PF Testing’s Role in Asthma Classification

Al Quinones, DHA, MA, FACHE, RRT, RPFT, AE-C
President, Quinones Healthcare Seminars, LLC
Associate Professor, Molloy College
Objectives:

1. Review Indications and Contraindications for Spirometry
2. Discuss clinical features of asthma
3. Explain the use of spirometry in asthma classification
Asthma Prevalence

– The percentage of people who have ever been diagnosed with asthma and still have asthma increased from 7.3% in 2001 to 8.4% in 2010.

– In 2010, an estimated 25.7 million people had asthma: 18.7 million adults aged 18 and over, and 7.0 million children aged 0–17 years.

– Spirometry evaluation is key is Asthma diagnosis and monitoring.
Indications for Spirometry

The primary indications for a spirometry test include:

- Show the presence or absence of lung dysfunctions
- Assess severity of known lung disease
- Evaluate the potential effect of occupational or environmental exposures
- Assess the potential risk for surgical interventions that can effect lung function to assess disability
Contraindications for Spirometry

- Hemoptysis
- Pneumothorax
- Unstable cardiovascular status
- Recent myocardial infarctation or pulmonary embolism
- Thoracic, abdominal or cerebral aneurism (risk of rupture because the increased intrathoracic pressure during forced expiration)
- Recent ocular surgery (eg. cataract)
- Nausea, vomiting
- Recent thoracic or abdominal surgery
Normal Flow Volume Loop
Abnormal Flow Volume Loop

Flow

Expiratory flow

Inspiratory flow

Volume

poor effort

cough

stopped blowing too soon

air leak
Spirometry and Race Adjustments

- Race is an important consideration in evaluating pulmonary function data.
- When compared with Caucasians of European decent:
  - 10-15% correction for those labeled “black”
  - 4-6% correction for those labeled “Asian”
  - Smaller static volumes
  - Lower forced expiratory flow rates
  - Similar FEV$_1$/FVC ratios
Obstructive Disorders

• Characterized by a limitation of expiratory airflow
  – Examples: Asthma, COPD

• Decreased FEV$_1$,
• Decreased FEF$_{25-75}$
• Decreased FEV$_1$/FVC
• Increased or Normal TLC

• If SVC is greater than FVC suspect obstructive disease.
Asthma and Flow Volume Loops

- Peak expiratory flow reduced so maximum height of the loop is reduced

- Airflow reduces rapidly with the reduction in the lung volumes because the airways narrow and the loop become concave

- Concavity may be the indicator of airflow obstruction and may present before the change in FEV₁ or FEV₁/FVC.
Reversibility

• Improvement in \( \text{FEV}_1 \) 12% and 200 ml in repeating spirometry 15 minutes post bronchodilator therapy
• Reversibility is a characteristic feature of Asthma
• In chronic asthma there may be only partial reversibility of the airflow obstruction
• COPD the airflow is irreversible although some cases show some improvement (<12 % improvement).
# Reversibility Standards

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Definition for Reversibility</th>
<th>Publication Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCP</td>
<td>FEV$_1$ $\geq$15%</td>
<td>1974</td>
</tr>
<tr>
<td>ATS</td>
<td>FEV$_1$ or FVC $\geq$12% and $\geq$200 mL</td>
<td>1991</td>
</tr>
<tr>
<td>ERS</td>
<td>Percentage predicted FEV $&gt;10%$</td>
<td>1995</td>
</tr>
<tr>
<td>ATS/ERS</td>
<td>FEV$_1$ and/or FVC $&gt;12%$ and $&gt;200$ mL</td>
<td>2005</td>
</tr>
<tr>
<td>GOLD</td>
<td>FEV$_1$ $&gt;12%$ and $&gt;200$ mL</td>
<td>2010</td>
</tr>
</tbody>
</table>
Bronchial Provocation Testing

