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Original Article

Correlation between FEV1 Percentage Predicted and 6 Minute Walk Distance In Patients of Chronic Obstructive Pulmonary Disease

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Abstract

Background: Spirometry is used not only for confirming the diagnosis but grading the severity of Chronic Obstructive Pulmonary Disease (COPD) as well. Forced expiratory volume in first second (FEV1% predicted) is used to define the severity of the disease. In COPD there are several associated conditions such as increased systemic inflammation, loss of fat-free mass combined with muscle dysfunction and osteoporosis, which add to the morbidity leading to reduced physical performance in these patients. Six-minute walk test (6MWT) is useful in assessing the exercise capacity in these patients and is reflective of activities of daily living. We did this study to see if any relationship exists between six-minute walk distance (6MWD) and spirometric parameter namely FEV1% predicted, in COPD patients.

Methods: This was a hospital-based cross-sectional study. Spirometry was performed in 65 patients, both males and females suspected of having COPD. Fifty-four patients met both clinical and spirometry criteria required for the diagnosis. After fulfilling the inclusion and exclusion criteria of our study, 30 patients were finally subjected to 6MWT. After the completion of 6MWT, correlation between 6MWD and FEV1 (%predicted)

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was analyzed using Spearman's correlation coefficient with the help of SPSS software.

Results: The Spearman's coefficient (r) of Forced Expiratory volume in first second (FEV1) (% predicted) and 6 Minute Walk Distance (6MWD) was not significant (r = –0.056, p-value - 0.768). Pre-test and post-test oxygen saturation (SpO2) measured before and after 6MWT showed a statistically significant correlation between pre-test and post-test oxygen saturation (SpO2) (r = 0.639; p<0.001). A statistically significant correlation was observed between post-bronchodilator FEV1 (% predicted) and Body mass index BMI (r = 0.522; p-value - 0.003).

Conclusion: In COPD patients, severity of disease as assessed by FEV1 was not found to be useful in predicting the exercise capacity.

Introduction

Chronic obstructive pulmonary disease (COPD), a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and lungs to noxious particles or gases. Exacerbations and comorbidities contribute to overall severity in individual patients (1). According to the WHO estimates, 65 million people have moderate to severe COPD (2). Several other associated conditions such as increased systemic inflammation in early stages of COPD, risk for future exacerbations, cardiovascular diseases, weight loss, loss of fat-free mass combined with muscle dysfunction, osteoporosis, hypoxemia and depression (3-5) add to the morbidity and lead to reduced physical performance in these patients. Spirometry is a simple pulmonary function test used for confirming the diagnosis of COPD. Ratio of FEV1/ FVC ratio (forced expiratory volume in first second divided by forced vital capacity) is used to define the presence or absence of airflow limitation i.e., a ratio of less than 70% is said to represent airflow-limitation. FEV1 (% predicted) is used to define the severity of the disease (6). There are tests available to assess the functional exercise capacity in COPD patients. These are cardio-pulmonary exercise test like stair climbing, 6- Minute Walk Test (6MWT) and shuttle-walk test (7). A simple and popular exercise test among these is a 6-MWT. Solway and co-workers found that 6MWT was the most commonly used, easy to administer, better tolerated and more reflective of activities of daily living than other walk tests (8). One of the parameters of 6MWT is 6-minute walk distance (6MWD). In our study, we assessed the relation between 6MWD and spirometry parameter (FEV1% predicted) in patients with COPD. The aim of this study is to establish the correlation between the spirometry assessment of severity of airflow-limitation and exercise capacity in COPD patients.

Material and Methods

This was a hospital-based cross-sectional study. The study was conducted after taking approval from Institute Ethics committee and in accordance with International Conference on Harmonisation - Good clinical practice (ICH-GCP) and other regulatory guidelines.

Sixty-five male and female patients were screened for COPD. After taking written informed consent, 30 males, above 40 years of age who fulfilled the inclusion criteria were enrolled in the study. These patients had complaints of long standing breathlessness, cough with or without sputum production, wheeze, intermittent exacerbations or "flare-ups", having history of cigarette, bidi or hookah smoking or exposure to smoke due to bio-mass fuel (9). For confirming the diagnosis of COPD by spirometry, GOLD criteria was used which is defined as post-bronchodilator FEV1/FVC < 0.7. Spirometry was performed on a turbine based spirometer (Cosmed- MicroQuark Spirometer, Italy). Inclusion criteria were patients with confirmed diagnosis of COPD with age ≥40 years who were willing to give written informed consent. Exclusion criteria were

