Pulmonary Rehab

Anthony J. Hericks D.O.
Avera Medical Group: Pulmonary and Sleep Medicine
Director of Inpatient Pulmonary Medicine/Pulmonary Rehabilitation

Disclosures

• None

Table 1—Relationship of Strength of the Supporting Evidence to the Balance of Benefits to Risks and Burdens*

<table>
<thead>
<tr>
<th>Strength of Evidence</th>
<th>Benefits Outweigh Risks/Burden</th>
<th>Risks/Burden Outweigh Benefits</th>
<th>Balanced</th>
<th>Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1A</td>
<td>1A</td>
<td>2A</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>1B</td>
<td>1B</td>
<td>2B</td>
<td></td>
</tr>
<tr>
<td>Low or very low</td>
<td>1C</td>
<td>1C</td>
<td>2C</td>
<td></td>
</tr>
</tbody>
</table>

*1A = strong recommendation; 1B = strong recommendation; 1C = strong recommendation; 2A = weak recommendation; 1B = weak recommendation; 2C = weak recommendation.
Pulmonary Rehabilitation: Definition

• "A service that complies with the general definition of rehabilitation and achieves therapeutic aims through a permanent alteration of lifestyle." – ACCP/AACVPR

• "Evidence-based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities. Integrated into the individualized treatment of the patient, pulmonary rehabilitation is designed to reduce symptoms, optimize functional status, increase participation, and reduce health care costs through stabilizing or reversing systemic manifestations of the disease. Comprehensive pulmonary rehabilitation programs include patient assessment, exercise training, education, and psychosocial support." – ATS/ERS

Epidemiology of COPD

- 120,000 deaths in the U.S. (2000)
- 4th leading cause of death worldwide
  - 4th in women (282% increase)
- 2nd leading cause of Social Security Disability
- CAD is #1

Other Chronic Respiratory Diseases (CRD)

- Asthma
- Cystic Fibrosis
- Interstitial Lung Diseases (ILD)/Pulmonary Fibrosis
- Neuromuscular/Musculoskeletal Disease
- Pulmonary Hypertension (PHTN)
- Obesity/Vanishing Lung Syndrome
**Morbidity of CRD**

**Impairment of:**
- Peripheral muscles
- Muscles of breathing
- Cardiovascular system
- Nutritional status
- Psychosocial well-being

**Results in:**
- Deconditioning
- Hypoxemia
- Bronchospasm
- Excess ventilation
- Earlier limitations in ventilation
- Muscle weakness/atrophy
- Cardiac ischemia/arythmias
- Anxiety/Depression
- Changes in symptom perception
- Poor motivation
- Poor self-management strategies

**Who?**

- Pulmonary rehab is beneficial for patients with all chronic respiratory diseases.
  - Grade of recommendation, 1B
  - COPD
  - Largest group referred to pulmonary rehab and studied

- Pulmonary rehab should be modified to include treatment strategies specific to individual diseases/patients, in addition to treatment strategies common to all chronic respiratory diseases
  - No recommendation
  - Lack scientific evidence
  - Based on current practice and expert opinion

**Inclusion Criteria**

- Benefit regardless of:
  - Age
  - Sex
  - Lung function
  - Smoking status
  - Type of lung disease

- Symptomatic
- Stable
- Evidence for use after an exacerbation
- Symptoms despite medications
- Exercise limitation
- Limited ADL's
- Decreased health related quality of life (HRQL)

- Not a "last ditch" effort
- Integral part of disease management
Exclusion Criteria

- Significant orthopedic or neurologic disease
  - Reduced mobility and cooperation required for training
- Poorly controlled coexisting medical conditions
  - Psychiatric
  - Unstable cardiac disease

Why?

Factors contributing to limitations
- Perception of HRQL
- Ability to adjust to the disease
- Self-efficacy
- Motivation
- Adherence
- Neuropsych impairments
  - Memory, concentration, etc...

