regional adenopathy has been described in cat scratch disease (option D) due to Bartonella henselae. Very rarely splenic calcifications but not pulmonary or mediastinal.

• Blastomycosis (option E) causes mediastinal adenopathy and calcification much less commonly than histoplasmosis (10-20%) and splenic calcification has not been reported.
Final page of the medical boards

BONUS QUESTION: (50 points)
What's the name of that thing that hangs down in the back of our throats?
Case #6: Baker’s assistant

- 30-year-old Hispanic woman
- Non-smoker
- 1 year of progressive episodic dyspnea
- Has heard herself wheeze on occasion
- Previous history of seasonal allergies
- Normal chest radiograph
### Case #5

**Date of Test:** (insert date)  
**Time of Test:** 9:40 AM  
**Location:** Hospital  

**Name of Subject:**  
**Age:** 30  
**Gender:** F  
**Race:** Caucasian  
**Ethnicity:** Hispanic  
**Height:** 5 ft. 4 in.  
**Weight:** 160 lbs.  

**ID #:**  
**Reason for Test:** Episodic Dyspnea in Baker's Assistant  

**Smoking History:** Yes  
**No**  
**Never**  
**Ex-smoker:** if yes, ____ppd and ____ total PY  

**Technician:** Frank Jones  
**Equipment:** System #3

<table>
<thead>
<tr>
<th>Baseline</th>
<th>After BD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
</tr>
<tr>
<td>FEV₁, L</td>
<td>2.51</td>
</tr>
<tr>
<td>FVC, L</td>
<td>3.46</td>
</tr>
<tr>
<td>FEV₁/FVC, %</td>
<td>72%</td>
</tr>
<tr>
<td>PEFR, L/S</td>
<td>6.42</td>
</tr>
<tr>
<td>FEF₂₅₋₇₅, L/S</td>
<td>2.24</td>
</tr>
</tbody>
</table>

| TLC, L   | 5.60     | 5.42  | 103%   | 4.28 |
| VC, L    | 3.60     | 3.75  | 96%    | 3.11 |
| FRC, L   | 3.42     | 2.98  | 115%   |     |
| ERV, L   | 1.42     | 1.31  | 108%   |     |
| IC, L    | 2.18     | 2.44  | 89%    |     |
| RV, L    | 2.00     | 1.67  | 120%   |     |
| RV/TLC, %| 36%      | 27%   |        |     |

**Method Used:** Body Plethysmograph
What is the spirometric interpretation?

1. Restriction
2. Obstruction
3. Mixed
4. Normal
<table>
<thead>
<tr>
<th>AME MUST REVIEW</th>
<th>ACCEPTABLE CERTIFICATION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treating physician finds the condition stable on current regimen and no changes</td>
<td>[ ] Yes</td>
</tr>
<tr>
<td>recommended</td>
<td></td>
</tr>
<tr>
<td>Symptoms: Stable and well-controlled (either on or off medication)</td>
<td>[ ] Yes for all of the following:</td>
</tr>
<tr>
<td></td>
<td>- Frequency of symptoms - no more than 2 days per week</td>
</tr>
<tr>
<td></td>
<td>- Use of inhaled short-acting beta agonist (rescue inhaler) - no more than 2 times per week</td>
</tr>
<tr>
<td></td>
<td>- Use of oral corticosteroids for exacerbations - no more than 2 times per year</td>
</tr>
<tr>
<td></td>
<td>- In the last year:</td>
</tr>
<tr>
<td></td>
<td>- No in-patient hospitalizations</td>
</tr>
<tr>
<td></td>
<td>- No more than 2 outpatient clinic/urgent care visits for exacerbations (with symptoms fully resolved).</td>
</tr>
<tr>
<td>Acceptable Medications</td>
<td>[ ] One or more of the following</td>
</tr>
<tr>
<td></td>
<td>- Inhaled long-acting beta agonist</td>
</tr>
<tr>
<td></td>
<td>- Inhaled short-acting beta agonist (e.g., albuterol)</td>
</tr>
<tr>
<td></td>
<td>- Inhaled corticosteroid</td>
</tr>
<tr>
<td></td>
<td>- leukotriene receptor antagonist, (e.g. montelukast [Singulair])</td>
</tr>
<tr>
<td></td>
<td>Note: A short course of oral or IM steroids during an exacerbation is acceptable. Examiner must caution airman not to fly until course of oral steroids is completed and airman is symptom free.</td>
</tr>
<tr>
<td>Pulmonary Function Tests (PFT)*</td>
<td>[ ] Current within last 90 days</td>
</tr>
<tr>
<td>*PFT is not required if the only treatment is PRN use on one or two days a week</td>
<td>[ ] FEV1, FVC, and FEV1/FVC are all equal to or greater than 80% predicted before bronchodilators</td>
</tr>
<tr>
<td>of a short-acting beta agonist (e.g. albuterol).</td>
<td></td>
</tr>
</tbody>
</table>
Approach to Interpretation

1. What is the reason for the test?
2. Mental Image of the patient (do the values make sense?)
3. Comment on test quality
4. Comparison with Predicted/Reference Values; using LLN
5. Pattern identified (obstructed, restricted, mixed)
6. Are there previous results for comparison?
Assessing Quality

