Application of BAP-65 Score for Risk Stratification of Acute Exacerbation of Chronic Obstructive Pulmonary Disease - A Prospective Observational Study in a Tertiary Care Institute in Telangana

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ABSTRACT

BACKGROUND

Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) carries a significant morbidity and mortality with a need for frequent hospitalizations and mechanical ventilation. Thus, a model was searched that required simple information that was consistently available in emergency department, upon the presentation of the patient which allowed risk stratification and to identify patients who might potentially benefit from early intervention.

METHODS

This was a prospective observational study conducted over a period of 6 months, from May 2018 to December 2018 with a study sample of 136 patients. The primary objective was aimed to validate the BAP-65 score system in predicting the need for ventilatory support and mortality in patients who presented with acute exacerbation of COPD.

RESULTS

Mean age of the study population was 64.13 ± 9.7 and 29 (21.32 %) were females with obvious male predominance. It was observed that as the BAP-65 score increases, the mortality increases. Mortality among the score groups 0, 1 and 2 was one, zero, one respectively. The mortality is about 37.5 % in the score group 3 and it increased to 90.9 % in the score group 4. The patients who needed mechanical ventilation were about 4 % in the score group 2 and it increased to 100 % in the score group 4. BAP-65 scoring system had a sensitivity of 88.89 % and specificity of 90.68 % in predicting the in-hospital mortality, and a sensitivity of 84 % and specificity of 94.59 % in predicting the need for mechanical ventilation during hospital stay.

CONCLUSIONS

The BAP-65 scoring system seems to be a promising tool which is simple and accurate. The score correlated well with both the mortality and also the need for mechanical ventilation, thus helping in decision making at triage level and also in prognostication of the disease.

KEYWORDS

Chronic Obstructive Pulmonary Disease, Acute Exacerbation, BAP-65, AECOPD, Mortality, Mechanical Ventilation

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BACKGROUND

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.[1] The main risk factor for the development of COPD is tobacco smoke but other environmental exposures such as biomass fuel exposure, indoor and outdoor pollution may also contribute.[2] COPD is the third most common cause of death and the fourth cause of disability in the world by the year 2020.[1,3]

As COPD progresses, patients tend to develop more frequent and severe exacerbations[4,5] which lead to increased rate of emergency room visits and hospitalizations.[6] Exacerbations are mostly triggered by upper respiratory tract infection, others being the environmental exposure to pollutants and ambient air etc.[7,8] Exacerbations of COPD are important events in the course of the disease because they affect patient's quality of life[9,10] accelerate the rate of decline of lung function,[11,12] are associated with significant mortality and morbidity and can increase the social and economic burden.[13,14] Hence managing patients with AECOPD may vary from just requiring change in medication to the need for mechanical ventilatory support for respiratory failure. Though, risk-assessment tools exist for patients with stable COPD, none have been validated for the use in AECOPD.

Few examples of risk stratification tools used in respiratory medicine are:

1. CURB-65 (confusion, urea, respiratory rate, blood pressure) score is used in community-acquired pneumonia for risk stratification.[15]
2. Pneumonia severity index (PSI) is used to predict the need for hospitalization in patients with pneumonia.[16]
3. The pulmonary embolism severity index and the prognosis in pulmonary embolism scores exist to aid in the management of acute pulmonary embolism.[17,18]

In BAP-65 scoring systems,[19] scores are calculated based on the presences of number of variables (variables include- BUN level > 53.5 mg/dl, mental status GCS < 14, pulse rate > 109 beats/minute and age > 65 years). The patients are stratified as to low risk, intermediate risk and high risk based on their BAP-65 scores, as to who may succumb during the hospital stay due to the disease and as to who may require mechanical ventilator support during hospital stay. In an earlier analysis of nearly 90,000 patients with AECOPD, it was demonstrated that BAP-65 correlated well with both the need for mechanical ventilation (MV) and in-hospital mortality.[19]

For stable COPD, several prognostic staging tools exist like BODE index, but none have been validated in AECOPD. The BODE index, provides better prognostication in patients with stable COPD and can predict mortality and exacerbations in these patients. Its usefulness is proved to be limited in the setting of acute exacerbation.[20] Thus a model was searched that required simple information that was consistently available in emergency department, upon the presentation of the patient which allowed risk stratification and to identify patients who might potentially benefit from early intervention. This prompted the establishment of the BAP-65 score. Scores like BAP-65 could aid in decisions regarding the level of care during hospital admission and can predict mortality in the setting of AECOPD. These decisions can allow early hospital discharge, thus reducing morbidity and mortality.

