STATE HIGHER EDUCATION UNIVERSITY
"UZHHOROD NATIONAL UNIVERSITY"
MEDICAL FACULTY №2
INTERNAL DISEASES

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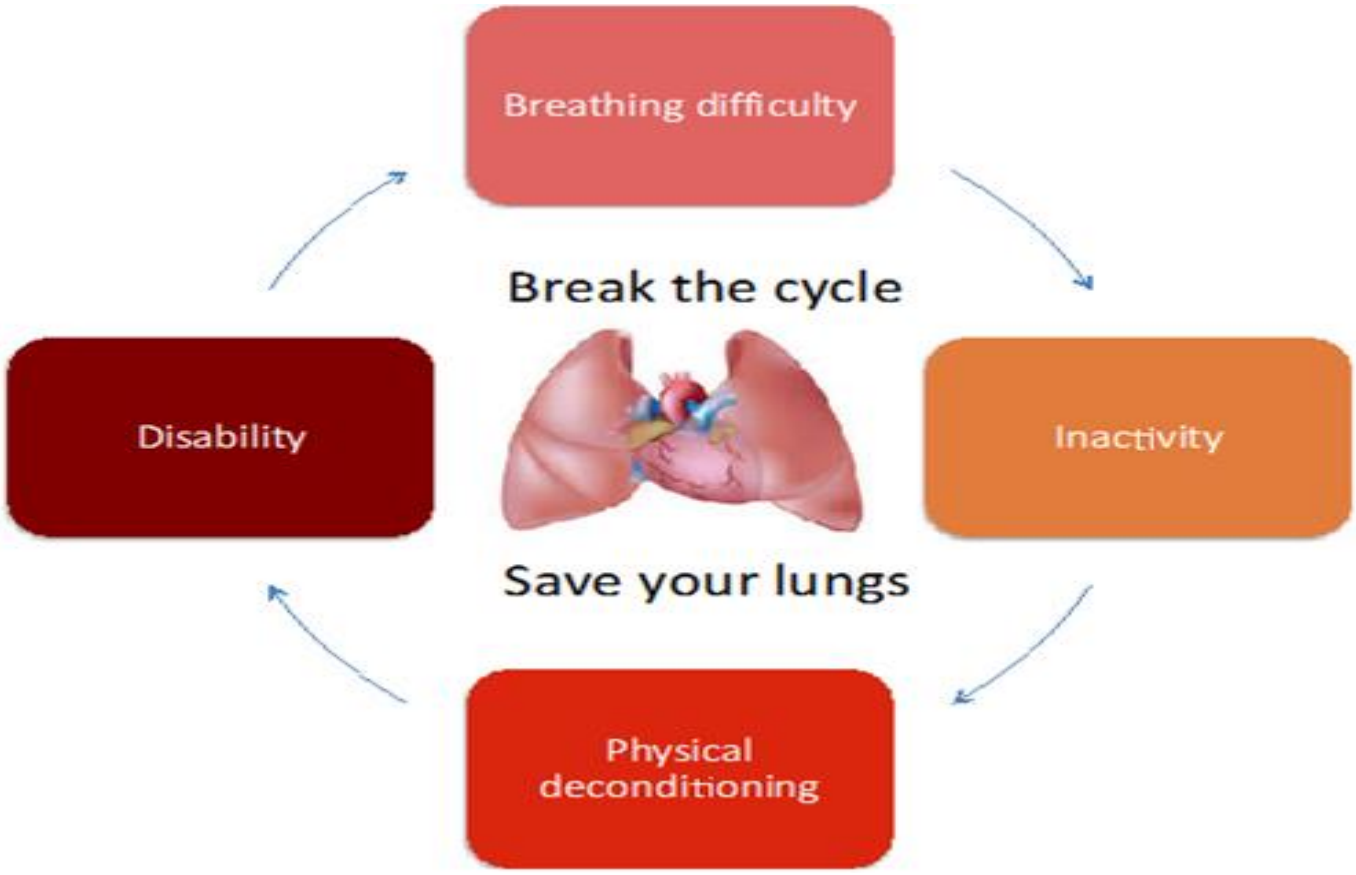
Guidelines to practical lessons

OK 42 PHYSICAL REHABILITATION, SPORTS MEDICINE
PULMONARY REHABILITATION (2 HOURS)

Module 2 “Physical Rehabilitation”

Topic 8



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The guideline is composed according to medical students' educational qualification characteristics and professional training programs.

