Question 1: PFT Interpretation

A 60 year old male presents with a 6 month history of gradually progressive dyspnea and non-productive cough. He has a 40 pack-year smoking history but stopped smoking approximately 10 years ago.

PMH: mild asthma since age 20
Meds: albuterol inhaler prn
Physical examination: unremarkable except for mild bilateral scattered wheezes
Question 1: PFT Interpretation

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>% Pred.</th>
<th>Post-BD (L)</th>
<th>Post-BD % Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>3.6 L</td>
<td>85%</td>
<td>3.8 L</td>
<td>+6%</td>
</tr>
<tr>
<td>FEV1</td>
<td>2.2 L</td>
<td>74%</td>
<td>2.4 L</td>
<td>+9%</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>61%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLC</td>
<td>5.2 L</td>
<td>112%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RV</td>
<td>1.6 L</td>
<td>135%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLCO</td>
<td></td>
<td>59%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The most likely diagnosis is:

A. Asthma
B. Chronic bronchitis
C. Emphysema
D. Chronic pulmonary emboli
E. Interstitial lung disease
Pulmonary function testing: Pattern interpretation

- **Obstructive disease:** most cases defined by ↓ FEV₁/FVC (absolute ratio < 0.7)
  - RV/TLC typically ↑ (air trapping)
  - Criteria for reversibility: ≥12% ↑ in either FEV₁ or FVC and ≥200 mL ↑ from baseline with bronchodilator therapy
- **Main causes of obstructive disease**
  - Asthma
  - COPD (emphysema and/or chronic bronchitis)
  - Bronchiolitis
  - Diffuse bronchiectasis (including CF)
- **Hint:** ↓ DLCO suggests emphysema

Pulmonary function testing: Pattern interpretation

- **Restrictive disease:** defined by ↓ TLC
  - FEV₁ and FVC ↓ but FEV₁/FVC normal (or ↑)
- **Main causes of restrictive disease**
  - Interstitial lung disease
  - Neuromuscular (NM) disease
  - Chest wall (CW) disease (stiff chest wall)
- **Helpful hints**
  - ↓ DLCO suggests interstitial disease
  - ↑ RV can suggest NM or CW disease

DLCO depends on alveolar-capillary surface area and RBCs

- **Low DLCO** → think emphysema, interstitial disease, or pulmonary vascular disease
- **Isolated low DLCO** → think pulmonary vascular disease
- **Isolated high DLCO** → think pulmonary hemorrhage, left-to-right shunt, and polycythemia
- **With restrictive disease, a normal DLCO suggests an extrapulmonary cause**
Question 2: Cough

A 58 year old woman presents with a 6 week history of bothersome non-productive cough. She does not recall a preceding URI. She never smoked and is on no meds. She denies symptoms of postnasal drip or GERD. On examination, she is afebrile but coughed intermittently during the visit. HEENT examination was negative, and lungs were clear, without wheezing.

What is the next step in this patient’s management?

A. Chest radiograph  
B. Pulmonary function testing  
C. Antihistamine-decongestant combination  
D. Inhaled bronchodilator  
E. Oral azithromycin

Question 2: Cough

What is the next step in the patient’s management?

A. Chest radiograph  
B. Pulmonary function testing  
C. Antihistamine-decongestant combination  
D. Inhaled bronchodilator  
E. Oral azithromycin
Classification of cough

- Acute: duration <3 weeks
  - Most commonly due to acute respiratory tract infection, including acute bronchitis
- Subacute: duration 3-8 weeks
  - Commonly “post-infectious,” but also can be due to same causes as for chronic cough
- Chronic: >8 weeks
  - 3 main causes: upper airway cough syndrome (post-nasal drip); asthma; GERD
  - Less common: non-asthmatic eosinophilic bronchitis

Evaluation of cough

- Acute: generally none; CXR not needed
- Subacute and chronic:
  - Ideally D/C smoking or ACE inhibitors
  - If one of the common causes suggested by hx. or PE → treat accordingly
  - If no clue to the common triad, or if concern for underlying pulmonary disease → CXR
  - If CXR normal, empirically treat or evaluate sequentially for UACS, asthma, non-asthmatic eosinophilic bronchitis, GERD
  - Refractory cough, consider gabapentin or pregabalin