Objectives

1. To validate the BAP-65 score system in predicting the need for ventilatory support in patients who come with acute exacerbation of COPD
2. To validate the BAP-65 score system in predicting the mortality risk in patients who come with acute exacerbation of COPD

METHODS

This was a prospective observational study conducted over a period of 6 months, from May 2018 to December 2018 in the Department of Pulmonary Medicine in Nizam's Institute of Medical Sciences (NIMS). An approval from Institutional Ethics Committee was obtained prior to the study. Written informed consent was taken from all the patients prior to participation into the study.

Inclusion Criteria

a. Male and female patients of age > 40 years
b. COPD patients who are requiring additional therapy in spite of good compliance and proper technique, thereby fulfilling the AECOPD criteria.

Exclusion Criteria

a. Age <40 years
b. Recent myocardial infarction / angina less than 3 weeks
c. Patients with pre and post renal failure
d. Mentally retarded patients
e. Hepatic encephalopathy
f. Patient with recent head injury
g. Patient on psychiatric medications, sedatives
h. Patients on beta blockers, calcium channel blockers, pacemaker
i. Patient who did not give consent

Methodology

All adult patients of both gender with age more than 40 years admitted in the Department of Pulmonary Medicine, NIMS with the diagnosis of acute exacerbation of chronic obstructive pulmonary disease, during the study period fulfilling the inclusion criteria were included in the study after obtaining informed consent. BAP- 65 score will be calculated after available information.

COPD Exacerbation Decision Tool (BAP-65)

1. BUN (blood urea nitrogen) > 25 mg/dl = UREA > 53.5 mg/dl
2. Altered mental status (AMS)
3. Pulse rate (PR) > 109 beats per minute (bpm)
4. Age > 65 years

(Altered mental status was defined using Glasgow Coma score (GSC) < 14 or a designation by the physician of disorientation, stupor or coma.)

BAP class will be calculated based on the number of variables present and the corresponding BAP-65 score will be assigned.

The Subjects Were Classified into 5 Classes

Class 1 – none of the three variables present and age younger than 65 years
Class 2 – none of the three variables present and age equal or more than 65years
Class 3 – age > 65 years and one of the variables present
Class 4 – age > 65 years and two of the variables present
Class 5 – age > 65 years and three of the variables present

Patients Were Then Classified into 3 Categories Based on the BAP-65 Score

1. Patients with a BAP-65 score of 0 or 1 are in the low-risk category for intubation and/or mortality
2. Patients with a score of 2 are at intermediate-risk
3. Patients with BAP-65 score of 3 or 4 are in the high-risk category for intubation and/or mortality.

All these patients are managed medically with antibiotics, bronchodilators, oxygen supplementation and other supports like non-invasive ventilation and/or mechanical ventilation as on when required as per guidelines and hospital protocol. All the above data will be tabulated and will be used for validation of BAP-65 score in predicting the need for mechanical ventilatory support and the in-hospital mortality in patients with AECOPD.

Sample Size

A sample size of 136 was taken for the study as per the prevalence of COPD in India (3.67 %) (1). A precision of 10 % with 95 % confidence level was considered.

Statistical Analysis

Demographic and clinical data are presented as mean +/- standard deviation for quantitative variables and proportions for qualitative variables. The validity of BAP-65 score in predicting the need for ventilator support and hospital mortality are tested by sensitivity, specificity, accuracy and precision analysis using standard hospital protocol as gold standard. BAP-65 score will be estimated as per the methodology mentioned.

RESULTS

Age & Sex Distribution

Mean age of the study population was 64.13 ± 9.7. Maximum numbers of patients were in the age group of 61 – 70 years (41.17 %). Out of 136 patients in the present study, 107 were males (78.67 %) and 29 were females (21.32 %) with obvious male predominance. The comorbidities in the present study were hypertension (50.73 %), diabetes mellitus (33 %) and coronary artery disease (20.5 %). In the study group, 71.32 % patients were smokers. Smoking was the most common risk factor associated with COPD.

Demographic Data and BAP Score Groups

Of the 136 patients included in the study, when classified based on the number of variables into their respective BAP scores, 61 (44.85 %) patients were in the score group '0', 23 (16.9 %) patients were in the score group '1', 25 (18.3 %) were in the score group '2', 16 (11.7 %) patients were in the score group '3', and 11 (0.08 %) were in the score group '4'. In the present study group, the mean age was more with BAP-65 score of '4' (72.36 years). By applying one-way analysis of variance (ANOVA), it was observed that there was a significant difference in mean age between BAP '0' score and rest of the BAP scores with P < 0.001.

