Pulmonary Rehabilitation

Presented by:

Dr. Vamsi Krishna
Rehabilitation

Disease

Treatment

Impairment

Rehabilitation

Disability

Rehabilitation

Handicap
Pulmonary Rehabilitation

Art of medical practice wherein individually tailored multidisciplinary program is formulated, which through accurate diagnosis, therapy, emotional support and education stabilizes or reverses both physio and psychopathology of pulmonary disease in attempts to return the patient to highest possible functional capacity allowed by pulmonary handicap and overall life situation.

American College of Chest Physicians, 1974

American Thoracic Society 1981
ATS – ERS definition (2005)

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.
History

Charles Denison 1895
After recovery from PTB
Walking each day
- Made him feel better
- Increased exercise tolerance
- Reduced respiratory and pulse rate

Albert Haas 1932
Carrying heavy books
- Noticed weight gain
- Feeling of well being
History

1965: Eighth (Thomas L. Petty) Aspen emphysema conference. COPD is not a hopeless and inexorably progressive disease and is amenable to emerging therapies.

1969: Haas and Cordon first showed benefits of pulmonary rehabilitation over conventional therapy in a cohort study.

1974: ACCP definition of pulmonary rehabilitation.

1979: Detailed monograph on pulmonary rehabilitation by ACCP in JAMA.
Aims of Pulmonary Rehabilitation

- Increase exercise tolerance and reduce dyspnea
- Increase muscle strength and endurance (peripheral and respiratory)
- Improve health related quality of life
- Increase independence in daily functioning
- Increase knowledge of lung condition and promote self management
- Promote long term commitment to exercise
Essentials of Pulmonary Rehabilitation

- Exercise training
- Education
- Nutritional therapy
- Psychosocial / Behavioural intervention
- Outcome assessment
- Promotion of long-term adherence
Pathophysiology

Inflammation
Cachexia
Malnutrition
Corticosteroids

Atrophy of muscles
Reduction in type 1 & 2b type fibers
Decreased glycogen stores

Decreased capillarisation
↓ oxidative metabolic capacity
Altered metabolism at rest
Oxidative stress

Inactivity

Anxiety
Depression

Decreased Exercise tolerance

Gas exchange limitation
Cardiac dysfunction

Respiratory muscle weakness
Ventilatory limitation

Skeletal muscle dysfunction
Exercise training
## Benefits of Exercise training

<table>
<thead>
<tr>
<th>Pathophysiological abnormality</th>
<th>Benefits of exercise training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased lean body mass</td>
<td>Increases fat free mass</td>
</tr>
<tr>
<td>Decreased TY1 fibers</td>
<td>Normalizes proportion</td>
</tr>
<tr>
<td>Decreased cross sectional area of muscle fibers</td>
<td>Increases</td>
</tr>
<tr>
<td>Decreased capillary contacts to muscle fibers</td>
<td>Increases</td>
</tr>
<tr>
<td>Decreased capacity of oxidative enzymes</td>
<td>Increases</td>
</tr>
<tr>
<td>Increased inflammation</td>
<td>No effect</td>
</tr>
<tr>
<td>Increased apoptotic markers</td>
<td>No effect</td>
</tr>
<tr>
<td>Reduced glutathione levels</td>
<td>Increases</td>
</tr>
<tr>
<td>Lower intracellular pH, increased lactate levels and rapid fall in pH on exercise</td>
<td>Normalization of decline in pH</td>
</tr>
</tbody>
</table>
Exercise training

Benefits of exercise training (mainly endurance training):

- Improves exercise tolerance
- Improve motivation for exercise
- Reduce mood disturbance
- Decreases dyspnea

Strength training improves bulk and strength of muscles but does not add to overall exercise tolerance or health status.
Exercise training

Components of exercise training:
- Lower extremity exercises
  - Arm exercises
- Ventilatory muscle training

Types of exercise:
- Endurance or aerobic
- Strength or resistance
Lower extremity exercise