A. Typically, administration of methacholine or histamine to evaluate airway hyperreactivity.

B. Test positive if 20% reduction in FEV$_1$.

C. Methacholine dose required = PD 20%

D. Bronchodilators held prior to testing:

E. Methacholine administered via neb or dosimeter
PFT Evaluation

FEF25%-75%:

Diffusing Capacity (DLCO):
Age Adjusted Spirometry Evaluation

- **FEV₁/FVC Ratio**
- Calculation: \((\text{FEV}_1/\text{FVC}) \times 100\)
- Normal varies with age:

<table>
<thead>
<tr>
<th>Age</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\leq 19)</td>
<td>85%</td>
</tr>
<tr>
<td>(8-19)</td>
<td></td>
</tr>
<tr>
<td>(\leq 39)</td>
<td>80%</td>
</tr>
<tr>
<td>(20-39)</td>
<td></td>
</tr>
<tr>
<td>(\leq 59)</td>
<td>75%</td>
</tr>
<tr>
<td>(40-59)</td>
<td></td>
</tr>
<tr>
<td>(\leq 80)</td>
<td>70%</td>
</tr>
<tr>
<td>(60-80)</td>
<td></td>
</tr>
</tbody>
</table>
Skin Testing
• Allergy shots are a type of immunotherapy treatment in which small doses of substances to which you are allergic (allergens) are injected under your skin.

Over time, your body may become less responsive to the allergens
Treating asthma can be very challenging for people living with limited resources

While some people with asthma rarely experience symptoms, others have persistent wheezing, shortness of breath, or chest tightness often due to allergy.

An important step in controlling asthma symptoms is to reduce exposure to triggers in the home like environmental tobacco smoke, cockroaches, dust mites, pets, and mold.
Four Primary Signs/Symptoms of Asthma

Wheezing:

Coughing:

Chest tightness:

SOB:
Auscultation/CXR

Breath Sounds:
- Vesicular
- Wheezing
- Absent Breath Sounds

CXR:
- Flattened diaphragm
Dyspnea Grades

- Grade I: normal, usual exertion
- Grade II: breathlessness going up hills or stairs
- Grade III: dyspnea while walking a normal speed
- Grade IV: dyspnea walking slowly for short distances
- Grade V: dyspnea at rest.
Activity of Daily Living (ADL) Assessment

• **ADLs** are routine tasks:

• **ADL** assessment used to determine:

• **Social Support** must be evaluated:
# Arterial Blood Gases During an Acute Asthma Episode

<table>
<thead>
<tr>
<th>PaCO₂</th>
<th>PaO₂</th>
<th>SaO₂</th>
<th>pH</th>
<th>HCO₃⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-45 Torr</td>
<td>80-100 Torr</td>
<td>95-98%</td>
<td>7.35-7.45</td>
<td>22-26 mEq/l</td>
</tr>
</tbody>
</table>

Blood gas values may vary during an acute exacerbation:

- Normal
- Alkalosis
- Acidosis
Classification of Asthma:

Six areas to be assessed for appropriate classification:

