Case Studies In Pulmonary Function

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Recap

• **What is FVC?**
  - FVC can be decreased in both obstructive lung diseases (COPD) and restrictive lung diseases (pulmonary fibrosis)

• **FEV1 and FVC Ratio**
  - Used to determine if your have a restrictive process or obstructive process
  - An FEV1/FVC of <0.7 (70%) is diagnostic of air flow obstruction and confirms obstructive disease
  - Restrictive disorders have a near-normal or higher than normal FEV1/FVC, but both the FEV1 and FVC are reduced proportionally.
Recap

- **Reversible bronchospasm**
  - In asthma with airway obstruction (FEV1/FVC ratio < 80%), repeat testing after an inhaled bronchodilator should increase the FEV1 > 200 mL or > 12% from baseline.

- **ATS/ERS FEV1% predicted**
  - > 70% Mild
  - 60-69 Moderate
  - 50-59 Moderately severe
  - 35-49 Severe
  - < 35 Very severe
Recap

- **Total lung capacity (TLC)**
  - Average lung capacity is about 6 liters

- **DLCO**
  - Normal DLCO: >75% of predicted, up to 140%
  - Mild: 60% to LLN (lower limit of normal)
  - Moderate: 40% to 60%
  - Severe: <40%

- **RV (Residual volume)**
  - Normal adult value is averaged at 1200ml (20-25 ml/kg)
  - Air trapping causes increased RV

- **Lung hyperinflation**
  - Total lung capacity (TLC) is >120% of the predicted value
Case 1

• A 60-year-old man presents to his primary care provider with complaints of increasing dyspnea on exertion.

• He has a 40 pack-year history of smoking and is retired following a career as a building contractor.

• His pulmonary function testing is as follows:
<table>
<thead>
<tr>
<th>Test</th>
<th>Pre-Bronchodilator (BD)</th>
<th>Post- BD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Predicted</td>
</tr>
<tr>
<td>FVC (L)</td>
<td>1.89</td>
<td>4.58</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>0.89</td>
<td>3.60</td>
</tr>
<tr>
<td>FEV₁/FVC (%)</td>
<td>47</td>
<td>79</td>
</tr>
<tr>
<td>RV (L)</td>
<td>5.72</td>
<td>2.31</td>
</tr>
<tr>
<td>TLC (L)</td>
<td>7.51</td>
<td>6.41</td>
</tr>
<tr>
<td>RV/TLC (%)</td>
<td>76</td>
<td>37</td>
</tr>
<tr>
<td>DLCO corr</td>
<td>20.73</td>
<td>33.43</td>
</tr>
</tbody>
</table>

The units for DLCO are ml/min/mmHg

**Spirometry**
Flow Volume Loop
What do you think about the FVC at 41% and FEV1 at 25% of predicted values?
  - Clearly airway obstruction.

What about the FEV1/FVC ratio being markedly reduced? What does that tell you?
  - The combination of the low FEV1, FVC and reduced FEV1/FVC ratio is consistent with a diagnosis of airflow obstruction.

The FEV1 at 25% of predicted is classified as “what”?
  - This would be classified as “severe” airflow obstruction.

Does the patient meet the criteria for reversible airflow obstruction?
  - Remember both the FEV1 and FVC improved by over 200 ml and 12% following administration of a bronchodilator.

What about the RV value? What does that tell you?
  - It is indicative of air-trapping.

The value of TLC at 117%, is this hyperinflation?
  - The total lung capacity (TLC) is somewhat elevated at 117% predicted but it is still shy of the 120% predicted level used to define hyperinflation.
Case 2

- A 73-year-old man presents with progressive dyspnea on exertion over the past one year.
- He reports a dry cough but no wheezes, sputum production, fevers or hemoptysis.
- He is a life-long non-smoker and worked as a lawyer until retiring 3 years ago.
- He likes to hunt and fish in his leisure time.
- His pulmonary function testing is as follows:
### Spirometry

<table>
<thead>
<tr>
<th>Test</th>
<th>Actual</th>
<th>Predicted</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC (L)</td>
<td>1.57</td>
<td>4.46</td>
<td>35</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>1.28</td>
<td>3.39</td>
<td>38</td>
</tr>
<tr>
<td>FEV₁/FVC (%)</td>
<td>82</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>FRC</td>
<td>1.73</td>
<td>3.80</td>
<td>45</td>
</tr>
<tr>
<td>RV (L)</td>
<td>1.12</td>
<td>2.59</td>
<td>43</td>
</tr>
<tr>
<td>TLC (L)</td>
<td>2.70</td>
<td>6.45</td>
<td>42</td>
</tr>
<tr>
<td>RV/TLC (%)</td>
<td>41</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>DLCO corr</td>
<td>5.06</td>
<td>31.64</td>
<td>16</td>
</tr>
</tbody>
</table>
Flow-Volume Loop
PA and Lateral Chest X-Ray

- Decreased lung volumes
- Reticulonodular opacities
- Ground-glass opacification
- Cyst appearance
Chest CT Images

- Interstitial B-lines
- Bibasilar reticular opacities
Case 2 Interpretation

- This patient has a reduced FEV1 and FVC but a normal FEV1/FVC ratio, what does this tell you?
  - The total lung capacity is reduced and the patient, therefore, has a restrictive defect.
- The flow-volume loop is tall, narrow, and a short expiratory phase. What kind of process is this?
  - Characteristic appearance of a restrictive process
- The TLC is below 50% predicted, what would you classify this as?
  - A “severe” restrictive defect.
- His DLCO is also markedly reduced? Why is this happening?
  - He has a reduced alveolar capillary interface for gas exchange and suggesting that the cause of his restrictive process lies within the lung parenchyma.
- Based on the X-ray/CT images findings and PFT values, what would you say is a possible diagnose?
  - This patient was found to have idiopathic pulmonary fibrosis.