DECAF Score and BAP-65 Score as Tools for Prediction of Clinical Outcome in Acute Exacerbation of Chronic Obstructive Pulmonary Disease

[1]Rakshana S*, [2]Velraj R
Department of Respiratory Medicine, Trichy SRM Medical College Hospital and Research Centre (Affiliated to The Tamilnadu Dr. MGR Medical University, Chennai), Tiruchirappalli, India

Corresponding Author: Rakshana S

Abstract:
Background: Episodes of worsening symptoms in individuals with chronic obstructive pulmonary disease (COPD), known as acute exacerbations of COPD (AECOPD), lead to substantial illness and death. Exacerbations are infrequent in the early stages of COPD and become more prevalent in cases with moderate-to-severe illness. The objectives of our study are to assess the DECAF score among patients with AECOPD, to assess the BAP-65 score among patients with AECOPD, to evaluate the ability of these scores for prediction of mortality among these patients and to assess the correlation between the DECAF score and BAP-65 score. Methods: This prospective observational study was done in the department of pulmonology. Patients with diagnosis of acute exacerbation of chronic obstructive pulmonary disease, age more than 35 years were included in the study. They were evaluated and DECAF score and BAP-65 scores were calculated and analyzed. **Results:** The mean ± SD age of the study population was 64.68±9.71 years, consisting of 83 (82.17%) males and 18 (17.82%) females. A total of 14 deaths occurred throughout the designated study period. Mean (SD) DECAF score was found to be 1.01 (0.92) among patients who recovered and 3.74 (1.4) among patients who expired. Mean (SD) BAP – 65 class was found to be 1.92 (1) among patients who recovered and 4.28 (0.91) among patients who expired. DECAF score has a sensitivity of 78.57% and specificity of 93.1%. BAP-65 class has a sensitivity of 71.42% and specificity of 94.25%.**Conclusion:** Both the DECAF and BAP-65 scores are equally effective indicators of mortality.
Keywords: COPD, DECAF score, BAP-65 score

Introduction

Chronic obstructive pulmonary disease (COPD) is a significant contributor to both illness and death on a global scale.[1]In 2019, COPD was approximated to rank as the sixth most common cause of death. India is currently seeing a persistent rise in the incidence of chronic obstructive pulmonary disease (COPD). Approximately 57 million individuals are believed to be affected by obstructive airway disorders.[2]

Based on Global Burden of Disease (GBD) study, chronic obstructive pulmonary disease (COPD) accounted for 50% of the instances of chronic respiratory diseases and 69% of the years lived with disability.[3] The majority of deaths associated to COPD occur in nations with low and moderate incomes, accounting for almost 90% of cases. In addition to imposing a significant economic burden, Chronic Obstructive Pulmonary Disease (COPD) leads to disability and diminishes the quality of life, reduces productivity, raises hospital admissions, and results in early mortality.[4]

An acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is defined as the worsening of respiratory symptoms that go beyond the usual day-to-day fluctuations.[5] Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD) represents 12.5% of all hospital admissions and is associated to a decrease in lung function, a decrease in health-related quality of life, and an increased risk of mortality.[6] The mortality rate of patients with AECOPD during their hospital stay varies between 4.4 to 25%. The survivors exhibit a readmission rate ranging from 25 to 55%, with 25 to 50% of these individuals being at a high risk of mortality within a year.[7]

Several clinical scores have been developed to assess the severity of AECOPD, among which are BAP65, CURB-65, along with APACHE II risk assessments. These scores aim to assist doctors in evaluating individuals who encounter these types of episodes. Nevertheless, the absence of sufficient data has resulted in the limited adoption of any of these methods. Two examples of these are DECAF and BAP-65.[8]

The DECAF scoring was initially suggested by Steer J et al. The researcher examined 920 patients from various geographical locations. The five most influential variables - breathing difficulties, eosinopenia, consolidation, acidosis, and AF - were chosen and given values based on the regression coefficient. This coefficient was determined to be superior compared to other evaluations in accurately predicting death.[9]

The BAP-65 was initially validated in 2011 and subsequently analyzed on 34,699 hospitalizations among 177 institutions in the US. The study's results suggest that BAP-65 could be a valuable addition to the early assessment of AECOPD. However, the widespread use of this cannot be justified due to the absence of comprehensive comparative research and appropriate guidelines.[10]

The objectives of our study are to assess the DECAF score among patients with AECOPD, to assess the BAP-65 score among patients with AECOPD, to evaluate the ability of these scores for prediction of mortality among these patients and to assess the correlation between the DECAF score and BAP-65 score.

