Pulmonary Disorders and Pulmonary Rehabilitation

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Overview

- Chronic Lung Diseases
  - Chronic Obstructive Lung Disease (COPD)
  - Asthma
  - Mycobacterium Tuberculosis
  - Restrictive Lung Diseases

- Pulmonary Rehabilitation
  - Key Components
    - Exercise Guidelines
    - Education on Disease Self-management
  - Evidence Based Guidelines

- Resources
COPD Definition and Incidence

- Airflow limitation – not fully reversible
  - Persistent, progressive dyspnea and chronic cough
  - History of smoking or particulate exposure
  - Significant systemic abnormalities
- WHO: 340 million with COPD worldwide
  - National COPD prevalence ranges: 4-20%
  - 70% of patients are under 65 years old
- 6th leading cause of death worldwide
  - Will be 4th leading cause by 2030
  - Worldwide deaths will increase 30% in 10 years
- Often undiagnosed and untreated until advanced
  - Nearly 80% undiagnosed and untreated

2 NHANES III, Mannino et al, MMWR 2002;51:1-16
COPD in Korea

- **Korean National Health & Nutrition Examination Survey**
  - 9,243 adults over 18 years: COPD prevalence based on spirometry in those over 45 years old: 17%;
  

- **Asia Pacific Round Table Group**: Korea COPD prevalence based on spirometry in persons over 45 years: 25.8%
  
  Asia Pacific Roundtable Group, Respirology 2003;8:192-198

- **Korean Health and Genome Study**:
  - 8140 without pulmonary diagnosis
  - **Undiagnosed airflow obstruction**:
    - 12% in men, 3.5% in women
    - Airflow obstruction common in men with respiratory symptoms - chronic cough, chronic sputum, wheezing, dyspnea, and smoking
  
Characteristics Asthma and COPD

**ASTHMA**
- Sensitizing agent (e.g., allergen)
- Mast Cell
- Eosinophil
- CD4+ T Lymphocyte

**COPD**
- Noxious irritant e.g., cigarette smoke
- Macrophage
- Neutrophil
- CD8+ T Lymphocyte

**Reversible (Improvement) on Spirometry after bronchodilator**
- Variable symptoms
- Inhaled corticosteroids decrease inflammation

**Not fully reversible on spirometry Persistent symptoms with exacerbations**
- Long acting bronchodilators reduce dyspnea, hyperinflation

Modified from Barnes, 1998.
Diagnosis of COPD

SYMPTOMS
- cough
- sputum
- dyspnea

EXPOSURE TO RISK FACTORS
- tobacco
- occupational dust and chemicals
- indoor/outdoor pollution

SPIROMETRY

Diagnosis of COPD
Hyperinflation and Air Trapping

Low, Flattened Diaphragm

Increased A-P Diameter

Air Trapping
COPD - Abnormalities

Pulmonary Impairments:
- Hyperinflation – trapped air causes dyspnea
  - Increases with exercise
- Impaired ventilation – hypoxia, hypercapnea

Secondary Impairments:
- Skeletal muscle dysfunction
- Underweight or overweight
- Osteoporosis
- Depression, anxiety disorders
- Heart disease
  - Heart failure, Pulmonary hypertension
- Anemia

Cross section thigh
Undiagnosed Airflow Limitation in Cardiovascular Disease

- Airflow limitation in hospitalized patients
  - 17% in without cardiovascular disease (CVD)
  - 19% with CVD
  - 34% with coronary artery disease (p <0.5)

- Under-diagnosis of airflow limitation range: 60% - 87%

- Left ventricular (LV) structure and function measured by MRI in 2816 persons 45-84 years old
  - 10% increase in COPD linearly related to reduction in LV end-diastolic volume, stroke volume, cardiac output
  - Greater magnitude among current smokers

- COPD may be a risk factor for CVD
Hospitalization and Death in COPD

- 2386 COPD patients – 50% men, 71% smokers
  - Mean follow-up: 12 years
  - 22% had hospitalization for COPD
  - Risks for hospitalization: older age, CVD, asthma, low physical activity, severe COPD
- 60% died during follow-up
  - Risks for death: older age, CVD, diabetes, low physical activity, more severe COPD


- 341 COPD patients followed for mean 1.1 year
  - 92% men, 63% readmitted, 29% died during follow-up
  - Readmission risk factors: low FEV\textsubscript{1}, low PO\textsubscript{2}, low physical activity, low quality of life

Can We Reverse COPD?

