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ORIGINAL ARTICLE

Effect of comorbidities on response to pulmonary rehabilitation in patients with chronic obstructive pulmonary disease

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KEYWORDS

Chronic obstructive pulmonary disease;
Rehabilitation;
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Abstract *Background and objective:* Patients with chronic obstructive pulmonary disease (COPD) typically manifest with worsening dyspnea, poor exercise tolerance and diminished quality of life. In addition, comorbidities are commonly reported in these patients, complicating management strategies. Pulmonary rehabilitation (PR) is an evidence-based multimodality therapy increasingly prescribed for symptomatic COPD patients. This study aimed to assess the impact of comorbidities on achieving proper response to PR in patients with COPD.

Methods: Forty patients with COPD were enrolled in PR program of upper and lower extremity exercise, and were prospectively followed. The minimal clinically important difference (MCID) was used as a cut-off to determine response in six-minute walk distance (6MWD), modified Medical Research Council (mMRC) dyspnea scale, Saint George Respiratory Questionnaire (SGRQ) and estimated maximum oxygen consumption (VO_{2max}). According to comorbidities patients were divided into three groups: patients without comorbidities, patients with one comorbidity and patients with more than one comorbidity.

Results: Comorbidities were diagnosed in 34 patients (85%). Patients with one or more comorbidity had significantly worse baseline mMRC, 6MWD, SGRQ score and VO_{2max} but not FEV_1%. Thirty-two patients (80%) showed improvements beyond the MCID. Factors that predicted better response included higher arterial $PaCO_2$, presence of osteoporosis, and lower baseline 6MWD, mMRC and VO_{2max}.

Conclusions: Pulmonary rehabilitation can be offered to COPD patients from different severity stages. Comorbidities occur very commonly in patients with COPD and their presence worsens the

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baseline functional status in these patients which makes them more liable to achieve larger benefits from PR.

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Introduction

Chronic obstructive pulmonary disease (COPD) is one of the most prevalent diseases in the world [1]. It afflicts around 1% of the global population and its prevalence rises steeply after the age of 40 [2]. The hallmark of COPD is progressive airflow limitation secondary to noxious stimuli, the most important of which is tobacco smoke. This is manifested as progressively worsening dyspnea and poor exercise tolerance [3].

Pathologically, COPD involves chronic inflammation of the lung, particularly in peripheral airways and parenchyma and this inflammation increases during acute exacerbations [4]. Inflammation is not only a pulmonary problem in COPD, but it has been demonstrated that systemic inflammation is a constant feature in the disease [5]. This diffuse inflammatory state is thought to be due to spill over from the lungs and is responsible for the systemic manifestations of COPD. Systemic inflammation is arguably a contributory factor in the development of several of the comorbidities of COPD or at least leads to its worsening [5].

Pulmonary rehabilitation (PR) is a cornerstone of management of COPD that aims to improve physical well-being while enhancing disease management. In addition to exercise training of lower and upper extremities, the core component of PR, it also incorporates patient education and behavioral change [6]. It is recognized that there is some heterogeneity in response to PR between individuals, with some people not achieving meaningful improvement [7]. Some researchers have striven to gauge the effect of comorbidities on response to PR [8–11]. While some of them noted a negative effect with some comorbidities, [9,11] others have not reported such findings [8,10].

This study aimed to evaluate the impact of baseline functional status as well as common comorbidities on the effect of PR on COPD patients.

Methods

Patients

Patients with COPD who presented to the outpatient clinic with acute exacerbation were offered PR after stabilization of the condition. Comorbidities were observed at the baseline as well as the physiologic and functional status of the patients. Patients were prospectively followed for response to PR according to previously set criteria. Diagnosis of COPD was confirmed by post bronchodilator spirometry and classification was based on the most recent guidelines of the global strategy for chronic obstructive pulmonary disease (GOLD) [3]. Patients with uncompensated respiratory acidosis, history of previous lung surgery, acute heart failure, disabling neuromuscular conditions, ischemic heart disease and cognitive impairment were excluded from the study.

Comorbidities were recorded based on the patients direct questioning, patients' medication list and specific diagnostic tests for certain comorbidities. According to the presence or absence of comorbidities as well as its frequency, patients were divided into three groups. The first group was assigned for patients who had no comorbidities with COPD. The second group was dedicated for patients suffering from one comorbidity and the third group included patients with more than one comorbidity.

Pulmonary rehabilitation

All patients underwent PR program with optimization of pharmacological therapy and/or long term oxygen therapy according to standard guidelines. Exercise training targeted upper and lower extremity muscles. For lower extremity, aerobic exercise on treadmill was done. The applied method of training was interval training; 3 min of exercise alternating with 3 min of rest and intensity of training was targeted to reach 60–80% of maximal heart rate but was modified according to patient's tolerance. Upper extremity exercise was in the form of repetitive lifting of free weights. Thirty repetitions were performed of weights that were determined according to patient's tolerance. Increased weights were used by the start of each new week. The training program ran for 8 weeks, 3 sessions per week under supervision. In addition, patients' education wad done, including instructions for disease self-management (prevention and early treatment of exacerbations, breathing strategies and bronchial hygiene techniques) [6].

Outcome measurement

The following physiological/functional parameters were recorded for all patients at the baseline and at the end of the program. Airway obstruction was measured by post-bronchodilator spirometry.

Functional exercise capacity was assessed using the six-minute walk distance (6MWD) performed according to American Thoracic Society guidelines [12]. Dyspnea was assessed by the modified Medical Research Council (mMRC) scale [13]. Quality of life was gauged via St. George's Respiratory Questionnaire (SGRQ) [14]. Aerobic capacity was estimated by calculating maximum oxygen consumption (VO_{2max}) via the modified Rockport walking test (RWT) [15]. The formula used to calculate the VO_{2max} was:

$$132.853 - (0.0769 \times \text{Weight}) - (0.3877 \times \text{Age}) + (6.315 \times \text{Gender}) - (3.2649 \times \text{Time}) - (0.1565 \times \text{Heart rate})$$

where weight is in pounds; gender is coded as Male = 1 and Female = 0; time is expressed in minutes and 100th of a minute and it refers to time taken to complete 400 m or till reaching degree of fatigue; maximum heart rate is in beats/minute and age is in years.

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