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Original Article

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The Role of Scoring in Predicting Mortality and Morbidity in Patients with Chronic Obstructive Pulmonary Disease

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Abstract

Aim: In this study, we aimed to determine the role of BAP-65, DECAF and DECAF-L scores in predicting morbidity and mortality in chronic obstructive pulmonary disease patients. These scores offer a potential standardized approach for evaluating chronic obstructive pulmonary disease (COPD) exacerbations in the emergency department.

Materials and Methods: This is a prospective observational study including COPD patients admitted to the emergency department. BAP-65, DECAF and DECAF-L scores were calculated. Initial outcomes including discharge, hospitalization or transfer to the intensive care unit, 30-day readmission and 30-day mortality were recorded.

Results: A total of 200 patients were included. BAP-65, DECAF and DECAF-L scores were significantly associated with the type of initial outcomes (discharge, hospital admission, or intensive care unit admission) and ($p<0.001$ for each). Lactate values were higher in deceased patients than in survived patients ($p=0.004$). When the lactate value increased by 1 unit, the risk of 30-day mortality increased by 35.8%. A significant difference was found between 30-day mortality and the DECAF-L score obtained by adding lactate to the DECAF score (area under the curve=0.653; $p=0.039$). This risk increased by 29.6% when the DECAF-L value increased by 1 unit.

Conclusion: Increasing the use of BAP-65, DECAF, and DECAF-L scores in the decision for discharge or hospitalization in COPD patients admitted to emergency departments will provide great convenience. In addition, we believe that it would be beneficial to increase the use of the DECAF-L score, which was found to be effective in predicting mortality in emergency departments.

Keywords: BAP-65, COPD, DECAF, DECAF-L, morbidity, mortality

Introduction

Chronic obstructive pulmonary disease (COPD) is a common and significant public health problem world-wide, with high mortality and morbidity. It is a preventable disease that occurs with air confinement due to airway obstruction, alveolar damage, airway collapse caused by damage to the small airways, and increased respiratory effort (1).

According to the World Health Organization, COPD is the third most common cause of death. Approximately 3 million people have died from COPD world-wide each year (2). In Türkiye, COPD is the fourth most common cause of death. The increase in the incidence of COPD leads to increases in hospital admissions, medical drug use, and costs (3).

COPD is a disease that progresses with exacerbations, clinically characterized by shortness of breath, cough, and increased sputum purulence (4). In adults with risk factors and long-term respiratory system symptoms, COPD is diagnosed by spirometric examination with FEV1/FVC <70% after bronchodilator treatment. Risk factors for COPD include genetic factors, age, sex, use of tobacco and tobacco products, air pollution, atopy, asthma, chronic bronchitis, infections, and low socioeconomic status (5). The main treatment approaches for COPD are bronchodilators, inhaled corticosteroids, antibiotics, and respiratory support treatments.

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In the management of COPD patients, biomarkers are needed to predict mortality, and to decide early whether discharge and palliative care are necessary. However, such markers that can determine hospital stay duration and patient mortality are limited.

The BAP-65 score consists of four parameters: blood urea nitrogen (BUN>25 mg/L), mental status change, pulse rate (>109 beats/minute), and patient age (≥65 years). The BAP-65 scoring system determines the need for mechanical ventilation and predicts the risk of in-hospital mortality and length of stay (6).

The DECAF score was developed to predict the risk of in-hospital mortality in COPD exacerbation. DECAF consists of five parameters: dyspnea, eosinopenia, consolidation, acidemia, and atrial fibrillation. The DECAF score is a simple risk score that can be applied at the bedside using the indices available in the emergency department and during hospitalization (7).

Lactic acid is a product of intracellular anaerobic respiration mechanisms, occurring due to hypoxemia associated with airway pathologies. DECAF-L scoring is obtained by adding the blood lactate value to the DECAF score. When the existing literature was examined, a limited number of studies were found using the DECAF-L score.

In our study, we aimed to determine BAP-65, DECAF, and DECAF-L scores for predicting patient outcomes and the 30-day mortality in patients diagnosed with COPD who were admitted to the emergency department with shortness of breath.