Additional points re cough

- Acute bronchitis is usually viral → don’t treat with antibiotics
- Consider testing for pertussis for cough >2 weeks if coughing paroxysms, post-tussive emesis, or inspiratory whoop
  - <4 weeks: nasopharyngeal culture and PCR (aspirate or swab)
  - >4 weeks: serology
- Non-asthmatic eosinophilic bronchitis: sputum eosinophilia but no airway hyperresponsiveness
- Consider bronchiectasis with chronic purulent sputum and/or culture with S. aureus, P. aeruginosa, non-tuberculous mycobacteria
Question 3. Pulmonary nodule

A 62-year-old man is evaluated after a CT angiogram to evaluate possible pulmonary embolus detected a 3-mm nodule in the right lower lobe of the lung. The patient is a lifelong nonsmoker and has not been exposed to potential carcinogens. Exam is unremarkable, and full chest CT scan shows only the 3-mm nodule, which is not calcified.

What is the appropriate management?

A. Needle biopsy
B. Follow-up chest x-ray in 6 months
C. Follow-up chest CT in 6 months
D. Follow-up chest CT in 1 year
E. No further management or F/U
Clinical points re DDx.

- Primary lung cancer – especially adenoCa, large cell Ca, but any cell type
- Carcinoid – 20% present as solitary pulmonary nodule
- Metastatic Ca – more commonly multiple
- Infectious granuloma – remember atypical (non-tuberculous) mycobacteria
- Hamartomas – slow growth over years; often various densities in nodule (fat, calcium)

Clinical pearls re pulmonary nodules

- Ca++ in lesion is not necessarily associated with benignity; pattern is important
  - Central or solid Ca++ typically benign
  - Eccentric Ca++ often malignant (“scar carcinoma”)
  - “Popcorn” calcification with hamartoma
- “Ground glass” appearance often suggestive of bronchoalveolar cell carcinoma (BAC)
  - Recent WHO reclassification (lepidic adenoCa, adenoCa in situ, minimally invasive adenoCa)

Ground glass pulmonary nodule

Source: ecancer.org
Points to remember:
Evaluation of solitary pulmonary nodule

- First priority is always to get old imaging studies: stability over >2 years usually means a benign lesion (except for ground-glass/subsolid nodules, suggestive of slowly growing BAC)
- Should biopsy any lesion that has shown growth
- No further evaluation if clearly benign pattern of calcification

Fleischner Society guidelines for CT F/U of solid solitary pulmonary nodule

<table>
<thead>
<tr>
<th>Nodule Size</th>
<th>Low-Risk Patient (non-smoker, no other risk factors)</th>
<th>High-Risk Patient (smoking history or other risk factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤4 mm</td>
<td>No follow-up needed</td>
<td>12 mos.; if unchanged, no further f/u</td>
</tr>
<tr>
<td>&gt;4 – 6 mm</td>
<td>12 mos.; if unchanged, no further f/u</td>
<td>6-12 mos.; then at 18-24 mos. if unchanged</td>
</tr>
<tr>
<td>&gt;6 – 8 mm</td>
<td>6-12 mos.; then at 18-24 mos. if unchanged</td>
<td>3-6 mos.; then at 9-12 and 24 mos. if unchanged</td>
</tr>
<tr>
<td>&gt;8 mm</td>
<td>3, 9, and 24 mos.; dynamic contrast-enhanced CT, PET, and/or biopsy</td>
<td></td>
</tr>
</tbody>
</table>

Source: Radiology 2005; 237:395

FDG-PET scanning

- Not useful for lesions <1 cm
- False positives more common than false negatives (sensitivity ~95%; specificity ~75-80%)
- False positives due to metabolically active infectious or inflammatory processes
- False negatives in well-differentiated tumors with low metabolic activity (esp. BAC, carcinoid)
- Also provides information about mediastinal lymph nodes
**Biopsy options**

- Percutaneous needle biopsy is preferred non-surgical approach
- Often difficult to get into lesion with bronchoscopy and transbronchial biopsy, esp. with lesions <2 cm
- Surgical resection through VATS an option for peripheral lesions

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**Question 4. Asthma: DDx.**

A 25-year-old woman is evaluated for recurrent episodes of acute dyspnea and wheezing associated with voice changes during the episodes. Treatment with albuterol provides only minimal relief. During an episode, she sounds “wheeezy,” particularly during inspiration.