Rehab benefits
- Reduction in symptoms
- Improved ADL performance
- Increased exercise tolerance
- Improved HRQL
- Reduces health care cost

Pulmonary rehabilitation improves dyspnea in patients with COPD:
- Grade of recommendation, 1A

Pulmonary rehabilitation improves HRQOL in patients with COPD:
- Grade of recommendation, 1A

Where?

- Inpatient
  - Planned admission during an exacerbation
  - High cost/lack of insurance coverage
- Outpatient
  - Cost effective
  - Safe environment
  - Availability of trained staff
- Home
  - Convenient
  - May prolong the benefit
  - Lack of support/motivation
  - Limited availability of a multidisciplinary team
  - Variability in exercise equipment
  - Cost
What/How?

- Address:
  - Physiologic/functional
  - Psychologic
  - Counseling

- Education:
  - Didactics
  - Behavioral modification
  - Self-management techniques
  - End-of-life decision making

Focus

- Multidisciplinary
  - Expertise from various healthcare disciplines
  - Comprehensive, cohesive program

- Individualized
  - Patients require individual
  - Assessment of needs
  - Attention
  - Realistic goals

Multidisciplinary Team

- Physicians
- Medical Directory
- Nurses
- Respiratory Therapists
- Physical/Occupational Therapists
- Psychologist
- Exercise Specialist
- Patient
- Family

Staff to Patient Ratio's
- Exercise → 1:4
- Education → 1:8

*Make-up depends on the resources and expertise available
Usually includes at least one full-time staff and/or coordinator
Pre-Rehab Evaluation

- Thorough assessment
  - Clinical Evaluation
  - Optimize medical management/pulmonary function
  - Cardiopulmonary Exercise Testing (CPET)?
  - Neuropsychologic/Testing?
  - Exercise prescription
- Optimal treatment regimens
  - Bronchodilator therapy, etc...
  - Long-term oxygen therapy
  - Treat other comorbidities

Goals of Pulmonary Rehab

- Control and alleviate symptoms
- Optimize functional capacity
- Restore to the highest possible independent function
  - Improved ADL function
  - Decrease disability
  - Improve physically activity/motivation
- Education: disease pathology, treatment, and coping skills
- Encouraged active participation in their health care
- Decrease dependence on health care resources

Exercise Training

- Cornerstone to Pulmonary Rehab
  - Improves muscle function
- Indication
  - Chronic respiratory disease
  - Decreased exercise tolerance
  - DOE
  - Fatigue
  - Impaired ADL's
  - Exacerbations prevention
  - Poor HRQL
Intensity of Exercise

- **Low Intensity**
  - Improvements of:
    - Symptoms
    - HRQL
  - Less effective

- **High Intensity**
  - > improvement’s
  - > 60% of peak exercise
  - Encouraged

- Interval training
  - More symptomatic patients
  - Reach a higher levels of training

Both low-intensity and high-intensity exercise training produce clinical benefits for patients with COPD:

- Grade of recommendation, 1A

Lower Extremity Training

- Lower extremity exercise training at higher exercise intensity produces greater physiologic benefits than lower intensity training in patients with COPD:
  - Grade of recommendation, 1B

- Exercise training of the muscles of ambulation
  - Recommended as a mandatory
  - Especially in patients with COPD
  - Grade of recommendation, 1A

Specific Training

- Lower Extremity Training
  - Treadmill
  - NuStep
  - Stationary bike ergometer

- Upper Extremity Training
  - Arm cycle ergometer
  - Free weights
  - Elastic bands
    - Reduces dyspnea during upper extremity activities
    - Reduces ventilator requirements during arm elevation

- Modified for:
  - Individual
  - Disease severity
  - Symptom/limitation
  - Comorbidities
  - Level of motivation

- Scores
  - Borg Dyspnea Score
    - 4-6 for dyspnea or fatigue
    - A reasonable target
  - Heart rate
  - Power output

Both low-intensity and high-intensity exercise training produce clinical benefits for patients with COPD:

- Grade of recommendation, 1A
Endurance Training

- Cycling or walking
- Long exercise sessions
- > 30 min
- High intensity
  - > 60% maximal work rate
- Difficult to achieve in some patients
- Modify the goal time and/or intensity
- Optional interval training
  - Lower symptom scores despite a high absolute training level

