

# Factors Associated with GOLD Staging and BODE Index in Patients with Chronic Obstructive Lung Disease in Elderly.

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## ABSTRACT

**Background:** We aimed to assess the clinical profile of Chronic obstructive pulmonary disease (COPD) occurring in elderly patient according to GOLD criteria/BODE index and to study the association of COPD with various risk factors in an elderly patient. **Methods:** We designed a hospital based observational study, in which we included patients with COPD who are elderly and admitted at the Lokmanya Tilak Municipal Medical College and Hospital, Mumbai from January 2015 till July 2016. After obtaining approval of the institutional ethics committee, all the eligible patients were interviewed for socio-demographic variables, clinical history and examination and risk factors for COPD. Post- bronchodilator spirometry and imaging studies were performed on the study patients, based on which patients were classified as per the GOLD criteria and BODE index. Associations between various risk factors and severity of pulmonary function impairment and prognosis was analysed. **Results:** During the study period 50 patients were included in the study. Body mass index and two dimensional echocardiography findings of pulmonary artery hypertension were found to be significantly associated with the staging of pulmonary function according to GOLD staging criteria. Additionally, statistically significant association between BODE index and smoking index, body index and two dimensional echocardiography findings of pulmonary artery hypertension (p value less than 0.01, 0.01 and 0.05 respectively) was found. We found higher creatinine levels, leucocyte count and acute on chronic type 2 respiratory failure to be significantly associated with death. **Conclusion:** Patient variables have a strong association with severity and prognosis of COPD.

**Keywords:** COPD, diagnosis, prognosis, risk factors.

## INTRODUCTION

Chronic obstructive pulmonary disease (COPD) represents an increasing burden worldwide which affects more than 5% of the population and is associated with high morbidity and mortality. COPD is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. Many authors have commented that COPD causes high resource utilization with frequent clinician office visits, frequent hospitalizations due to acute exacerbations, and the need for chronic therapy (eg, supplemental oxygen therapy, medication). Routine screening spirometry is generally not indicated for adults who have none of the features suggestive of COPD. The severity of lung function impairment is

stratified using the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, which suggests using an assessment of airflow limitation in parallel with a combined assessment of an individual's symptoms and exacerbation history to guide therapy. The BODE index is another system for assessment of COPD severity and prognosis. In this research we aimed to assess the clinical profile of COPD occurring in elderly patient according to GOLD criteria/BODE index and to study the association of COPD with various risk factors in an elderly patient.

## MATERIALS AND METHODS

### Study Design and Setting

We designed a hospital based observational study, in which we included patients with COPD who are elderly and admitted at the Lokmanya Tilak Municipal Medical College and Hospital, Mumbai from January 2015 till July 2016. The study sample consisted of 50 patients taken from the client of hospital, both male and female, aged more than 60

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years and who met all the inclusion criteria were eligible for the study. Approval of the institutional ethical committee was sought before the commencement of the study.

### **Sample population**

We included all patients of COPD of either gender who were more than 60 years and were willing to participate. We excluded patients who did not demonstrate obstruction on pulmonary function testing, were not able to perform pulmonary function testing up to satisfactory level, who were known cases of bronchial asthma, with known malignancy other than lung cancer or suffering from active tuberculosis. Patients refusing to consent for the study were excluded as well.

### **Study definitions**

Smoking index was calculated by the formula : number of cigarette per day x number of years. It is a better index to quantify smoking in Indian context as compared to pack years (one pack of 20 cigarettes smoked every day for one pack year) because usually the cigarette packets in India contain 10 cigarettes and also many smokers smoke bidi. A smoking index of <100, 100 to 300 and > 300 is used to classify smokers as mild, moderate and heavy respectively. COPD survival prediction was calculated with BODE index. The four factors included in the index were weight (Body Mass Index), airway obstruction (forced expiratory volume in 1st second), dyspnea (Modified Medical Research Council dyspnea score), and exercise capacity (six-minute walk distance). BODE index assesses the risk of death and it can also predict hospitalization.

### **Data Collection and Data Analysis**

After obtaining informed written consent, all the eligible patients were interviewed for their socio-demographic information like age, sex, area, of residence and occupation. Complete medical history and history of risk factors for COPD like smoking, domestic chullah smoke, environmental and occupational exposure were inquired. Past history of diabetes mellitus, hypertension, pulmonary Koch's and dyslipidemia and treatment history were obtained as well. Personal history including smoking (cigarette/bidi smoke per days and duration), tobacco and alcohol consumption was noted for all patients.

