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


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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 airflow and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases. COPD will become the third most common cause of death and the fourth cause of disability in the world by the year 2020. COPD exacerbations are defined as an acute worsening of respiratory symptoms that result in additional therapy. As COPD progresses, patients develop more frequent and severe exacerbations and have an increased rate of the disease because they accelerate the rate of decline of lung function. 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 colleagues, for predicting mortality risk of COPD patients which includes Body mass index (B), Degree of airflow obstruction (O), Dyspnea (D) and Exercise 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 prospective 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 FEV1/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). Basw on these variables (BODE index score) patients were grouped into 4 subgroups 0-, 3-4, 5-6, 7-10. Also, patients were categorized on GOLD severity staging into stage 1, 2, 3 and 4. Comparison was done between these groups. During their follow up period, patients were assessed for number of exacerbations and exacerbation outcomes.
Data Analysis:
Mean ± 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 in 89.4% of the cases. The baseline characteristics of these patients are summarized in Table #1.

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

As BODE index increased, the stage (GOLD severity staging) of disease also increased statistically significant (p = 0.001). Please refer Table #4.
A significant negative correlation was found between BODE index and FEV$_1$ was shown in Figure 1.

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 were 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%) with GOLD stage 4 experienced exacerbations.

Patients with a higher 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.**

<table>
<thead>
<tr>
<th>Exacerbations</th>
<th>BODE Index</th>
<th>FEV$_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC</td>
<td>0.951</td>
<td>0.794</td>
</tr>
<tr>
<td>P Value</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Associated Criterion</td>
<td>&gt;5</td>
<td>≤48</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>83.33</td>
<td>94.44</td>
</tr>
<tr>
<td>Specificity</td>
<td>91.38</td>
<td>50.00</td>
</tr>
</tbody>
</table>

**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)
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Table no 8: BODE Index vs FEV1 in predicting Mortality

<table>
<thead>
<tr>
<th>Mortality</th>
<th>BODE Index</th>
<th>FEV1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC</td>
<td>0.884</td>
<td>0.619</td>
</tr>
<tr>
<td>P Value</td>
<td>&lt;0.0001</td>
<td>0.1379</td>
</tr>
<tr>
<td>Associated Criterion</td>
<td>&gt;5</td>
<td>&lt;48</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>91.67</td>
<td>91.67</td>
</tr>
<tr>
<td>Specificity</td>
<td>70.73</td>
<td>36.50</td>
</tr>
</tbody>
</table>

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

Figure 5: curves of BODE Index vs FEV1 in predicting Mortality
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 therefore, are a potential high-risk population. BODE index was a better predictor of exacerbations (AUC=0.794), with higher specificity rate. Improved home-based healthcare and frequent, regular follow-up visits might 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 hospitalization 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 relationship with mortality, while BMI did not. Contrary to general perception, airflow obstruction (FEV$_1$) i.e., GOLD severity staging did not seem to be a significant predictor of mortality. BODE index as a whole, seemed to show a significant relationship with mortality. This finding assumes significance, in that, BODE index scores can be used to risk stratify and prioritize manage patients with higher scores, as they are more prone to increased rate of mortality.

A significant negative correlation exists 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 strategies and in effect, improved survival rates.

VI. Conclusion
Although the unidimensional 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 components – 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 multidimensional tool like BODE index in stratification COPD patients is evident from our study.

References