Unsupported endurance training of the upper extremities is beneficial in patients with COPD and should be included in pulmonary rehabilitation programs:

Grade of recommendation, 1A

Strength/Resistance Training

- > potential to improve muscle mass and strength
  - Only modestly improved by endurance exercise
- 2-4 sets of 6-12 repetitions
- 50-85% of a maximum repetition
- Results in:
  - Less dyspnea

The addition of a strength-training component to a program of pulmonary rehabilitation increases muscle strength and muscle mass:

Strength of evidence, 1A

Strength + Endurance Training

- Best strategy to treat peripheral muscle dysfunction
- Results in:
  - Increased muscle strength
  - Increased whole body endurance
  - Doesn’t increase training time
  - Multiple benefits
  - Well tolerated
Other Considerations

Safety
- Avoid fall risks
- Adaptive assistive equipment
  - NMD or weak patients
- Telemetry and BP monitoring
- Rules for exercise cessation
- Staff training in resuscitation techniques
  - Appropriate resuscitation equipment on site

Oxygen
- Supplemental oxygen should be used during rehabilitative exercise training in patients with severe exercise-induced hypoxemia:
  - Grade of recommendation: 1C
  - Use may improve:
    - Exercise tolerance
    - Quality of life
  - May need higher flow rates depending on the intensity
- Administering supplemental oxygen during high-intensity exercise programs in patients without exercise-induced hypoxemia may improve gains in exercise endurance:
  - Grade of recommendation: 2C
  - Non-hypoxemic patients improve HRQoL, increased training intensities and enhance exercise performance
Non-Invasive Positive Pressure Ventilation (NPPV)

- As an adjunct to exercise training in selected patients with severe COPD, noninvasive ventilation produces modest additional improvements in exercise performance:
  - Grade of recommendation, 2B
  - Reduces breathlessness
  - Increases exercise tolerance
  - Probably decreases respiratory muscle load
  - Combination of NPPV and Pulmonary Rehab
    - Improved exercise tolerance
    - Improved HRQL
  - Difficult and labor intensive
    - Used only in those with a demonstrated benefit

Respiratory Muscle Training

- The scientific evidence does not support the routine use of inspiratory muscle training as an essential component of pulmonary rehabilitation:
  - Grade of recommendation, 1B
  - May improve exercise tolerance > exercise training alone

- Inspiratory muscle training
  - Inspiratory Resistive Training
  - Threshold Loading
  - Normocapnic Hyperpnea

Neuromuscular Electrical Stimulation

- Passive stimulation of contractions of peripheral muscles to elicit beneficial training effects
  - 6 weeks of therapy may improve strength in those with severe limitations
**Body Composition**

Abnormalities exist in all patients with advanced respiratory disease

- **Underweight**
  - BMI < 21 Kg/m²
  - 1/3 of all patients with COPD
  - Recent weight loss
  - > 10% over 6 mos
  - > 5% over 1 mos

  Independent predictor of morbidity and mortality

- **Muscle wasting**
  - Not only in the underweight population

- **Fat-free Mass (FFM)**
  - Organs, muscle, bone, water

  - Skin fold anthropometry

  - Bioimpedance

  - Dual energy X-ray absorptiometry (DEXA)

**Body Composition, Cont’d**

- **Obesity**
  - BMI > 30 Kg/m²
  - Increases work
  - Increases oxygen consumption
  - Impairs exercise tolerance
  - Decreases disability
  - Decreased HRQL

- **Causes**
  - Abnormal mechanics despite normal lung function
  - Low lung volumes
  - Decreased compliance
  - Increased small airway resistance
  - Alterations in breathing patterns and respiratory drive

  - Obesity Hypoventilation Syndrome

  - Hypercapnia and Hypoxemia

**Nutrition**

- **Chronic lung disease results in:**
  - Increased energy and substrate metabolism
    - Secondary to the work of breathing
  - Imbalance between protein synthesis and breakdown
  - Low grade inflammatory response
Nutritional Supplementation