- Walking
- Treadmill
- Stationary bicycle
- Stair climbing
Benefits in COPD

- Increased work capability as assessed by incremental treadmill protocol, 6 min walking distance and 12 min walking distance (1,2,3,9,10)
- No increase in peak work rate or VO$_2$ max (1-5)
- 40 – 102% increase in endurance of maximal work rate (6-8)
- Decreased VO$_2$ at a given exercise level (1)
- Significant improvement in subjective assessment using Borg dyspnea scale (9,10)
- No changes in hemodynamics during exercise (1)

1. Chester EH. Chest 1977; 72:695-70
5. Lake FR. Chest 1990; 97:1077-82
Intensity of exercise & benefits

- Achievements of exercise training are proportional to intensity of exercise
- Exercising at maximal tolerated intensity led to greater VO$_2$ max. and reduction in blood lactate levels at iso-exercise.

\[ \text{Giminez M. Arch Phys Med Rehabil. 2000;81:102-109} \]

- Most of the patients with FEV1 38 % ( +/- 13) could achieve exercise intensity of >60% W$_{max}$ (mean intensity was 60.4% W$_{max}$). But only 5/42 could reach 80% W$_{max}$.
- % increase in W$_{max}$ was not influenced by FEV 1 (same in FEV1 < 40 and FEV1 > 40%)

\[ \text{Maltias F. Am J Respir Crit Care Med. 1997;155:555-561} \]
Arm exercise training

- Arm cycle ergometer
- Unsupported arm lifting
- Lifting weights
Potential benefits

- Has the potential to improve arm exercise performance by decreasing ventilatory demand during arm work, and by improving arm endurance.

- Arm training improves the ventilatory contribution of those muscles by increasing shoulder girdle muscle strength.

Banzett RB. Am Rev Respir Dis 1988; 138:106-09
COPD: What does evidence say?

- Increases exercise capacity of the arms.
  
  *Belman MJ. Am Rev Respir Dis 1981;123:256-61*

- Decreases metabolic and ventilatory demand for similar arm work (measured by VO$_2$)
  
  *Couser JI Jr. Chest 1993;103:37–41*
  *Epstein SK. J Cardiopulm Rehabil 1997;17:171–177*
  *Martinez FZ. Chest 1993;103:1397-1402*

- No significant effect on outcomes, such as functional status and performance when arm training used alone.
  
  *Lake FR Chest 1990; 97:1077-82*
  *Ries AL. Chest 1988; 93:688-92*
  *Bernard S. Am J Respir Crit Care Med1999;159(3):896-901*
Strength exercise

When strength exercise was added to standard exercise protocol led to greater increase in muscle strength and muscle mass.

But **NO additional benefit** in:
- Exercise capacity as assessed by 6MWD
- HRQOL
- Physiological parameters of heart rate or blood lactate levels

*Bernard M. Am J Respir Crit Care Med. 1999;139:896-901*
## Ventilatory muscle training

<table>
<thead>
<tr>
<th>Resistive IMT:</th>
<th>Threshold IMT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient breaths through hand held device with which resistance to flow can be increased gradually.</td>
<td>Patient breaths through a device equipped with a valve which opens at a given pressure.</td>
</tr>
<tr>
<td>- Difficult to standardize the load</td>
<td>- Easily quantitated and standardized</td>
</tr>
<tr>
<td>- Patients may hypoventilate.</td>
<td></td>
</tr>
<tr>
<td>- Leads to increased Pulm. Atr. Pressure and fall in oxygen tension</td>
<td></td>
</tr>
</tbody>
</table>

- Difficulty: Difficult to standardize the load.
- Hypoventilation: Patients may hypoventilate.
- Respiratory: Leads to increased Pulm. Atr. Pressure and fall in oxygen tension.
- Easier: Easily quantitated and standardized.
Ventilatory muscle training

Isocapnic hyperventilation:
- Patient hyperventilates into a rebreathing bag so as to maintain pH.
- Cumbersome and requires CO2 tension monitoring.
- Predominantly a research tool and not for routine clinical use

Meta-analysis of 17 RCTs, demonstrated overall lack of positive treatment effect. But adequate training loads (an intensity of at least 30% of PImax) had showed improvements in respiratory muscle strength and endurance.

VMT: Conflicting evidence

- No additional increase in exercise tolerance by VMT when added to limb exercises although inspiratory muscle strength and endurance had increased.