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PULMONARY REHABILITATION

Pulmonary rehabilitation (PR) has demonstrated physiological, symptom-reducing, psychosocial, and health economic benefits in multiple outcome areas for patients with chronic respiratory diseases.

Patients with chronic respiratory diseases experience disabling symptoms (including dyspnea and fatigue) and exercise intolerance, have low physical activity levels, and report impaired quality of life. Persons with respiratory diseases have heterogeneous features, and, for many, extrapulmonary manifestations such as skeletal muscle dysfunction and medical and psychological comorbidities (such as anxiety and/or depression) are key contributors to their symptoms and functional limitations.

Pulmonary rehabilitation is a program that combines exercise, education, and support to help people learn to breathe and function at the highest level possible.

Indications for Pulmonary rehabilitation:

1. Chronic Obstructive Pulmonary Disease (COPD)
2. Restrictive Pulmonary Disease
3. Before and after lung transplantation
4. Before and after lung reduction surgery

Contraindications for Pulmonary rehabilitation:

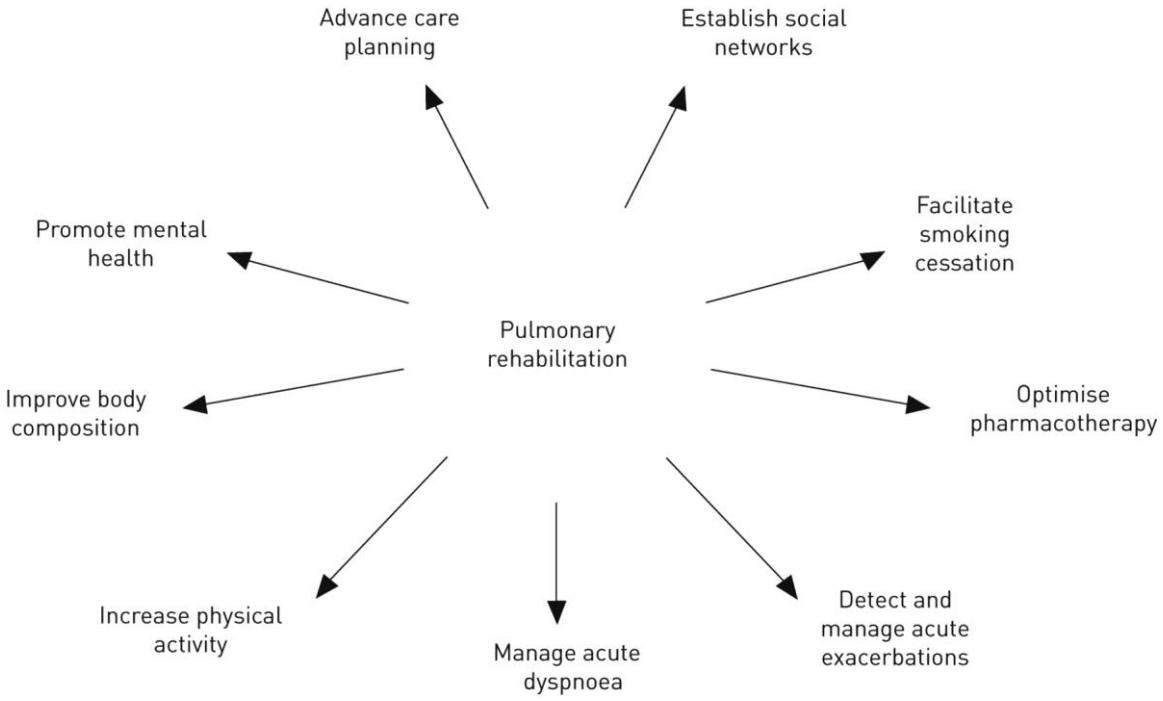
1. Unstable angina
2. Resting systolic blood pressure > 200 mm Hg or resting diastolic blood pressure > 110 mm Hg
3. Moderate to severe aortic stenosis
4. Acute systemic illness or fever
5. Uncontrolled atrial or ventricular arrhythmias
6. Uncontrolled tachycardia (> 100 bpm)
7. Symptomatic congestive heart failure
8. Third-degree heart block without pacemaker
9. Active pericarditis or myocarditis
10. Recent embolism
11. Thrombophlebitis
12. Resting ST displacement (> 3 mm) (as seen on ECG)
13. Uncontrolled diabetes
14. Orthopaedic problems that would prohibit exercise

