

The Six Minute Walk Test as a Tool to Evaluate Functional Progress in Persons with Respiratory Disability

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Abstract

Chronic obstructive pulmonary disease is a widely prevalent disorder and the most common cause for respiratory impairments and disability. It is expected to rise at the fifth position as a cause of disability adjusted life year by the year 2020. Patients of COPD suffer from chronic breathlessness which limits their activities and functional capacity. The Six minute walk test is a valid and simple tool to evaluate the functional limitation and monitor progress. The aim of our study was to assess the functional progress in COPD patients undergoing a six week exercise program using the 6 MWT as a tool. 45 subjects with a history of smoking and a diagnosis of stable COPD were made to undergo a six weeks exercise program and the 6 MWT was performed before and after six weeks. The variables evaluated were the walk distance and dyspnoea ratings. There was a statistically significant increment in both the parameters after six weeks. The mean increment for walk distance was 31 meters and the dyspnoea rating improved by 0.5 and 0.7 for the baseline and completion values. These increments over a short period are positive indicators of clinical progress and signify potential scope for enhancement in the functional capacity of these eternally breathless patients.

Keywords: Chronic obstructive pulmonary disease (COPD); Respiratory disability; Functional capacity; Six minute walk test (6MWT); Six minute walk distance (6MWD); Rating of perceived exertion (RPE); Therapeutic exercises.

Introduction

Respiratory impairment refers to an alteration in lung structure or function that results in decrease or limited functional ability and is usually manifested by dyspnoea on exertion. Out of the many respiratory diseases that cause impairment chronic obstructive pulmonary disease leads the cause. The impairment ratings for persons with respiratory impairment and disability are described using the framework set forth by the American thoracic society (ATS). Chronic obstructive pulmonary disease (COPD) is a common and costly medical condition.

Among adults of working age about five percent report having COPD. COPD is the fourth leading cause of death in the world[1], representing an important public health challenge that is both preventable and treatable.

COPD is a major cause of chronic morbidity and mortality throughout the world. Many persons suffer from this condition for years and die prematurely from it or its complications. World over the incidence of COPD is projected to increase in the coming years as the exposure to risk factors is increasing and also the global population is aging.[2]

The important causative factors in the etiology of COPD are smoking, air pollution and recurrent infections. These patient suffer from a chronic airflow obstruction which is also diagnostic of the disease. This is progressive in nature and not completely reversible. Chronic airflow limitation results from a combination of airway inflammation

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increase in mucous production and repeated infections in persons who are genetically predisposed.

The symptoms of a COPD patient include cough, sputum, wheezing, and progressive dyspnoea or breathlessness. The specific form that COPD takes can range along a spectrum.[3] At one end of the spectrum people get chronic bronchitis with narrow inflamed airways filled with mucous accompanied by a chronic p cough. At the other end of the spectrum people get emphysema, which indicates the destruction of small respiratory units (alveoli and respiratory bronchioles) and the formation of large, useless airspaces in the lungs. These are called bullae.

The most common symptom of COPD is breathlessness on exertion which leads to gradual decline in physical functioning acting through a vicious cycle. A practical quick and inexpensive method of measuring the physical function is to ambulate for a given distance as it indicates the capacity of a person to undertake physical activity.[4] The six minute walk test (6 MWT) is one of the most widely used functional walk test as it is simple, practical and just requires the ability to walk.[5] The role of six minute walk test is to evaluate the functional exercise capacity which is reflective of individuals capacity to perform the activities of daily living.[6] It is a clinical evaluation method which measures the performance through a sub-maximal effort.[7]

Historical Overview

Lipkin was the first person to introduce the 6MWT as a functional exercise test in 1986. Originally, it was developed by Balke in 1963 to evaluate the functional capacity.[8] It was a modified derivation of the 12 minute walk test developed by Cooper to predict the maximum oxygen uptake.[9] Since some respiratory patients were unable to complete the 12 minute walk test due to exhaustion, the six minute walk test was developed. A recent review of functional walking tests concluded

that "the 6MWT is easy to administer, better tolerated and more reflective of activities of daily living than other walk tests".[10]

Clinical Usefulness of the 6MWT

Six minutes walk test is a simple and practical test which requires only a measured feet hallway and no other exercise equipments or advanced training for technicians. Walking is an activity that is performed on a daily basis by all except the most severely impaired persons. The 6MWT measures the distance that a patient can quickly walk on a flat, hard surface in a period of six minutes. It can evaluate both the global and the integrated responses of all the systems involved during the exercise including the pulmonary and cardiovascular system, systemic circulation, peripheral circulation, blood, neuromuscular units and muscle metabolism. It does not provide the specific information on the function of each of the different organs and systems involved in exercise or the mechanism of exercise limitation as is the case with maximal cardiopulmonary exercise testing.

