Original Research Article

Study on correlation between six minute walk test and BODE index in chronic obstructive pulmonary disease patients

Babulal Bansiwal[1], Anees K. V.[3], Maneesha Jelia[2], Satyam Agarwal[1]*

[1]Department of Respiratory Medicine, [2]Department of Anatomy, GMC, Kota, Rajasthan, India
[3]Department of Pulmonary medicine, FHC Pulingome, Kannur, Kerala, India

*Correspondence:
Dr. Satyam Agarwal,
E-mail: satyamagarwal95@gmail.com

ABSTRACT

Background: Chronic obstructive pulmonary disease is preventable and treatable disease with progressive persistent airflow limitation and enhanced chronic inflammatory response in the airways. Indian council of medical research conducted a study and found that total burden of COPD in India has more than doubled to about 14.84 million in 2011 from about 6.45 million in 1971

Methods: It was an open label cross sectional study. It was conducted on patients attending the outpatient department of respiratory medicine, new medical college and hospital, Kota, over a period of one year. 100 COPD patients attending the respiratory outpatient department of GMC, Kota and fulfilling the inclusion criteria's were included in the study. A diagnosis and severity of COPD was established by clinical symptoms and spirometric data as per GOLD guideline (ratio of FEV1 and forced vital capacity <0.7).

Results: We found a significant negative correlation (Pearson correlation coefficient r = -0.664, p< 0.001) between 6 MWD and BODE index in study population.

Conclusions: Thus, we concluded that the functional exercise capacity of COPD patients measured by 6MWT deteriorates linearly with severity of the disease assessed by the GOLD staging criteria. Hence we can use 6 MWT for assessing the severity of COPD in place of spirometry where the facility of spirometry is not feasible.

Keywords: Chronic obstructive pulmonary disease, Indian council of medical research, BODE, 6 MWT

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is preventable and treatable disease with progressive persistent airflow limitation and enhanced chronic inflammatory response in the airways. Exacerbations and comorbidities contribute to the overall severity in individual patient.[1]

According to World Health Organization (WHO), COPD will be the third leading cause of mortality and fifth leading cause of morbidity by 2020.[2] Recently Indian council of medical research (ICMR) conducted a study and found that total burden of COPD in India has more

than doubled to about 14.84 million in 2011 from about 6.45 million in 1971. This is generally attributable to the overall increase in the population of India

This study aimed to investigate the correlation between 6 MWT (minute walk test) performed on representative sample of patients with COPD and BODE index.

METHODS

Study design

The study was an open label cross sectional study.

Study population

Study was conducted on 100 COPD patients attending the outpatient department of respiratory medicine, new medical college and hospital, Kota, over a period of one year from August 2015 to July 2016.

Inclusion criteria was patients with COPD with any severity as defined by GOLD 2019 guidelines (FEV1/FVC <0.7). Exclusion criteria were patients with ischemic heart disease or heart failure, patients with resting heart rate >120 bpm, systolic BP >180 and DBP >100, patients with respiratory failure, neurological, musculoskeletal and peripheral vascular disease in lower extremities, patients with asthma, pneumonia, lung cancer, tuberculosis and other respiratory illness limiting patient's movements and patients not willing to be a part of the study.

Data collection

A clinical diagnosis of COPD had been considered in any patient with progressive exertional dyspnoea, chronic cough and sputum production and history of exposure to risk factors. After taking an informed consent, thorough history was taken. Physical examination and investigations were done to rule out exclusion criteria and to detect other comorbidities. Age, gender, weight and height of the patient were noted. A diagnosis and severity of COPD was established by clinical symptoms and spirometric data as per GOLD guidelines, ratio of FEV1 and forced vital capacity (FVC) <0.7.

Six minute walk test

After diagnosing COPD by spirometry 6 MWT was performed in every cases in a 30 meter long and ventilated indoor corridor according to ATS guidelines.[3] All the patients were made to undergo the 6 MWT within 1 hour of spirometry.

Evaluation

Severity of dyspnoea was evaluated using the BORGE scale (Table 1).[4] The lap counter was set to zero and timer to 6 minutes. Patients were instructed to walk as far as possible for 6 minutes and slow down, or stop to rest as necessary. Patients were given one lap demonstration and started the test. Encouraging phrases such as "keep up the good work", "well done", and "good" were used during the test. All the subjects were allowed to stop if there was chest pain, dyspnoea, or diaphoresis during the test and then allowed to continue walk when they felt better. However, the resting time was included in the 6 minute time period. The test was discontinued if patients experienced any chest pain, severe dyspnoea, spasm of lower extremity muscles, or if the patient wanted to quit. At the end of the test, blood pressure, heart rate, oxygen saturation by pulse oximeter and the distance walked for 6 minutes in meters were recorded. The percentage predicted 6 MWD (minute walk distance) was calculated by using Enright et al formula.[5] The patients were asked to be observed for a 10-15 minutes period after the test, to assess any possible complications. The 6 MWW (minute walk weight) was calculated by multiplying the body weight in kilograms with walking distance in meters.[6] BODE index consisting of body mass index (BMI), airflow obstruction, dyspnoea, and exercise capacity was calculated for each patient.[6]

Table 1: The BORGE scale.