Goals of pulmonary rehabilitation:

1. Improvement in cardiopulmonary function
2. Prevention and treatment of complications
3. Increased understanding of the disease
4. Increased patient responsibility for self-care and compliance with medical treatment
5. Improvement in level of activity and quality of life, return to work

Benefits of pulmonary rehabilitation:

1. Improvement in exercise tolerance, symptom-limited oxygen consumption, work output, mechanical efficiency, and vital capacity
2. Exercise increases arterial venous oxygen (AVO2) difference, increasing oxygen extraction from arterial circulation
3. Reduction in dyspnea and respiratory rate
4. Aerobic exercise helps to increase sputum expectoration, increase ciliary beat with improvement of mucous transport and improve exercise capacity, respiratory muscle endurance, and reduce airway resistance
5. Improvement in general quality of life; decreased anxiety and depression, improvement in Activities of Daily Living (ADLs)
6. Improvement in ambulation capacity
7. Decreased hospitalization rates, reduced unscheduled healthcare visits
8. Focus on conditioning peripheral musculature in order to improve their efficiency and reduce stress on the heart and lungs



Pulmonary rehabilitation is a multidisciplinary programme of care for patients with COPD. Many patients with COPD are in a vicious cycle of breathlessness, reduced physical activity and deconditioning of skeletal muscles, with resultant loss of social contact and autonomy. Pulmonary rehabilitation can reduce dyspnea, improve exercise tolerance and quality of life.

The ACSM recommends assessment of COPD patients before beginning an exercise training program. This should include pulmonary function testing, arterial oxyhemoglobin saturation based on direct arterial oxygen saturation (SaO 2) or indirect peripheral oxygen saturation measured by oximetry (SpO 2), and dyspnea monitoring using the Borg CR 10 scale. Exercise testing is an important element of the initial PR assessment. A cardiopulmonary exercise test including ventilation and gas exchange assessment and a standardized ramp protocol may be used. Submaximal exercise testing may be used depending on the rationale for the test and

the patient's clinical status. Persons with chronic lung disease may have ventilatory limitations to exercise; therefore, peak oxygen uptake estimated using age-predicted heart rate may not be appropriate.

Components of a rehabilitation programme must be adjusted to meet the needs of the individual patient, but typically include the following:

I. Smoking cessation. Advice, encouragement and support should be offered in achieving and maintaining smoking cessation.

II. Nutrition. Respiratory muscle weakness is associated with metabolic deficits, decreased in magnesium, calcium, potassium, and phosphates which is reversible after replacement. Serum albumin level correlates better with hypoxia than spirometric values. Indicates visceral protein depletion and is a good predictor of rehabilitation potential. Impaired nutritional status is associated with increased morbidity and mortality: more frequent infections: impaired cell-mediated immunity, decreased macrophage action in the pulmonary alveolar region, increased bacterial adherence and colonization in upper and lower airways, pseudomonas species commonly colonize in patients with poor nutrition. Poor nutritional state affects lung repair mechanisms, including surfactant synthesis. Patients with COPD are often underweight because of the increased work of breathing, the systemic effects of inflammatory cytokines and a decreased food intake from anorexia and breathlessness. Some patients, however, are overweight, because of reduced activity and overeating. A patient's weight and body mass index should be measured and appropriate dietary advice should be given.

