Correlation between spirometric findings and 6-min walk test in patients with chronic obstructive pulmonary disease

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is characterized by permanent respiratory symptoms and limitation of airflow which is due to airway and/or alveolar abnormalities, caused by significant exposure to noxious particles or gases. COPD is a common, preventable, and treatable disease. The present study was undertaken to correlate the spirometric values with the result of 6MWT and to assess whether 6MWT can be used as an alternative test to spirometry in predicting the severity of COPD. **Aims and Objectives:** The present study observed correlate the spirometric values with result of 6-min walk test (6MWT). **Materials and Methods:** A total of 40 male and female COPD patients within the age group of 25–75 years of were part of the study. Spirometric indices forced expiratory volume 1 s(FEV1), %FEV1, forced vital capacity (FVC), FEV1/FVC ratio were recorded. Soon after the spirometry, the subjects were subjected to 6MWT. 6MWT was performed on a 30 m stretch. Distance walked in 6 min was recorded in meters. Predicted 6-min walk distance (6MWD) (For males) = 561.022-(2.507 × age {years}) + (1.505 × weight {kg})-(0.055 × height {cm}) Predicted 6-min walk distance(for females) = 30.325–(0.809 × age {years})-(2.074 × weight {kg}) + (4.235 × height {cm}) Patients were divided into normal (> 80%), mild impairment (60–79%), moderate impairment (40–59%), and severe impairment (< 40%). **Results:** Out of 40 participants, there were 15 females and 25 male participants. In age group of 25–35 years -2 males, 36–45 years-9 patients (6 females and 3 males), 46–55 years -10 cases (5 females and 5 males), 56–65 years -13 patients (3 females and 10 males), 66–75 years- 6 patients(1 female and 5 males. Correlation of 6MWD with FEV1 (P = 0.00026), FEV1% predicted (P = 0.000), FVC (P = 0.00096), FEV1/FVC (0.001). Correlation of % predicted 6MWD with FEV1 (P = 0.001), FEV1 %predicted (P = 0.000), FVC (P = 0.002), FEV1/FVC (0.006). There is significant positive correlation of 6MWD and % predicted 6MWD with FEV1, FEV1 predicted value, FVC, and FEV1/FVC. **Conclusion:** The study results provide additional evidence that the 6MWT is a simple reproducible, inexpensive test to assess the patient's functional capacity in the south Indian population. Further detailed studies are recommended in this area.

Key words: Spirometry; Pulmonary diseases; Chronic obstructive pulmonary disease; Diagnostic tests

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterized by permanent respiratory symptoms and limitation of airflow which is due to airway and/or alveolar abnormalities, caused by significant exposure to noxious particles or gases. COPD is a common, preventable and treatable disease.[1] It is one of the leading cause of the disability, morbidity, and mortality

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throughout the world. Forced expiratory volume in 1st second (FEV1) and forced vital capacity (FVC)[2] play a crucial role in the diagnosis of COPD. Hence, spirometry is the gold standard test to diagnose COPD. Spirometry measures the volume of air exhaled forcibly from the point of maximal inspiration FVC and the volume of air exhaled during the first second of this procedure (in 1 s, FEV1), and the ratio of these two measurements (FEV1/FVC) was calculated. The criteria for airflow limitation is a post-bronchodilator fixed ratio of FEV1/FVC <0.70.[1] Because of its weak specificity, this non-invasive test alone cannot be reliably used as the only diagnostic test.[1] Cardiopulmonary exercise tests (CPET) are also taken into consideration as gold standard tests to assess the exercise capacity and quality of life in COPD. CPET monitor overall responses of the respiratory, cardiovascular, neuromuscular, and hematopoietic systems. However, these tests are time consuming and expensive.[7] 6 min walk test (6MWT) is a simple test which assess the functional capacity of the patient (ability for day to day activities). It is cost-effective requiring minimal equipment and the test is reproducible In remote areas, spirometry is not available all the times. To overcome these situations, we can do 6MWT. In 2002, ATS approved 6MWT as standard test for assessing pulmonary function.[3] The work/energy required to perform the walk is affected by body weight. Hence, the work (energy expenditure) is calculated as force × distance. Therefore, force (body weight) as well as walk distance must be included during assessment of an individual's ability to ambulate.[7] The important goal in COPD management is improvement in patient's symptoms However, in recent years, modified shuttle walk test is also preferred.[2] The spirometric results (FEV1) may or may not relate to the picture of patient's exercise capacity. It is important to understand whether severity stages of GOLD criteria correlate with functional capacity of patient.[3-5] There are only few published articles in India correlating the exercise capacity of the patient with severity of COPD (based on FEV1) The present study was undertaken to correlate the spirometric values with result of 6MWT and to assess whether 6MWT can be used as an alternative test to spirometry in predicting the severity of COPD.

