BODE Index Vs FEV1 in predicting outcome and number of exacerbations in COPD Patients

[1]Dr Naga Lakshmi Katragadda [2] Dr K Venkata Ramana
[3] Dr K V V Vijaya Kumar [4] Dr G Samba Siva Rao

[1] Dr Naga Lakshmi Katragadda : Assistant Professor Dept of Pulmonary Medicine m DR.Mallareddy Medical College Hyderabad India

[2] Dr K Venkata Ramana : Designated Associate Professor Dept of Pulmonary Medicine[TB&CD] Andhra Medical College Visakhapatnam AP India

[3]Dr K V V Vijayakumar : Professor Dept of Pulmonary Medicine Andhra Medial College Visakhapatnam AP India

[4]Dr G Samba Siva Rao : Professor Dept of Pulmonary Medicine Andhra Medical College Visakhapatnam AP India

Corresponding Author: Dr K Venkata Ramana

I.   Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases . COPD will become the third most common cause of dearth and the fourth cause of disability in the world by the year 2020 . COPD exacerbations are defined as an acute worsening of respiratory symptioms that result in additional therapy 3,4 . As COPD progresses, patients develop more frequent and sereve exacerbations5,8 and have an increased rate of the disease because they accelerate the rate of decline of lung function7.8 are associated with significant mortality and have a high socioeconomic burdan9. It is a high priority to have a proper and simple tool that helps in predicting exacerbations.

The BODE index was developed in 2004 by Celli and colleagurs, for predicting morality risk of COPD patients which includes Body mass index (B). Degree of airflow obstruction (O). Dyspnea (D) and Exerc ise capacity (E).

II. Aims and Objectives

1. To assess BODE index and GOLD severity staging in stable COPD patients.
2. To assess predictor value of BODE index and GOLD severity staging in number of acute exacerbations and their outcome in the following one year.

III. Material and Methods

It is a ptospective study done at GHCCD Visakhapatnam, Andhra Pradesh, from September 2014 to November 2016 with follow up of 1 year at an interval of 4 monhs or until death whichever was earlier.

Inclusion criteria:

100 Stable COPD patients (whithout acute exacerbations for at least 8 weeks prior to enrolment into the study), Age >40 years and post bronchodilator FEV $_1$/FVC < 0.7 were included in the study.

Exclusion criteria:

Patients with bronchial asthma , recent M1, AE COPD, other major life-threatening illness were excluded from study.

The study population was assessed for BMI, Air flow obstruction, MMRC dyspnea scale, exercise capacity (measured based on 6-minute walk test according to ATC guidelines). Baswd on these variables (BODE index score) patients wete grouped into 4 subgroups 0-, 3-4, 5-6, 7-10. Also, patients were categoriszed on GOLD severity staging into stage 1, 2, 3 and 4. Comparison was done between these groups. During their follow up period, patients wete assessed for number of exacerbations and exacerbation outcomes.

Data Aansysis:

Mea ± SD was used for baseline characteristics. The chi-square test of contingency tables was used to compare proportions for discrete variables. The main outcome measure was exacerbation occurrences during 1 year. We evaluated the influence of GOLD staging (GOLD I, II, III, and IV) and BODE classes (classes 1,2,3, and 4) as continuous variables on exacerbation by logistic regression and by the area under the receiver-operator curve (ROC). P value<0.05 was considered statistically significant.

IV. Results

Out of 100 patients, 6 patients were lost to follow up; 70 were males and 24 were females. Smoking was the most common risk factor associated with COPD and was seen in89.4% of the cases. The baseline characteristics of these patients are summarized in Table#1.

Table no 1: Mean values of various patient variables in the study population

Parameter	Mean	Standard Deviation
Age	61.30	8.71
BMI	24.08	6.00
FEV_1	45.17%	18.96%
MMRC	1.19	1.01
6MWD	277.86	92.50
BODE	4.61	2.68

Table#2 shows classification of patients according to BODE index score and most of them are equally distributed between an index of 3-4 and 7-10.

