Evaluation of correlation of oxygen desaturation with bode index in stable COPD patients

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Abstract---Introduction: Chronic Obstructive Pulmonary Disease (COPD) is the world's third leading cause of death, accounting for 3.23 million deaths in 20191. It is the second major cause of death in India and affects an estimated 53 million people 1. BODE INDEX is multivariable grading system that estimates severity of respiratory and systemic components of COPD patients and was designed to predict quality of life in COPD patients. The four variables BMI (B), FEV1% predicted (O), Dyspnoea (D) as measured by MMRC, Exercise capacity (E) as measured by the six-minute–walk test. In stable COPD patients desaturation upon exertion is a major factor which can be used as a predictor of QOL (quality of life) , future exacerbations, severity of the

disease etc. The current study is focussed upon estimation of COPD prevalence by clinical severity stages as measured by BODE index and the correlation between exercise induced desaturation and various quartiles of BODE INDEX in stable COPD patients. Methodology: In this prospective study we included 50 stable COPD patients. BODE index was calculated, 6MWT was performed and desaturation on exertion was noted in all patients and the two parameters are correlated. Results: In this study it is observed that there is no exertional desaturation in patients with BODE Quartile 1 (score 0-2) and there is desaturation in (5 patients) 100% patients with BODE Quartile 4 (score 7-10). In patients with BODE Quartile 2 (score 3-4) desaturation is observed in 7 patients out of 18 patients that corresponds to 38.8% of the total patients in stage 2. In patients with BODE Quartile 3 (score 5-6) desaturation is observed in 7 patients out of 14 patients that corresponds to 50 % of the total no of patients in Quartile 3. Conclusion: Our study demonstrated that there is a strong association and correlation between high BODE score (BODE quartile 4, score 7-10) and exercise induced desaturation which helps us to modify the treatment and educate the patient about preventive measures to stop further progression and complications of the disease.

Keywords---COPD, BODE INDEX, exercise, desaturation.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is the world's third leading cause of death, accounting for 3.23 million deaths in 2019[1]. It is the second major cause of death in India and affects an estimated 53 million people[1]. The COPD's economic burden in India is estimatedto be over 6.2 billion USD per year[2], however this figure is likely to be underestimated. Despite the growing and huge burden of COPD in India, more than 95% of COPD patients in the community are undiagnosed.[3] COPD is a chronic disease, in the natural history of the disease, COPD patients typically experience episodes of exacerbation. An acute worsening of pulmonary symptoms that result in additional therapy is known to be COPD exacerbation [4]. The task of providing medical aid to the most needful patients without knowing the prevalence of the disease in various grades of severity can be a tough proposition in disease like COPD which affects vast number of patients. We also need a good and consistent grading system that is designed properly which helps to identify those who are in highest need of a therapeutic intervention in healthcare support system. Celli postulated the BODE index to satisfy this purpose in COPD patients.

Bode Index is multivariable grading system that estimates severity of respiratory and systemic components of COPD patients and was designed to predict outcome in COPD patients. The four variables that predicted the severity best were the BMI (B), FEV1% predicted (O), Dyspnoea (D), Exercise capacity (E) as measured by the six-minute–walk test. Exercise intolerance is seen in many COPD patients and is likely a multi-factorial origin. The 6 minute walk distance (6MWD) is a simple test

which has also been correlated with mortality in COPD in various settings like Lung Volume Reduction Surgery[6] and Pulmonary rehabilitation [5]. The 6MWT has been considered to be more sensitive than maximum incremental cycle testing for the detection of oxygen desaturation; it has become the preferred test for the evaluation of oxygen requirements in COPD[7].Even if there is no obvious resting hypoxemia, the daily activities of patients with moderate to severe COPD, such as walking, washing, and eating, are also associated with a transient decrease in oxygen saturation [8]. The possibility of exacerbation increases by 50%, higher decline in lung function, and the mortality rate is doubled in COPD with ED compared to that without ED [9]. SpO2 during a 6MWT identifies a COPD phenotype with an increased risk of morbidity and mortality [10]. As BODE index predicts the quality of life in COPD patients even desaturation on exertion also contributes as a major factor in predicting the Quality Of Life. The current study is focussed upon estimation of COPD prevalence by clinical severity stages as measured by BODE index and the correlation between exercise induced desaturation and various quartiles of BODE INDEX in stable COPD patients.