In the morning, after an overnight fast, non tourniquet blood samples were collected for measurement of complete blood counts, erythrocyte sedimentation rate, peripheral blood smear, C-reactive protein, fasting and post prandial blood sugar levels, renal function tests, liver function tests, electrolytes (sodium, potassium, calcium and magnesium) and lipid profile consisting of levels of total cholesterol, triglycerides, low density lipoproteins (LDL) & high density lipoproteins

(HDL). Arterial blood analysis, chest x-rays of posterior-anterior view, electrocardiography and echocardiography were performed in all the patients. Post bronchodilator pulmonary function test (PFT) were performed in all the cases of study group either during hospital stay or after stabilization. Throughout the study VIASYS computerized Body Plethysmograph , model Master screen body (manufactured by Jaegger) was used for standardization of spirometry. Computed tomography (high resolution computed tomography or contrast enhanced computed tomography) was performed in those patients where diagnosis of COPD was not clear and malignancy was suspected. After data collection, data entry was done in Excel. Data was compiled and statistical analysis was carried out using SPSS version 15.0. Descriptive statistics was presented in percentage, means and standard deviations. Associations were analysed using chi square test, p value less than 0.05 were taken as statistically significant.

## **RESULTS**

**Table 1: Baseline characteristics of the patients included in the study.**

Variables	n (%)
Total number of patients	50
<b>Age distribution</b>	
60 to 64 years	18 (36%)
65 to 69 years	19 (38%)
70 to 74 years	8 (16%)
75 to 80 years	5 (10%)
<b>Smoking Index</b>	
Moderate	11 (26%)
Severe	31 (74%)
<b>Body Mass Index</b>	
Undernourished (<18 kg/m <sup>2</sup> )	11 (22%)
Normal (18 to 24 kg/m <sup>2</sup> )	28 (56%)
Overweight (> 24 kg/m <sup>2</sup> )	11 (22%)
<b>BODE Index</b>	
0 to 2	17 (34%)
3 to 4	22 (44%)
5 to 6	1 (2%)
7 to 10	10 (20%)
<b>Past medical history</b>	
Hypertension	15 (30%)
Diabetes mellitus	7 (14%)
<b>Pulmonary function testing (GOLD staging)</b>	
Stage 1 (mild obstruction)	7 (14%)
Stage 2 (moderate obstruction)	28 (56%)
Stage 3 (severe obstruction)	9 (18%)
Stage 4 (very severe obstruction)	6 (12%)
<b>Two dimensional echocardiography</b>	
Mild pulmonary artery hypertension	6 (12%)
Moderate pulmonary artery hypertension	2 (4%)
Severe pulmonary artery hypertension	4 (8%)
No pulmonary artery hypertension	38 (76%)
<b>Ventilatory support</b>	
Ventilator	9 (18%)
Non invasive	10 (20%)

During the study period 50 patients satisfied our inclusion criteria and were included in the study. Majority of the patient population was in the age group of 65 to 69 years, range from 60 to 80 years. 74% of the patients included in the study ranked severe on the smoking index [Table 1], 22% were overweight and 44% had BODE index score of 3 to 4. 30% and 14% of the patients were hypertensives and diabetics. According to the GOLD staging 56% had moderate obstruction of pulmonary function and 12% of the patients had very severe obstruction. Two dimensional echocardiography revealed that majority of the patients (76%) had no pulmonary artery hypertension. Only 4 patients had severe pulmonary hypertension. Ten patients received non-invasive ventilatory support. Body mass index and two dimensional echocardiography findings of pulmonary artery hypertension were found to be significantly associated with the the staging of pulmonary function according to GOLD staging criteria [Table 2].

Additionally, we found a statistically significant association between BODE index and smoking index, body index and two dimensional echocardiography findings of pulmonary artery hypertension (p value less than 0.01, 0.01 and 0.05 respectively, Table 3). We found creatinine value more than 1.2 mg% to be significantly associated with death in patients (p value less than 0.05). Similarly, higher leucocyte count, acute on chronic type 2 respiratory failure and invasive ventilatory support was found to be significantly associated with death in patients.

**Table 2: Association between pulmonary function staging according to GOLD staging and patient variables.**

Variable	GOLD staging for pulmonary function				p value*
	Stage 1 (n=7)	Stage 2 (n=28)	Stage 3(n=9)	Stage 4(n=6)	
<b>Smoking index</b>					
Moderate	2	9	0	0	>0.05
Severe	5	13	7	6	
<b>Body Mass Index</b>					
Underweight	2	3	5	1	<0.01
Normal	4	19	2	3	
Overweight	1	6	2	2	
<b>2D Echocardiography findings</b>					
Mild PAH**	0	2	2	2	<0.05
Moderate PAH	0	0	1	1	
Severe PAH	0	0	4	0	
No PAH	7	26	2	3	

\*using chi square test

\*\*PAH = pulmonary artery hypertension

**Table 3: Association between BODE index and patient variables.**

Variable	BODE index				p value*
	0-2	3-4	5-6	7-10	
<b>Smoking index</b>					
Moderate	7	4	0	0	<0.01
Severe	7	15	1	8	
<b>Body Mass Index</b>					
Underweight	2	4	0	5	<0.01
Normal	12	13	0	3	
Overweight	3	5	1	2	
<b>2D Echocardiography findings</b>					
Mild PAH**	1	2	0	3	<0.05
Moderate PAH	0	0	1	1	
Severe PAH	0	0	0	2	
No PAH	16	18	0	4	