Aim and objectives

The present study observed correlate the spirometric values with result of 6MWT.

MATERIALS AND METHODS

This was a cross-sectional study, approved by institutional ethical committee at Government Thanjavur Medical College and Hospital (IEC-1194/2023 dated July 28, 2023). Before the start of the study, informed written consent was obtained from all study participants. This study was conducted in the Department of Thoracic Medicine in collaboration with the Department of Physiology. A total of 40 male and female COPD patients within the age group of 25–75 years were part of the study. The patients attending to the OPD were screened and recruited the willing participants. All willing, confirmed cases of COPD, within the age group of 25–75 years, in stable clinical conditions and were not on oxygen therapy were part of the study. Patients with severe autonomic dysfunction, evidence of LVF, IHD, other major cardiovascular diseases, neurological diseases, pneumonia, relative contraindications for spirometry include recent abdominal or thoracic surgical procedures, recent eye surgery or retinal detachment, hemoptysis of unknown origin, pneumothorax, unstable angina pectoris, recent myocardial infarction, and thoracic, abdominal or cerebral aneurysms, musculoskeletal pain which would interfere with walk test, exercise-related syncope were excluded from the study. After the recruitment of the participants, demographic data of the participants was recorded. Blood pressure was measured by a manual mercury sphygmomanometer (Diamond Original Mercurial Deluxe Deluxe Bp Monitor). Spirometry was performed as per the standard guidelines mentioned in the literature. For analysis, the best result of three attempts was selected. Spirometric indices FEV1, %FEV1, FVC, FEV1/FVC ratio were recorded. Based on these results, patients were grouped as mild, moderate, and severe and very severe as per guidelines of the American Thoracic Society. Soon after the spirometry, the subjects were subjected to 6MWT. 6MWT was performed on a 30 m stretch. Before the test, patient was rested for 10 min. Resting oxygen saturation (SpO_2), heart rate, blood pressure, baseline dyspnea, and respiratory rate were recorded before and after the end of the test. Then, the patient was asked to walk as much distance as possible in 6 min. Distance walked in 6 min was recorded in meters. Percent (%) 6 min walk distance (6MWD) was calculated from Indian reference equation.[6] Predicted 6MWD (For males)=561.022–(2.507×age [years])+(1.505×weight [kg])–(0.055×height [cm]) Predicted 6MWD (for females)=30.325–(0.809×age [years])–(2.074×weight [kg])+(4.235×height [cm]) Patients were divided into normal (>80%), mild impairment (60–79%), moderate impairment (40–59%) and severe impairment (<40%).

Statistical analysis

Data were analyzed using SPSS 20.0 version. The correlation was observed using the Pearson correlation coefficient test. A probability value of <0.05 was considered significant.

RESULTS

Mean and SD of the parameters recorded in the participants were presented in Table 1. The mean and standard deviation of parameters such as age (54.15±11.92 years), body mass index (21.84±3.97 kg/m²), FEV1 (1.10±0.54 L), FEV1%

Predicted (51.38±24.27 L), FVC (1.82±0.71), FEV1/FVC (26.97±31.62), 6MWD (298.63±85.20). Out of 40 participants, there were 15 female and 25 male participants. In age group of 25–35 years -2 males, 36–45 years -9patients (6 females and 3 males), 46–55 years -10 cases (5 females and 5 males), 56–65 years -13 patients (3 females and 10 males), 66–75years- 6 patients (1 female and 5 males). Table 2 presents the number of Patients in various stages of severity of COPD. Six participants were in mild category, 13 were moderate, 14 were in severe, and 7 were in very severe category. Table 3 shows correlation of 6MWD and % predicted 6MWD with spirometric values. The correlation of 6MWD with FEV1 (P=0.00026), FEV1% predicted (P=0.000), FVC (P=0.00096), FEV1/FVC (0.001). Correlation of % predicted 6MWD with FEV1 (P=0.001), FEV1%predicted (P=0.000), FVC (P=0.002), FEV1/FVC (0.006). There is significant positive correlation of 6MWD and %predicted 6MWD with FEV1, FEV1 predicted value, FVC, and FEV1/FVC (Table 4).

