

RESEARCH ARTICLE

Prognostic Values of Lactate and qSOFA Scores in Patients Presenting to the Emergency Department with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

Laktat ve Qsofa Skorunun Acil Servise KOAH Alevlenmesi ile Başvuran Hastalardaki Prognostik Değerleri

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ABSTRACT

Objective: Various clinical and laboratory markers have been used to predict the prognosis of acute exacerbations of chronic obstructive pulmonary disease (COPD). Our aim in this study was to contribute to the literature by examining the prognostic value of lactate level and quick Sequential Organ Failure Assessment (qSOFA) score in patients admitted to the emergency department with COPD exacerbation.

Material and Method: This study was conducted as a retrospective study in patients with chronic obstructive pulmonary disease presenting to the Emergency Medicine clinic with acute exacerbation. For each patient, the relationship between the lactate level and Qsofa score at the time of emergency department admission and the duration of hospital stay, 28-day mortality, and hospitalization to the ward or intensive care unit was examined.

Results: The results of our study examining the prognostic values of lactate level and qSOFA score on patients admitted to the Emergency Department with COPD exacerbation are as follows: (i) Lactate levels and qSOFA scores of hospitalized patients were higher than those of discharged patients. (ii) It was statistically shown that patients with high qSOFA scores had longer hospitalization duration. (iii) In the inpatient group, patients with qSOFA score 3 were more likely to be admitted to intensive care, while patients with qSOFA score 1 were more likely to be admitted to the ward.

Conclusion: According to our study, we think that qSOFA score and lactate level in patients admitted to the emergency department with COPD exacerbation may be useful parameters for physicians to make hospitalization or discharge decisions.

Keywords: COPD, Lactat, qSOFA.

ÖZET

Amaç: Kronik obstrüktif akciğer hastalığının akut alevlenmelerinin prognozlarını tahmin etmeye yönelik çeşitli klinik ve laboratuvar belirteçler kullanılmaktadır. Kan laktat düzeyinin ve qSOFA skorlamasının KOAH alevlenmeli hastalar üzerindeki prognostik değerini inceleyen çalışmalar sınırlı sayıdadır. Bizim de çalışmamızdaki amacımız laktat seviyesi ve qSOFA skorunun KOAH alevlenme ile acil servise başvuran hastalar üzerindeki prognostik değerlerini inceleyerek literatüre bu yönde katkı sağlamaktır.

Gereç ve Yöntem: Bu araştırma retrospektif bir çalışma olarak Acil Tıp kliniğine akut alevlenme ile başvuran kronik obstrüktif akciğer hastalarında yapılmıştır. Her hasta için acil servis başvuru anındaki laktat düzeyi ve Qsofa skorunun skorunun hastanede kalış süresi, 28 günlük mortalite, servis ya da yoğun bakıma yatışı ile ilişkisine bakıldı.

Bulgular: Laktat düzeyi ve qSOFA skorunun Acil Servise KOAH alevlenmesi ile başvuran hastalar üzerindeki prognostik değerlerini inceleyen çalışmamızda bulduğumuz sonuçlar şu şekildedir: (i) Hastaneye yatan hastaların laktat düzeyleri ve qSOFA skorları taburcu edilen hastalara göre daha yüksektir. (ii) qSOFA skoru yüksek olan hastaların yatış süresinin uzadığı istatistiksel olarak gösterilmiştir. (iii) Yatan hasta grubunda qSOFA skoru 3 olan hastaların yoğun bakıma yatış olasılığı yüksekken qSOFA skoru 1 olan hastaların servise yatış olasılığı daha yüksek bulunmuştur.

Sonuç: Çalışmamıza göre KOAH alevlenme ile acil servise başvuran hastalarda qSOFA skoru ve laktat düzeyinin, hastaların hastaneye yatış veya taburculuk kararını vermede hekimlerin faydalanabileceği parametreler olabileceğini düşünüyoruz. Ayrıca çalışmamız qSOFA skorunun KOAH alevlenmesi ile başvuran hastaların yoğun bakım ihtiyacı, hastanede kalış süresi ve mortaliteleri ile ilişkili olduğunu göstermiştir.

Anahtar Sözcükler: KOAH, Laktat, qSOFA.