  Larson JL. Am J Respir Crit Care Med. 1999;160: 500-507

- Increase in 12 MWD and bicycle exercise endurance compared to limb exercise alone was observed when Threshold IMT was added.

  Weiner P. Chest 1992;102:1351-1356

- Increased exercise tolerance (6MWD) was observed in patients receiving additional Resistance IMT.

  Van Herwardeen CLA. Chest 1991;99:128-133
ATS/ERS statement (2005)

- A minimum of 20 sessions should be given.
- At least three times per week Twice weekly supervised plus one unsupervised home session may also be acceptable.
  Once weekly sessions seem to be insufficient
- Each session to last 30 minutes
- High-intensity exercise (>60% of maximal work rate) produces greater physiologic benefit and should be encouraged; however, low-intensity training is also effective for those patients who cannot achieve this level of intensity
Both upper and lower extremity training should be utilized

Lower extremity exercises like treadmill and stationary bicycle ergometer &
Arm exercises like lifting weights and arm cycle ergometer are recommended

The combination of endurance and strength training generally has multiple beneficial effects and is well tolerated; strength training would be particularly indicated for patients with significant muscle atrophy.

Respiratory muscle training could be considered as adjunctive therapy, primarily in patients with suspected or proven respiratory muscle weakness.
BTS STATEMENT (2001)

- A course duration of 4–12 weeks
- Supervised training sessions 2–5 times per week
- A session duration of 20–30 minutes
- A target exercise intensity corresponding to at least 60% of the maximum attained power output or VO2 peak in a preliminary progressive maximal exercise test; Alternatively, 60% of the maximal walking speed achieved on the shuttle walk test could be used.

- Strength training can be offered
- Respiratory muscle training is not an essential component
GOLD 2006

- The minimum length of an effective rehabilitation program is 6 weeks.
- Daily to weekly sessions
- Duration of 10 minutes to 45 minutes per session
- Intensity of 50% of VO2 max to maximum tolerated
- Endurance training can be accomplished through continuous or interval exercise programs.
- The latter involve the patient doing the same total work but divided into briefer periods of high-intensity exercise, which is useful when performance is limited by other co-morbidities
Additional considerations

- Optimal bronchodilator therapy should be given prior to exercise training to enhance performance.

- Patients who are receiving long-term oxygen therapy should have this continued during exercise training, but may need increased flow rates.

- Oxygen supplementation during pulmonary rehabilitation, regardless of whether or not oxygen desaturation during exercise occurs, often allows for higher training intensity and/or reduced symptoms in the research setting.

  ATS/ERS STATEMENT 2005

- Reasonable to recommend supplementary oxygen to those showing significant hypoxia (Spo2 < 90%) during exercise.

  BTS STATEMENT 2001
In severely disabled COPD patients with incapacitating dyspnea, 6 week NMES of muscles involved in ambulation improved muscle strength and endurance, whole body exercise tolerance, and breathlessness during ADL.

Neder JA. Thorax 2002;57:333–337

14 COPD patients with Ty 2 RF on MV through tracheostomy tube received NMES as a part of rehabilitation. Significant reduction in duration required for transfer from bed to chair (14.33 +/- 2.53 Vs 10.75 +/-2.41)


NMES may be an adjunctive therapy for patients with severe chronic respiratory disease who are bed bound or suffering from extreme skeletal muscle weakness.

ATS/ERS Guidelines 2005
Non invasive mechanical ventilation

- Proportional assist ventilation while exercise training, enabled a higher training intensity, leading to a greater maximal exercise capacity.
  

- Addition of nocturnal domiciliary NPPV in combination with pulmonary rehabilitation in stable COPD patients (FEV1 0.96 L, PaO$_2$ 65.4 and PaCO$_2$ 45.6) resulted in improved exercise tolerance and quality of life.
  

- Because NPPV is a very difficult and labor-intensive intervention, it should be used only in those with demonstrated benefit from this therapy. Further studies are needed to further define its role in pulmonary rehabilitation.
  
  *ATS/ERS guidelines 2005*
Bronchial asthma

A 10-week aerobic conditioning program led to decrease in dyspnea, ventilatory requirement and oxygen consumption for a given level of exercise.