III. Education. An education programme for patients and their families should include advice on how and when to take medications, the benefits of exercise, the importance of smoking cessation and the use of techniques such as breathing control, relaxation and anxiety management. Patients who are vulnerable to exacerbations can be taught to recognise the onset of symptoms and instructed to start a 'rescue pack' (including a course of prednisolone, and an antibiotic if sputum is purulent) and to increase their use of bronchodilator drugs.

IV. Optimisation of drug treatment. The patient should take a comprehensive treatment regimen, with a good inhaler technique.

V. Exercise training. Breathless patients often reduce their level of exercise and lose general fitness and muscle mass. Exercise training (e.g. walking, cycling) can counteract muscle atrophy and improve fitness. Typically, an exercise training programme involves three supervised aerobic exercise sessions per week over a period of 8 weeks.

This type of exercise allows the patient to increase the ability to perform ADLs.

- Activities may include: aerobic conditioning (bicycle, pool exercise program, walking, stair climbing, calisthenics), ROM exercises (coordinated with diaphragmatic breathing) and upper extremity strengthening exercises
- A daily 12-minute walk with a record of time spent and distance achieved; and 15 minutes a day of inspiratory training is also advised. The 12-minute walk can be used to estimate exercise tolerance.
- Pulse parameters include: increase of at least 20% to 30% during the activity with a return to baseline within 5 to 10 minutes after exercise.

- The program is reevaluated weekly for 10 to 12 weeks, and modifications are made along with patient education
- Upper extremity exercise reduces the metabolic demand and increased ventilation associated with arm elevation, and dyspnea. Improvement in lower limb function may help walking, and arm training improves performance of day-to-day tasks such as lifting, dressing, washing and brushing one's hair.
- Unsupported upper extremity activities produced the most benefits, including decreased O2 consumption. These types of activities include self-care, lifting, reaching, carrying, and athletic activities.
- All exercises should be performed to tolerance (symptom limited, subjective dyspnea)
- Should hold exercise for a HR >120 beats/minute. Hold exercise if the patient has premature beats > 6/minute. Hold exercise for oxygen saturation less than 92%. If the patient desaturates during exercise (<90%) may use supplemental O2 to enhance exercise performance and protect patients with CAD from dysrhythmia
- Aerobic exercise in patients with cystic fibrosis may include: Exercises involving the trunk muscles such as sit-ups, Swimming, Jogging.
- Monitor hypercapnia as an indicator for the need of a rest period. Ventilatory assistance provides relief to tired respiratory muscles decreasing their energy expenditure. Diaphragm rest can be achieved by assisting ventilation noninvasively with the use of body ventilators, mouthpiece, or nasal intermittent positive pressure ventilation (IPPV) or tracheostomy IPPV.

Specifically, for people with COPD to accumulate the recommended dose (≥ 150 minutes per week of moderate intensity exercise, involving large muscle groups and accumulated over ≥ 5 days) they frequently need to undertake periods of exercise interspersed with rest periods in order to manage their dyspnea. It is important to reassure patients that breathlessness on activity is not harmful and a degree of breathlessness is necessary in order to gain the benefits of exercise. When commencing an exercise program most individuals will need to gradually build up to the recommended weekly dose of exercise. Walking (ground-based or treadmill) and or stationary cycling are the forms of endurance exercise most commonly employed in exercise training programs for people with COPD with ground-based walking having the advantage that it requires no equipment and can translate into improvements in walking capacity. Strength training is also recommended on at least 2 days each week interspersed with at least one rest day.