Materials and Methods

The prospective observational study included patients with COPD who presented for shortness of breath, at the Emergency Department of the Manisa Celal Bayar University Faculty of Medicine Hospital between May 1, 2022 and May 1, 2023. Written consent was obtained from Manisa Celal Bayar University Faculty of Medicine Ethics Committee (decision number: E-20478486-050.04.04-358705, date: 20.07.2022). Informed consent was obtained from the participants in the study.

All adult patients (≥18 years old) with COPD confirmed by spirometry were included in this study. Patients with coronavirus disease-2019 and pregnant women were excluded.

Age, gender, fever, pulse, systolic and diastolic pressures, respiratory rates, glasgow coma scale values, and peripheral capillary oxygen saturation measurements were recorded in the patients' follow-up charts. Hemogram, biochemical, and blood gas tests taken from the patients at the first admission were recorded. In addition, electrocardiograms were evaluated, and atrial fibrillation (AF) was recorded. The presence of consolidation areas was assessed in the radiological imaging of the patients.

After the follow-up of the patients in the emergency department, the following were recorded: the diagnosis, type of initial outcomes (e.g., discharge, hospitalization, and intensive care unit transfer), the 30-day mortality, the length of hospital stay in the emergency department, intubation status, and the 30-day readmission were recorded.

Statistical Analysis

Statistical analyses were performed using the SPSS program (IBM SPSS Statistics 27). For the variables with normal distribution, the Independent sample t-test (t-table value) was used to compare the two independent groups. For the variables that are not normally distributed, the Mann-Whitney U test (z-table value) was used to compare two independent groups, and the Kruskal-Wallis H test (x^2-table value) was used to compare three or more independent groups. Pearson's chi-squared cross-tabulations were used to examine the relationships of two qualitative variables. Binary logistic regression: the Backward LR model was used to examine the factors affecting the 30-day mortality. ROC curves were used to evaluate the significant variables in predicting the 30-day mortality.

Results

A total of 200 patients with COPD were included in the study. Of those, the mean age was 70.69±9.42 years, and 73% were male. AF was present in 27 patients (13.5%). Community-acquired pneumonia was diagnosed in 94 patients (47.0%). When the types of initial outcomes in the emergency department were examined: of the 200 patients, 37.5% (n=75) were admitted to the general wards, 33% (n=66) were admitted to the intensive care unit, and 29.5% (n=59) were discharged from the emergency department. The mean length of hospital stay in the emergency department was 4.29±1.34 hours.

BAP-65, DECAF, and DECAF-L scores were significantly associated with the type of initial outcomes (discharge, hospital admission, or intensive care unit admission) (χ^2=26.685, p<0.001; χ^2=82.793, p<0.001; χ^2=91.701, p<0.001). Significant differences were found between patients transferred to the intensive care unit and those patients hospitalized in general wards and discharged. BAP-65, DECAF, and DECAF-L values of hospitalized patients in the intensive care unit were significantly higher than those in general wards and those of discharged patients. Likewise, a significant difference was found between discharged patients and patients hospitalized in general wards. BAP-65, DECAF, and DECAF-L values were significantly higher in hospitalized patients than in discharged patients (Table 1).

BAP-65, DECAF, dyspnea scale, and severity of exacerbation were not associated with 30-day mortality (all p value >0.05). DECAF-L score was associated with 30-day mortality (z=-2.067; p=0.039). DECAF-L score was higher in deceased patients than in survivors (Table 2).

According to the results of Backward logistic regression analysis, including significant parameters in the univariate analysis, the DECAF-L value was the only independent parameter affecting risk of 30-day mortality (p<0.05). When the DECAF-L value increased by 1 unit, the risk of mortality increased by 29.6% (odds ratio=1.296) (Table 3).