*Haalstrand TS. Chest. 2000;118:1460-1469*

6 week swimming training programme has a beneficial effect on aerobic capacity assessed with bicycle ergometer 4.5 watt Vs 3.8 watt p<0.001)

No effect on bronchial airway reactivity measured by histamine response.

*Matsumoto I. Thorax 1999;54:196-201*
Aerobic exercise training for 8 weeks led to short term decrease in the daily use of inhaled and oral steroids, in moderate to severe disease.

Reduction of inhaled steroid dose of fluticasone from 1125 to 575 micro grams per day (p<0.05).
Oral steroids could be withdrawn in all the 4 patients

Neder JA. Thorax 1999; 54: 202-206

Insufficient evidence to suggest that IMT provides any clinical benefit to patients with asthma (review of 5 RCTs)

Ram FSF. Eur Respir J 2004; 24: Suppl. 48, 520s
Cystic fibrosis

Physical activity augments airway clearance in cystic fibrosis

Exercise training

Better airway clearance

Exercise capacity
Cardiovascular fitness

Better HRQOL

Anderson B. Acta Pediatrlica Scand. 1987;76:70-75
Cystic fibrosis

- Regular aerobic exercise attenuates the decline in pulmonary function over a 3-year period compared to a control group.

  *Schneiderman-Walker, JJ Pediatr 2000;136,304-310*

- Review of 3 RCTs suggested addition of exercise to standard physiotherapy halted fall in FEV1 and an increase of FEV1 by 6.4% (p<0.04) was observed.

  *Thomas J. Am J Respir Crit Care Med.1995;151:846-850*
Cystic fibrosis

- Appropriate vigorous physical exercise enhances cardiovascular fitness, increases functional capacity, and improves quality of life.

- Pulmonary rehabilitation regimens previously targeted for adults with emphysema and chronic bronchitis will likely prove to be effective in the CF population.

Aerobic activities, such as swimming, jogging, and cycling, are recommended

*Cystic Fibrosis Adult Care - Consensus Conference Report Chest. 2004;125:1S-39S*
For motivated patients a combination of exercise training, education, and psychosocial support may help, not by improvements in lung function, which are not likely to occur, but with improvement in exercise tolerance, together with decreased symptoms of breathlessness, improved quality of life.

*ATS/ERS statement on treatment of IPF 1999*
Body composition abnormalities: interventions
Body composition abnormalities

- Increased activity related Energy expenditure
- Hyper metabolic state
- Decreased intake

- Impairment of Energy balance
- Imbalance in Protein synthesis and breakdown

- Loss of fat
  - Loss of weight: BMI < 21
    - 10% weight loss in 6 months
    - 5% weight loss in 1 month

- Loss of FFM
  - Anthropometry
  - Bioimpedence analysis
  - DEXA
Under weight : Low BMI

- One-third of outpatients and up to two thirds of those referred for pulmonary rehabilitation are underweight
  
  *Enjelen MPKJ. Eur Respir J 1994;7:1793-97
  Schols AWMJ. Am Rev Respir Dis 1993;147:1151–1156*

- Underweight patients with COPD have significantly greater impairment in HRQL than those with normal weight
  
  *Schoup R. Eur Respir J 1997;10:1576–1580*

- In COPD, there is an association between underweight status and increased mortality, independent of the degree of airflow obstruction.
  
  *Schols AWMJ. Am J Respir Crit Care Med 1998;157:1791–1797*
Low lean body mass (FFM)

Because normal-weight patients with COPD and low FFM (FFM <16 kg/m² for men and <15 kg/m² for women) have more impairment in HRQL than underweight patients with normal FFM, this body composition abnormality appears to be an important independent of weight loss.

Mostert R. Respir Med 2000;94:859–867

Patients with COPD and reduced FFM have lower exercise tolerance as measured using either 12-minute walk distance (a) or VO₂max (b,c) than those with preserved FFM.

(a) Mostert R. Respir Med 2000;94:859–867
(b) Baarends EM. Eur Respir J 1997;10:2807–2813
(c) Kobayashi A. Lung 2000;178:119–127
Why intervene?