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease characterized by progressive and persistent airflow limitation, usually associated with an increased chronic inflammatory response in the airways and lungs, resulting from exposure to harmful gases and particles. Acute exacerbations of chronic obstructive pulmonary disease are defined as acute worsening of respiratory symptoms requiring additional treatment (1). In 2030, the disease is expected to be the third most common cause of death worldwide, and early diagnosis and effective follow-up of patients is becoming more and more important. For this purpose, various clinical and laboratory markers are used to predict the prognosis of patients, and new research on the potential use of different markers is being published every day (2). Many studies have shown that factors such as age, male gender, performance status, comorbid diseases, bronchodilator and corticosteroid reversibility affect the prognosis of patients presenting with COPD exacerbation (3). Laboratory values such as procalcitonin (PCT), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), white blood cell (WBC), neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR) are other parameters whose prognostic values in COPD patients have been examined (4, 5).

Plasma lactate level is a rapid and easily accessible test that can be measured in an arterial blood gas (ABG) sample and is a marker of the severity of tissue oxygen demand. Although there are many studies showing that high lactate levels increase the risk of heart failure, trauma, sepsis, pulmonary embolism and cardiovascular mortality, there are a limited number of studies examining the relationship between COPD exacerbation and lactate (6). Similarly, few studies have examined the prognostic value of Rapid Sequential Organ Failure Assessment (qSOFA) scoring, a scoring system used to diagnose sepsis through a rapid assessment at the time of initial presentation, in patients with COPD exacerbations. Predicting with high probability the future clinical outcome of a disease with high morbidity, such as COPD, would be very useful in making certain precautions and treatment decisions about COPD patients. In this context, there is a need for new parameters that can help determine the prognosis of COPD patients. Our aim in this study was to contribute to the literature by examining the prognostic value of lactate level and qSOFA score in patients admitted to the emergency department with COPD exacerbation.

MATERIAL AND METHOD

Study design

This study was conducted as a retrospective study on chronic obstructive pulmonary disease patients who applied to the Emergency Medicine clinic with acute exacerbation. Patients were previously diagnosed with COPD according to international diagnostic guidelines. Local Ethics Committee approval (Decision No: 2024/10-192) was obtained and the study was conducted in accordance with the ethical standards set out in the 1964 Declaration of Helsinki and its subsequent amendments. Informed consent was waived because the study was retrospective. All patients enrolled in the study were those presenting to the emergency department between July 2024 and September 2024. A total of 147 cases were selected for the study. Patients over 18 years of age, with a previous diagnosis of COPD and one or more of the following exacerbation symptoms were included in the study;

- i) increased shortness of breath,
- ii) cough and wheezing,
- iii) increased sputum purulence and quantity.

Patients with other chronic respiratory diseases such as bronchiectasis, active tuberculosis, asthma, pulmonary embolism, immune system diseases, bacterial infections outside the respiratory system, lung cancer and other malignant tumors were excluded.

Data collection

Patient data were accessed using the hospital information management system. A data collection form was completed for each patient, in which age, gender, arterial blood pressure, pulse rate, respiratory rate, fingertip saturation value, fever, comorbidities and blood parameters taken at the time of initial presentation were recorded. In addition, the duration of hospitalization, mortality rates and the need for intensive care were analyzed. The qSOFA scores of all patients were calculated. Afterwards, comparisons were made between hospitalized and discharged patients in terms of the parameters in the patient follow-up form. Furthermore, the association of lactate and qSOFA scores with length of hospital stay, 28-day mortality, and hospitalization to the ward or intensive care unit was examined.

qSOFA

qSOFA scores were calculated for all patients hospitalized or discharged from the emergency department. qSOFA consists of 3 points: impaired consciousness, systolic blood pressure of 100mmHg or

less and respiratory rate more than 22 breaths/min (6)

Statistical Analysis

The data were first transferred to the Excel program and after some adjustments such as converting textual data into numerical data and labeling the data, they were transferred to the SPSS version 29.00 (SPSS, Inc, Chicago, IL) package program. The data were analyzed in two ways: descriptive and interpretive. Before the analysis, the data were subjected to different normality tests and the findings were reported according to the values obtained. Accordingly, normally distributed data were reported as mean and standard deviation, and non-distributed data were reported as median and quartiles. Categorical variables are presented with frequency and percentage. Two-group variables were analyzed with independent sample t-test or Mann Whitney U test according to their meeting the assumptions. For variables with three groups or more, Oneway ANOVA or Kruskal-Wallis (MKW) test was used according to the fulfillment of the assumptions. In-group comparisons of categorical variables were made using the chi-square test or Fisher Exact test according to the fulfillment of the assumptions. In addition, the relationship between

two continuous variables was determined by Pearson correlation analysis. All statistical analyses were two-tailed and the significance level was set at 0.05.