DISCUSSION

COPD has a definite social and economic impact. It is a leading cause of morbidity and mortality worldwide. As per the World health organization, COPD is the third-leading cause of mortality and fifth-leading cause of morbidity in 2020. The 6MWT is considered an effective tool for assessing

Table 1: Mean and SD of the parameters recorded in the participants

Parameters	Mean and SD
Age (years)	54.15±11.92
BMI (kg/m²)	21.84±3.97
FEV1	1.10±0.54
FEV1% predicted	51.38±24.27
FVC	1.82±0.71
FEV1/FVC	26.97±31.62
6-min walk actual distance (meters)	298.63±85.20

Data were presented as mean and SD. FEV1: Forced expiratory volume, FVC: Forced vital capacity, BMI: Body mass index

Table 2: Number of patients in gender wise

Gender	Frequency	Percentage
Female	15	37.5
Male	25	62.5

Table 3: No. of Patients in various stages of severity of COPD

% Predicted FEV1	Female	Male	Total
Mild (≥80)	2	4	6
Moderate (50–79)	5	8	13
Severe (30–49)	5	9	14
Very severe (<30)	3	4	7

Data was presented as mean and SD. COPD: Chronic obstructive pulmonary disease, FEV1: Forced expiratory volume

exercise tolerance.[13] There are only few studies correlating 6MWD with spirometry values in COPD patients in our location. 6MWT is commonly used in the diagnostic tests for COPD patients. The spirometry test is considered Gold standard for assessing the disease severity, and staging of COPD and also for management. However, it is costly and is not available in many centers of India, particularly in rural areas where we have poor infrastructure. Furthermore, it requires a respiratory technician and is effort-dependent our study includes 40 COPD patients. The percentage of male and female patients was 62.5% and 37.5%, respectively. 52.5% of our patients belong to Stage 3 and Stage 4. The present study showed that % predicted FEV1 and FVC had strong significant positive correlation with 6MWD as well as percent predicted 6MWD. Hence, fall in FEV1 or FVC or both were associated with a significant fall in 6MWD. The previous study showed a positive linear correlation between 6MWT and absolute values of spirometric indices FEV1, FVC[1] Another study showed a significant correlation of 6MWD and % 6MWD with spirometric and clinical indices (Peak expiratory flow rate, FEV1, %FEV1, FVC, and height)[3] The result of this study contradicted the reports of Andrello AC et al., which did not find significant correlation between 6MWD and FEV1.[8] The assessment of the correlation between the 6MWD and spirometry helps not only to understand the severity of the disease but also helps to plan the early interventions.[9] Earlier study reported that the 6MWD was significantly correlated with the spirometry values in the patients with respiratory disorders.[10] Interestingly, it was observed that the 6MWD was correlated significantly with the readings of echocardiography.[11] Another study observed the correlation between the 6MWD and spirometry parameters in patients with pulmonary hypertension. Significant correlation was observed which suggest that the 6MWD is an alternative test for spirometry.[12] The present study has immense importance, especially in a rural setup when the spirometry is not available. The correlation of 6MWD with FEV1 (P=0.00026), FEV1 % predicted (P=0.000), FVC (P=0.00096), FEV1/FVC (0.001). Correlation of % predicted 6MWD with FEV1 (P=0.001), FEV1 % predicted (P=0.000), FVC (P=0.002), FEV1/FVC (0.006). There is significant positive correlation of 6MWD and % predicted 6MWD with FEV1, FEV1 predicted value, FVC, and FEV1/FVC observed in the present study. The study results support that the 6MWT is a simple reproducible, inexpensive test to assess the patient's functional capacity. Further detailed studies are recommended in this area. The most important aspect that should be considered is the pulmonary hypertension in the patients who fails to perform the walk test. I such patients it is recommended to assess the SpO$_2$ in each followup.[14] Further, interesting aspect to be considered is that although there are multiple studies quoted positively about the correlation, there

Table 4: Correlation of 6MWD and % predicted 6MWD with spirometric values

Variables	6 min walk distance	P-value	% Predicted 6MWD	P-value
AGE	0.014	0.92	0.213	0.187
FEV1	0.613	0.000026	0.504	0.001
FEV1% Predicted	0.758	0.0000	0.756	0.000
FVC	0.577	0.000096	0.482	0.002
FEV1/FVC	0.487	0.001	0.426	0.006

FEV1: Forced expiratory volume, FVC: Forced vital capacity, 6MWD: 6 min walk distance

should be consideration to the efforts that the patients are keeping during the test and the characteristics of the patients which is subjective.[15]

Limitations of the study

As the study is preliminary, the sample size is less. Hence, the results may not be generalized. The control group was not included in the study.

CONCLUSION

The study results provide additional evidence that the 6MWT is a simple reproducible, inexpensive test to assess the patient's functional capacity. Further detailed studies are recommended in this area.

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SS- Design of the study, review of literature, analysis and preparing the manuscript; **VV-** Data collection, preparing the manuscript; **VS and SSKG-** Analysis and preparing the manuscript.

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