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Correlation of BODE Index with Diffusing Capacity of Lung for Carbon Monoxide in Assessing Disease Severity in Chronic Obstructive Pulmonary Disease

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Abstract: ***Background: Chronic Obstructive Pulmonary Disease(COPD) is the third leading cause of death globally but about 90% of COPD mortality occurs in low- and middle-income nations. There are several studies in literature on role of BODE Index and DLCO (Diffusion capacity of carbon monoxide) as independent factors in predicting prognosis and disease severity in COPD. But there is paucity of data pertaining to relationship between BODE Index and DLCO in establishing disease severity in COPD. In this study, we intend to analyze correlation between BODE index and DLCO in patients with various stages of COPD. Methods: The study was conducted as an observational, cross-sectional, study involving stable COPD patients(diagnosed and grouped according to GOLD guidelines) of all age groups attending respiratory medicine OPD of a tertiary care hospital .The 73 patients selected were subjected to spirometery,DLCO and Six minute walk Test(6MWT) after taking proper history and detailed physical examination.Subsequently BODE index was calculated and patients were categorized amongfour quartiles of BODE index, similarly patients were also categorized based on DLCO(Mild, Moderate, Severe,Very severe).Uncategorized and categorized data on BODE index and DLCO were correlated independently various groups of GOLD classification (Group A,B,C& D).Association between various study variables was doneby chi-square test. Spearman correlation coefficient was used to correlate BODE Index and DLCO. Results:Majority of patients in our study were belonging to quartile -2 of BODE score, Medium grade according to CAT score and category "D" according to GOLD. In our study BODE score was much better in predicting the prognosis in COPD than FEV1.BODE index was correlated well with GOLD scoring. Conclusion: Overall BODE index is accurate in categorizing COPD severity. Cross tabulation with DLCO categories and GOLD categories showed better correlation compared to BODE index.***

Keywords: COPD, DLCO, BODE

1. Introduction

According to WHO estimates, nearly 65 million individuals have modest to severe COPD. More than 3 million persons deceased of COPD in 2005, which is about 5% (roughly estimate to 1 in 20) of all mortality globally. Maximum of the evidence available on COPD occurrence, illness and death comes from high-income and industrialized nations. Even in those nations, precise epidemiologic statistics on COPD are difficult and expensive to collect. And about 90% of COPD mortality occurs in low- and middle-income nations. (1). Total deaths due to COPD are likely to increase by more than 30% in the next 10 years unless urgent action is taken to decrease the underlying risk factors, particularly tobacco usage. (2). A range of factors have been identified as predictors of future risk on morbidity and mortality in patients with COPD. An objection can be made for measuring gas transfer (DLCO) in routine clinical practice for patients with COPD. To assess the finest prognostic information, forthcoming classifications of COPD may also include DLCO and not depend simply on the severity of obstruction in airway. Combining quite a few of these prognostic aspects in a multidimensional index like BODE index enables physician to evaluate and screen illness severity and aids in decision making for better management of disease (3).

Although there are several studies in literature on role of BODE Index and DLCO as independent factors in predicting disease severity in COPD, there is paucity of data pertaining to relationship between BODE Index and DLCO in establishing disease severity in COPD(4-6). In this study, we intend to analyze the correlation between BODE index and DLCO in predicting disease severity in COPD. The secondary objective is to relate variables of BODE index with DLCO

2. Methods

This was an observational cross-sectional study conducted among the COPD patients attending theRespiratory medicine OPD of a tertiary care hospital during the period of June 2017 – June 2018 after approval by institutional ethics committee.Sampling technique used was universal sampling. Patients with acute exacerbation of COPD, Asthma –COPD overlap, Coronary artery disease, past history of pulmonary tuberculosis and those who can't perform spirometery or DLCO maneuver was excluded from the study. A total of 73 COPD patients of all age groupsdiagnosed according to GOLD 2017 guidelines were included in the study after obtaining written informedconsent (7). After obtaining proper history and detailphysical examination spirometery was performed to stratify patient in to A, B, C &D group according to new GOLD combined assessment system (7).

Subsequently DLCO and 6MWT was performed (according to ATS guidelines) (8). BODE Index was calculated using BMI, FeV1, mMRC Dyspnea grading and 6MWT (9). Patients were categorized among four quartiles of BODE index as well as based on DLCO severity(Mild, Moderate, Severe, Very severe) (6-7). Uncategorized and categorized data on BODE index and DLCO were correlated independently to various groups of GOLD classification.

Statistical Methods

Data analyzed using the statistical package for social sciences (SPSS) version 23.0. Descriptive statistics such as frequency Mean ± Standard deviation, median and percentage were calculated.Association between various study variables was done by chi-square test. Spearman correlation coefficient was used to correlate BODE Index and DLCO. A p-value of 0.05 or less was taken to indicate a significant difference.

3. Results

In our study 90.4% of the subjects (66) were male and 9.65were females (7). The mean age of the study population was 63.01±10.86 with a range of 42-91years .The mean FEV1 /FVC ratio and mean FEV1% of the studied patient was 63.79±7.74 and 58.85±11.40 respectively .The mean BMI was 20.62 ± 2.58 with a range of 15.60 and 28.50 . Out of the 73 patients 48 were having symptom duration ≤ 10yrs. The mean duration of symptoms among study population was 10.71 ± 5.85 years.On evaluating thefrequency ofexacerbation in the previous year, study population showed mean frequency of 2.38±0.61.The 6MWD of study subject ranged from 90- 390 m with a mean of 284.81±42.20. With regard to DLCO percentage, mean value was 88.75 ± 21.39.The mean CAT score recorded was 13.70.

