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
  - dyspnea
  - wheezing
  - orthopnea
  - chest pain

- Signs:
  - hyperinflation
  - expiratory slowing
  - 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 inspiration.

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 patients 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)

“Step Therapy” Age 5-11 years

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

Total lung capacity
- Inspiratory reserve volume
- Tidal volume
- Expiratory reserve volume
- Residual volume
- Inspiratory capacity
- Vital capacity

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

- 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
Sue: I have inserted a bracket and shifted the obstructive label. The FVC in this slide is about 3.4 by eyeball - should 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

- Maximum expiratory flow (PEF)
- TLC
- PVC
- RV

Expiratory flow rate L/sec
Inspiratory flow rate L/sec
Volume (L)
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 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 PFTs to confirm

Ensuring Accuracy

- 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 within 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
Unacceptable Trace: Slow Start

Unacceptable Trace: Coughing

Unacceptable Trace: Extra Breath
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

Spirometry vs. Peak flow meter

- Peak Flow Meter is used for monitoring only
- Measures only large airway function
- No graphic display or printout
- No regular calibration
Questions?

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