**Table 4: Association between patient's clinical parameters and death**

Clinical parameter	Death		p value*
	Yes	No	
<b>Creatinine value</b>			
<1.2 mg%	3	30	<0.05
>1.2 mg%	3	14	
<b>Total leucocyte count</b>			
<10,000/cumm	1	39	<0.05
10,000 to 20,000/cumm	3	4	
>20,000/cumm	2	1	
<b>Arterial blood gas diagnosis</b>			
Acute type 2 respiratory failure	1	2	<0.01
Acute on chronic type 2 respiratory failure	4	3	
Chronic type 2 respiratory failure	1	14	
<b>Non-invasive ventilator support</b>			
Yes	1	9	>0.05
No	5	35	
<b>Invasive ventilator support</b>			
Yes	6	3	<0.05
No	0	41	

\*using chi-square test

## DISCUSSION

In this study 50 patients with COPD were analysed for their clinical profile and associated risk factors. Hypertension and diabetes mellitus is a major risk factor in patients suffering from COPD. Presence of hypertension is seen in COPD patients probably because both the diseases share common risk factors such as age, cigarette smoking and decreased physical activity. The potential mechanism of increased risk of cardiovascular disease in COPD are systemic inflammation, increased oxidative stress. BODE index is a multidimensional grading system for COPD which assists in predicting death from respiratory and other causes. It has been reported that BODE index is superior to uni-dimensional assessment based on FEV1 Value alone. Higher scores indicate a greater risk of death. In our study group, most of the patients had scored less than four, which is suggestive of good survival rate. In our

study we found that 81.8% of patient with moderate smoking index and 41.9 % patient with heavy smoking index belonged to stage II of GOLD staging whereas only 22.6 % patients with heavy smoking index had BODE index between 0 and 2. Since majority of patients in our study group were males, a preponderance of smoking was expected.

Pulmonary arterial hypertension is the major cardiovascular complication of COPD and is associated with the development of right ventricular hypertrophy (cor pulmonale) with poor prognosis. Agarwal et al have shown that most of the cases of severe COPD are associated with right axis deviation. We found similar results in our study population. We found that 60.83 % of individuals had normal axis, 28.3 % had right axis deviation, 10.87 % had left deviations. However in the severe COPD group 86.6 % individuals had right axis which was significantly higher compared to other groups. This could be attributed to the higher level of deterioration in lung function and pulmonary hypertension in these individuals. Arcasoy et al has demonstrated an incidence of pulmonary hypertension of around 16 % in patients with COPD. Our study revealed a total incidence of 32.5% of pulmonary artery hypertension among patients with COPD.

Additionally, we studied mortality of the patients in relation to some important biochemical profile variables like acute kidney injury (AKI) (creatinine more than 1.2 mg%), leukocytosis (total leucocyte count > 10,000/cumm) and arterial blood gas analysis (acute/acute on chronic/chronic type 2 respiratory failure). We found that higher percentage of patients with creatinine more than 1.2 mg% died as compared to patients with creatinine less than 1.2 mg%. High mortality among patients with AKI is partially explained by the presence of other comorbidities like diabetes mellitus, heart failure and preexisting renal disease. However, the underlying comorbidities do not fully explain all the AKI mortality associations seen clinically. This suggests that there are unknown modifiable risk factors that could help prevent mortality associated with AKI in patients with COPD exacerbations. According to the UK Renal Association, AKI is commonly seen in hospitalized patients with a mortality rate ranging from 10% to 80%, which is consistent with our study's results. Uncomplicated AKI has a mortality rate of up to 10%, while that with multi-organ failure holds a mortality rate of more than 50%. Furthermore, arterial blood gas analysis play an important role in the management of COPD. In our study, 57.1% of patients with acute on chronic type 2 respiratory failure died which was significantly more as compared to 33.3% and 6.7% of patients with acute type 2 respiratory failure and chronic type 2 respiratory failure.

There are a few limitations of our study. First is the small sample size in our study, due to which our

study population might not be representative of the general population. Secondly, the results of our study need to be supported by a larger multi-centric study in future.

## CONCLUSION

Our study found significant association of body mass index and two dimensional echocardiography findings of pulmonary artery hypertension with the the staging of pulmonary function according to GOLD staging criteria. Additionally, we found a statistically significant association between BODE index and smoking index, body index and two dimensional echocardiography findings of pulmonary artery hypertension. Furthermore, we found higher creatinine, leucocyte count and acute on chronic type 2 respiratory failure to be significantly associated with death in patients. Future research is needed to support our findings.

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