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**Which of the following is the most appropriate next diagnostic step?**

A. Chest radiography
B. CT scan of the neck
C. Flow volume loops
D. Thyroid function tests
Question 4. Asthma: DDx.

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A. Chest radiography
B. CT scan of the neck
C. Flow volume loops
D. Thyroid function tests

Disorders mimicking asthma

- Postnasal drip – can also worsen asthma
- GE reflux – can also worsen asthma
- Paradoxical vocal cord motion
- CHF (“cardiac asthma”)
- Cystic fibrosis
- Alpha-1-antitrypsin deficiency
- Post-viral airway hyperreactivity

Paradoxical vocal cord motion

- Clinical clues
  - Loss of voice/dysphonia
  - Inspiratory stridor
  - Normal FEV1, FVC, and FEV1/FVC
  - Normal O2 saturation
- Diagnostic evaluation
  - Visualize cords by direct laryngoscopy
  - Flow-volume curve can be helpful
- Treatment
  - Speech therapy consultation
  - ?? Psychotherapy
  - Acutely: He-O2 mixture (effect of gas density in areas of turbulent airflow)
Paradoxical vocal cord motion

Question 5. Asthma Rx.

A 35-year-old woman with asthma has daily coughing and shortness of breath. She uses triamcinolone, 4 puffs BID, and albuterol, 2 puffs BID as needed. Her sleep is disturbed nightly by coughing.

Which of the following is the most appropriate next step in management?

A. Add a long-acting bronchodilator
B. Add omalizumab
C. IV corticosteroids
D. Add theophylline and 5 day course of azithromycin
Question 5. Asthma Rx.

Which of the following is the most appropriate next step in management?

A. Add a long-acting bronchodilator
B. Add omalizumab
C. IV corticosteroids
D. Add theophylline and 5 day course of azithromycin

Asthma classification

<table>
<thead>
<tr>
<th>Stage</th>
<th>Day Symptoms</th>
<th>Night Symptoms</th>
<th>FEV1</th>
<th>Interference with activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermittent</td>
<td>&lt;2 days per week</td>
<td>&lt;2 nights per month</td>
<td>≥80%</td>
<td>None</td>
</tr>
<tr>
<td>Mild persistent</td>
<td>&gt;2 per week, &lt;1 per day</td>
<td>3-4 nights per month</td>
<td>≥80%</td>
<td>Minor limitation</td>
</tr>
<tr>
<td>Moderate persistent</td>
<td>Daily</td>
<td>&gt;1 night per week</td>
<td>≥60% - &lt;80%</td>
<td>Some limitation</td>
</tr>
<tr>
<td>Severe persistent</td>
<td>Continual</td>
<td>Often nightly</td>
<td>&lt;60%</td>
<td>Extremely limited</td>
</tr>
</tbody>
</table>

From NAEPP 3 (2007)

Step-based therapy of asthma

<table>
<thead>
<tr>
<th>Preferred Medication</th>
<th>Treatment Step</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6</td>
</tr>
<tr>
<td>SABA prn</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>ICS</td>
<td>LD LD MD MD HD HD</td>
</tr>
<tr>
<td>LABA</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td>Oral CS</td>
<td></td>
</tr>
<tr>
<td>Omalizumab</td>
<td></td>
</tr>
</tbody>
</table>

SABA = short-acting β-agonist; LABA = long-acting β-agonist; ICS = inhaled corticosteroids; Oral CS = oral corticosteroids; LD = low-dose; MD = medium-dose; HD = high-dose. *Leukotriene antagonist is an alternative.
A 65-year-old woman with COPD has ongoing symptoms of dyspnea, chronic cough, and mucoid sputum. Her only medication is inhaled albuterol as needed.
Examination shows decreased breath sounds.
FEV₁ = 62% predicted; FEV₁/FVC = 0.65.