High prevalence and association with morbidity and mortality

Higher caloric requirements from exercise training in pulmonary rehabilitation, which may further aggravate these abnormalities (without supplementation)

Enhanced benefits, which will result from structured exercise training.
Body composition abnormalities: interventions

- Increased activity related Energy expenditure
- Hyper metabolic state
- Decreased intake

Impairment of Energy balance
- Loss of fat
  - Loss of weight: BMI < 21
    - 10% weight loss in 6 months
    - 5% weight loss in 1 month

Imbalance in Protein synthesis and breakdown
- Protein supplements
- Strength exercise
- Loss of FFM
  - Anthropometry
  - Bioimpedence analysis
  - DEXA

Caloric supplements

Protein supplements

Anabolic steroids
- Growth hormone

Strength exercise

Caloric supplementation

Should be considered if:

- BMI less than 21 kg/m²
- Involuntary weight loss of >10% during the last 6 months or more than 5% in the past month
- Depletion in FFM or lean body mass.

May be unsuccessful if:

- A reduction in spontaneous food intake
- Suboptimal implementation of nutritional supplements in daily meal and activity pattern
- Portion size and macronutrient composition of nutritional supplements
- Presence of systemic inflammation
Caloric supplementation

- Much of the weight gain with caloric supplementation is in the form of fat but not fat free mass. Schols AM. Am J Respir Crit Care Med 1995;152:1268–127

- Meta-analysis of 9 RCTs showed nutritional support alone cannot increase exercise capacity or anthropometric measures Ferreira I M. Chest 2000 117:672–8


<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>Trials, No.</th>
<th>Patients, No. Treat/Control</th>
<th>Effect size, SD Unit</th>
<th>Effect Size, Natural Unit</th>
<th>p Homogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>9</td>
<td>144/133</td>
<td>0.24 (0.00/0.48)</td>
<td>1.65 kg (0.00/3.29)</td>
<td>1.00</td>
</tr>
<tr>
<td>AMC</td>
<td>6</td>
<td>66/66</td>
<td>0.11 (−0.23/0.45)</td>
<td>0.3 cm (−0.5/1.0)</td>
<td>0.40</td>
</tr>
<tr>
<td>TSF</td>
<td>5</td>
<td>49/49</td>
<td>0.36 (−0.04/0.76)</td>
<td>1.4 mm (−0.2/2.9)</td>
<td>0.90</td>
</tr>
<tr>
<td>6-min walk</td>
<td>3</td>
<td>38/39</td>
<td>0.03 (−0.41/0.47)</td>
<td>3.4 m (−46.1/52.9)</td>
<td>0.19</td>
</tr>
<tr>
<td>FEV₁</td>
<td>5</td>
<td>60/59</td>
<td>0.03 (−0.33/0.39)</td>
<td>0.5% pred (−5.4/6.4)</td>
<td>0.49</td>
</tr>
<tr>
<td>Pimax</td>
<td>4</td>
<td>36/34</td>
<td>0.01 (−0.46/0.48)</td>
<td>0.1 cm H₂O (−8.1/8.5)</td>
<td>0.80</td>
</tr>
<tr>
<td>PEmax</td>
<td>4</td>
<td>36/34</td>
<td>−0.10 (−0.57/0.37)</td>
<td>−3.0 cm H₂O (−16.6/10.8)</td>
<td>0.24</td>
</tr>
</tbody>
</table>
Nutritional supplementation

- Energy dense foods
- Well distributed during the day
- No evidence of advantage of high fat diet
- Patients experience less dyspnea after carbohydrate rich supplement than fat rich supplement. (probably due to delayed gastric emptying)

- Daily protein intake should be 1.5 gm/kg for positive balance
Physiological intervention: Strength exercise

- 8 weeks of strength exercise lead to increase in FFM (52.4 ± 7.3 to 53.4 ± 7.7 kg, p<0.05)
  Fransen FM. Chest 2004;125:2021–2028

- Addition of strength training lead to increase in strength and mid thigh circumference (measured by CT)

- No difference in 6MWD, HRQOL
  Bernard S. Am J Respir Crit Care Med 1999;159:896–901
Pharmacological intervention: Anabolic steroids

- Anabolic steroids increased lean body mass (1.4 ±/−2.6 kg, p<0.05)
- No side effects seen
- Anabolic therapy alone increases muscle mass but not exercise capacity (assessed with 12MWD)