General exercise guidelines for patients with COPD

1. Gradually increase your activity level, especially if you have not been exercising regularly.
2. Choose an activity you enjoy.
3. Wait at least 1½ hours after eating a meal before exercising. When drinking liquids during exercise, remember to follow your fluid restriction guidelines.
4. Dress for the weather conditions and wear protective footwear.

5. Take time to include a five-minute warm-up, including stretching exercises, before any aerobic activity and include a five- to 10-minute cool down after the activity. Stretching can be done while standing or sitting.
6. Schedule exercise into your daily routine. Plan to exercise at the same time every day (such as in the mornings when you have more energy).
7. Exercise at a steady pace. Keep a pace that allows you to still talk during the activity.
8. Breathing during activity. Always breathe slowly to save your breath. Inhale through your nose, keeping your mouth closed. These warms and moisturizes the air you breathe and at the same time filters it. Exhale through pursed lips.
9. Breathe out slowly and gently through pursed lips. This permits more complete lung action when the oxygen you inhale is exchanged for the carbon dioxide you exhale.
10. Try to inhale for two seconds and exhale for four seconds. You might find slightly shorter or longer periods are more natural for you. If so, just try to breathe out twice as long as you breathe in.
11. Exercise will not harm your lungs. When you experience shortness of breath during an activity, this is an indication that your body needs more oxygen. If you slow your rate of breathing and concentrate on exhaling through pursed lips, you will restore oxygen to your system more rapidly.

Walking guidelines

1. Start with a short walk. See how far you can go before you become breathless. Stop and rest whenever you are short of breath.
2. Count the number of steps you take while you inhale. Then exhale for twice as many steps. For example, if you inhale while taking two steps, exhale through pursed lips while taking the next four steps. Learn to walk so breathing in and exhaling out will become a habit once you find a comfortable breathing rate.
3. Try to increase your walking distance. If you can set specific goals, you'll find you can go farther every day. Many people have found that an increase of 10 feet a day is a good goal.
4. Set reasonable goals. Don't walk so far that you can't get back to your starting point without difficulty breathing. Remember, if you are short of breath after limited walking, stop and rest.
5. Never overdo it. Always stop and rest for two or three minutes when you start to become short of breath.

Stair climbing

1. Hold the handrail lightly to keep your balance and to help yourself climb.
2. Take your time.
3. Step up while exhaling or breathing out with pursed lips. Place your whole foot flat on each step. Go up two steps with each exhalation.
4. Inhale or breathe in while taking a rest before the next step.

5. Going downstairs is much easier. Hold the handrail and place each foot flat on the step. Count the number of steps you take while inhaling, and take twice as many steps while exhaling.

VI. Breathing control techniques. These involve pursed-lip breathing, slower deeper respirations and better coordination of breathing patterns. COPD patients exhibit an altered pattern of respiratory muscle use. The rib cage inspiratory muscles generate more pressure than the diaphragm. Expiratory muscles are also involved.

Controlled breathing techniques are used to reduce dyspnea, reduce the work of breathing, improve respiratory muscle function and pulmonary function parameters.

Techniques to Improve Pulmonary Function Parameters:

1. Diaphragmatic breathing

Used to reverse altered pattern of respiratory muscle recruitment in COPD patients. Patient uses the diaphragm, relaxes abdominal muscles during inspiration: Lying down, or at 15% to 25% head-down position, the patient places one hand over the thorax below the clavicle to stabilize the chest wall, and the other over the abdomen. The patient takes a deep breath, and expands the abdomen using the diaphragm. Feedback of abdominal and rib cage movement is obtained through hand placement as described previously. **Benefits**: increased tidal volume, decreased functional residual capacity, and increase in maximum oxygen uptake.