The cut off value for age in the BAP-65 scoring system is > 65. The results show that the need for MV and mortality increases as the age rises above 65. In the present study, the need for MV and mortality were 6.6 % and 3.33 % respectively for age < 65. Based on the Fisher's test, there was a significant association for the need of mechanical ventilator support whose age is >/= 65 years with a P value of 0.0016. Also, there was a significant association of mortality when the patients age was >/= 65 years with a P value of 0.0021.

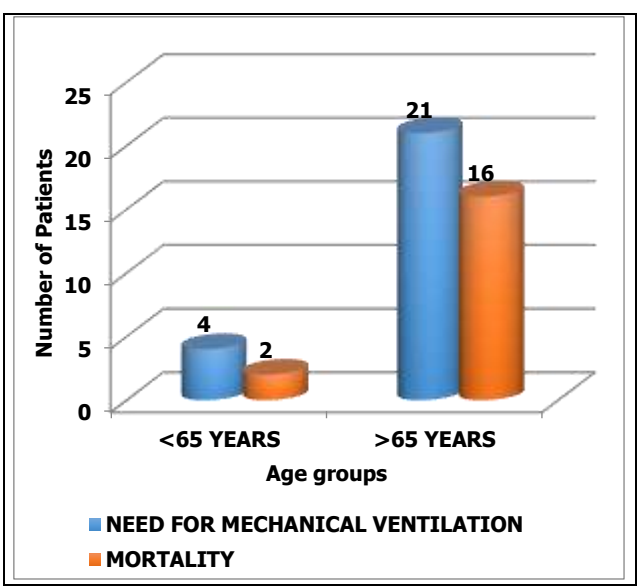

Figure 1. Age Variable of BAP-65 Score Versus Primary End Points of the Study

Blood Urea Variable Distribution among BAP-65 Score Groups and Its Association with End Points of the Study

The mean blood urea value increased in the present study as the BAP-65 score increased. Of the total 136 patients, 18.4 % of patients required mechanical ventilation. 88 % of the patients who were mechanically ventilated had blood urea levels > 53.5 mg/dl and there was a significant association between the need for mechanical ventilation and blood urea > 53.5 mg/dl, as tested by Fisher's exact test with a P value < 0.001. Of the total 136 patients, 13.2 % of patients succumbed during hospital stay. 83.33 % of the patients of who had succumbed during hospital stay had blood urea levels > 53.5 mg/dl and there was significant association between blood urea > 53.5 mg/dl and mortality, as tested by Fisher's test with a P < 0.0001.

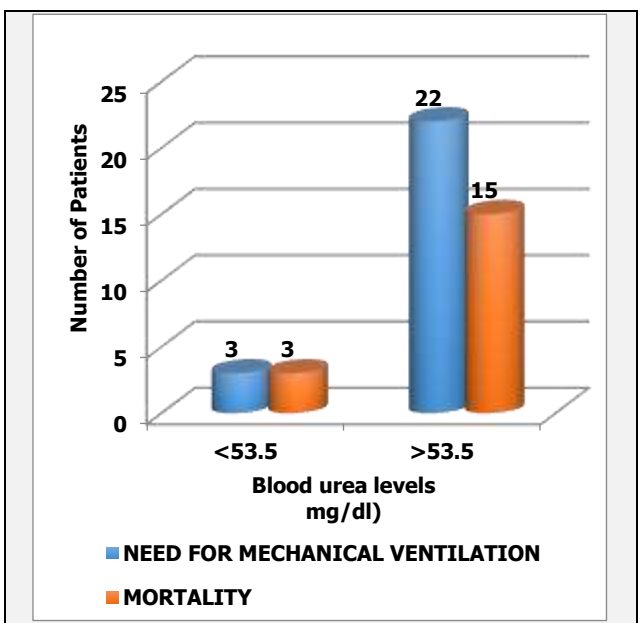

Figure 2. Blood Urea Criteria of BAP-65 Score Versus End Points of the Study

Distribution of Pulse Rate among BAP-65 Score Groups and Its Association with End Point of the Study

The cut off value for pulse rate in the BAP-65 scoring system is 109/min. The mean pulse rate value increased in the present study as the BAP-65 score increased. Of the total 136 patients, 18.4 % of patients required mechanical ventilation. 68 % of the patients who were mechanically ventilated had pulse rate > 109/min. Hence there is association between the need for mechanical ventilator in patients with pulse rate > 109/min, as confirmed by Fisher's test with a P value 0.000059. Of the total 136 patients, 13.2 % of patients succumbed during hospital stay. 83.3 % of the patients who had pulse rate > 109/min succumbed during hospital stay. Hence there was a significant association between pulse rate > 109/min and mortality, as confirmed by Fisher's test with a P value 0.0000017.

