



Pulmonary rehabilitation: recent developments

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Educational aims

- To present innovative papers from the field of pulmonary rehabilitation published in 2005 and to discuss the important points and conclusions from each.

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality and an increasing economic problem worldwide [1]. Progressively disabling dyspnoea and reduced exercise capacity are the main complaints of patients suffering from COPD. Randomised controlled studies, as well as meta-analyses, have clearly shown that intensive, multidisciplinary, pulmonary rehabilitation programmes (PRPs) are a well-established means of enhancing standard therapy to alleviate symptoms and optimise function,

independent of disease stage, in the short and long term [2]. Pulmonary rehabilitation is of increasing scientific interest (figure 1). This article is an overview of some of the most relevant original papers recently published on pulmonary rehabilitation. Research was conducted using Entrez PubMed covering the period from January 1, 2006 to March 31, 2007 and the search term "Pulmonary Rehabilitation". A total of 359 articles were extracted, 78 of which were reviews or editorials.

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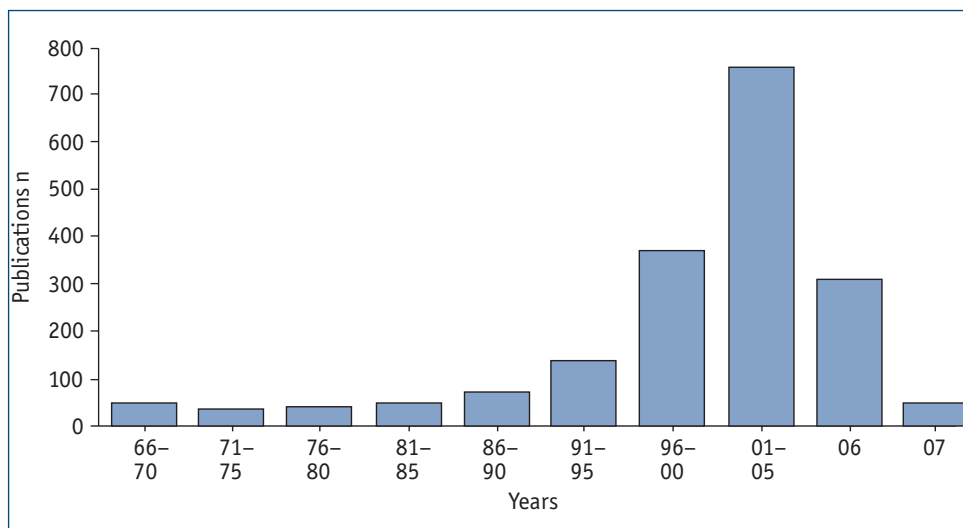


Figure 1

Pulmonary rehabilitation publications 1966–2007. Source: Entrez PubMed.

Main image from Respiratory
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Educational questions

Are the following statements true or false?

1. Ventilatory assistance during exercise training is always indicated in COPD patients.
2. Oxygen supplementation during exercise training is always indicated in normoxaemic COPD patients.

Oxygen therapy

Selected COPD patients with chronic hypoxaemia live longer if they receive long-term oxygen therapy (LTOT) [3]. As a result, healthcare systems in many countries include public funding of LTOT for eligible applicants [4]. Ambulatory oxygen supplementation has been widely shown to increase exercise performance and to relieve exercise breathlessness in COPD patients [5]. A systematic review [6] of the short-term effectiveness of ambulatory oxygen from single-assessment studies in COPD has recently been published. In total, 31 studies met the inclusion criteria. Oxygen improved primary outcomes relating to endurance and maximal exercise capacity and improved breathlessness, oxygen saturation and minute ventilation at isotime in endurance exercise. Short-term oxygen supplementation also prevented exercise-induced oxidative stress in normoxaemic, muscle-wasted patients [7]. Combining the benefits of bronchodilators (reduced hyperinflation) and oxygen (reduced ventilatory drive) produced additive effects on exercise endurance in normoxic COPD patients [8].

Air-heliox mixtures

Heliox breathing can ameliorate dyspnoea and increase high-intensity exercise endurance capacity in moderate-to-severe COPD by reducing air-flow limitation and dynamic hyperinflation [9–11]. Combining heliox and hyperoxia delays dynamic hyperinflation and improves respiratory mechanics, resulting in further improvements in exercise tolerance [12].

Exercise training

Although a study in mice showed endurance training causes epithelial damage and repair but does not appear to be a powerful pro-inflammatory stimulus [13], it has been reported that regular physical activity may reduce lung function decline and cut the risk of developing COPD among active smokers [14], as well as the risk of hospital admission and mortality [15]. Pulmonary rehabilitation reduces chest wall volumes during exercise by decreasing abdominal volumes. The improvement in exercise capacity following a PRP is independent of this pattern of exercise-induced dynamic hyperinflation [16].