2. Segmental breathing

Obstructions, such as tumors and mucous plugs, should be cleared prior to practicing this technique. The patient is asked to inspire while the clinician applies pressure to the thoracic cagemto resist respiratory excursion in a segment of the lung. As the clinician feels the local expansion, the hand resistance is decreased to allow inhalation. This facilitates the expansion of adjacent regions of the thoracic cavity that may have decreased ventilation.

3. Techniques to Reduce Dyspnea and the Work of Breathing

Pursed-lip breathing. Patient inhales through the nose for a few seconds with the mouth closed, then exhales slowly for 4–6 seconds through pursed lips. By forming a wide, thin slit with the lips, the patient creates an obstruction to exhalation, slowing the velocity of exhalation and increasing mouth pressure. Expiration lasts 2–3 times as long as inspiration. **Benefits:** Prevents air trapping due to small airway collapse during exhalation and promotes greater gas exchange in the alveoli. Increases tidal volume, reduces dyspnea and work of breathing in COPD patients. When added to diaphragmatic breathing, reduces the respiratory rate and can improve blood ABGs.

4. Airway clearance techniques:

1. **Controlled cough.** The patient assumes an upright sitting position, inhales deeply, holds the breath for several seconds, contracts the abdominal muscles (“bears down” increasing intrathoracic pressure), then opens the glottis and rapidly and forcefully exhales while contracting the abdominal muscles and leaning slightly forward. This is repeated two or three times and followed by normal breaths for several minutes before attempting controlled cough.
2. **Huffing.** An alternative is huffing—following a deep inhalation, the patient attempts short, frequent exhalations by contracting the abdominal muscles and saying “ha, ha, ha”. The glottis remains open during huffing, and does not increase

intrathoracic pressure, therefore, in COPD patients where airways can collapse. This is a more efficient means of secretion removal.

5. Secretion Mobilization Techniques (Postural Drainage, Percussion, Vibration)

Indications:

1. Sputum production >30 ml/day
2. Aspiration
3. Atelectasis
4. Moderate sputum production in debilitated patients that are unable to raise their own secretions

Postural Drainage. Use gravity-assisted positioning to improve the flow of mucous secretions out of the airways. The affected lung segment is placed uppermost to increase oxygenation and drainage. Best done after awakening in the morning (secretions accumulate at night) and one to two hours after meals to avoid gastroesophageal reflux. Common position is the Trendelenburg or head-down posture, which can be done with the patient supine or prone, and different postural variations such as side lying or trunk bending.

Percussion. Mechanical percussor or a cupped hand can be used to rhythmically strike the thoracic cage during the entire respiratory cycle to loosen mucus within the lungs. Delivered at a frequency of 5 Hz for 1 to 5 minutes or longer over the chest area desired to be drained. Used on patients who are unable to mobilize and expectorate excess secretions, or to help expand areas of atelectasis.

Precautions: Coagulation disorders, Anticoagulation therapy, Platelet count below 50,000, Fractured ribs, Flail chest, Severe osteoporosis

Contraindications: Cardiovascular instability or failure, Aortic aneurysm, increased intracranial pressure, increased intraocular pressure, cannot do percussion over a tumor.

Vibration. Rapid shaking back and forth, (not downward) on the thorax over a segment of the lung, causing mucus to move toward the trachea. Applied to the thorax or airway to facilitate secretion elimination. Can be applied manually or through the use of a mechanical vibrator.

VII. Social support. Patients with advanced disability may have difficulty in performing daily tasks, such as climbing stairs, shopping and washing, and may benefit from assessment by an occupational therapist with regard to home aids such as stair lifts and bath aids. Assessment by a social worker will allow a patient to obtain appropriate allowances (e.g. disability or mobility allowances) from government agencies.

VIII. Psychological support. Depression and social isolation are common and can be helped by psychological support focusing on restoring coping skills. Patient self-help groups may be useful.