The self paced 6MWT assesses the sub-maximal level of functional capacity. Most patients do not achieve maximal exercise capacity during the 6MWT, instead they choose their own intensity of the exercise and are allowed to stop and rest during the test. However, since most activities of daily living are performed at a sub-maximal level of exertion, the 6MWT may better reflect on the functional exercise level of daily physical activities.

The strongest indication for six minute walk test is for measuring the response to therapeutic interventions in patients with the moderate to severe heart or lung disease. The 6MWT is also used as an one time measure of functional status of patients as well as predictor of morbidity and mortality. Studies have found a good correlation between formal cardiopulmonary exercise testing and 6MWT. A significant correlation of $r = 0.73$ was reported between 6MWT and severe lung disease.[11,12] In fact in issues pertinent to

quality of life parameters, the 6MWT is more relevant and correlates better with quality of life than does the peak oxygen uptake.[13] Also the questionnaire indices of functional status in COPD have a larger short term variability that is 22 to 33% than does the six minute walk test.[14,15,16] If we compare the 6MWT with the shuttle walking test it scores somewhat lower in the peak oxygen uptake correlations with the activities of daily living but the shuttle test has a definite disadvantage as it carries more potential for cardiovascular problems and has less validation than the 6MWT.

The main contraindications to the 6MWT are angina and myocardial infarction one month prior to testing. Its relative contraindications are a resting heart rate over 120, systolic BP more than 180 mm Hg and diastolic BP more than 100 mm Hg. The criterion for immediate termination of the test includes chest pain, intolerable dyspnoea, leg cramps, staggering, diaphoresis and pale appearance. If the test is stopped for any of these reasons the patient is made to sit or lie supine depending on the severity of the event and an assessment of the cause is made.

An interesting study was made by Turner *et al* in 2004.[17] They investigated the cardiorespiratory and dyspnoea responses to incremental and self paced exercise test in patients with COPD. The pattern of responses in heart rate and dyspnoea seen during 6MWT suggests that the patients with COPD tend to titrate exertion against dyspnoea to achieve a peak tolerable intensity. This strategy is not possible in incremental shuttle walking or cycle ergometry.

The submaximal nature and self paced aspect of the 6MWT makes it a very safe evaluation tool. Because it is relatively low intensity, it allows the assessment of many persons who would otherwise be limited by their symptoms during an evaluation of their functional status or exercise capacity. This is true in various disease states in which the 6MWT is indicated and especially true in elderly persons where physical limitation can prevent more strenuous evaluations of

physical capacity. In two very large studies, thousands of patients were subjected to six minute walk test without any complications or complaints of limiting symptoms. Finally, should the complication arise, because the test is self paced the patients can stop the test at any time they feel necessary.[10]

From investigator to investigator there were slight differences in the protocols in the evolution stage. Some used a straight track (out and back type), others used a continuous circular, oval or rectangular track. The distance between the start and the end point varied between 20, 30 or 50 meters. The six minutes walk distance ranges between 400 meters to 700 meters for healthy adults. In case of patients an improvement of more than 70 meters walk was clinically important.[18]

Material and Methods

The primary objective of the study was to evaluate the difference in the distance walked by the patients before and after completing an exercise therapy program of six weeks. The secondary aim of the study was to evaluate the variance in the dyspnoea ratings before and after six weeks. For studying both the above parameters six minute walk test was used as a tool.

Design

A pre and post intervention study.

Setting

The study was conducted in the physiotherapy OPD department of Safdarjung Hospital and V. M. Medical College. The selected patients for the study were referred from the department of respiratory medicine and critical care.

Participants

Seventy subjects with stable COPD were screened for the study and enrolled after the

process of evaluating, the inclusion and the exclusion criteria. There were 25 dropouts and 45 participants completed the study over a period of six weeks.

Intervention

The patients underwent an exercise therapy program for six weeks which constituted of warm-ups, endurance, strengthening, postural and breathing exercise. All the exercises were active range of motion exercises except for strength training for which half Kg weights were used for both the lower and upper extremity. The patients were taught the exercises on a individualized training basis and in the presence of a caretaker. They were supervised in the OPD for twice a week and they followed through the program at home on a twice daily basis.