Materials and methods

Study design and participants

This prospective observational study was done in the department of pulmonology in an academic private tertiary care institution from May 2023 to May 2024. Ethical clearance was obtained from the institutional ethical committee (Ref no: LIII-IRB-22, IEC NO: 028). Patients who were inpatients with primary diagnosis of acute exacerbation of chronic obstructive pulmonary disease (spirometry proven), age 35 years and above, and willing to give consent for the study were included. Patients with primary reason for admission other than COPD, bronchial asthma, co-existing malignancy, coronary artery disease and those not willing to give consent were excluded from the study.

Recruitment

One hundred and one (101) consecutive patients admitted with acute exacerbation of chronic obstructive pulmonary disease in the pulmonology department and willing to give consent were recruited. They were evaluated and values noted in proforma.

Outcomes and measures

Initial evaluation consisting of medical history, physical examination, ECG, ABG analysis, standard laboratory tests were done. Details of co-morbidities and maintenance medications were obtained from the patients. Presence of any consolidation on chest x-ray were noted. Patients were then scored as per the DECAF score and BAP- 65 scores. Hospital outcomes were evaluated in terms of mortality and length of stay. The use of DECAF score and BAP-65 score to predict mortality among these patients was assessed, and the correlation between the two scores was analyzed.

Statistical analysis

The data was inputted into an MS-Excel spreadsheet and analyzed using SPSS IBM version 26.0. The Kolmogorov-Smirnov test was conducted for continuous variables. The descriptive measures were examined using the mean, standard deviation, and range values, and were compared using an independent t-test. The categorical data were displayed as frequencies and percentages. The data that was given had a skewed distribution and was summarized using the median and interquartile range. ROC analysis was done to find the optimal sensitivity and specificity level of mortality by assessing the cut-off value of the two scores. The Yuden index cut-off value was determined. A bivariate correlation analysis was done to examine the linear relationship between the two scores. A significance level of $p<0.05$ was used to determine statistical significance.

Results

Demographic characteristics

The mean ± SD age of the study population was 64.68±9.71 years, consisting of 83 (82.2%) males and 18 (17.8%) females. A total of 14 deaths occurred throughout the designated study period, resulting in a mortality rate of 13.9%. The demographic characteristics of the patients is tabulated in table 1. Mean (SD) hospital stay days was 7.29 (3.4) days. Comparison between DECAF score and hospital stay days is given in table 2.

Table 1. Demographic characteristic of the patients (n=101)

Characteristic	Mean	SD	95% CI	
			Lower bound (α=2.5%)	Upper bound (α=97.5%)
Age	63.68	9.72	61.79	65.58
Sex (M:F)	83 : 18			
SBP	144.59	29.67	138.81	150.38
DBP	86.02	15.02	83.09	88.95
RR	29.22	6.23	28.00	30.43
PR	95.78	21.81	91.53	100.04
SPO2	62.47	18.76	58.81	66.12
GCS	13.76	1.93	13.39	14.14
HB%	11.46	3.04	10.87	12.05
TC	12.52	6.95	11.17	13.88
Neutrophils	70.90	12.75	68.41	73.39
Eosinophils	2.06	1.13	1.84	2.28
Urea	83.34	59.12	71.81	94.87
Creatinine	9.28	6.85	7.95	10.62
pH	7.39	0.20	7.35	7.43
PCO2	57.85	17.92	54.35	61.34
BUN	33.45	27.95	27.99	38.90

Table 2: Comparison between DECAF score and hospital stay days

DECAF score	Average of hospital stay days	Standard Deviation of hospital stay days
0	5.48	2.31
1	6.84	2.78
2	8.17	3.59
3	9.13	4.12
4	12.50	3.32
5	11.67	3.51
6	10.00	2.83

DECAF score

Mean (SD) DECAF score was found to be 1.01 (0.92) among patients who recovered and 3.74 (1.4) among patients who expired. It was significantly higher among patients who expired (p<0.0001). Among the 14 expired patients, 6 (42.85%) patients had DECAF score from 4-6. Among recovered patients 3 (3.44%) had DECAF score 4-6. Comparison of DECAF score among recovered and expired patients is given in table 3.