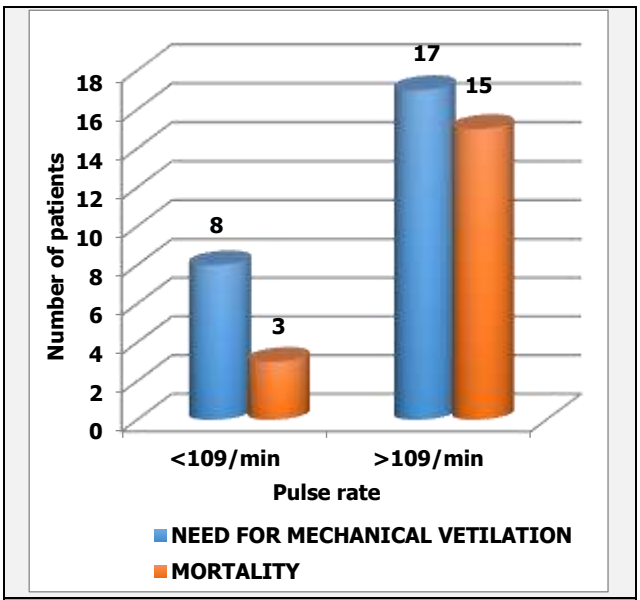

Figure 3. Pulse Rate Variable of BAP-65 Score Versus End Points of the Study

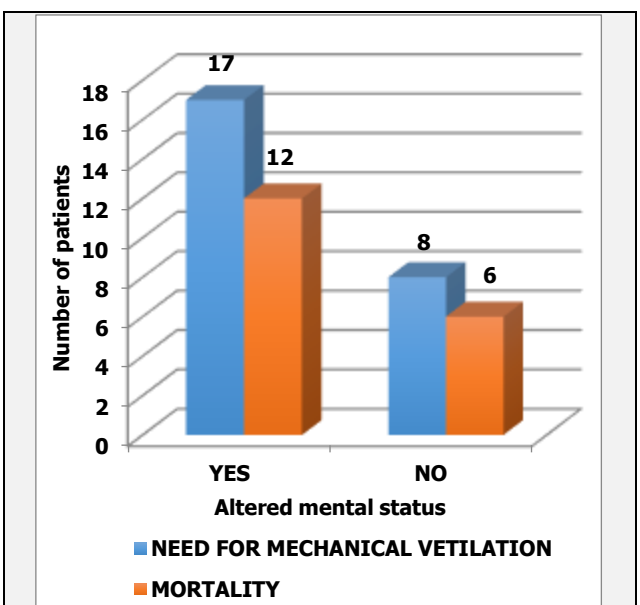

Figure 4. Altered Mental Status Variable of BAP-65 Score Versus End Points of the Study

Altered Mental Status Variable Distribution among BAP-65 Score Groups and Its Association with End Points of the Study

The number of patients with altered mental status (AMS) were more with BAP-65 score of 3 and 4. There were no patients with altered mental status in the score group 0 and 1. Of the total 136 patients, 18.4 % of patients required mechanical ventilation. 85 % of the patients who were mechanically ventilated had GCS < 14 at the time of presentation to hospital. Hence there was a significant association between the need for mechanical ventilator in patients and GCS < 14, confirmed by Fisher's test with a P value < 0.0001. Of the total 136 patients, 13.2 % of patients succumbed during hospital stay. 60 % of the patients who had GCS < 14 at the time of presentation to hospital succumbed during hospital stay. Hence there is significant

association between GCS < 14 and mortality, confirmed by Fisher's test with a P value of 0.001.

Need for Mechanical Ventilation among BAP-65 Score Groups

As the BAP-65 score increased from 1 to 4, the need for mechanical ventilation increased, however three patients with score 0 required ventilator support. The patients who needed MV was about 4 % in the score group 2 and it increased to 100 % in the score group 4.