Procedure of the Test

The six minute walk test was conducted on the patients before starting the exercise therapy program and at the end of six weeks that is at the completion of the exercise therapy program. The test was performed keeping the safety issues in mind. Emergency equipments, oxygen, sublingual nitroglycerine, nebulizer, telephone and the physician were all present in the testing area. The test was performed indoors along a 30 meter long, flat, straight enclosed corridor inside the ward. The length of the corridor was marked and the distal end of the walk way and the starting point which marks the beginning and end of each lap ($30 \times 2 = 60$ meters) was marked on the floor using a bright red colored tape. All the patients were instructed to wear light comfortable clothing and since the test was performed in the forenoon OPD time, they were also requested to have a standardized light breakfast. Before starting the test a warm up period was allowed to practice the walk and they were all demonstrated by the therapist by walking a lap herself. The patients were made to understand and rate their baseline dyspnoea using the modified Borg's scale. The timer was set to six minutes and the patients were

instructed to walk starting from the red line. Standardized phrases were used to encourage the patients. After the completion of six minutes post walk dyspnoea ratings were noted along with the number of laps which were ticked on a sheet of paper. The total distance covered was noted. After completion of the test patients were thanked and offered water.

Outcome Measures

The primary outcome measure was the six minute walk distance which was measured in meters and the secondary outcome measure was the dyspnoea on exertion ratings which were measured using the modified Borg's scale. The modified Borg's scale is a visual analogue scale and the patient is asked to rate the difficulty of his/her breathing. The scale has a base of 0 which indicates no difficulty at all and a apex of 10 which signifies maximum difficulty in breathing.

Results

Our present study had 45 patients ranging from 42 years to 86 years. The percentile gender distribution was 73.34 males and 26.66 females. 81 percent of the patients belonged to lower socio economic group according to Kuppuswamy scale. All the persons were smokers and 86% reported bidi smoking and only 14% were cigarette smokers (Fig. 1).

Our results demonstrate an increment in the six minute walk distance over a period of six weeks. The means of the scores were 207 ± 60.41 meters at the baseline and 237.91 ± 69.76 meters after the completion of six weeks exercise program (Fig. 2).

Improvements were also noted in the scores of perceived exertion. The mean of modified Borg's scale score for the pre six minute walk test was 3.71 ± 1.12 at the baseline and 3.36 ± 1.26 after six weeks ($p = 0.005$). For the post six minute walk test the scores were 6.42 ± 1.26 at the baseline and 6.05 ± 1.38 after six weeks ($p = 0.005$). This improvement of minus

Figure 1: Demographic Profile of the Patients

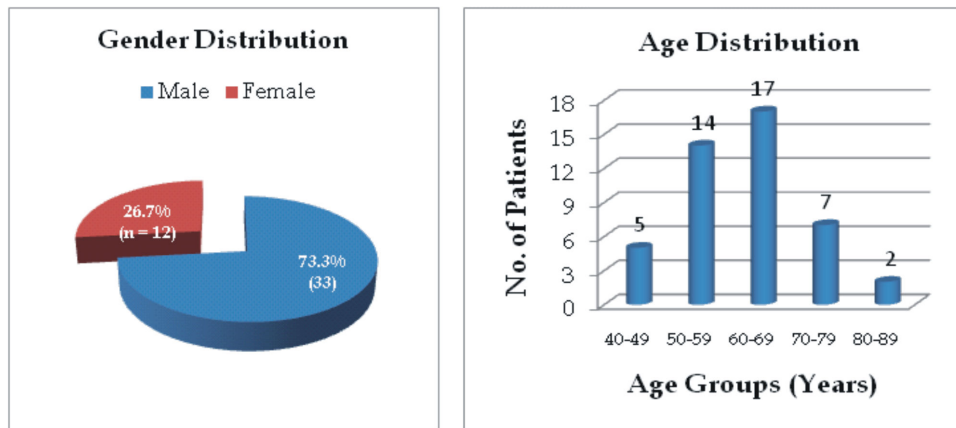


Figure 2: Comparison of Distance Walked (6-MWD)