Studies also report the beneficial effects of physiotherapy in COPD patients in intensive care [17]. Early activity is feasible and safe in respiratory failure patients and may be useful to prevent or treat the neuromuscular complications of critical illness [18].

Ventilatory assistance during exercise

Although PRPs should be considered a significant component of therapy, even in severe COPD patients [19], extreme breathlessness and/or peripheral muscle fatigue may prevent patients attaining higher levels of exercise intensity. Increased inspiratory muscle work may contribute to dyspnoea and exercise limitation. Recent studies have provided additional information on noninvasive ventilatory assistance during exercise in COPD patients. It has been reported that mask ventilation may enhance exercise tolerance during a PRP [20], as well as reducing dyspnoea and the work of breathing during arm elevation [21]. In tracheostomised difficult-to-wean COPD patients, arm exercise performed during unassisted respiration causes greater increases in respiratory rate and in respiratory muscle pressure output than arm exercise performed during pressure support ventilation. Exercise-induced dyspnoea and arm discomfort are similar during assisted and non-assisted respiration [22]. A caveat must be given with ventilation-supported exercise: as many COPD patients have significant comorbidities, including a high proportion of cardiac ischaemic disease [23]. This kind of "mechanical doping" might expose an unaware COPD and ischaemic patient to a load greater than his/her coronary ischaemic threshold [24].

Timing and intensity of exercise

Passive training of specific locomotor muscle groups by means of neuromuscular electrical stimulation might be better tolerated than whole-body exercise in patients with severe COPD. A study in severe COPD patients has added information on this technique with encouraging results [25].

The optimal duration of PRPs, meanwhile, is still to be established. Shortened supervised programmes seem equivalent to longer supervised programmes at comparable time points [26].

Whole-body exercises, such as cycling, walking and stair climbing, result in higher cardio-pulmonary stress than arm cranking and resistance training. Dyspnoea is greater during cycling than during resistance training. Cardiopulmonary stress during resistance training is lower than during whole-body exercise and results in fewer symptoms [27]. Studies demonstrate the effectiveness of one-legged exercise, at the same muscle-specific intensity, in extending the duration of exercise among patients with COPD [28].

A rollator improves the biomechanical efficiency of walking and breathing, positioning the body forwards, anchoring the upper extremities and assuming a small amount of the user's weight. Rollators may improve exercise test, especially among more severe patients. These improvements are accompanied by a patient preference for assisted walking, in addition to reducing dyspnoea and a greater sense of safety [29, 30].

Inspiratory muscle training

The addition of inspiratory muscle training (IMT) to an exercise programme results in a significant increase in the maximal inspiratory pressure. This is accompanied by a significant improvement in the perception of dyspnoea and a further significant improvement in health-related quality of life [31]. Another study confirms that high-intensity IMT improves inspiratory muscle function in moderate-to-severe COPD, yielding meaningful reductions in dyspnoea and fatigue [32]. Also, a short outpatient programme of expiratory muscle training can ameliorate symptoms and improve health-related quality of life [33].

Pre-operative rehabilitation

There are only a few trials that support the prophylactic usefulness of pre-operative respiratory physiotherapy. Pre-operative IMT was shown to reduce the incidence of post-operative

pulmonary complications and duration of post-operative hospitalisation in patients at high risk of developing a pulmonary complication whilst undergoing coronary artery bypass graft surgery [34]. Nevertheless, one systematic review seems to indicate that the routine use of respiratory physiotherapy after abdominal surgery does not seem to be justified [35]. In adolescents with idiopathic scoliosis who are candidates for surgery, a PRP was found to improve pulmonary capacity, volumes and performance on walking test, and to reduce the perceived effort, heart rate and respiratory rate [36].

Intrapulmonary percussive ventilation

Intrapulmonary percussive ventilation (IPV) associated with noninvasive positive-pressure ventilation by helmet reduces the duration of ventilatory treatment and intensive care stay and improves gas exchange at discharge from the intensive care unit in patients with severe exacerbations of COPD [37]. It has been also reported that IPV was able to guarantee adequate ventilation while inducing a significant unloading of the diaphragm [38]. Addition of IPV to the usual chest physiotherapy in tracheostomised patients improves gas exchange and expiratory muscle performance and reduces the incidence of pneumonia [39].

Other interventions

Breathing techniques may be useful in the management of patients with mild asthma symptoms who frequently use a reliever, but there is no evidence to favour shallow nasal breathing over nonspecific upper body exercises [40]. One study suggests that PRP without a specific psychosocial intervention can improve psychosocial morbidity in patients with COPD [41]. Another study showed that in patients with severe COPD, a PRP induced important changes in depression and anxiety independent of changes in dyspnoea and health-related quality of life [42].

Suggested answers

1. False
2. False

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