Preoperative and Postoperative Chest Therapy Program

Airway clearance and secretion mobilization techniques can be applied prior to surgery, and after the procedure. A preoperative and postoperative chest therapy program has the following advantages:

• Decreases the incidence of pneumonia

• Reduces the probability of developing postoperative atelectasis following thoracic and abdominal surgery

Pre-operative Program: The patient is taught standard postoperative treatment.

Deep breathing—Taught with the patient in the semi-Fowler position, in which the abdominal muscles are on slack. This allows greater diaphragmatic excursion. Most important modality of postoperative pulmonary hygiene.

Rolling—Allows patient mobility and minimizes trunk movement

Coughing—Decreased cough effectiveness can be a result of anesthesia

Two-stage cough, preceded by a deep diaphragmatic breath. First cough raises the secretions, second cough facilitates expectoration. May use splinting techniques for coughing, splinting the surgical incision with the use of a pillow or hands.

Huffing

Incentive spirometry—Provides the patient with visual feedback of the air volume inspired during a deep breath. Patients practice deep inspiration every hour in addition to their chest physical therapy sessions.

Post-operative Treatment

Most therapy programs start one day postoperatively. Diaphragmatic and segmental breathing is used to assist the ventilator. Breathing exercises are provided. Secretion management techniques include postural drainage, vibration and percussion.

If the patient underwent abdominal surgery, one hand is placed between the incision site and the area to be percussed to decrease discomfort during the treatment. A pillow over the incision may also be used.

Vibration is preferred post operatively because it is less traumatic.

These treatments are contraindicated in patients with cardiac or hemodynamic instability or in cases of pneumothorax.

REHABILITATION OF THE PATIENT WITH RESTRICTIVE LUNG DISEASE

Respiratory complications are the most common causes of death in advanced restrictive lung disease. The major cause of acute respiratory failure for these patients is impaired secretion clearance. Rehabilitation of the patient with restrictive lung disease is based on prevention of complications and assistance with secretion management.

Patient Education

• Prevents development of pneumonia, respiratory failure, and subsequent intubation and mechanical ventilation

• Importance of vaccinations should be stressed: Influenza, pneumococcal, and the possible use of antiviral agents

• Avoid crowded areas or exposure to respiratory tract pathogens

• Avoid sedatives at night and the risk of possible aspiration

• Avoid oxygen therapy. Central ventilatory drive can be suppressed, exacerbation of carbon dioxide can occur, and the risk of respiratory failure can be increased

• Avoid obesity and heavy meals

• Develop goals and start planning for the future

Nutrition

• Respiratory muscle insufficiency can be exacerbated by hypokalemia

Controlled Breathing Techniques

- **Glossopharyngeal breathing**

This is a noninvasive method to support ventilation, and it can be used in the event of ventilator equipment failure. The patient takes a deep breath, and uses the pistoning action of the tongue and pharyngeal muscles to project air boluses into the lungs. Rhythmic opening and closing of the vocal cords occur with each air bolus. Each breath usually consists of 6 to 9 air boluses (or up to 65), with each bolus consisting of 30 to 150 ml of air (usually 60 to 200 ml.)