Methodology

In this prospective study we included 50 stable COPD patients visiting the Department of Respiratory medicine, NRI medical college, Sangivalasa, Visakhapatnam. BODE index was calculated, 6MWT was performed and desaturation on exertion was noted in all patients and the two parameters are correlated. Patients with acute exacerbation of COPD, cardiovascular disease, age < 40 years, unrelated life-threatening major illness (lung cancer, neurological disease), with other active pulmonary disease or other systemic diseases and those who are unable to perform PFT/ 6 min walk test are excluded. Each patient's BODE index was calculated by using the formula Weight in kgs/(Height in meter)^2 to measure BMI, spirometry to measure the obstruction, MMRC classification to grade the dysnoea of patient and 6MWT is performed to know the exercise capacity. Oxygen saturation levels were recorded along with 6MWT. After calculating the patients are distributed into 4 Quartiles depending on the BODE index scoring, and the oxygen saturation levels which were recorded along with 6MWT are correlated to the BODE Quartiles.

Results

Correlation of BODE score and Desaturation

Table 1
Correlation of BODE score and Desaturation

Bode Score	Total No Of Patients	Patients With Desaturation	Patients Without Desaturation
Quartile 1 (0-2)	13	0(100%)	13(100%)
Quartile 2 (3-4)	18	7(38.8%)	11(61.1%)
Quartile 3 (5-6)	14	7(50%)	7(50%)

Quartile 4 (7-10)	5	5(100%)	0(0%)

In this study it is observed that there is no exertional desaturation in patients with BODE Quartile 1 (score 0-2) and there is desaturation in (5 patients) 100% patients with BODE Quartile 4 (score 7-10). In patients with BODE Quartile 2 (score 3-4) desaturation is observed in 7 patients out of 18 patients that corresponds to 38.8% of the total patients in stage 2. In patients with BODE Quartile 3 (score 5-6) desaturation is observed in 7 patients out of 14 patients that corresponds to 50 % of the total no of patients in Quartile 3.

Correlation between desaturation and 6 minute distance walked

Table 2
Correlation between desaturation and 6 minute distance walked

6MWD in meters	Total No of patients	Desaturation	No desaturation
>350	10	0(0%)	10(100%)
250-349	16	3(18.7%)	13(81.2%)
150-249	21	13(61.9%)	8(38%)
<149	3	3(100%)	0(0%)

It is observed that among 10 patients who walked > 350 meters none got desaturated.3 (18.7%) out of 16 patients who walked 250-349 meters, 13 (61.9%)out of 21 patients who walked 150-249 meters , 3(100%) out of 3 patients who walked <149 got desaturated.

Correlation of patients in BODE quartile 4 with desaturation and the statistical significance

Table 3
Correlation of patients in BODE quartile 4 with desaturation and the statistical significance

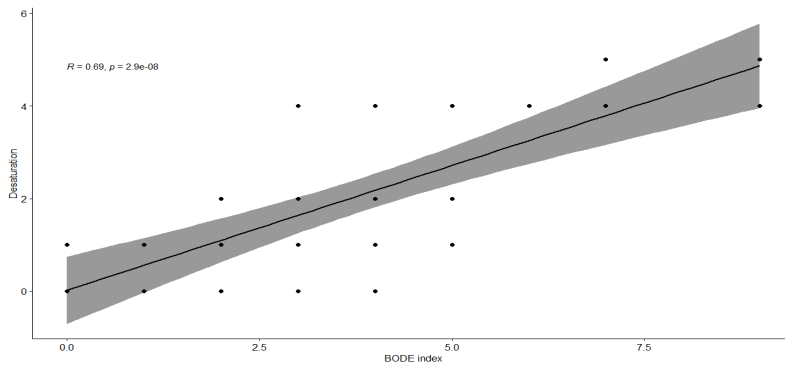|	Desaturation	No Of Patients	Percentage	P Value	R Value
BODE QUARTILE 4	Yes	5	100%	<0.001	0.6903804
	No	0	0%		

Chart 1. Correlation of patients in BODE quartile 4 with desaturation and the statistical significance

There is an association and correlation between high BODE score (BODE quartile 4, score 7-10) and exercise induced desaturation. Patients with higher BODE score ie in 4th quartile had more chances of desaturation showing strong statistical significance with p value of <0.001 and R value of 0.6903804.

Discussion

COPD is one of the commonest cause of illness burden both internationally and in India. It is a leading cause of death and morbidity all over the world[12]. COPD is expected to be the top cause of death on the globe by 2030[13]. COPD was shown to be more prevalent in men than women in the current study, as expected. There were 38 male (76%) patients and 12 female (24%) patients. Recently in 2021, Daniel et al mentioned that Prevalence of this disease among the Indian population as 7.4% and the prevalence among males and females was 11.4% (95% CI: 6.0%-16.9%) and 7.4% (95% CI: 5.2%–9.6%), respectively[14]. These studies show a significant variation in the prevalence indicating the rising disease burden. According to recent evidence, the prevalence and mortality of COPD have risen faster in women than in males[15].