Schols AM. Am J Respir Crit Care Med 1995;152:1268–1274

Anabolic steroids
Nandrolone decanoate
- 50 mg for male
- 25 mg for females
- 2 Weekly for 4 doses

IGF – 1
- Anti Glucocorticoid action
- Erythropoietic action

Increase fat free mass
Growth hormone

- rhGH 0.05 mg/kg for 3 weeks in addition to 35 Kcal/kg and 1gm protein/kg per day has shown to increase fat free mass (1.37 +/- 0.23 Vs 0.07 +/- 0.11 kg) significantly. (p<0.01)

  *Pape GS. Chest 1991;99:1495-1500*

- Daily administration of 0.15 IU/kg rhGH during 3 wk increases lean body mass when assessed in in underweight patients with COPD. at 3 weeks (2.3 +/- 1.6 Vs 1.1 +/- 0.9 kg, p<0.01) and at 8 weeks (1.9 +/- 1.6 Vs 0.7 +/- 1.1 kg, p<0.05).

- But does not improve muscle strength or exercise tolerance (hand grip and maximal exercise) and no change in well being of the patient.

- REE has significantly increased by 107.8% in study group (p<0.001)

  *Burdet C. Am J Respir Crit Care Med. 1997;156: 1800-1806*
Testosterone

- Testosterone 100 mg weekly for ten weeks in men with low testosterone levels 320 ng/ml showed weight gain of 2.3 kg
- Addition of exercise to testosterone has augmented weight gain to 3.3 kg (p<0.001)

_Casburi R. Am J Respir Crit Care Med. 2004;170:870-878_

- Physiological consequences and long term effects not studied.
## Body composition abnormalities: interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Weight gain</th>
<th>FFM gain</th>
<th>Exercise capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caloric supp.</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Caloric supplementation + exercise training</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Strength exercise</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Anabolic steroids</td>
<td>++</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Anabolic steroids + exercise</td>
<td>++</td>
<td>+++</td>
<td>?</td>
</tr>
</tbody>
</table>
Guidelines

- Increased calorie intake is best accompanied by exercise regimes that have a nonspecific anabolic action.

- Anabolic steroids in COPD patients with weight loss increase body weight and lean body mass but have little or no effect on exercise capacity.

  GOLD 2006

- Pulmonary rehabilitation programs should address body composition abnormalities. Intervention may be in the form of caloric, physiologic, pharmacologic or combination therapy.

  ATS/ERS STATEMENT 2005
Education
Self management education

Should involve:
- Patient
- Family
- Primary care physician
- Other health care providers
Patient education : BTS statement 2001

- Anatomy, physiology, pathology and pharmacology (including oxygen therapy)
- Dyspnoea/symptom management, chest clearance techniques
- Energy conservation/ pacing
- Nutritional advice
- Managing travel
- Benefits system
- Advance directives
- Making a change plan
- Anxiety management
- Goal setting and rewards
- Relaxation
- Identifying and changing beliefs about exercise and health related behaviours
- Loving relationships/sexuality
- Exacerbation management (including coping with setbacks and relapses)
- The benefits of physical exercise

Box 3 Suggested content of education sessions.
Self management Education

<table>
<thead>
<tr>
<th>Breathing Strategies</th>
<th>Normal Lung Function and Pathophysiology of Lung Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proper Use of Medications, including Oxygen</td>
</tr>
<tr>
<td></td>
<td>Bronchial Hygiene Techniques</td>
</tr>
<tr>
<td></td>
<td>Benefits of Exercise and Maintaining Physical Activities</td>
</tr>
<tr>
<td></td>
<td>Energy Conservation and Work Simplification Techniques</td>
</tr>
<tr>
<td></td>
<td>Eating Right</td>
</tr>
<tr>
<td></td>
<td>Irritant Avoidance, including Smoking Cessation</td>
</tr>
<tr>
<td></td>
<td>Prevention and Early Treatment of Respiratory Exacerbations</td>
</tr>
<tr>
<td></td>
<td>Indications for Calling the Health Care Provider</td>
</tr>
<tr>
<td></td>
<td>Leisure, Travel, and Sexuality</td>
</tr>
<tr>
<td></td>
<td>Coping with Chronic Lung Disease and End-of-Life Planning</td>
</tr>
<tr>
<td></td>
<td>Anxiety and Panic Control, including Relaxation Techniques and Stress Management</td>
</tr>
</tbody>
</table>

