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ORIGINAL ARTICLE

COPD patients with severe diffusion defect in carbon monoxide diffusing capacity predict a better outcome for pulmonary rehabilitation

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Abstract
Purpose: The aim of this study was to compare the effects of pulmonary rehabilitation (PR) on six-minute walk test (6mWT) between chronic obstructive pulmonary disease (COPD) patients with moderate or severe carbon monoxide diffusion defects. We also evaluated dyspnea sensation, pulmonary functions, blood gases analysis, quality of life parameters and psychological symptoms in both groups before and after pulmonary rehabilitation.
Methods: Patients with COPD underwent a comprehensive 8-week out-patient PR program participated in this study. Patients grouped according to diffusion capacity as moderate or severe. Outcome measures were exercise capacity (6mWT), dyspnea sensation, pulmonary function tests, blood gases analysis, quality of life (QoL) and psychological symptoms.
Results: A total of 68 patients enrolled in the study. Thirty-two (47%) of them had moderate diffusion defect [T_{LCO}; 52 (47–61) mmol/kPa] and 36 (53%) of them had severe diffusion defect [T_{LCO}; 29 (22–34) mmol/kPa]. At the end of the program, PaO_2 ($p = 0.001$), Modified Medical Research Council dyspnea scale ($p = 0.001$), 6mWT ($p < 0.001$) and quality of life parameters improved significantly in both groups ($p < 0.05$). Also the improvement in D_{LCO} ($p = 0.04$) value and FEV_1% ($p = 0.01$) reached a statistically significant level in patients with severe diffusion defect. When comparing changes between groups, dyspnea reduced significantly in patients with severe diffusion defect ($p = 0.04$).

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Conclusion: Pulmonary rehabilitation improves oxygenation, severity of dyspnea, exercise capacity and quality of life independent of level of carbon monoxide diffusion capacity in patents with COPD. Furthermore pulmonary rehabilitation may improve D_{LCO} values in COPD patients with severe diffusion defect.

Introduction

Chronic obstructive pulmonary disease (COPD) is defined by airflow limitation and is a complex pathological condition. COPD is associated with an important reduction in physical activity that contributes to the patient's disability and poor health-related quality of life. Pulmonary rehabilitation (PR) is aimed to eliminate or at least attenuate these difficulties.[1,2] Therefore, PR has been recommended as an integral part of management for patients with COPD.[3,4] However, the responses to PR may vary significantly among individuals. Although there are many studies mentioning changes of FEV1, FVC, FEV1/FVC after PR, in some studies, significant changes in forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and FEV1/FVC values were not detected after PR.[5–8]

The diffusing capacity for carbon monoxide (D_{LCO}) is a common and clinically useful test that provides a quantitative measure of gas transfer in the lungs.[9] The decrease in Dl_{CO}, one of the first signs of disease progression, can point out the arterial O_2 desaturation during exercise. For COPD patients with low D_{LCO} values pose a high risk for poor survival.[10] Although PR is known to have many effects on functional outcomes of COPD patients, there is not enough information about the diffusion capacity in terms of PR outcome.[2] Also in a recent study authors suggest that diffusing capacity was the strongest predictor of exercise capacity in all subjects with COPD.[11] Therefore can CO diffusion capacity be used to evaluate which patient will benefit more from PR program? Moreover will there be a significant change in CO diffusion capacity after PR program in patients with COPD?

The aim of our study was to compare the results of PR program on exercise capacity (6mWT) between COPD patients with moderate and severe diffusion defect detected by D_{LCO}. Our secondary aims were comparing the results of the program on arterial blood gas analysis, dyspnea sensation, exercise capacity, quality of life and psychological symptoms between two groups.

Methods

We conducted a prospective cohort study to compare the effectiveness of exercise training in COPD patients with moderate and severe diffusion defect. The study was approved by the local institutional review board. Patients included in the study completed an informed written consent form.

Subject selection

We recruited COPD patients diagnosed according to Global initiative for Chronic Obstructive Lung Disease (GOLD) definition, stable from exacerbations (with no worsening of respiratory symptoms, no increase in the use of rescue medication, and no unscheduled visits due to COPD worsening) for at least 4 weeks. All patients were suffering from dyspnea, reduced exercise tolerance and limitation of daily living activities. The recruitment criteria included a minimum age of 40 years old, a history of 10 or more pack-years of smoking, a FEV1 of less than 80% of the predicted value after bronchodilator use and a ratio of FEV1 to FVC of 0.7 or less after bronchodilator use.[12] The condition of the patients was graded according to the stages of disease defined by the GOLD.[13] The patients' self-reported respiratory symptoms, medications, smoking history, and coexisting medical conditions were documented at the beginning of the study. Comorbid diagnoses were established using the clinical history and physical examination findings during the visit and were supported by a review of the available medical records. We excluded patients who were suffering from acute exacerbation, history of other lung diseases, (pneumoconiosis, pulmonary tuberculosis, interstitial lung disease); and orthopedic, neurologic, or cardiovascular impairment that might render the subject incapable of completing the exercise training. Also subjects with lack of motivation, poor compliance (not attending the program more than 2 times) or having transport problems were excluded from the study. We grouped patients; those with diffusion capacity between 41 and 60% of predicted as moderate (group 1) and under 40% of predicted as severe (group 2) diffusion defect.[14]

Measurement of pulmonary parameters and questionnaires

All patients underwent cardiac and respiratory system examinations and were evaluated by chest X-rays and blood gases analysis. Pulmonary functions were assessed by measuring body plethysmography (Zan 500, Germany) and carbon monoxide diffusing capacity test (Zan 300, Germany). The DLCO maneuver begins with a full exhalation to residual volume (RV), the mouthpiece is then connected to the test gas (0.3 percent carbon monoxide [CO], 10 percent helium), and the subject inhales rapidly to total lung capacity. Following a 10 s breath hold, the subject exhales quickly and completely to RV. An alveolar sample of the exhaled gas

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