- There is insufficient evidence to support the routine use of nutritional supplementation in the pulmonary rehabilitation of patients with COPD:
  - No recommendation is provided.
  - Maintain adequate protein and calorie intake
  - Adequate salt and fluid intake

- Current scientific evidence does not support the routine use of anabolic agents in pulmonary rehabilitation for patients with COPD:
  - Grade of recommendation: 2C
  - Anabolic Steroids, Growth Hormone, Progesterone

Education

- Education should be an integral component of pulmonary rehabilitation. Education should include information on collaborative self-management, and the prevention and treatment of exacerbations:
  - Grade of recommendation: 1B
  - Start at time of diagnosis and continue throughout end-of-life care
  - Participants
    - Patients
    - Families
    - Non-physician health care providers (RN, RT, PT/OT, Nutritionist, etc...)
    - PCP/Specialists

Self management > Didactic

Education Topics

- Breathing strategies
- Normal lung function and pathophysiology of lung disease
- Proper medication/ventilator use
- Bronchial hygiene techniques
- Benefits physical activity/maintenance
- Energy conservation/work simplification techniques
- Nutrition
- Nutrient avoidance/smoking cessation
- Preventing and treating exacerbations
- Indications for calling your health care team
- Leisure, travel and sexuality
- Coping skills/End-of-Life Planning
- Stress, anxiety and depression management
Breathing Strategies

- Pursed-lip breathing
  - Prevents airway collapse
- Active expiration
- Diaphragmatic breathing
- Adaptive body positioning
- Coordinating paced breathing with activities

- Improve
  - Regional ventilation
  - Gas exchange
  - Respiratory muscle function
  - Dyspnea
  - Exercise tolerance
  - HRQL

Bronchial Hygiene Techniques

- “Pulmonary Toilet”
  - Flush the airways
    - Reduce mucus hypersecretion
    - Improve impaired mucociliary clearance
  - Postural drainage
  - Percussion
  - Forced expiration
  - Cough assist
  - Bronchodilator therapy

Prevention and Early Treatment of Exacerbations

- Exacerbation
  - Sustained worsening of the patient’s symptoms from baseline
- Results
  - More rapid decline in lung function
  - Increased peripheral muscle weakness
  - Decreased HRQL
  - Increased health care costs
  - Increased mortality

- Early treatment
  - Speeds recovery
  - Decreases health care costs
  - Consider a COPD Action Plan
  - Initiation of Pulmonary Rehab immediately after the exacerbation
Self Management Benefits

- Improves health status
  - Physical
  - HRQL
- Reduces
  - ER visits
  - Unscheduled office visits
  - Hospitalizations
- Includes
  - Education
  - COPD action plan
  - Home exercise program

End-Of-Life Decision Making

- Barriers
  - Prognostic uncertainty
  - Unrealistic goals/fear of dying
  - Health care provider reluctance
- Develop an adequate support system

- Pulmonary rehab can address advanced care planning, code status and palliative care decisions

How Much and How Long?

- At least:
  - 2-3 times per week
  - 4-6 weeks duration (minimum of 20 cessions)
  - Ideal 8-12 weeks

  Six to twelve weeks of pulmonary rehabilitation produces benefits in several outcomes that decline gradually over 12 to 18 months:
  - Grade of recommendation, 1A.
  - Some benefits, such as HRQOL, remain above control levels at 12 to 18 months:
    - Grade of recommendation, 1C
  - Longer pulmonary rehabilitation programs (beyond 12 weeks) produce greater sustained benefits than shorter programs:
    - Grade of recommendation, 2C
Adherence

- WHO Definition:
  - Extent to which a person's behavior corresponds with agreed-on recommendations by the health care provider

Adherence Interventions

- Crucial health behavior in the management of CRD Patient
  - Motivation is huge factor
  - High after rehab
  - Falls significantly at 6 months
  - Limitations
  - Education level
  - Past exercise behavior
  - Progression of the disease
  - Confusion
- Most effective adherence-enhancing interventions are designed to improve patient self-management
  - Enhanced when patient and their health care team are "partners"