ATS & ERS Joint statement on pulmonary rehabilitation, 2005
Early treatment of exacerbations

- Detection of exacerbation:
  Sustained worsening of symptoms from beyond daily variations

- Activating predetermined action plan:
  Pre-determined medication regime
  Informing health care providers
Bronchial hygiene techniques

- Postural drainage
- Percussion & vibration
- Directed cough
- Forced expiratory technique (huff cough)
- Active cycle of breathing
- Autogenic drainage
- Positive expiratory pressure
Bronchial hygiene techniques

- Meta analysis of 6 RCTs suggested chest percussion and vibration to be very effective in clearance of secretions in cystic fibrosis. SD 0.61, p<0.0001.
  
  *Thomas J. Am J Respir Crit Care Med.1995;151:846-850*

- Combination of postural drainage, percussion, directed cough and forced expiration improved airway clearance, but not pulmonary function, in patients with COPD and bronchiectasis
  
  *The Cochrane Database of Systematic Reviews 2007 Issue 1*

- PT advice to patients with sputum production is appropriate.
  
  *BTS STATEMENT 2001*

- In selected patients bronchial hygiene techniques can be considered.
  
  *ATS/ERS STATEMENT 2005*
Breathing strategies

- Adopting specific postures: Leaning forward
- Slow deep breathing
- Purse lipped breathing

**Diaphragmatic breathing:**

- Increases work & increases dyspnea


**Gosselink RA. Am J Crit Care Med. 1995;151:1136-442**

**Vitacca M. Eur Respir J. 1998;11:408-415**

**Should be considered (although individualized)**

**ATS & ERS statement 2005**
Psychological considerations
Psychological considerations

Dyspnoea

Fear and anxiety

Heightened physiological arousal

Disability

Chronic disease

Abnormalities in Blood gases

Irritability
Depressive symptoms (45%):
- Pessimism
- Hopelessness
- Withdrawal from social interactions

Neuropsychological impairments
Magnitude of problem

- Approximate prevalence of symptoms of depression in moderate to severe COPD is about 45%
  

- Sub-threshold depression (clinically relevant depression that does not fit operational criteria) is seen in 25% of elderly patients with COPD

  *Yohannes AM. Int J Geriatr Psychiatry 2003;18:412–416*
Psychological considerations

- Screening for anxiety and depression should be part of the initial assessment.
- Mild or moderate levels of anxiety or depression related to the disease process may improve with pulmonary rehabilitation.
  

- Patients with significant psychiatric disease should be referred for appropriate professional care.

ATS/ERS STATEMENT

- Antidepressants and anxiolytics appear not to have additional general value.

BTS STATEMENT
Patient selection and Assessment
Patient selection

- Gains can be achieved from pulmonary rehabilitation regardless of age, sex, lung function, or smoking status
  
  ATS/ERS statement 2005

- No justification for selection on the basis of age, impairment, disability or smoking status.
  
  BTS statement 2001

- COPD patients at all stages of disease appear to benefit from exercise training programs, improving with respect to both exercise tolerance and symptoms of dyspnea and fatigue
  
  GOLD 2006
# Initial assessment

<table>
<thead>
<tr>
<th>Medical history and physical examination</th>
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<tbody>
<tr>
<td>Measure dyspnea</td>
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<tr>
<td>Multidimensional clinical instruments</td>
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<tr>
<td>Ratings during exercise</td>
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<tr>
<td>Measure HRQL</td>
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<tr>
<td>Disease-specific instruments</td>
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<td>Generic instruments</td>
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<tr>
<th>Diagnostic testing</th>
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<tr>
<td>Pulmonary function tests</td>
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<td>Cardiopulmonary exercise tests</td>
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<td>Pulse oximetry or arterial blood gases</td>
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<tr>
<th>Psychosocial assessment</th>
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<tr>
<td>Evaluate anxiety/depression</td>
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<tr>
<td>Assess social and family support</td>
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<tr>
<td>Coping and self-care skills</td>
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</tbody>
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_Mahler DA. Chest 1998;113;263-268_
Exclusion criteria