- BODE Index: Impacts survival and hospitalizations
  - Body Mass Index $> 21$
  - Obstruction: $> \text{Forced Expiratory Volume in one second}$
  - Dyspnea: $< \text{Medical Research Council dyspnea scale}$
  - Exercise: $> 6 \text{ minute walk distance}$

- Pulmonary Rehabilitation improves dyspnea & exercise
  [http://content.nejm.org/cgi/content/abstract/350/10/1005](http://content.nejm.org/cgi/content/abstract/350/10/1005)

- Rehabilitation to reverse muscle dysfunction
  - Quitting smoking reduces mortality, loss of lung function
  - Reduce hyperinflation - exercise, bronchodilators
  - Treat hypoxemia with oxygen
  - Limit exacerbations with education and exercise
  - Improve weight
# GOLD Stages of Therapy

<table>
<thead>
<tr>
<th>Stage</th>
<th>FEV₁/FVC &lt; 70%</th>
<th>All stages: Smoking cessation; avoidance of risk factors; influenza vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I:</td>
<td>FEV₁ &gt; 80%</td>
<td>Add short-acting bronchodilator when needed</td>
</tr>
<tr>
<td>Stage II:</td>
<td>FEV₁ &gt; 50 &lt; 80%</td>
<td>Add regular treatment with one or more long-acting bronchodilators; add rehabilitation</td>
</tr>
<tr>
<td>Stage III:</td>
<td>FEV₁ &gt; 30 &lt; 50%</td>
<td>Add inhaled glucocorticosteroids if repeated exacerbations</td>
</tr>
<tr>
<td>Stage IV:</td>
<td>FEV₁ &gt; 30</td>
<td>Add long-term oxygen if chronic respiratory failure; consider surgical treatments</td>
</tr>
</tbody>
</table>
Restrictive Ventilatory Defect

- Mycobacterium Tuberculosis
  - Pulmonary complications
  - Cavitary lesion, miliary TB

- Interstitial Lung Disease:
  - Inflammation leading to scaring
  - Pulmonary Fibrosis, scleroderma, etc.

- Chest wall abnormalities
  - Kyphosis, kyphoscoliosis

Diagnosis: History and physical, Chest X ray, Pulmonary function test (PFT), Chest CT for interstitial lung disease
Findings: Decreased forced vital capacity (FVC), Decreased total lung capacity (TLC) normal FEV₁ / FVC

Management: disease-focused care
Pulmonary Rehabilitation improves function, quality of life, dyspnea
Rationale for PR in Chronic Lung Disease

Impairment in ventilation; exchange of oxygen and carbon dioxide

Exacerbations* – severe flares in symptoms

Anxiety*
Depression*
Fear

Knowledge deficits*

Cardiovascular impairments

Skeletal muscle wasting*
Reduced strength*
Reduced endurance*

Exercise Impairment Symptoms
Decreased Participation

Anemia

Nutritional impairment

*Pulmonary Rehabilitation – strong evidence of improvement
Adapted from Rochester 2008
If exposure to noxious agents stops, disease progression slows.

Lung Function (FEV₁ (% of Value at Age 25))

- Never smoked or not susceptible to smoke
- Smoked regularly and susceptible to its effects
- Stopped smoking at 45
- Stopped smoking at 65

<table>
<thead>
<tr>
<th>Medication</th>
<th>FEV₁</th>
<th>SOB</th>
<th>QOL</th>
<th>Exacerbations</th>
<th>Exercise</th>
<th>Side effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theophylline</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>Some</td>
</tr>
<tr>
<td>Inhaled steroids</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Some</td>
</tr>
<tr>
<td>Long Acting Beta Agonists</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Minimal</td>
</tr>
<tr>
<td>Tiotropium</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Minimal</td>
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<tr>
<td>Albuterol</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>Some</td>
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<tr>
<td>Ipratropium</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Some</td>
</tr>
<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Minimal</td>
</tr>
<tr>
<td>Theophylline</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Important</td>
</tr>
</tbody>
</table>

**Side effects:**
- **Important:** Important side effects that should be considered.
- **Some:** Side effects that may be experienced but are not necessarily important.
- **Minimal:** Minimal side effects that are typically not significant.
Evidence-based, multidisciplinary, comprehensive program

- Chronic respiratory diseases
- Symptomatic, decreased daily activities
- Integrated into individualized treatment
- Designed to optimize functional status
  - Increase participation
  - Reduce healthcare costs
  - Reduce symptoms

Stabilizing or reversing systemic manifestations

Nici, Garvey, et al. ATS/ERS Statement on PR Am J Respir Crit Care Med V173. Pp 1390-413, 2006,
Pulmonary Rehabilitation

- Physician - supervised program
  - Supervised exercise
  - Education – disease self-management training
  - Outcome assessment

- Goal: Improvement in:
  - Functional capacity, long term exercise
  - Maximum potential in self care
  - Long term use of treatments
  - Quality of life
  - Reduce hospitalizations

- Chronic, stable, symptomatic lung disease
- Physically and mentally able to participate
Pulmonary Rehabilitation Setting

- Multidisciplinary Team:
  - Medical Director
  - May include nurses, physical therapists, respiratory therapists, social workers, dietitians

- Progressive exercise: aerobic and resistance
  - 30 minutes of moderate intensity physical activity such as walking five or more days per week

Am Fam Physician 2008;77:8;1136-1138.