Table no 2: Classification of patients according to BODE index score

BODE Index	Male	Female	Total
0-2	20 (90.9%)	2 (9.09%)	22 (23.40%)
3-4	20 (74.07%)	7 (25.9%)	27 (28.72%)
5-6	8 (42.1%)	11(57.8%)	19 (20.21%)
7-10	22 (84.6%)	4 (15.3%)	26 (27.67%)
Col. Total	70	24	94

Classification of GOLD severity staging is mentioned in Tables #3 and majority of patients were in GOLD stage-3 (37.23%)

Table no 3: Classification of patients according to GOLD severity

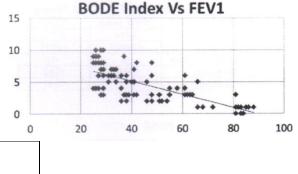| GOLD staging	Male	Female	Total
1 (≥80)	10 (83.3%)	2 (16.6%)	12 (12.76%)
2 (50-79)	12 (63.1%)	7 (36.8%)	19 (20.21%)
3 (30-49)	26 (74.2%)	9 (25.7%)	35 (37.23%)
4 (<30)	22 (78.5%)	6 (21.4%)	28 (29.80%)
Col. Total	70	24	94

As BODE index increased , the stage (GOLD severity staging) of disease also increased statistically significant (p = 0.001). Please refer Table #4.

Table no 4: BODE index vs GOLD Severity staging

BODE Index	Stage 1	Stage 2	Stage 3	Stage 4	Total
0-2	11 (50%)	7 (31.8%)	4 (18.1%)	0 (0%)	22
3-4	1 (3.7%)	10 (37.03%)	8 (29.6%)	8 (29.6%)	27
5-6	0 (0%)	2 (10.5%)	15 (78.9%)	2 (10.5%)	19
7-10	0 (0%)	0 (0%)	8 (30.7%)	18 (69.2%)	26
Col. Total	12	19	35	28	94

P = 0.001

A significant negative correlation was found between BODE index and FEV $_1$ was shown in Figure 1.

BODE Index Vs FEV1

Pearson Coefficient = -0.736
P value <0.01

Figure 1 : BODE Index $_{vs}$ FEV $_1$

Out of 94 patients, 36 (38.29) patients experienced at least one exacerbation during one year follow up period. Out these 36 patients with exacerbations, 5(5.31%) were merged with OP- based treatment and the remaining 31 (31.97%) patients wete hospitalized in which 12(12.76) patients died.

As the above BODE index increased, the percentage of exacerbations on follow up also increased. Patients with BODE index 0-2 never experienced any exacerbation, whereas 92.3% of patients having BODE index 7.10 experienced at least one exacerbation during follow up. Out of four GOLD stages, majority of patients (52.77%) whit GOLD stage 4 experienced exacerbations.

Patients with ahigher BODE index (7-10) experienced more no of (≥2) exacerbations when compared to patients with lower (3-4) BODE index. (p=0.007) whereas GOLD severity staging was not significantly associated with no. of exacerbations. (p=0.09)

Table no 5: BODE index Vs FEV $_1$ in predicting exacerbations.

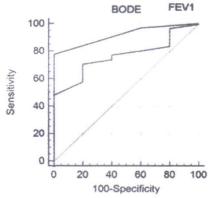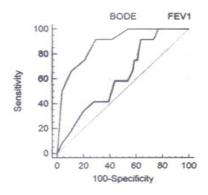| Exacerbations	BODE Index	FEV$_1$
AUC	0.951	0.794
P Value	<0.0001	<0.0001
Associated Criterion	>5	≤48
Sensitivity	83.33	94.44
Specificity	91.38	50.00

Figure 2: ROC curves of BODE index vs FEV$_1$ in predicting exacerbations.