Grade	Degree of breathlessness
0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight (light)
3	Moderate
4	Somewhat severe
5-6	Severe (heavy)
7-9	Very severe
10	Very, very severe (maximal)

Statistical analysis of the data was performed using the statistical package for the social science (SPSS) program. Results were expressed as mean±standard deviation. Analysis of variance (ANOVA) f test, and estimation of p value, correlation coefficient (r) and regression analysis were done.

RESULTS

Severity of COPD

Based on GOLD criteria, the patients were divided into 4 groups depending on FEVI expressed as the percentage of their predicted values (Table 2). Majority of patients (83%) had severe and very severe COPD, 2 patients had mild COPD, and 15% had moderate COPD.

Table 2: Distribution of cases according to severity of COPD.

Severity of COPD	FEVI % predicted	N (%)
Stage 1	≥80	2 (2)
Stage 2	50-79	15 (15)
Stage 3	30-49	50 (50)
Stage 4	<30	33 (33)
Total		100 (100)

Six minute walk distance

Mean and standard deviation of 6 MWD values among different COPD stages and their comparison to the FEV1 measurements are shown in (Table 3). The mean and standard deviation of 6 MWD values among different GOLD staging of COPD patients were calculated. The

mean value of 6 MWD was 377.00 meters with standard deviation (SD) of 9.89 meters in patients with stage I COPD. Whereas, the mean and SD of 6 MWD were 336.67±13.25 meters, 301.64± 20.20 meters and 272.58± 24.07 meters among stage II, III and stage IV COPD respectively. Total range of 6 MWD was 230-387 meters.

Table 3: Mean and standard deviation of 6 MWD values among different COPD stages.

Severity of COPD	FEVI % predicted	N	6 MWD Mean±SD (meters)	6 MWD % predicted (Mean±SD)
Stage 1	>80	2	377.00± 9.89	67.66±12.78
Stage 2	50-79	15	336.67±13.25	56.49±7.89
Stage 3	30-49	50	301.64±20.20	52.20±6.78
Stage 4	<30	33	272.58±24.07	48.07±6.18
Total		100	298.81±31.45	51.79±7.66

*$p=0.00$, correlation is significant at 0.01 level

A significant association was observed between the severity of COPD measured by FEV1% and the result of the 6MWD ($f=44.258$ and $p<0.001$). We could also make a similar inference of association between the severity of COPD measured by FEV1% and the % predicted 6 MWD ($f=9.246$ and $p<0.001$).

Significant negative correlation (Pearson correlation coefficient $r= -0.664$, $p<0.001$) between 6 MWD and BODE index in study population was observed (Table 4), however no such relation between 6 MWD and BMI could be proved.

Table 4: Correlation between 6 MWD with BODE index.

Spirometry parameters	r	p value
BODE index	-0.664	<0.001

BODE Index

We found a significant negative correlation (Pearson correlation coefficient $r= -0.664$, $p<0.001$) between 6 MWD and BODE index in study population (Table 5).

DISCUSSION

Most of the information available on COPD prevalence, morbidity and mortality comes from developed countries. Even in these countries, accurate epidemiological data on COPD are difficult and expensive to collect. Prevalence and morbidity data underestimate the total burden of COPD because as disease is usually undiagnosed until it is clinically apparent.

The development of COPD is multifactorial and the risk factors of COPD include genetic and environmental factors. The cellular events that occur in the small airways in COPD include replacement of Clara cells with mucus-secreting and infiltrating mononuclear cells and goblet cell metaplasia.[7] Smooth muscle hypertrophy is also an important finding. As a result of excess mucus secretion, oedema formation, cellular infiltration and the resultant fibrosis cause airway narrowing. The proposed pathogenesis of COPD includes proteinase-antiproteinase hypothesis, immunological mechanisms and oxidant-antioxidant balance. Typical symptoms of COPD include dyspnoea, cough with sputum production, chest tightness, wheezing and other symptoms. Chronic cough usually produces sputum that may be clear, white, yellow or greenish. Blueness of the lips or fingernail beds (cyanosis), frequent respiratory infections, Lack of energy and weight loss (in later stages) is common features. GOLD is a global consensus-group of scientists from the US National heart, lung, and blood institute and the World Health Organization (WHO). GOLD has defined COPD to be present when the FEV1/FVC ratio is below 70%.[1]

Table 5: Number of cases in different points of BODE index.