Table 3: Comparison of DECAF score among recovered and expired patients

DECAF score	Number of patients alive	Number of patients expired
0	29 (33.3%)	0 (0%)
1	37 (42.52%)	0 (0%)
2	15 (17.24%)	3 (21.42%)
3	3 (3.44%)	5 (35.71%)
4	3 (3.44%)	1 (7.1%)
5	0 (0%)	3 (21.42%)
6	0 (0%)	2 (14.28%)
Total	87	14

BAP-65 CLASS

Mean (SD) BAP – 65 class was found to be 1.92 (1) among patients who recovered and 4.28 (0.91) among patients who expired. Comparison of BAP-65 class among alive and expired patients is given in table 4.

Table 4: Comparison of BAP-65 class among alive and expired patients.

BAP 65 class	Number of patients alive	Number of patients expired
1	36 (41.37%)	0 (0%)
2	30 (34.48%)	0 (0%)
3	16 (18.39%)	4 (28.57%)
4	2 (2.29%)	2 (14.28%)
5	3 (3.44%)	8 (57.14%)
Total	87	14

DECAF score and BAP-65 class in predicting mortality

Cut off value was >2 for DECAF score and >3 for BAP-65 class for predicting mortality. DECAF score has a sensitivity of 78.57% and specificity of 93.1%. BAP-65 class has a sensitivity of 71.42% and specificity of 94.25%. The values are tabulated in table 5.

Table 5: DECAF score and BAP-65 class in predicting mortality

	DECAF score	BAP-65 class
Sensitivity	78.5%	71.4%
Specificity	93.1%	94.25%
Positive predictive value	64.7%	66.67%
Negative predictive value	96.4%	95.34%

Discussion

AECOPD is a frequent reason for hospitalization in Intensive Care Units, while the optimal therapeutic approach for patients with AECOPD admitted to the ICU remains a subject of debate.[11]It would be beneficial to identify patients who are at a high risk of dying in the hospital upon admission. This information can help in prioritizing patients for the proper level of care, deciding how aggressive the treatments should be, and directing the objectives for therapy to ensure secure discharges.[12] There is a debate regarding if ICU admission along with invasive ventilation ought to be the standard approach for all COPD patients experiencing acute respiratory failure, or if it should be considered as a final option. The uncertainty surrounding the decision to use invasive ventilation among COPD patients is influenced by the clinician's ability to accurately determine whether intubation is suitable for patients with AECOPD, as well as identifying which prognostic factors are indicative of a poor prognosis following admission to the ICU.[13]

Several clinical factors are present that may have prognostic importance in the treatment of patients experiencing acute exacerbation of COPD. Possible prognostic factors encompass age, smoking history, pre-existing conditions, FEV1, physical fitness, previous intensive care unit admissions over severe exacerbations, earlier functional status, body mass index (BMI), need for oxygen when in stable condition, coexisting medical conditions, as well as a range of physiological, laboratory, and biomarker measurements.[14]

Considering the wide-ranging effects of COPD on the body, utilizing a composite score to determine prognosis could offer a more thorough approach to assessing the condition.[15] Among them, clinical physiological markers, which are included into the BODE index along with other multidimensional staging methods, have the potential to provide useful insights into the evaluation of disease severity and progression. The BODE score is the main measure used to predict death in stable people with chronic obstructive pulmonary disease (COPD).[16] Various measures, including CURB-65, the BAP-65 rating, as well as DECAF score, have been suggested for predicting mortality in AECOPD. The utilization of the CURB-65 score for evaluating and directing treatment in patients admitted to the hospital AECOPD exacerbated with consolidation was demonstrated to be less than ideal.[17]

The DECAF score was recently added to the tools. Based on a prior study, the DECAF score has been found to be a more powerful prognosis score compared to the CURB-65, APACHE, as well as COPD along with Asthma Physiological Score prediction tools. We assessed the use of the DECAF score and BAP-65 score in predicting mortality in patients hospitalized with AECOPD.[18]

Steer et al. established the DECAF score. The researchers discovered that the AUROC curve for predicting 30-day mortality was 0.82. Additionally, in the subset of individuals with consolidation, this was proven to be a more powerful predictor than CURB-65.[9] They contrasted their score alongside the score developed by a different investigation in 2008.[19] They found that the 2008 score had excellent discrimination for mortality in hospitals (AUROC = 0.79), yet it encompassed subjectively determined signs of clinical severity.