Neuropsychologic Testing

- Screen for anxiety and depression
  - Refer for appropriate consultation if need
- Promote adequate patient support

There are psychosocial benefits from comprehensive pulmonary rehabilitation programs in patients with COPD:
  Grade of recommendation, 2B

There is minimal evidence to support the benefits of psychosocial interventions as a single therapeutic modality:
  Grade of recommendation, 2C

Psychosocial interventions should be included as an intervention component of comprehensive pulmonary rehabilitation programs for patients with COPD:
  No recommendation is provided
  Lack of scientific evidence/Current practice and expert opinion
Long-term Strategies

- Immediate goals
  - Reduce symptoms
  - Improve physical function
  - Enhance HRQL

- Long-term goals
  - Maintain these benefits
  - Improve self-management
  - Limiting dependence on medical care
  - Reduce health care related resource utilization
    - Admission, readmissions, decreased LOS

Maintenance

Maintenance strategies following pulmonary rehabilitation have a modest effect on long-term outcome:

  Grade of recommendation, 2C

- Continuous rehabilitation
  - Short additional benefit
    - Minimal improvement compared to short-term
- Maintenance programs
- Repeated courses
  - Reproduces short-term gain
    - No long-term advantage
- Monthly interventions and telephone support
  - Effect wears off rapidly with discontinuation course of rehabilitation

Other considerations for support

- Changing the attitude of caregivers
- Attendance at self-help support groups
- Exercise sessions in community centers

Health Care Utilization

- CRD patients are heavy consumer of health care resources

- Pulmonary rehabilitation reduces the number of hospital days and other measures of health-care utilization in patients with COPD:
  - Grade of recommendation, 2B

- Pulmonary rehabilitation is cost-effective in patients with COPD:
  - Grade of recommendation, 2C
  - Cost effective compared to Quality-adjusted-life-years
Survival

- Slight improvement in mortality comparing the pulmonary rehab group to controls
  - Not statistically significant
- Lack of evidence does not prove there is no effect
  - 6-MWT and MRC-rated dyspnea improve with pulmonary rehabilitation
  - Correlated with survival in patients with COPD
- There is insufficient evidence to determine whether pulmonary rehabilitation improves survival in patients with COPD:
  - No recommendation is provided.

Outcome Assessment

- Patient perception
  - Interview
  - Formal evaluation/questionnaires
- Program perception
  - Formal testing
- Society
  - Family member
- Measurements
  - Symptom management
  - Education of disease
  - Physiologic
    - Strength and endurance
  - HRQL
  - Coping skills
  - Family/care giver education and support

Audit and Quality Control

- Simple Programs
  - = Good Results
- Complex Programs
  - = Improved Opportunity
    - Greater flexibility in physical training
    - Research opportunities
    - Ability to deal with the more complex patients

Data Collection

- Common patient outcomes of health status/physical performance
- Quality of performance of the programs
- Minimum datasets need to be generated on nationally
- Quality control and pooling of data to facilitate comparison of outcomes across centers
- Quality control and continuous quality improvement
  - Program attendance
  - Adherence to home exercise prescription
  - Hospital admissions
  - Clinic visits
  - Patient satisfaction surveys
Benefits of Pulmonary Rehab

- Improves:
  - Skeletal muscle function/efficiency
  - Exercise tolerance/capacity
  - Despite any lack of improvement in lung function
  - Oxygen utilization
  - HRQL
  - Patient control over the disease

- Decreases:
  - Work of breathing for the same amount of work done
  - Dynamic hyperinflation
  - Dyspnea, fatigue, and other symptoms
  - Health care utilization

Conclusion

- Pulmonary rehab is the cornerstone in comprehensive management of patients with COPD
- Improves exercise endurance, dyspnea, functional capacity, and quality of life
- Better than any other intervention for COPD
- Most patients who enter pulmonary rehab will benefit from it
- Number needed to treat is low

? Questions?

Thank You
Bibliography