BODE index was also able to predict the outcome of exacerbations better than FEV$_1$ alone. Outcomes were measured in terms OP based management, hospitalization and morality (Table # 6,7,8 and Figure # 3,4,5)

Table no 8: BODE Index vs FEV₁ in predicting Mortality

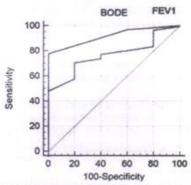| Mortality	BODE Index	FEV₁
AUC	0.884	0.619
P Value	<0.0001	0.1379
Associated Criterion	>5	≤48
Sensitivity	91.67	91.67
Specificity	70.73	36.59

Figure 4: ROC curves of BODE Index vs FEV₁ in predicting Hospitalization

Table no 8: BODE Index vs FEV₁ in predicting Mortality

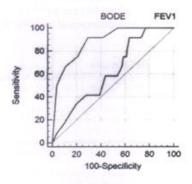| Mortality	BODE Index	FEV₁
AUC	0.884	0.619
P Value	<0.0001	0.1379
Associated Criterion	>5	≤48
Sensitivity	91.67	91.67
Specificity	70.73	36.59

Figure 5: curves of BODE Index vs FEV ₁ in predicting Mortality

Table no 9: Factors predicting exacerbation and mortality

	Exacerbation Prediction		Mortality Prediction	
	Odds Ratio	*P value*	*Odds Ratio*	*P value*
BMI	0.8200	<0.001	0.9824338	0.735
FEV_1	0.9208954	<0.001	0.9679797	0.139
MMRC Dyspnea scale	4.20944	<0.001	4.729377	<0.001
Exercise Capacity	0.9825172	<0.001	0.9747843	<0.001
BODE Index	3.531692	<0.001	2.08113	<0.001
GOLD Staging	4.252382	<0.001	1.985086	0.075

V. Discussion

Exacerbations:

Each component of the BODE index showed a significant relationship with the number of exacerbations. Our study showed that patients with a BODE index between 7-10 and GOLD stage 4 have experienced the highest number of exacerbations and therfore, are a potential hgh-risk population. BODE index was a better predictor of exacerbations (AUC=0.794), with higher specificity rate. Improved home based healthcare and frequent, regulat follow up vistis moght be a good strategy in the patients to reduce exacerbations to increase quality of life.

OP based management of exacerbations:

Majority of patients with low BODE index (≤6) and GOLD stage 3. Were managed by OP based treatment. BODE index predicts OP based management of exacerbations better than FEV_1 (AUC –0.916 vs 0.771).

Hospitalization:

Majority of patients with high BODE index (<6) and GOLD stage 4, were hospitalized. BODE index was also found to be a better predictor of hospitalozation rates when compared to FEV_1 (AUC – 0.916 vs 0.771).

Mortality :

Surprisingly, only two components – Dyspnea scale and Exercise capacity _ showed a significant ralationship with motality, while BMI did not. Contrary to general perception, airflow obsturction (FEV_1) i.e., GOLD severity staging did nog seem to a significant predictor of martality. BODE index as a whole, seemed to show a significatnt relationship with mortality. This finding assumes significance, in that. BODE index scores canbe used to risk stratify and priority manage patients with higher scores, as they are more prone to increased rato of martality.

A significant negative correlation exosts between FEV_1 and BODE index _ as FEV_1 decreases, BODE index increases.

Thus, BODE index seems to be a good predictor of exacerbations and its outcome in stable COPD patients and can be used to stratify patient population for effective treatment startegies and in effect, improved survival rates.

VI. Conclusion

Although the unidimentsional GOLD classification system and the multidimensional BODE index along with its individual components, seem to be predictors of exacerbation in stable COPD patients, BODE index seems to predict exacerbations more effectively. BODE index and two of its momponents – dyspnea scale and exercise capacity, seem to be better predictors of mortality when compared to GOLD severity staging. COPD, a complex airway disease and the importance of a multidimentsional tool like BODE index in stratification COPD patients is eviedent from our study.

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