patients not giving consent for the test along with COPD patients with acute exacerbations within last 6 weeks, patients receiving domiciliary oxygen therapy, patients with other diseases affecting respiratory and cardiovascular systems, recent thoracic or abdominal surgery, eye surgery or retinal detachment, patients who have musculoskeletal pain which would interfere with walk test. Subjects having resting heart rate of more than 120 beats per minute, a systolic blood pressure of more than 180 mm Hg, and a diastolic blood pressure of more than 100 mm Hg, having history of unstable angina or myocardial infarction, arrhythmias in the previous month or exercise related syncope were also excluded from the study. After confirming the diagnosis of COPD, procedure of the six-minute walk test (6MWT) was explained to the patient. Informed written consent was taken before subjecting the patient to 6MWT. Testing was performed under the supervision of nursing staff and resident doctor in a location where a rapid, appropriate response to an emergency was possible. In the end, the distance covered by the patient was measured in metres. During the test pulse rate and oxygen saturation (SpO2) were continuously monitored with a portable pulse oximeter and recorded every minute with walking distance. Anthropometric and spirometry data of all the patients who underwent 6MWT was recorded for statistical analysis using Spearman's correlation coefficient with the help of SPSS version 21 (IBM Armonk, NY: IBM Corp). The conventional p value of statistical significance of 0.05 was used.

Results

Patient characteristics such as demographics, pulmonary function tests and exercise performance are described in Table I. The age group distribution

TABLE I: Baseline characteristics of COPD patients.

	Mean	*Standard deviation*	*N*
Age (years)	63.27	8.391	30
BMI (kg/m^2)	19.73	4.20	30
Post BD FEV_1 (% predicted)	57.87	20.33	30
6MWD (metres)	375.37	67.64	30
Pre SpO_2(%)	97.10	1.56	30
Post SpO_2 (%)	96.70	2.70	30

TABLE II: Number of participants in each age group.

Age group (in years)	*Number of participants*
40-49	1
50-59	7
60-69	14
70-79	7
>80	1

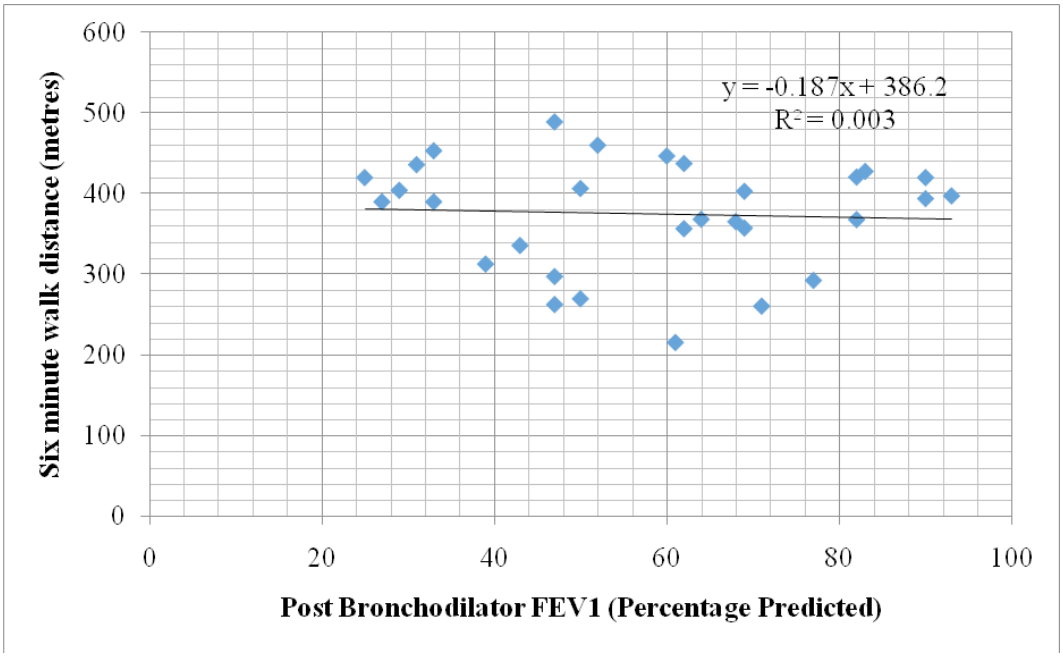

Fig. 1: Correlation plot of FEV1 (% predicted) and 6 Minute Walk Distance (6MWD).