Discussion

COPD is one of the leading causes of mortality and morbidity world-wide. Many studies are conducted world-wide to detect COPD early, implement preventive measures, reduce exacerbation

Table 1. Comparison of quantitative characteristics according to the outcome pattern

Outcome variable	Hospital admission (n=75)		Intensive care unit transfer (n=66)		Discharge (n=59)		Statistical analysis* Probability
	Mean±SD	Median [IQR]	Mean±SD	Median [IQR]	Mean±SD	Median [IQR]	
BAP-65	1.52±0.76	2.0 [1.0]	2.12±1.10	2.0 [2.0]	1.18±0.84	1.0 [1.0]	χ^2=26,685 p<0.001 [2-1.3] [1-3]
DECAF	2.37±1.07	2.0 [1.0]	3.26±1.19	3.0 [1.0]	1.00±1.00	1.0 [2.0]	χ^2=82,793 p<0.001 [2-1.3] [1-3]
DECAF-L	2.77±1.32	3.0 [1.0]	4.03±1.59	4.0 [2.0]	1.08±1.10	1.0 [2.0]	χ^2=91,701 p<0.001 [2-1.3] [1-3]

*BAP-65: Blood urea nitrogen (BUN>25 mg/L), mental status change, pulse rate (>109 beats/minute) and patient age (≥65 years). DECAF: Dyspnea, eosinopenia (<0.05×10^9/L), consolidation, acidemia (pH <7.30) and atrial fibrillation. DECAF-L: Dyspnea, eosinopenia (<0.05×10^9/L), consolidation, acidemia (pH <7.30), atrial fibrillation and blood lactate value. *Kruskal-Wallis H test (χ^2-table value) statistics were used to compare the measurement values of three or more independent groups in data that did not have a normal distribution. IQR: Interquantile range, SD: Standard deviation

Table 2. Comparison of quantitative characteristics according to the 30-day mortality

Variable	Deceased (n=16)		Survived (n=184)		Statistical analysis* Probability
	Mean±SD	Median [IQR]	Mean±SD	Median [IQR]	
BAP-65	1.81±0.83	2.0 [1.0]	1.60±0.99	2.0 [1.0]	z=-1.025 p=0.305
DECAF	2.69±1.35	3.0 [2.0]	2.22±1.41	2.0 [2.0]	z=-1.572 p=0.116
DECAF -L	3.50±1.71	3.5 [2.8]	2.62±1.78	3.0 [3.0]	z=-2.067 p=0.039

*BAP-65: Blood urea nitrogen (BUN>25 mg/L), mental status change, pulse rate (>109 beats/minute) and patient age (≥65 years). DECAF: Dyspnea, eosinopenia (<0.05×10^9/L), consolidation, acidemia (pH <7.30) and atrial fibrillation. DECAF-L: Dyspnea, eosinopenia (<0.05×10^9/L), consolidation, acidemia (pH <7.30), atrial fibrillation and blood lactate value. *In the normally distributed data, Independent sample t-test (t-table value) statistics were used to compare the measurement values of the two independent groups. Mann-Whitney U test (z-table value) statistics were used to compare the measurement values of two independent groups in the data without normal distribution. IQR: Inter quantile range, SD: Standard deviation

Table 3. Logistic regression model based on exitus in the last 1 month

Variable	β	SE	Wald-χ^2	df	p value	OR	95% Confidence interval (OR)	
							Under	Top
DECAF-L	0.260	0.139	3.470	1	0.042	1.296	1.110	1.704
Lactate	0.306	0.117	6.819	1	0.009	1.358	1.079	1.709
Constant	-3.233	0.543	35,516	1	<0.001	0.039		
CCR=92.0% $\chi2_{(8)}$=8.593; p=0.474 Hosmer-lemeshow test								

CCR: Correct classification rate, DECAF-L: Dyspnea, eosinopenia (<0,05×10^9/L), consolidation, acidemia (pH <7.30), atrial fibrillation and blood lactate value, Df: Degrees of freedom, OR: Odds ratio, SE: Standard error, β: Beta coefficient frequency, preserve lung capacity to enhance quality of life, decrease hospital admissions, and prevent deaths. There are few studies evaluating the prognosis in patients hospitalized with the diagnosis of the exacerbation of COPD (8). In our study, we investigated the performance of BAP-65, DECAF, and DECAF-L scores to predict short-term morbidity and mortality of patients with COPD who were admitted to the emergency department with shortness of breath.

Advanced age is a well-known risk factor for COPD. With age, COPD-like changes are seen in the lung parenchyma and airways (GOLD2024). In our study, the mean age was 70.69±9.42 years, and 73% were male. Our results are similar to those in the literature (9,10).