Which of the following is the most appropriate therapy?

A. Add a long-acting β₂-agonist
B. Add an inhaled corticosteroid
C. Add an oral corticosteroid
D. Add theophylline and montelukast
E. Continue current albuterol therapy
**GOLD severity classification of COPD**

<table>
<thead>
<tr>
<th>Stage</th>
<th>FEV1/FVC &lt; 0.70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>FEV1 ≥ 80% predicted</td>
</tr>
<tr>
<td>Moderate</td>
<td>FEV1 ≥ 50% predicted</td>
</tr>
<tr>
<td>Severe</td>
<td>FEV1 ≤ 30% predicted</td>
</tr>
<tr>
<td>Very Severe</td>
<td>FEV1 ≤ 20% predicted or FEV1 &lt; 50% predicted plus chronic respiratory failure (PaO2&lt;60 mmHg or PaCO2&gt;50 mm Hg)</td>
</tr>
</tbody>
</table>

Source: www.goldcopd.com

**Stage-based therapy of COPD**

<table>
<thead>
<tr>
<th>Preferred Medication</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Very Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>SABA prn</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>LABA or LA anti-cholinergic</td>
<td>Single or both*</td>
<td>Single or both*</td>
<td>Single or both*</td>
<td></td>
</tr>
<tr>
<td>ICS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
<td>Considered</td>
</tr>
</tbody>
</table>

SABA = short-acting β-agonist; LABA = long-acting β-agonist; LA = long-acting; ICS = inhaled corticosteroids; Oral CS = oral corticosteroids; * Especially if repeated exacerbations

**Points to remember: COPD Dx.**

- Evaluate for α1-antitrypsin deficiency if:
  - Early onset emphysema (<50 y.o.)
  - Positive family history
  - Predominantly lower zone disease
- Guidelines recommend that asymptomatic, “at risk” patients (i.e. smokers) **not** be screened
- Treatment **not** indicated for asymptomatic patients
Points to remember: COPD Rx.

- Rx. can ↓ sx. and exacerbations, ↑ exercise capacity
- No treatment clearly accepted as modifying course of disease or mortality (except supplemental O2)
- Inhaled route of rx. is preferred

Additional points about COPD Rx.

- All patients with COPD should receive influenza and 23-valent pneumococcal immunization; also 13-valent after age 65
- Pulmonary rehabilitation (with exercise rehab) improves exercise tolerance but not pulmonary function
- Supplemental O2 (at least 15 hrs./day) if PaO2<55 mmHg or SaO2<88% (PaO2<59 mmHg or SaO2<89% if cor pulmonale or erythrocytosis)

Surgical options for COPD Rx.

- Lung volume reduction surgery (LVRS)
  - Rationale: ↑ elastic recoil; improve mechanical function of diaphragm
  - Best with upper lobe predominant emphysema
  - Avoid with FEV1<20% predicted, DLCO<20% predicted, or homogeneous disease by CT scan
- Lung transplantation
  - Consider when LVRS not indicated: FEV1<20% predicted, DLCO<20% predicted, homogeneous disease
A 30 year old man presents with a 3 month history of mild exertional dyspnea and cough. He is a non-smoker and has been previously healthy. Examination reveals a healthy-appearing man. He is afebrile and has an O₂ saturation of 96% by pulse oximetry. Chest examination is clear. Pulmonary function tests are notable for FVC 75% predicted, FEV1 78% predicted, TLC 76% predicted, and DLCO 65% predicted.

Chest radiograph is shown.

Which of the following is the most likely diagnosis?

