Objectives

- To understand the uses and importance of spirometry testing
- To perform spirometry testing including reversibility testing
- To identify normal and abnormal patterns and classify asthma severity
- To review the definitions of lung volumes and capacities

Objectives

- To understand the value of spirometry for asthma diagnosis and management in the primary care setting
- To feel comfortable in the interpretation of PFTs and be able to use them as an aid in the diagnosis of obstructive and restrictive pulmonary disease
- To have a basic understanding of how to properly administer a PFT
Myths

- Spirometry is a poor test of little benefit
- Equipment is expensive, works poorly
- Spirometry is hard to do right
- Numbers are difficult to interpret

Why Pulmonary Function Testing???

- Asthma incidence continues to grow
- COPD is the 4th leading cause of death and the only increasing cause in the top 10
- PFT's can provide early diagnosis of lung disease, and assist in evaluation of treatment effectiveness
- PFT's are greatly underutilized, and can be helpful in making early interventions
Objective Testing

- Spirometry is a powerful diagnostic and assessment tool
- Provides clear, objective documentation of lung function
- Reliable tool to obtain pulmonology vital signs
  - easy to use and accurate
  - carried out in primary care setting

Spirometry in primary care...

- Improves clinical outcomes through better diagnosis and staging
- Supports motivation and lifestyle
- Promotes more appropriate referrals to specialists
- Generates revenue

Desktop Electronic Spirometers

- Portable
- Easy to calibrate
- Immediate feedback
- Billable
When to Utilize Spirometry

- Symptoms
  - chronic cough
  - frequent colds slowing
  - dyspnea
  - wheezing
  - orthopnea
  - chest pain

- Signs:
  - hyperinflation
  - expiratory
  - cyanosis
  - chest deformity

What is Spirometry?

- Spirometry is a method of assessing lung function by measuring the volume of air the patient can expel from the lungs after a maximal expiration.

Benefits of Spirometry

- Spirometry results can help confirm a diagnosis of asthma
- Spirometry shows severity of airways obstruction
  - peak flow shows only a moment in time
  - spirometry looks at the breathing process over time
- Spirometry and the bronchodilatator test
  - allows patient to see benefit of medication
  - allows physician to better assess patient response to medication and adjust treatment regimen as appropriate
Spirometry

- Quantifies patient's ability to exhale
- **Measures basic lung function** – spirometry values
  - Total *exhaled* volume: forced vital capacity (FVC)
  - Forced expiratory volume exhaled in first second (FEV1)
  - Ratio of volume exhaled in first second to total (FEV1/FVC)

Interpreting Results

- Spirometry allows comparison of patient's lung function to reference values
- Helps to define disease class: obstructive, restrictive or mixed type

Classification of Asthma Severity: Clinical Features Before Treatment
Stepwise Approach to Therapy: Assessing Control (5-11 yo)

<table>
<thead>
<tr>
<th>Components of Control</th>
<th>Classification of Asthma Control (5-11 years of age)</th>
<th>Well Controlled</th>
<th>Not Well Controlled</th>
<th>Very Poorly Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic interference</td>
<td></td>
<td>Less than 2 days, 1 day or less</td>
<td>2-4 days/month</td>
<td>Throughout the day</td>
</tr>
<tr>
<td>Medication adherence</td>
<td></td>
<td>More than 80%</td>
<td>Less than 80%</td>
<td>Less than 50%</td>
</tr>
<tr>
<td>Interim control visits</td>
<td></td>
<td>All</td>
<td>Some limitation</td>
<td>Extremely limited</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;, or peak flow</td>
<td></td>
<td>&gt;80% predicted</td>
<td>50-79% predicted</td>
<td>&lt;50% predicted</td>
</tr>
</tbody>
</table>

Risk: Evaluation requires long-term follow-up

Recommended Action for Treatment (See Figure 4-10 for treatment advice)

Inter-individual variability:
- Age
- Sex
- Height
- Race
Predicted normal lung values

• Based on large population surveys
• Predicted values are the mean values obtained from the survey
• No surveys have been done in elderly populations