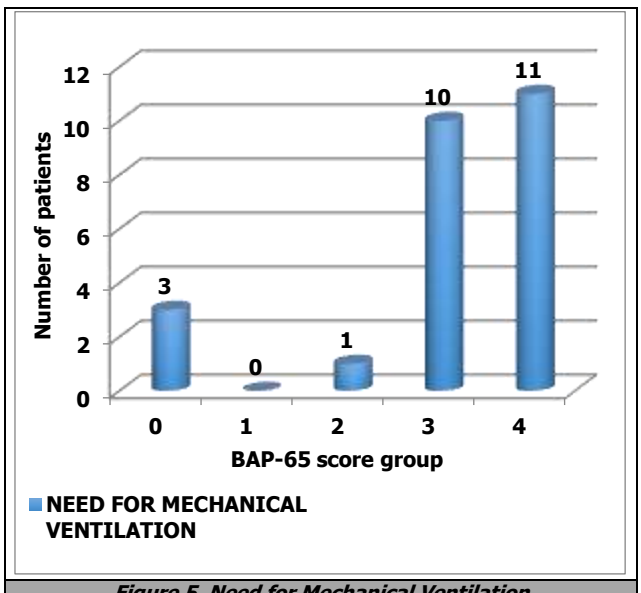

Figure 5. Need for Mechanical Ventilation among BAP-65 Score Groups

Mortality among BAP-65 Score Groups

In the present study it was observed that as the BAP-65 score increases, the mortality increases. Mortality among the score groups 0, 1 and 2 was one, zero, one respectively. The mortality is about 37.5 % in the score group 3 and it increased to 90.9 % in the score group 4.

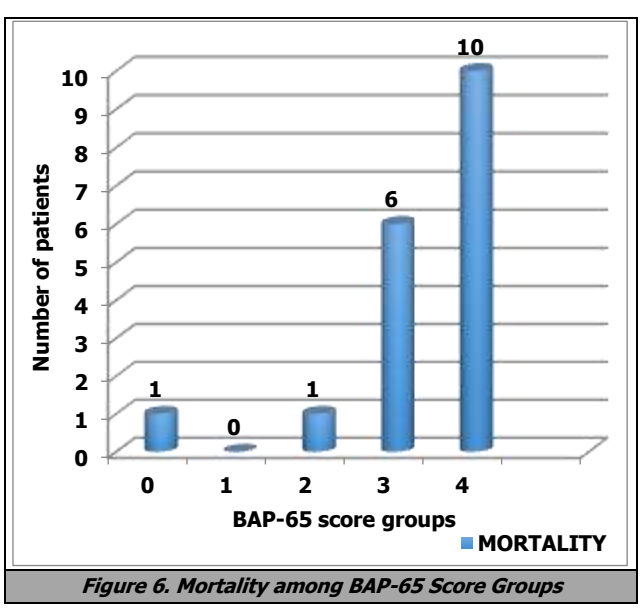

Figure 6. Mortality among BAP-65 Score Groups

Sensitivity and Specificity of BAP-65 Scoring System in Predicting the In-Hospital Mortality and the Need for Mechanical Ventilation During the Hospital Stay

In the present study, BAP-65 scoring system had a sensitivity of 88.89 % and specificity of 90.68 % in predicting the in-hospital mortality. The scoring system had a positive predictive value of 59.26 % and a negative predictive value of 98.17 % and accuracy of 90.44 %. In the present study, BAP-65 scoring system had a sensitivity of 84 % and specificity of 94.59 % in predicting the need for MV during hospital stay. The scoring system had a positive predictive value of 77.76 % and a negative predictive value of 96.33 % and accuracy of 92.65 %.

BAP Score	Need for Mechanical Ventilation	
	Yes	No
3,4	21	6
0,1,2	4	105

Table 1. Sensitivity and Specificity of BAP 65 Scoring System in Predicting Need for Mechanical Ventilation During Hospital Stay Mortality

BAP Score	Succumbed	Survived
3,4	16	11
0,1,2	2	107

Table 2. Sensitivity and Specificity of BAP 65 Scoring System in Predicting Mortality

DISCUSSION

This prospective observation study was conducted in the Department of Pulmonology in NIMS. A total of 136 patients with diagnosis of AECOPD with age > 40 years were included in the study. All the patients were followed up till the time of discharge**.** The data gathered demonstrates that the BAP-65 scoring system correlates well with both the in-hospital mortality and the need for mechanical ventilatory support during the hospital stay in patients admitted with the diagnosis of AECOPD. The strength of the study is that it is a prospective observational study, as the patients are followed throughout the hospital stay. The mortality and the need for MV support increased with the increasing BAP-65 score. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of BAP 65 scoring system were 88.89 %, 90.68 %, 59.26 %, 98.15 %, 90.44 % respectively in predicting the in-hospital mortality. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of BAP-65 scoring system were 84 %, 94.59 %, 77.76 %, 96.33 %, 92.65 % respectively in predicting the need for MV.