A. Sarcoidosis
B. Idiopathic pulmonary fibrosis
C. Hypersensitivity pneumonitis
D. Cystic fibrosis
E. Nonspecific interstitial pneumonia
Question 7. Parenchymal lung disease

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C. Hypersensitivity pneumonitis  
D. Cystic fibrosis  
E. Nonspecific interstitial pneumonia

Important causes of diffuse interstitial lung disease

- Idiopathic pulmonary fibrosis (IPF) – UIP
- Other forms of idiopathic interstitial pneumonia – NSIP, DIP/RB-ILD, LIP
- Pulmonary fibrosis associated with connective tissue disease – either UIP or NSIP pathology
- Sarcoidosis
- Hypersensitivity pneumonitis

Idiopathic pulmonary fibrosis

- Typically 50-70 y.o.
- Exam: dry bibasilar crackles; +/- clubbing
- CXR: interstitial changes
- CT scan: patchy peripheral fibrotic changes, honeycombing
- Prognosis: generally poor, non-responsive to steroids or immunosuppressives
- Treatment: lung transplant
  - 2 new drugs: pirfenidone; nintedanib – slow disease progression (rate of decline of FVC)
Sarcoidosis

- Multisystem disease: lungs most common; also eye, liver, skin, nodes, heart, CNS
- Intrathoracic: parenchymal disease and/or ↑ nodes (hilar, mediastinal)
- HRCT: often micronodular pattern following bronchovascular bundles
- Variable course; often do not need rx.
  - Rx. with steroids based on sx. and organ dysfunction
Hypersensitivity pneumonitis

- Hypersensitivity to organic antigen, e.g., thermophilic actinomycetes, animal proteins
- Acute (respiratory sx. 4-6 hrs. after exposure) or chronic
- Dx. by history, precipitins (though neither sensitive nor specific)
- HRCT: often ground-glass
- Rx.: Ag avoidance, steroids

Question 8. Pulmonary vascular disease

A 53-year-old man has acute dyspnea that developed 2 days after total hip arthroplasty. PMH is notable for chronic kidney disease.

On exam, T 38.5 °C (101.3 °F), BP 156/92 mm Hg, HR 110/min, and RR 24/min.
Cardiopulmonary examination is normal.
SaO₂ is 87% by pulse oximetry (breathing oxygen at 3 L/min by nasal cannula). CXR is clear. Serum creatinine = 2.1 mg/dL
Which of the following is the next diagnostic step?

A. CT angiogram
B. D-dimer
C. Lower extremity duplex Doppler
D. Echocardiogram
E. Ventilation-perfusion lung scan

Question 8. Pulmonary vascular disease

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A. CT angiogram
B. D-dimer
C. Lower extremity duplex Doppler
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Wells and modified Wells criteria

<table>
<thead>
<tr>
<th>Variable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical signs/sx. of DVT</td>
<td>3.0</td>
</tr>
<tr>
<td>Alternative dx. deemed less likely than PE</td>
<td>3.0</td>
</tr>
<tr>
<td>Heart rate &gt;100 bpm</td>
<td>1.5</td>
</tr>
<tr>
<td>Immobilization or surgery in previous 4 wks.</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous DVT or PE</td>
<td>1.5</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1.0</td>
</tr>
<tr>
<td>Cancer</td>
<td>1.0</td>
</tr>
<tr>
<td>Clinical Probability</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>&lt; 2.0</td>
</tr>
<tr>
<td>Intermediate</td>
<td>2.0-6.0</td>
</tr>
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<td>High</td>
<td>&gt; 6.0</td>
</tr>
<tr>
<td>Modified</td>
<td></td>
</tr>
<tr>
<td>Unlikely (&lt;4)</td>
<td></td>
</tr>
<tr>
<td>Likely (&gt;4)</td>
<td></td>
</tr>
</tbody>
</table>
D-Dimer in PE diagnosis

- Sensitive but not specific
- Negative test useful in patient with low or intermediate pre-test probability (or PE unlikely by modified Wells)
- Positive test does not confirm diagnosis

The bottom line for PE diagnosis

- If pre-test probability low or intermediate (or unlikely by modified Wells):
  - D-dimer should be the next test
  - If D-dimer is negative, no further W/U is needed
  - If D-dimer is positive, proceed to CT angio (or V/Q scan)
- If pre-test probability high (or PE likely):
  - Do not do D-dimer
  - Proceed directly to CT angio (or V/Q scan)

Additional points re PE diagnosis

- Focus diagnostic target based on sx.
  - Lower extremity ultrasound if leg sx.
  - CT angio or V/Q scan for respiratory symptoms
- CT angio has largely supplanted V/Q scan
  - V/Q scan still used in patients with renal insufficiency to avoid dye load
Points to remember: PE Rx.