BODE index	Points	N
Post FEV1 (%)		
≥65	0 points	5
50-64	1 point	12
36-49	2 points	35
≤35	3 points	48
6 Minute walk distance (meters)		
≥350	0 points	6
250-349	1 point	87
150-249	2 points	7
≤149	3 points	0
mMRC dyspnea scale		
mMRC 0-1	0 points	13
mMRC 2	1 point	32
mMRC 3	2 points	55
mMRC 4	3 points	0
Body mass index		
>21	0 points	16
≤21	1 point	84

Exercise testing

There are several modalities available for the objective evaluation of functional exercise capacity. The most popular clinical exercise tests in order of increasing complexity are stair climbing, a 6MWT, a shuttle-walk test, detection of exercise-induced asthma, a cardiac stress test (Bruce protocol), and a cardiopulmonary exercise test.[8,9]

Six minute walk test

The 6 MWT is a simple test requires a 100 feet hallway with no exercise equipment or special training for technicians. This test measures the distance a patient can walk on a flat, hard surface in a 6 minutes period (6 MWD). It evaluates the responses during exercise, including the cardiovascular systems and pulmonary, peripheral circulation, systemic circulation, blood, neuromuscular units and muscle metabolism. It allows choosing own intensity of exercise and stopping to rest during the test. However, it reflects the functional exercise level for daily physical activities.

Indications

Pre-treatment and post treatment comparisons include lung transplantation, lung resection andlung volume reduction surgery. Functional status (single measurement) of COPD, cystic fibrosis, heart failure and peripheral vascular disease. Predictor of morbidity and mortality in terms of heart failure, COPD and primary pulmonary hypertension.

Contraindications

Unstable angina during the previous month and myocardial infarction during the previous month.

BODE index

It is a prognostic tool in COPD. Physicians are poor prognosticators of survival in COPD. A multi dimensional prognostic index that takes into account several indicators of COPD prognosis is the BODE index (body mass index, obstructive ventilatory defect severity, dyspnoea severity, and exercise capacity).[10] For calculation of the BODE prognostic score, the components are derived from measures of the body mass index (weight in kilogram/height in square meter), FEV1 percent predicted, and the modified medical research council (mMRC) dyspnoea score (Table 6).

Table 6: BODE prognosis score.

BODE score	2 year mortality (%)
>7	30
5-6	15
<5	<10

Four variables identified as being predictive of survival in patients with COPD and the values (0–3) assigned to each variable by category (Table 7).

Table 7: Variable points on the BODE index.

BODE index parameters	Score			
	0	1	2	3
Body mass index (kg/m2)	>21	≤21	-	-
FEV1 (% predicted)	≥65	50-64	36-49	≤35
Distance walked in 6 minutes (meters)	≥350	250-349	150-249	≤149
mMRC dyspnoea scale (score)	0-1	2	3	4

A significant negative correlation (Pearson correlation coefficient r= -0.664, p<0.001) of 6 MWT with BODE index was observed which implies that there was decrease in 6 MWD with increasing BODE index (i.e. with increasing severity of disease). Thus 6 MWT also was able to predict severity of COPD. Though BMI correlates well with severity of COPD as shown by Landbo et al in their study, we did not find a strong correlation between BMI and 6MWD and this finding was comparable with the study done by Santana et al.[11,12]

CONCLUSION

Thus, we conclude that the functional exercise capacity of COPD patients measured by 6MWT deteriorates linearly with severity of the disease assessed by the GOLD staging criteria. Hence we can use 6MWT for assessing the severity of COPD in place of spirometry where the facility of spirometry is not feasible.

REFERENCES

1. Global strategy for diagnosis, management, and prevention of COPD. Available at: http://goldcopd. org/global-strategy-diagnosis-management-prevention-copd-2016/. Accessed on 10 June 2020.
2. Murray CJ, Lopez AD. Evidence based health policy lessons from the global burden of disease study. Science. 1996;274:7403.

3. Casanova C, Cote CG, Marin JM, Torres JP, Aguirre-Jaime A, Mendez R, et al. The 6-min walking distance: Long-term follow up in patients with COPD. Eur Respir J. 2007;29:535-40.
4. Borg GAV. Psycho-physical bases of perceived exertion. Med Sci Sports Exerc. 1982;14:377-81.
5. Enright PL, Sherrill DL. Reference equations for the six-minute walk in healthy 16] adults. Am J RespirCrit Care Med. 1998;158:1384-87.
6. Chuang ML, Lin IF, Wasserman K. The body weight-walking distance product as related to lung function, anaerobic threshold and peak VO2 in COPD patients. Respir Med. 2001;95:618-26.
7. Shapiro SD, Ingenito EP. The pathogenesis of chronic obstructive pulmonary disease: advances in the past 100 years. Am J Respir Cell Mol Biol. 2005;32:367-72.
8. Wasserman K, Hansen JE, Sue DY, Casaburi R, Whipp BJ. Principles of exercise testing and interpretation, 3rd ed. Philadelphia: Lippincott; 1999:116.
9. Weisman IM, Zeballos RJ. An integrated approach to the interpretation of cardiopulmonary exercise testing. Clin Chest Med. 1994;15:421-45.
10. Celli BR, Cote CG, Marin JM, et al: The Body mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med. 2004;350:1005-012.
11. Santana P, Cintra RM, Rodrigues F, Casanova C, Oca MM, Mendez RA, et al. Correlation study on the result from measures of function and functionality test of COPD patients. Available at: http://www.scriptiesonline.bib.hva.nl/documeny/127414. Accessed on 10 June 2020.
12. Landbo C, Prescott E, Lange P, Vestbo J, Almdal TP. Prognostic value of nutritional status in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1999;160:1856-61.