On evaluating combined assessment GOLD grade 62 patients were in the D group(84.93%) while 8 belonged to C group(10.96%) and 3 belong to B group (4.11%).None of them belonged to A group. Most of the study population belong to the Quartile 2(40) of BODE index category followed by Quartile 3(22),Quartile 1(9)and Quartile 4(2). DLCO study was normal for 49 patient .Rest belonged to mild (16) and moderate(8) DLCO grades

On correlating BODE index Quartiles and DLCO grades with GOLD category using kendall tau correlation test, only BODE index showed significant correlation with p values of 0.003. Even on correlating BODE index and DLCO value directly (Without catogerisation) with GOLD category using pearson correlation test , only BODE index showed significant correlation with a p value of 0.081.

Quartiles of BODE index and grades of DLCO were cross tabulated with the GOLD categories and the results are represented in Table1 and 2.The difference between the groups was statistically significant with p-value of 0.014 (test statistic value of 15.93 - Kappa statistic used) and 0.009 (test statistic value of 13.57

Table 1: Cross tabulation BODE index Quartiles with GOLD category

		GOLD category				Total	Test statistic & p-value
		A	B	C	D		
BODE index	Quartile1	0	0	4	5	9	15.931 0.014
	Quartile2	0	3	4	33	40	
	Quartile3	0	0	0	22	22	
	Quartile4	0	0	0	2	2	
Total		0	3	8	62	73	

Table 2: Cross tabulation DLCO grades with GOLD category

		GOLD category				Total	Test statistic & p-value
		A	B	C	D		
DLCO Grading	Normal	0	0	7	42	49	13.57 0.009
	Mild Disease	0	1	0	15	16	
	Moderate Disease	0	2	1	5	8	
	Severe Disease	0	0	0	0	0	
Total		0	3	8	62	73	

On correlating Quartiles of BODE index with DLCO grades using kendall tau correlation test no significant correlation was found but on correlating uncategorized BODE index with DLCO value using pearson correlation test showed a significant correlation with a p value of 0.005

4. Discussion

Even though GOLD combined assessment ofCOPD take into account objective criteria (FEV1) as well as subjective data as perceived by the patient ,it failed to include two fundamental defect in COPD patient ;exercise capacity and defect in oxygen exchange (10).In our study we addressed these major lacunae by studying the correlation of BODE index (which includes exercise capacity) and DLCO (measure of oxygen exchange) with disease severity. BODE index showed a significant correlation with GOLD in both categorized and uncategorized data sets .Similar results are shown by Fanny W.S.KO et al which can be attributed to similar distribution of BODE index in comparison to our study (11). Their study highlighted the significance of continuous measurement of BODE index In estimating survival as well as readmission of COPD patient .These findings are more valid being derived from a prospective study. Similar prospective studies also support the proposal of BODE index as simple integrative index of death risk and severity in COPD (12-13).These studies also share similar quartile wise distribution of BODE index as that of our study . But these studies had compared BODE index with only certain components of the present GOLD combined assessment system.

In the study by Takashi M et al annual rate of exacerbation(component of GOLD) showed significant correlation with BODE (p=0.001) (14). This study also brought out one major lacunae in the multi dimensionality as its failure to include smoking status as one of his component .This study also showed significant correlation of DLCO with COPD exacerbation rate (p=0.021) . This can be considered to be in partial congruence with our study finding. These comparisons can be attributed to similarity in built between indian and Japanese population resulting in a complimentary distribution of BODE index .Also both

studies have used self-reporting of acute exacerbation by the study population (14) .Another study showing survival benefit with interventions focused at COPD patients with severe diffusion defect in CO showed a more clear correlation between DLCO and COPD severity than with our study(15). This may be explained by higher percentage (67%) of subjects with normal DLCO in our study.

5. Limitations

The size of sample is very small, not a representative of general population and may be limited in its application to general population. Caution is required while using the results in populations outside India as there are no systematic comparisons of the regional manifestations of COPD. As a cross-sectional study, the present analysis is limited in its ability to elucidate, whether improving the BODE index reverses the various parameters analyzed. The follow up of these patients and analysing the results with the details of the acute exacerbations and mortality data would have yielded better results..Alternate causes and medication effects influencing the parameters analyzed should also be considered.Berkesonian bias (Bias due to difference in admission of patients to hospital) can be expected as this is a hospital-based study.

6. Recommendation

BODE index is simple and reliable method to predict hospitalisation and the severity in patients with COPD.BODE index could be of great practical value in a primary health care setup to identify individuals who areat need for further evaluation in a higher center.Further studies with a larger or a wider sample representative of general population may be needed to tap the underutilized potential and DLCO as an indicator of prognosis and severity

7. Conclusion

Overall, we yielded the study result showing BODE index as a reliable index for assessing severity and correlating well with GOLD combined assessment grouply.

It is simple and dependable method to estimate hospital admission and severity in patient with COPD. Since the measurement of BODE index requires only a pulmonary function test, which is comparatively simple, economical and can easily be made handy, this index could be of great value in a primary health care format to identify patients who are at need for further analysis and referral to higher center.

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