Lung Volume Terminology

Normal Trace Showing FEV₁ and FVC

FEV₁ = 4L
FVC = 5L
FEV₁/FVC = 0.8
Spirogram Patterns

• Normal
• Obstructive
•Restrictive
• Mixed Obstructive and Restrictive

Spirometry: Obstructive Disease

Volume, liters

1 2 3 4 5 6

Time, seconds

FEV₁ = 1.8L
FVC = 3.2L
FEV₁/FVC = 0.56

Diseases Associated w/ Airflow Obstruction

• COPD
• Asthma
• Bronchiectasis
• Cystic Fibrosis
• Post-tuberculosis
• Lung cancer (greater risk in COPD)
• Obliterative Bronchiolitis
CRJ 1  Sue i have inserted a bracket and shifted the obstructive label. The FVC in this slide is about 3.4 by eyeball - shoudl be moved down to 3.2 or the numbers should be changed

Christine Jenkins, 4/14/2008
Bronchodilator Reversibility Testing in Asthma

Results

• An increase in FEV₁ that is both greater than 200 ml and 12% above the pre-bronchodilator FEV₁ (baseline value) is considered significant

• It is usually helpful to report the absolute change (in ml) as well as the % change from baseline to set the improvement in a clinical context

Flow Volume Curve

• Standard on most desk-top spirometers
• Adds more information than volume time curve
• Less understood but not too difficult to interpret
• Better at demonstrating mild airflow obstruction

Flow Volume Curve

- Expiratory flow rate L/sec
- Inspiratory flow rate L/sec
- Volume (L)
- Maximum expiratory flow (PEF)
- TLC
- RV
- FVC
need to delete Figure reference.
Christine Jenkins, 4/14/2008
Flow Volume Curve Patterns

Obstructive
- Reduced peak flow, scooped out mid-curve

Severe obstructive
- Steep slope pattern, reduced peak flow, rapid fall off

Restrictive
- Normal shape, normal peak flow, reduced volume

Spirometry: Abnormal Patterns

Obstructive
- Slow rise, reduced volume expired; prolonged time to full expiration

Restrictive
- Fast rise to plateau at reduced maximum volume

Mixed
- Slow rise to reduced maximum volume; measure static lung volumes and full PFT’s to confirm

Ensuring Accuracy: Best Effort

- Best effort
  - Inhale as deeply as possible
  - Exhale as fast and as long as possible
  - Exhale for at least six seconds

- Reproducibility
  - Two "best efforts" out of a minimum of three exhalations, no more than 6-8 attempts
  - Two readings within 0.2 L of each other
Preparing the patient...

Patients are asked:
• Avoid smoking within 2 hrs of test
• Avoid drinking alcohol with 4 hours
• Avoid vigorous exercise within 30 minutes
• Avoid restrictive clothing
• Avoid eating substantial meal within 2 hours
• Avoid SABA with 4-6 hours
• Avoid LABA within 12 hours

Preparing the coach...

• Patient may sit (feet on floor) or stand with chair behind patient in case of dizziness
• Loosen any restrictive clothing
• Reassure patient; help them feel relaxed
• Explain in simple terms what the test measures
• Explain the technique in simple terms and then demonstrate how it is done
• Make sure the mouthpiece is placed between the teeth and that the tongue and teeth do not occlude the mouthpiece.

Coach the patient!!!!

• BLAST IT OUT!!!
• BLOW!! BLOW!! BLOW!!
• SQUEEZE! SQUEEZE!! SQUEEZE!!!!
• KEEP GOING! KEEP GOING!
Troubleshooting

Examples - Unacceptable Traces

Unacceptable Trace: Poor Effort
- Variable expiratory effort
- Inadequate sustaining of effort
- May be accompanied by a slow start

Unacceptable Trace: Stop Early
- Normal

Volume, liters
Time, seconds
**Summary**

Spirometry is a powerful diagnostic and assessment tool
- provides clear documentation of lung function
- Spirometry is easy to use and accurate
- can be carried out in the primary care setting
- offers test results to include in patient’s chart
- Spirometry measures lung airflow
  - helps detect obstructive and restrictive lung disease
  - objectively measures and illustrates the severity of lung disease

**Spirometry reimbursement**

- Cost of spirometer:
  - 94010 Spirometry test – FVC: $70.00
  - 94060 Pre-Post Bronchodilator Spirometry test: $145.00

**Questions?**

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