BAP-65 and DECAF scores have been used to show the prognosis in patients presenting with acute exacerbation of COPD (11, 12). Steer et al. (7) conducted a study in 2012 involving 920 patients to determine the prognosis of patients hospitalized with COPD exacerbation complicated by pneumonia. Therefore, the researchers developed the DECAF score. They demonstrated that the DECAF score showed an outstanding performance in predicting mortality (area under the receiver operating characteristic curve=0.86, 95% confidence interval=0.82 to 0.89), and this score outperformed other clinical scores. The meta-analysis of Shen et al. (12), published in 2021, was the first large-scale study using the DECAF score in the evaluation of mortality in patients with COPD exacerbation. Sangwan et al. (13) showed that the DECAF and BAP-65 scores were important predictors for mortality in patients hospitalized with COPD exacerbation. The sensitivity of both scores was 100%. Specificity was 34.1% in the DECAF score and 63.4% in the BAP-65 score.

In our study, we found significant relationships between the type of initial outcome and BAP-65 ($p<0.001$) and DECAF scores ($p<0.001$) in patients admitted to the emergency department with COPD exacerbation, in accordance with the literature. We found that patients with high BAP-65 or DECAF scores were more likely to be hospitalized in general wards or transferred to the intensive care unit compared to those with lower BAP-65 or DECAF scores. We believe that these scores can be beneficial for emergency room physicians and consultation physicians in managing patients with COPD.

There are a limited number of studies on the DECAF-L score in the literature. In our study, we evaluated scores and some blood parameters that may be effective in predicting morbidity and mortality in COPD patients. In these patients, we assessed the levels of lactic acid, which is produced resulting from the intracellular anaerobic respiratory mechanism due to hypoxemia caused by airway pathologies. Seker et al. (14) examined the blood lactate value to predict mortality in COPD patients admitted to the emergency department. The blood lactate level was significantly higher in patients who did not survive. Villanueva Rábano et al. (15) emphasized that NEWS2-L, a novel score created by adding lactate to NEWS2, had better performance than NEWS2 and lactate separately in predicting mortality in the emergency department. Chen and Li (16) examined 1641 pneumonia patients admitted to the emergency department and reported that blood lactate level was superior to CURB-65 in predicting mortality, admission to the general ward, and transfer to the intensive care unit. They also reported that the LAC-CURB-65 score with the addition of lactate significantly improved the performance of CURB-65 in predicting mortality.

In our study, a significant difference was found between blood lactate values of patients who died within 30 days, those who survived ($p=0.004$). In addition, a significant relationship was found between the 30-day mortality and the DECAF-L score, obtained by adding the lactate value to the DECAF, ($p=0.039$). In addition, we found the DECAF-L score was associated with the decision for discharge or hospitalization ($p<0.001$).

Study Limitations

A limitation of our study is that it was conducted in a single-center setting. Therefore, our results are open to regional differences.

In addition, some patients could not be hospitalized due to limited bed capacity in the Chest Diseases unit. These patients were treated in the emergency room and discharged. However, this may cause repeated admissions of patients in a short time, an increase in the number of intensive care unit admissions, and deaths.

Conclusion

Considering the density of patients in emergency departments, it is extremely important for emergency room physicians to evaluate and make appropriate decisions quickly and effectively. The most important result of our study is the utility of BAP-65, DECAF, and DECAF-L scores to predict morbidity and mortality in patients admitted to the emergency department with exacerbation of COPD. However, among these scores, the DECAF-L score, created by adding the lactate value, was found to be superior in predicting morbidity and mortality. For this reason, we recommend the use of the DECAF-L score in COPD patients admitted to the emergency department.

Ethics

Ethics Committee Approval: Written consent was obtained from Manisa Celal Bayar University Faculty of Medicine Ethics Committee (decision number: E-20478486-050.04.04-358705, date: 20.07.2022).

Informed Consent: Informed consent was obtained from the participants in the study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.O., E.S.G., Concept: A.O., E.S.G., M.Y., Design: A.O., E.S.G., M.Y., Data Collection or Processing: A.O., E.S.G., Analysis or Interpretation: A.O., E.S.G., M.Y., Literature Search: A.O., E.S.G., M.Y., Writing: A.O., E.S.G.

Conflict of Interest: The authors declare that they have no conflict of interest.

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