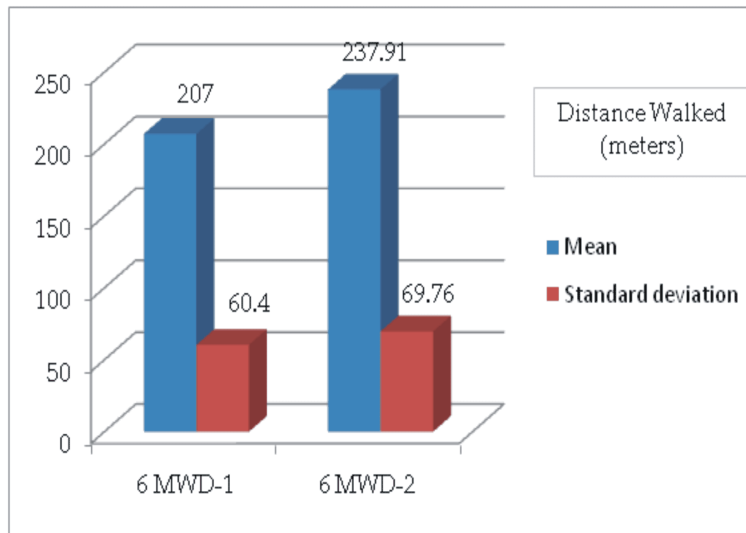
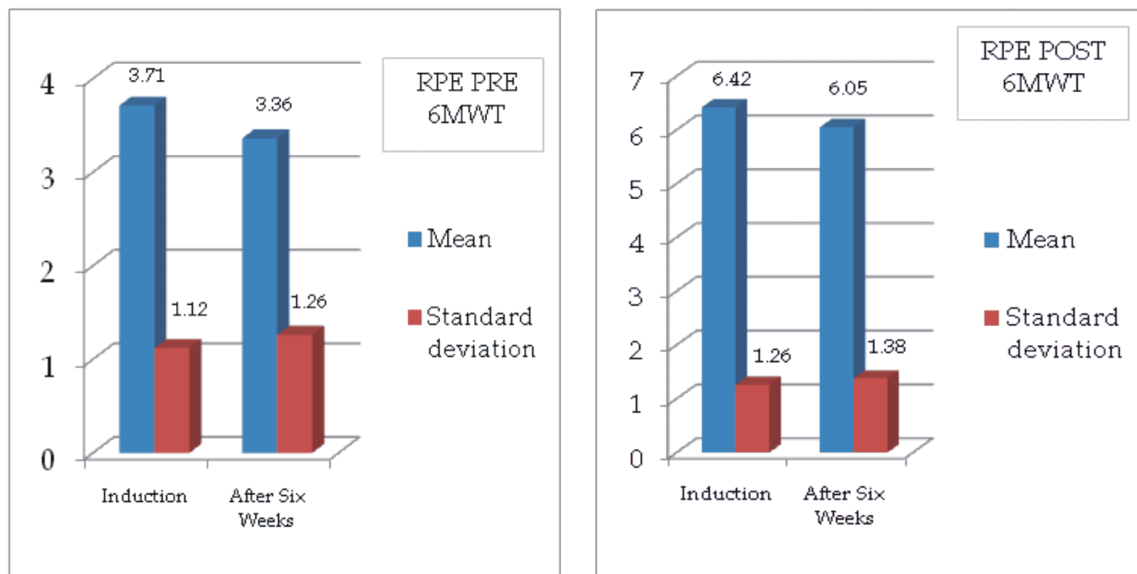


Figure 3: Comparison of Rating of Perceived Exertion Scores



0.35 in the pre six minute walk test values and minus 0.37 in the post six minute walk test values is statistically significant (Fig. 3).

Discussion

The results of our present study indicate that the exercise capacity and dyspnoea perception, both improve after a six week exercise program. This supports the experimental hypothesis. The 6MWT is a simple and useful measure of functional capacity which is reflected by its main measurements of distance walked and ratings of perceived exertion. 6MWT was performed using the guidelines issued by American Thoracic society in 2002. For the Six minute walk distance our results are comparable to Goldstein *et al* (1994) who also demonstrated a significant improvement of 37.9 meters. Barakat *et al*[19] showed an improvement of 54 meters but their incorporated exercise program was for a duration of 14 weeks. Singh *et al* (2003) in their study of 40 stable subjects showed an improvement of 54 meters over a period of 4 weeks. A probable explanation could be the homogeneous profile of stable COPD while selection. In contrast, our subjects were referred from the department of respiratory medicine and had a few subjects who were sub acute in nature and were recently admitted for an exacerbation.

It is proposed that exercises improve the functional capacity in part by reducing the systemic oxidative stress, changing the ventilatory capacity and improving the respiratory pattern. Regular exercising is also associated with the phenomenon of desensitization to dyspnoea. Recently in a Korean study Sung Soon Lee *et al*[20] demonstrated a significant improvement of 48.8 meters ($p = 0.0017$) after 12 weeks of home-based program. For the dyspnoea indices our finding are comparable to Kirsten and Barakat *et al* who demonstrated a decline of 1.2. They proposed that the reduction in dyspnoea is due to reduced ventilatory

requirements at an identical work rate and identical oxygen consumption.

Conclusion

The results obtained from our study suggest that there is a significant increment in the functional capacity and also an improvement in the dyspnoea ratings in the subjects who underwent a supervised six week exercise therapy program. The parameters were evaluated by utilizing the six minute walk test which worked out to be a simple, inexpensive and quick method to assess the extent of clinical improvement in functional capacity in the persons who underwent an individualised respiratory rehabilitation program. Its use in clinical settings and research themes is recommended from our side.

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