- Initially, LMWH, UFH, fondaparinux, or “novel oral anticoagulant” (NOAC)
- Options following initial heparinization
  - Start warfarin on day 1; stop heparin after at least 4-5 days overlap and at least 24 hrs. with therapeutic INR
  - Start NOAC – can stop heparin immediately
- Duration
  - Continue 3 mos. if temporary risk factor
  - Continue ≥3 mos. (? indefinite) if unprovoked or with ongoing risk factor
- Thrombolytic therapy reserved for hemodynamically unstable patients

Question 9. Pleural disease

A 65 year old woman presents with low-grade fever and a 10 pound weight loss. She denies respiratory symptoms.
On exam, T 38.2°C, and chest examination has dullness and absent breath sounds over the lower third of the left hemithorax.
CXR shows a left pleural effusion.
Pleural fluid sampled at thoracentesis shows WBC 3700 with 95% mature lymphocytes, 3% PMNs, 2% mesothelial cells.

The most likely diagnosis is:

A. Sarcoidosis  
B. Lymphoma  
C. Tuberculosis  
D. Lung cancer  
E. Mesothelioma
Question 9. Pleural disease

The most likely diagnosis is:
A. Sarcoidosis
B. Lymphoma
C. Tuberculosis
D. Lung cancer
E. Mesothelioma

Criteria for exudative effusion

- Light’s criteria – any of the following:
  - Pleural fluid/serum protein >0.5
  - Pleural fluid/serum LDH >0.6
  - Pleural fluid LDH >2/3 upper normal
- Other criteria haven’t replaced Light’s
- Implications
  - Transudate – imbalance of hydrostatic and oncotic pressure
  - Exudate – increased pleural permeability

Etiologies of pleural effusion

- Transudate
  - Heart failure
  - Cirrhosis (often from transdiaphragmatic passage of ascitic fluid)
  - Nephrotic syndrome
- Exudate
  - Infection (e.g., parapneumonic, empyema, TB)
  - Inflammation (e.g., RA, SLE, contiguous subdiaphragmatic inflammation)
  - Tumor
- Pulmonary embolus: either transudate or exudate
Bloody pleural fluid

- Trauma
- Malignancy
- Pulmonary infarction

Pleural fluid WBC differential

- Lymphocytes
  - Tuberculosis (esp. if almost all cells are mature lymphocytes)
  - Lymphoma
  - Sarcoidosis
  - Chronic rheumatoid pleurisy
  - Carcinoma
- Eosinophils
  - Following blood or air in pleural space
- Mesothelial cells: >5% goes against diagnosis of tuberculous effusion

Low pleural fluid glucose

- Lowest values (<20 mg/dL)
  - Rheumatoid arthritis – decreased transport into pleural space
  - Empyema – increased utilization
- Other
  - Tuberculosis
  - Malignancy
  - Systemic lupus erythematosus
  - Esophageal rupture
**Pleural fluid pH**

- Low pleural fluid pH tends to follow low pleural fluid glucose
- Prognostic implications of low pH
  - Malignancy – positive yield on cytology and poorer prognosis
  - Parapneumonic effusion – risk for loculation and complicated course; drain by thoracostomy (chest tube) when pleural fluid pH <7.20

**Tuberculous pleural effusion**

- Can occur with either primary or reactivation TB
- First diagnostic consideration with lymphocyte-predominant effusion (esp. almost all mature lymphs)
  - Neutrophilic in earliest stages
- Low diagnostic yield with fluid AFB stain or culture
  - Need pleural biopsy for histology and culture
- Typically ↑ pleural fluid adenosine deaminase (>45 IU): sensitivity and specificity ~80-85%