A study by Shorr et al.[21] which analyzed 34,699 admissions in 177 hospitals with the diagnosis of AECOPD concluded that BAP-65 system correlated well with the need for MV and hospital mortality. Nearly 4 % of subjects died while hospitalized and 9 % required MV. Mortality increased with increasing BAP-65 class (P < 0.001) and the need for MV also increased with escalating score (P < 0.001) in their study.

A study by Tabet et al.[22] which analyzed 980 admissions in two Lebanese hospitals reported that BAP-65 scoring system is a promising risk stratifying tool in AECOPD. The study correlated well with both need for MV and mortality. It showed consistent results when applied in different populations. In their study the end points increased with the increasing BAP class. Another study by Shorr et al.[23] which compared CURB-65 and BAP-65 score also showed the same results. The study concluded that area under curve (AUC) for early and anytime MV was higher for BAP-65 when compared to CURB-65.

A south Indian study by Kumaraguru et al.[24] found that a patient with a BAP-65 score of 3 and above has a higher risk of mortality or will have the need for MV during hospital stay with a sensitivity and specificity of 71.9 % and 86.9 % respectively. A prospective observational study by Sangwan et al.[25] which included 63 patients, compared BAP 65 and DECAF (Dyspnoea, Eosinopenia, Consolidation, Acidaemia and Atrial Fibrillation) scoring system for risk stratification and need of ventilator support and mortality in AECOPD. Sensitivity for prediction of mortality for both DECAF and BAP-65 scores was 100 % and specificity was 34.1 % and 63.4 %, respectively. They concluded that both DECAF and BAP-65 scores were found to be good predictors of mortality and need for invasive mechanical ventilation (IMV).

BAP-65 score is preferred over CURB score or DECAF score in a clinical setting as this scoring system is the simple model which requires history taking and physical examination for data collection. Other scores are more cumbersome as we need extensive laboratory investigations and imaging which also increases the cost and time consuming. Moreover, these scores correlate only with mortality rate, but do not predict the risk of endotracheal intubation and the need for MV.

The need for MV in the present study (18.4 %) correlated well with the values in the studies done by Rabih tabet et al. (17.3 %)[22] and Shorr et al. (9.22 %).[21] The lower percentage in the study by Shorr et al.[21] may due to the fact that study population was very large consisting of 34669 cases and also the hospital care and efficient management in a developed nation.

In the present study, BAP-65 scoring system had a sensitivity of 84 % and specificity of 94.59 % in predicting the need for MV during hospital stay. In the study done by Tabet et al.[22] the sensitivity was 65.29 % and specificity was 95.1 % for MV use. In the present study, BAP-65 scoring system had a sensitivity of 88.89 % and specificity of 90.68 % in predicting the in-hospital mortality. Whereas in the study conducted by Tabet et al.[22] the sensitivity was 79 % and specificity was 88.8 %. The results showed that the scoring system was more sensitive in the present study compared to that done by Tabet et al.[22] as the sample was small. But the specificity obtained in both the studies corresponded. The BAP-65 was found to correlate significantly both with the mortality and also the need for mechanical ventilation support.

CONCLUSIONS

The BAP-65 scoring system seems to be a promising tool which is simple and accurate. The score correlated well with both the mortality and also the need for mechanical ventilation. The scoring system helps in decision making at the triage level in directing the health resources to the most needed and also in prognostication of the disease.

Limitations of Our Study

However, there are some weak points in the study. First, the sample size was small (N = 136). The number of patients required to test the predictive power of the BAP-65 score and end points has to be prospectively determined by larger studies. Since very few women (29) were included in the study, we cannot generalize the results to both genders. The higher male sex distribution in the present study may be due to cultural factors in the country and the small proportion of females with COPD may be due to biomass fuel exposure and passive smoking. Second, the population was restricted to age > 40 years to remove the confounding factor, i.e. bronchial asthma. Third, we lacked the patient information on the severity of COPD i.e. spirometry value, GOLD classification. Also, the predictive value of BAP-65 was tested mainly for the score groups 3 and 4 only. Lack of information regarding the previous health status of the patients and number of previous acute exacerbations of COPD are also serious limitations.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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