In contrast, the DECAF Score performed even better in its sample than the tool outlined in 2008 in its deriving cohort. Additionally, the predictive indices encompassed in the DECAF rating are objective and have little room for variable interpretation. Nevertheless, they confirmed the accuracy of their score by applying it to a different group of hospitalized AECOPD patients. They discovered that the score remained consistent in this new population, just as it did in the original population it was developed on. The score demonstrated a reliability in casualty patients, with an AUROC of 0.77, a sensitivity of 69%, and a specificity of 76%. They argued that incorporating biological or imaging data, such as in the DECAF system, could enhance the predictive ability of the scoring systems. However, this could hinder their practical application in community settings and even in hospitals, as waiting for the results could cause delays in making decisions based on the scores.[9]

A separate study conducted on a sample of 200 patients with acute exacerbations of chronic obstructive pulmonary disease (AECOPD) demonstrated the findings that the DECAF rating exhibited a high level of accuracy in predicting the likelihood of death during hospitalization, with an area under the receiver operating characteristic curve (AUROC) value of 0.83. In addition, the DECAF Score demonstrated superior performance in predicting in-hospital mortality compared to the Acute Physiology and Chronic Health Evaluation (APACHE) II predictive index and the COPD and Asthma Physiology Score (CAPS), both of which have been suggested as effective predictive tools for acute exacerbations of chronic obstructive pulmonary disease (AECOPD). Additionally, they discovered that the DECAF score was a considerably more accurate indicator of in-hospital death than CURB-65 for a specific subset of individuals with radiological consolidation.[18]

A study attempted to substitute the atrial fibrillation component in the DECAF score with mortality based on the frequency of hospital admissions. The revised score was named the Modified DECAF score, which includes breathing difficulties, eosinopenia, consolidation, respiratory acidosis, as well as frequency of admission. There was a strong statistical correlation ($p < 0.001$) among the modified DECAF rating and death caused by AECOPD. The researchers determined that the Modified DECAF score is more accurate and precise for forecasting death in the hospital in acute exacerbation of COPD compared to the DECAF score, with no significant difference observed between the two scores. The AUROC curve was determined to be 0.848 for the DECAF score and 0.874 for the modified DECAF score. Our investigation yielded AUROC values of 0.828 and 0.774 for both the DECAF and modified DECAF models, respectively.[20]

The BAP-65 score, devised by Shorr et al., is determined by four factors: years of age, a change in mental state, pulse, and the blood urea nitrogen (BUN) level, which serves as the sole laboratory marker. The researchers discovered that the AUROC value was 0.77, indicating a strong correlation with several clinical outcomes such as in-hospital mortality, requirement for mechanical ventilation, duration of stay, and cost. In addition, they asserted that the BAP-65 score also accurately indicated individuals who were unlikely to require mechanical ventilation in the future. The BAP-65 has the benefits of simplicity and convenience of calculation, without requiring complex analysis of various elements that indicate the severity of the disease. Unlike the 2008 score, it does not include subjective characteristics such as dyspnea. The BAP-65 incorporates a single laboratory marker, specifically BUN, which simplifies its use compared to the DECAF and modified DECAF scoring systems.[21]

In our study, we found significant difference between the DECAF and BAP-65 values of alive and expired patients. This was similar to previous studies by Manchu et al. and Meena et al. A significant limitation of this study was the absence of post-hospital monitoring data, which is essential for validating predicting parameters. The study had a relatively modest number of female participants, which was lower than anticipated. Nevertheless, given patients were enrolled consecutively, this must be seen as reflecting real-life circumstances.

Conclusion

Both the DECAF and BAP-65 scores are equally effective in forecasting death, and we consider them to be good indicators. Both ratings can be readily used in AECOPD patients in order to reduce the occurrence of death throughout admission for AECOPD.

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