In this study all the men ie 100% were smokers and 33.3% (4 female) of women were reverse chutta smokers and also had biomassfuel (BMF) exposure. 66.6% (8 female) had BMF exposure only. According to meta analysis done by Utkarsh Pathak et al in 2020 exposure to biomass smoke is strongly associated with COPD[22]. Similar findings have been made in other developing countries[21], implying that the health risk of COPD caused by biomass smoke exposure is comparable to that caused by tobacco smoking. In COPD patients, the BODE index predicts survival and is used as a prognostic indicator of mortality [18]. The predictive potential of this index is being improved by integrating additional variables and extending validation in different COPD cohorts [19]. According to previous research, oxygen desaturation during daily activities may have a negative impact on survival. Despite of the fact that this is an unresolved issue, recent research suggests that exertional desaturation may be a significant mortality factor. The BODE index and other related tools for determining disease severity [18] do not include a measure of oxygen saturation during exercise.

Patients who desaturated early while doing the 6MWT had a higher risk of desaturating during everyday activities and developing severe hypoxemia. Another theory is that individuals who desaturate during activity have a more prevalence of nocturnal desaturation, which leads to chronic micro-trauma, as observed in a study by Scott et al[16]. Different methods of cardiopulmonary exercise testing (CPET) have been utilised in the past to detect patients with exertional desaturation[16]. Even in individuals who were not hypoxemic at rest, some authors identified a substantial link between desaturation during CPET or 6MWT and mortality[17].The 6MWT is more sensitive than the cycle CPET in detecting desaturation during exercise, implying that the sensitivity of exercise testing techniques for detecting hypoxemia varies[16].

Among the 50 stable COPD patients who participated 19 (38%) patients showed desaturation and 31 (62%) patients didn't show any significant desaturation. All the three patients who are females in the age group 40-50 got desaturated and they fall one each in BODE quartiles 2,3,4 . In the age group 51-60 3 (30%) males and 1 (100%) female falling in BODE quartile 2, 2(66%) male and 3(100%) female in BODE quartile 3, 3(100%) females from BODE quartile 4   got desaturated. In the age group 61-70 desaturation is observed in 1 male (100%) each in 2,3,4 quartiles respectively. Compared to ECLIPSE[11] study which showed desaturation in only 20% of patients in their cohort, present study showed desaturation in 38% of patients and it may be due to presence of more number of obese patients particularly females with desaturation as explained earlier.

In this study it is observed that there is no exertional desaturation in patients with BODE Quartile 1 (score 0-2) whereas desaturation is seen in all 5 patients (100%) with BODE Quartile 4 (score 7-10). In patients with BODE Quartile 2 (score 3-4) desaturation is observed in 7 patients out of 18 (38.8%). In patients with BODE Quartile 3 (score 5-6) desaturation is observed in 7 patients out of 14 (50%) of the total number of patients in Quartile 3. Exertional desaturation correlated positively with BODE index and all patients with BODE index >7 showed desaturation. Daily activities were categorised into four categories by Michael Cutania et al[20], 1.Walking, 2.Slow-Intermittent-Walking (SIW), 3.Active-Not-Walking (ANW), and 4.Rest. For Walking and SIW, there was a substantial association between BODE score and desaturation. Desaturation was seen in 21, 44, and 86 percent of patients in BODE groups I, II, and III, respectively, during walking, which corresponds to 6MWT in our study. As in this study, an increasing percentage of patients were desaturated as the severity of BODE index increased and all patients with BODE score of 7 and above displayed desaturation while walking. In their investigation, no differences were observed between patients who used LTOT and those who didn't use LTOT[20].

The finding of an association between BODE score and exertional desaturation after 6MWT is a new finding suggesting that the BODE index may have clinical utility as a screening tool to identify patients with exertional desaturation. As BODE index and EID are markers of severity it is worthwhile to study the prognosis of patients with BODE scale severity plus EID compared to BODE index alone and EID alone with a prospective study comprising large number of COPD patients.

Conclusion

The current study and many other studies mentioned show a link between desaturation and disease severity. The BODE index is an easy to apply scale in determining the disease severity and prognosis in COPD. Our study demonstrated that there is strong association between desaturation and BODE scale. All COPD patients in BODE 2, 3 and 4 quartiles must be screened for desaturation with 6mt walk test. After advent of Covid-19 most of the population is aware of pulse oximeters, oxygen desaturation and 6mt walk test. The finding of desaturation may also act as a warning sign to quit smoking in current smokers and also stop biomass fuel exposure in women and may also help the patient to adhere to treatment. Smoking cessation, decreasing biomass fuel exposure and adherence to treatment in turn help to lower mortality and also alleviate the need for LTOT which is a costly commodity and not within reach of many households.

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