of participants is shown in Table II. Scatter diagram showing correlation between FEV1 (% predicted) and 6MWD (in meters) is shown in Fig. 1. Spearman's correlation coefficient (r) between 6MWD and FEV1 (% predicted) was non-significant (r = -0.056, p-value - 0.768). This shows there was no correlation between the two variables. We had also recorded other parameters in our study. Two of them, namely pre-test and post-test oxygen saturation (SpO2) measured before and after 6MWT showed a statistically significant correlation between pre-test and post-test oxygen saturation (SpO2) (r = 0.639; p<0.001). We also found a statistically significant correlation between post-bronchodilator (BD) FEV_1(% predicted) and Body mass Index (BMI) (r = 0.522; p-value - 0.003).

Discussion

COPD patients experience a progressive deterioration and disability leading to worsening of their health-related quality of life. There have been ample studies directed towards examining the efficacy of various exercise capacity measuring parameters used in COPD. A study by P.J. Wijkstra et al (10), found a strong correlation between spirometry and distance walked whereas the one by Bernstein ML (11) and Elie Fiss et al (12), found weak correlations. On staging COPD according to GOLD guidelines, a study showed that it does correspond to important differences in HRQoL (health-related quality of life) of COPD patients having severe disease, but not for the mild form. Whereas in the same study it was shown that functional exercise capacity (measured by 6MWD) deteriorates in linear fashion with severity of disease (13). In another study, IPAQ (international physical activity questionnaire), mBQ (modified Baecke questionnaire) BMI, airway obstruction and dyspnoea score in COPD patients with or without severe physical inactivity (SPI) were analysed and compared. The severe physical inactivity group had more advanced age, higher mBQ scores, lower 6MWD and also lower IPAQ scores (14). In 2013, Valdermas S et al, conducted a study in which the fatigue scores showed significant correlation between dyspnoea grade as well with 6MWD and stage of disease in accordance with GOLD guidelines (15). Significant correlation between FEV1 and FVC and % predicted 6MWD has also been shown in a study by Agarwal MB et al. (16). Another study that needs mention here is the one that showed that total energy intake significantly accounted for the variation in BODE index, severity of perceived dyspnea, and 6MWD after controlling for age, duration after diagnosis, and physical activities (17). In another study, exercise-induced desaturation (EID) in 6MWT was found to have significant negative correlation with FEV1, resting oxygen saturation and 6MWD. The resting SpO2 ≥93% was found to be a predictor of EID with a sensitivity and specificity of 83% and 78% respectively (18).

The severity of COPD is conventionally assessed and graded by spirometry variable, Post-bronchodilator FEV1 (percentage predicted). Various studies had been conducted to find any relationship between pulmonary function and exercise capacity in COPD patients. We performed 6MWT in COPD patients and tried to find out if there was any correlation between post-bronchodilator FEV1 (% Predicted) and 6MWD. There have been studies that found a strong correlation between the two, such as studies by Wijkstra PJ et al (10) and Carter R et al. (19). Two different studies by Bernstein ML et al (11) and Elie Fiss et al (12) showed weak or no correlations between the two variables. The variation in 6MWD in COPD patients has been found to be dependent on multiple factors. Lee H et al (17) tried to see for any relationship between 6MWD and nutritional status of COPD patients and found how total energy intake affected 6MWD after controlling for age, duration of COPD and physical activities. Van Gestel et al (20) showed the importance of cardiopulmonary functions such as oxygen uptake (VO2) in COPD patients affecting their exercise tolerance reflected by 6MWD. A study by Altenburg WA et al (21) suggests that variation in 6MWD could be due to psychological factors as well. The above mentioned studies support the findings of our study that 6MWD is dependent on many factors and not just on a single spirometry parameter. Therefore, we assume that these could be the reasons affecting the results of our study in which we found no statistically significant correlation between FEV1 (% predicted) and 6MWD in COPD patients. There were some limitations in our study like small sample size; anthropometric variables such

as age and BMI were not adjusted during analysis. Also, the nutritional status, dyspnoea severity and psychological status of the patients should have been taken into account before performing the 6MWT. Strong correlations have been shown between pulmonary function parameters such as inspiratory capacity (IC), diffusion capacity for carbon-monoxide (DLCO), body mass index (BMI) and exercise capacity in COPD patients (10, 16, 18, 22). Thus, efforts directed towards exploring the correlation of these variables with exercise capacity should be made in future studies.

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