Adequate Secretion-Management Techniques

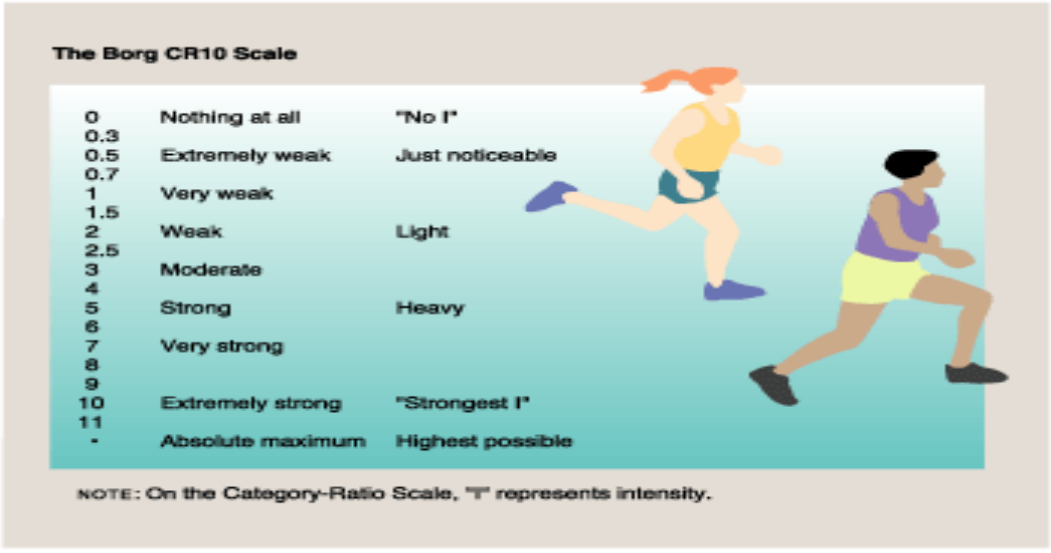
- **Manually assisted cough**

The clinician's or the assisting person's heel of the hand or arm is placed at various sites along the anterior chest or abdomen to provide pressure, and is coordinated with the patient's coughing or expiratory effort

- **Chest percussion, postural drainage may also be used**.
- **Mechanical insufflator-exsufflator.** Most effective method of mechanical assistance for secretion clearance in paralyzed patients. A deep inspiration (positive-pressure insufflation) is provided via a mask or through the tracheal tube, followed by rapid controlled suction (negative pressure exsufflation).

List of questions.

1. Pulmonary rehabilitation: indications, contraindications, goals.
2. Benefits of pulmonary rehabilitation.
3. Pulmonary rehabilitation for patients with COPD.
4. Components of a rehabilitation program for patients with COPD.
5. Exercise training as a component of pulmonary rehabilitation.
6. General exercise guidelines for pulmonary rehabilitation.
7. Breathing control techniques.
8. Airway clearance techniques.
9. Secretion mobilization techniques.
10. Preoperative and postoperative chest therapy program.
11. Physical rehabilitation of patients with restrictive lung disease.



Rated Perceived Exertion (RPE) Scale. Borg CR 10 scale

The RPE scale is used to measure the intensity of your exercise. The RPE scale runs from 0-10. The numbers below relate to phrases used to rate how easy or difficult you find an activity. For example, 0 (nothing at all) would be how you feel when sitting in a chair; 10 (very, very heavy) is how you feel at the end of an exercise stress test or after a very difficult activity.

0 - Nothing at all
0.5 - Just noticeable
1 - Very light
2 - Light
3 - Moderate
4 - Somewhat heavy
5 - Heavy
6
7 - Very heavy
8
9
10 -Very, very heavy

In most cases, you should exercise at a level that feels 3 (moderate) to 4 (somewhat heavy). When using this rating scale, remember to include feelings of shortness of breath, as well as how tired you feel in your legs and overall.

Table 2. Guidelines for Exercise Training in Patients with COPD

Recommendation	*Strength of evidence*
Lower-extremity exercise training should be a mandatory component of pulmonary rehabilitation.	Strong evidence; strong recommendation
Low- and high-intensity exercise training produces clinical benefits for patients with COPD.	Strong evidence; strong recommendation
Lower-extremity exercise training performed at a high level of intensity produces greater physiologic benefits than lower-intensity training.	Moderate evidence; strong recommendation
Unsupported upper-extremity endurance training should be included in pulmonary rehabilitation exercise programs.	Strong evidence; strong recommendation
Including a strength training component in a pulmonary rehabilitation exercise program increases muscle strength and muscle mass.	Strong evidence; strong recommendation
There is no evidence to support the routine use of inspiratory muscle training as an essential component of pulmonary rehabilitation.	Moderate evidence; strong recommendation

COPD = chronic obstructive pulmonary disease.

Information from reference 4.

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