- Patients with severe orthopedic or neurological disorders limiting their mobility
- Severe pulmonary arterial hypertension
- Exercise induced syncope
- Unstable angina or recent MI
- Refractory fatigue
- Inability to learn, psychiatric instability and disruptive behavior.
Outcome assessment

Control of symptoms of cough and fatigue:
- Real time evaluation: VAS & Borg dyspnea scale
- Recall of symptoms

Performance evaluation: Ability to do ADL
- Directly observed or self reported

Exercise tolerance:
- 6 minute walking test
- Cardiopulmonary exercise testing

Quality of life:
- Chronic respiratory disease questionnaire
- St Georges’s respiratory questionnaire
- SF- 36

Assessment of respiratory and peripheral muscle strength (GOLD 2006)
Pulmonary rehabilitation: At what cost?

- Incremental health care cost of pulmonary rehabilitation was 11,597 dollars per annum per patient.
- NNT for improvement in dyspnea 4.1, fatigue 4.4 and 3.3 for emotion
  

- Decreased no of exacerbations (3.7+/- 2.2 Vs 6.9+/-3.9) in 24 months. No change in hospitalization rates.
  
  Guell K. Chest 2000;117:976-83

- Decrease in utilization of health care services:
  Decreased length of hospital stay when admitted
  No change in number of hospital admissions
  Fewer primary care home visits

Long term efficacy pulmonary rehabilitation

- Benefits of rehabilitation (exercise tolerance, dyspnea, HRQOL) are evident up to 1 year and may last longer.
  
  *Foglio K. Eur Respir J. 1999;13:125-32*

- One third of the patients (both COPD and bronchial asthma) retain the benefits for 2 years (NNT 3)
  
  *Guell R. Chest 2000;117:976-83*

- Meta-analysis showed significant improvement in exercise capacity and 6 MWD 9 months post rehabilitation.
  
  *Cambach W. Arch Phys Med Rehab 1999;80:103-111*
[Image 27x61 to 568x781]

Maintenance rehabilitation & Repeat rehabilitation program

- Continued participation in supervised program is essential for sustenance of benefits.
  
  *Swerts PMJ. Arch Phys Med Rehab 1990;71:570-573*

- Yearly repeat rehabilitation program had shown:
  Short term benefits in the form of less frequent exacerbations
  But no long term physiological effects on exercise tolerance, dyspnea & HRQL.


**Current guidelines does not comment on maintenance & repeat rehabilitation**
Proper patient selection

Patient assessment

Individualization of programme

Exercise training:
- Leg and arm exercises
- Sessions
- For weeks

Caloric supplements
- Strength exercise
- Anabolic steroids

Self management education

Psychological aspects
- Depression
- Anxiety

Outcome assessment:
- Symptoms
- Exercise performance
- Quality of life

Structure of Pulmonary rehabilitation program
<table>
<thead>
<tr>
<th>Figure 5.3-10. Benefits of Pulmonary Rehabilitation in COPD</th>
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<tbody>
<tr>
<td>• Improves exercise capacity <em>(Evidence A).</em></td>
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<tr>
<td>• Reduces the perceived intensity of breathlessness <em>(Evidence A).</em></td>
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<tr>
<td>• Improves health-related quality of life <em>(Evidence A).</em></td>
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<tr>
<td>• Reduces the number of hospitalizations and days in the hospital <em>(Evidence A).</em></td>
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<tr>
<td>• Reduces anxiety and depression associated with COPD <em>(Evidence A).</em></td>
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<tr>
<td>• Strength and endurance training of the upper limbs improves arm function <em>(Evidence B).</em></td>
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<tr>
<td>• Benefits extend well beyond the immediate period of training <em>(Evidence B).</em></td>
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<tr>
<td>• Improves survival <em>(Evidence B).</em></td>
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<tr>
<td>• Respiratory muscle training is beneficial, especially when combined with general exercise training <em>(Evidence C).</em></td>
</tr>
<tr>
<td>• Psychosocial intervention is helpful <em>(Evidence C).</em></td>
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Thank you