1. Activity level
2. Lung function
3. Symptoms
4. Awakening at night
5. Bronchodilator use (short acting)
6. Risk
<table>
<thead>
<tr>
<th>Classification</th>
<th>Impairment</th>
<th>&lt;4 Years</th>
<th>5-11 Years</th>
<th>12 Year to Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermittent</td>
<td>Activity level</td>
<td>No Limitation</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &gt;80%, FEV&lt;sub&gt;1&lt;/sub&gt;/FVC &gt;85%</td>
<td>No Limitation</td>
</tr>
<tr>
<td></td>
<td>Lung function</td>
<td>N/A</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;/FVC &gt;80%</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;/FVC normal</td>
</tr>
<tr>
<td></td>
<td>Symptoms</td>
<td>≤ 2 days /week</td>
<td>≤ 2 days /week</td>
<td>3. ≤ 2 days /week</td>
</tr>
<tr>
<td></td>
<td>Awakening at night</td>
<td>None</td>
<td>≤ 2 days /week</td>
<td>≤ 2 days /week</td>
</tr>
<tr>
<td></td>
<td>Bronchodilator use (short acting)</td>
<td>&lt;2 days /week</td>
<td>&lt;2 days /week</td>
<td>&lt;2 days /week</td>
</tr>
<tr>
<td></td>
<td>Risk</td>
<td>4. None</td>
<td>&lt;2 nights/month</td>
<td>&lt;1 annually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. ≤ 2 days /week</td>
<td>≤ 2 days /week</td>
<td>&lt;1 annually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. &lt;1 annually</td>
<td>&lt;1 annually</td>
<td>&lt;1 annually</td>
</tr>
<tr>
<td>Mild Persistent</td>
<td>Activity level</td>
<td>Minor Limitation</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &gt;80%, FEV&lt;sub&gt;1&lt;/sub&gt;/FVC &gt;80%</td>
<td>Minor Limitation</td>
</tr>
<tr>
<td></td>
<td>Lung function</td>
<td>N/A</td>
<td>≥ 3 days /week</td>
<td>≥ 3 days /week</td>
</tr>
<tr>
<td></td>
<td>Symptoms</td>
<td>≥ 3 days /week</td>
<td>≥ 3 days /week</td>
<td>≥ 3 days /week</td>
</tr>
<tr>
<td></td>
<td>Awakening at night</td>
<td>&gt;1 night/month</td>
<td>&gt;3 night/month</td>
<td>&gt;3 night/month</td>
</tr>
<tr>
<td></td>
<td>Bronchodilator use (short acting)</td>
<td>≥ 3 days /week</td>
<td>≥ 3 days /week</td>
<td>≥ 3 days /week</td>
</tr>
<tr>
<td></td>
<td>Risk</td>
<td>≥2 in 6 months</td>
<td>≥2 annually</td>
<td>≥2 annually</td>
</tr>
<tr>
<td>Moderate Persistent</td>
<td>Activity level</td>
<td>Some Limitation</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; 60-80%, FEV&lt;sub&gt;1&lt;/sub&gt;/FVC 75-80%</td>
<td>Some Limitation</td>
</tr>
<tr>
<td></td>
<td>Lung function</td>
<td>N/A</td>
<td>Daily</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td>Symptoms</td>
<td>3. Daily</td>
<td>&gt; 3 nights/month</td>
<td>&gt; 2 nights a week</td>
</tr>
<tr>
<td></td>
<td>Awakening at night</td>
<td>4. ≥ 3 nights/month</td>
<td>4. ≥ 2 nights a week</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bronchodilator use (short acting)</td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td>Risk</td>
<td>≥2 in 6 months</td>
<td>≥3 annually</td>
<td>≥3 annually</td>
</tr>
<tr>
<td>Severe Persistent</td>
<td>Activity level</td>
<td>Extreme Limit</td>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &lt;60%, FEV&lt;sub&gt;1&lt;/sub&gt;/FVC &lt; 75 %</td>
<td>Extreme Limit</td>
</tr>
<tr>
<td></td>
<td>Lung function</td>
<td>N/A</td>
<td>All day</td>
<td>All day</td>
</tr>
<tr>
<td></td>
<td>Symptoms</td>
<td>All day</td>
<td>All week</td>
<td>All week</td>
</tr>
<tr>
<td></td>
<td>Awakening at night</td>
<td>≥ 1 night/week</td>
<td>All day</td>
<td>All day</td>
</tr>
<tr>
<td></td>
<td>Bronchodilator use (short acting)</td>
<td>5. All day</td>
<td>All week</td>
<td>All day</td>
</tr>
<tr>
<td></td>
<td>Risk</td>
<td>≥2 in 6 months</td>
<td>≥ 3 annually</td>
<td>≥ 3 annually</td>
</tr>
</tbody>
</table>
Thank you

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