- Clinical monitoring: oxygen saturation, dyspnea, heart rate, blood pressure, blood glucose in diabetes

- Evaluate patient’s progress related to rehabilitation

- Outcomes - pre and post Pulmonary Rehabilitation
  - Objective, patient-centered outcomes
  - Functional capacity, dyspnea, quality of life
Pulmonary Rehabilitation Education

- Dyspnea control – pursed lip breathing
- Prevention, management of exacerbations
- Energy conservation – Activities of Daily Living
- Proper use of inhaled medications
- Control of anxiety, panic, depression
- Oxygen needs, safety, monitoring, portability
- Secretion clearance techniques, devices
- Nutrition counseling
- Home exercise program and guidelines
- Disease progression, end of life planning
**Dyspnea Screening / Monitoring**

**MMRC Dyspnea Scale**
- **0:** I only get breathless with strenuous exercise
- **1:** I get short of breath when hurrying on level ground or walking up a slight hill
- **2:** On level ground, I walk slower than people of the same age because of breathlessness, or have to stop for breath when walking at my own pace
- **3:** I stop for breath after walking about 100 yards or after a few minutes on level ground
- **4:** I am too breathless to leave the house or I am breathless when dressing

**Modified Borg Scale**
- **0 No Breathlessness at all**
- **1 Very Slight**
- **2 Slight Breathlessness**
- **3 Moderate**
- **4 Somewhat Severe**
- **5 Severe Breathlessness**
- **6**
- **7 Very severe breathlessness**
- **8**
- **9 Very very severe**
- **10 Maximum**

*Keep “shortness of breath” 3 – 4 with exercise*
Quality of Life Questionnaires

- **St George's Respiratory Questionnaire (SGRQ)**
  
  sgrq@sgul.ac.uk  

- **Chronic Respiratory Disease Questionnaire (CRQ)**
  
  1-877-836-9235, Fax: 905-540-8019 Email: orcip@mcmast.ca

- **Medical Outcomes Study Short Form 36 (SF-36)**
  

Functional Capacity Testing

- **6 Minute Walk Test**
  
  - Self-paced, reliable, correlates with VO₂ peak in moderate COPD
  

- **Incremental Shuttle Walk Test**
  
  - Externally paced, reliable, correlates with VO₂ peak in mod COPD
  

- **Cardiopulmonary Exercise Test**
  
  - Direct measure of O₂, CO₂, minute ventilation, tidal volume, respiratory rate on breath-by-breath basis
  
Outcomes of Pulmonary Rehabilitation Randomized Controlled Trials

- Increase in sub-maximal exercise\(^1, 3, 4, 5, 7, 9\)
- Improvement in dyspnea\(^1, 2, 3, 4, 5\)
- Improvement in health status\(^4, 7, 8, 9\)
- Fewer hospital days and primary care visits\(^7\)
- Enhanced psychological well being, quality of life, depression, anxiety\(^7, 13, 14\)
  cognitive function\(^4\)

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Oxygen For Hypoxemia

- Oxygen improves survival, exercise capacity, sleep quality and cognitive performance in hypoxemia
- Promote portable oxygen systems for ambulation
- Address air travel with hypoxemia
  - Ambient oxygen concentration - 21% at sea level
  - Ambient oxygen concentration - 15% in aircraft
Clinical Resources

- Global Initiative for COPD (GOLD) [http://www.goldcopd.com](http://www.goldcopd.com)
- ACCP / AACVPR Evidence based guidelines [http://chestjournal.chestpubs.org/content/131/5_suppl/4S.full.pdf+html](http://chestjournal.chestpubs.org/content/131/5_suppl/4S.full.pdf+html)
Patient Resources

- American College of Chest Physicians: http://www.chestnet.org/patients/guides/
- Travel: aeromedix.com breathineasy.com/
- Oxygen portableoxygen.org, homeoxygen.org
Pulmonary Rehabilitation – Where East Meets West

- Haeso cheonsik ‘cough and dyspnea’
  - Could be COPD, asthma, heart failure, other diseases
  - Considered part of normal aging process

- COPD is not a well know term by public or medical community

- 36% of severe – very severe COPD patients do not have a physician diagnosis of COPD
Pulmonary Rehabilitation – Where East Meets West

- Need for multifaceted approach to improve disease prevention and effective management:
  - Improve awareness of COPD prevalence
  - Facilitate accurate diagnosis of COPD
  - Health care policies to reduce risk factors for COPD
  - Wider use of evidence based guidelines

- What is My Role as a Clinician?
  - Assess and monitor:
    - Risk factor exposure
    - Symptom, activity level and changes
    - Accurate diagnosis based on spirometry
    - Medication adherence and inhaler technique
    - Exacerbations