1. Technician comments regarding effort
2. Acceptability
3. Extrapolated Volume < 0.15 L (or 5% of VC)
4. Repeatability: largest and next largest within 0.15 L (for VC < 1.0 L, repeatability <0.10 L)
5. View Curves (Volume Time and Flow Volume)
6. Compare vital capacities from different tests (if available)
## Case # 5: PFT Results

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>After BD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Pred</td>
</tr>
<tr>
<td>FEV1, L</td>
<td>2.51</td>
<td>3.23</td>
</tr>
<tr>
<td>FVC, L</td>
<td>3.46</td>
<td>3.75</td>
</tr>
<tr>
<td>FEV1/FVC,%</td>
<td>72%</td>
<td>84%</td>
</tr>
<tr>
<td>TLC, L</td>
<td>5.60</td>
<td>5.42</td>
</tr>
<tr>
<td>VC, L</td>
<td>3.60</td>
<td>3.75</td>
</tr>
<tr>
<td>DLCO, ml/mmHg/min</td>
<td>24.2</td>
<td>23.8</td>
</tr>
<tr>
<td>VC, L</td>
<td>3.58</td>
<td>3.75</td>
</tr>
</tbody>
</table>
Obstructive Impairment

![Graph showing volume vs time for normal and obstructive conditions.](image-url)
Case #5: Spirometry Graphs

Volume (Liters)

Flow (L/sec)

Time, seconds

Volume, liters
Pattern of Spirometry Abnormality
(follow your checklist of variables)

1. $\text{FEV}_1$/FVC less than LLN: obstructed
2. FVC > than LLN: look at TLC (via lung volumes)
3. Comment on Severity of Abnormality
4. TLC > LLN: ?Air trapping
5. $D_L\text{CO}$ > LLN
6. Bronchodilator Response (+ 12% & + 0.2 L)
What do you think she has?

1. Silicosis
2. Severe OSA
3. Mild asthma
4. Neuromuscular weakness
Type of Lung Impairment

**Obstructive**
- Asthma
- Chronic Bronchitis
- Emphysema
- Bronchiolitis Obliterans
- Bronchiectasis

**Restrictive**
- Extra-thoracic
  - Obesity, kyphoscoliosis, etc.
- Pleural disease
- Interstitial Disease
- Parenchymal Disease
Case #6

Primary spontaneous pneumothorax in adults:

A. Occurs more often in women than men.
B. Rarely occurs at rest.
C. Is strongly associated with cigarette smoking.
D. Increases in incidence with age through the sixth decade.

0% 0% 0% 0%
Question 10
Primary spontaneous pneumothorax in adults:

- A. Occurs more often in women than men.
- B. Rarely occurs at rest.
- C. Is strongly associated with cigarette smoking.
- D. Increases in incidence with age through the sixth decade.
C. Is strongly associated with cigarette smoking.

- Primary spontaneous pneumothorax (PSP):
  - is a pneumothorax that occurs without a precipitating event in a patient who does not have known lung disease.

- A majority of PSPs result from rupture of small subpleural blebs, and other microscopic pleural pathologic changes have been described. So not entirely normal lungs.
Risk Factors for PSP

• Cigarette smoking is a prominent risk factor for PSP (choice C is correct). (Some studies suggest > 90% patients with PSP have concurrent tobacco exposure). The risk appears to related to the exposure.

  – Family history
  – Homocystinuria
  – Marfan syndrome
  – Endometriosis.
Primary Spontaneous Pneumothorax

• Incidence 7/100,000 in United States
• Much more common in men then women (choice A is incorrect).
• Familial clustering has been noted.
• The Birt-Hogg-Dube Syndrome: skin and renal tumors is associated with very high incidence of PSP. Linked to FLCN (familiar cancer) gene on Chromosome 17.
• Most commonly occurs when the patient is at rest (choice B is incorrect).
• Patients typically have PSP diagnosed in their later teenage years or in their twenties and very rarely after the age of 40 (choice D is incorrect).
• The diagnosis is often clear by the history of sudden onset of shortness of breath and pleuritic chest pain coupled with the physical findings of diminished breaths on the affected side.
• Tension pneumothorax is very rare in this context but has been described.
Treatment of PSP

• Consensus guidelines available for management, both acutely and in order to prevent recurrence.
• For small PSPs (2-3 cm between pleural edge and chest wall on chest radiograph), supplemental oxygen and observation is appropriate.
• For larger PSPs in stable patients or those who are significantly symptomatic should undergo needle aspiration to withdraw air. If this fails, tube thoracostomy should be performed, and thoracoscopy during the same hospitalization should be considered.
• Persisting air leaks most often require surgical repair.
• For a recurrent PSP or a concomitant hemothorax, tube thoracostomy should be performed.
• An intervention should be performed on all recurrent PSPs. (i.e.: video-assisted thoracoscopic (VATS) pleurodesis after their initial disease management.)
• Patients with their initial PSP diagnosis should have pleurodesis if they initially required VATS or tube thoracostomy, or if they are high risk for being intolerant of recurrent PSPs (e.g., airplane pilot, commercial scuba diver).
SUMMARY AND DISCUSSION