RESULTS

Comparison of demographic characteristics of inpatients and discharged patients

Parameters such as age, gender, vital signs, comorbidities, laboratory findings, need for non-invasive mechanical ventilation and qsofa were compared in hospitalized and discharged patient groups. As a result of the analysis, significant differences were found between the two groups in terms of blood pressure arterial, pulse rate, respiratory rate, finger tip saturation, renal failure, CRP, lactate and qSOFA. In terms of lactate, the inpatient group had higher lactate values than the discharged patients. This difference was statistically significant. In addition, of the 42 patients with zero qSOFA, 34 were discharged and 8 were hospitalized. This difference between the groups was statistically significant (Table 1).

Table 1. Patient characteristics.

Variables	Hospitalized patients (n =78)	Outpatients (n =69)	p ¹	Effect Size
Age, $\bar{x}$ (ss) ^a	72,62 (11,22)	69,71 (9,54)	0,09	
Sex				
Females, n (%)	32 (41)	15 (22)	0,01*	0,21 ^a
Male, n (%)	46 (59)	54 (78)		
Vital signs				
ST, $\bar{x}$ (ss)	123,91 (26,14)	133,62 (22,30)	<0,01**	0,39 ^b
DT, $\bar{x}$ (ss)	68,20 (16,23)	74,02 (12,86)	<0,01**	0,39 ^b
Pulce, $\bar{x}$ (ss)	100,01 (17,27)	94,71 (15,04)	0,02*	0,32 ^b
RR, median (IQR)	31 (24-35)	21 (18-32)	<0,01**	0,37 ^c
SpO2, median (IQR)	76 (70-83)	84 (77-90)	<0,01**	0,32 ^c
Fever, median (IQR)	36,30 (36-37)	36,30 (36-36,70)	0,15	
Comorbidities				
DM, n (%)	16 (60)	11 (40)	0,47	
HT, n (%)	20 (48)	22 (52)	0,40	
CAD, n (%)	18 (55)	15 (45)	0,84	
CKD, n (%)	20 (74)	7 (26)	0,01*	0,20 ^a
Laboratory results				
Lactat, $\bar{x}$ (ss)	2,42 (1,52)	1,88 (0,74)	0,01*	0,41 ^b
HCT, $\bar{x}$ (ss)	44,37 (8,27)	47,73 (7,95)	<0,00**	0,41 ^b
HGB, $\bar{x}$ (ss)	13,74 (2,64)	14,93 (2,48)	<0,00**	0,46 ^b
BUN, median (IQR)	25 (18 - 40)	17 (14-18)	0,11	
WBC, median (IQR)	7770 (6540 - 8810)	7970 (6620-11375)	0,31	
CRP, median (IQR)	26 (9 - 75)	30 (8 - 60)	<0,00**	0,28 ^c
ph, $\bar{x}$ (ss)	7,36 (0,07)	7,36 (0,05)	0,92	
qSOFA				
0, n (%)	8 (10,3)	34 (49,3)		
1, n (%)	40 (51,3)	31 (44,9)	<0,00**	0,51 ^a
2, n (%)	15 (19,2)	4 (5,8)		
3, n (%)	15 (19,2)	0 (0)		
NIMV Need n (%)	20 (25,6)	3 (4,3)	<0,00**	0,29 ^a
Place of Hospitalization				
Service, n (%)	66 (84,6)			
Intensive care	12 (15,4)			
28-day mortality				
Died	22 (28,2)			
Alive	56 (71,8)			

¹, chi-square for categorical variables, independent sample t-test for variables reporting mean and standard deviation, Mann-Whitney U test for variables reporting median and IQR; **, significant at 0.01 level; * significant at 0.05 level; Cramer's V for a, Cohen's D for b and r for c were used to determine the effect size.

Notes: DM, diabetes mellitus; HT, hypertension; CKD, chronic kidney disease; CAD: coronary artery disease; BUN, blood urea nitrogen; WBC, white blood cell; CRP, C-reactive protein; HCT, hematokrit; HGB, hemoglobin; ST, systolic tension; DT, diastolic tension; IQR, interquartile range; $\bar{x}$, mean; ss, standard deviation; RR, respiratory rate; NIMV, non invasive mechanical ventilation; SpO2, Saturation; pH, potential hydrogen.

Association of lactate with length of hospitalization, place of hospitalization and mortality

The relationship between Lactate and place of hospitalization, mortality and length of stay in the hospitalized patient group was analyzed by Mann-

Whitney U-test, independent sample t-test and Pearson Correlation test. As a result of the analyses, no significant association of Lactate with any variable was found ($p>0.05$ for each variable) (Table 2).

Table 2. Association of lactate with length of hospitalization, place of hospitalization and mortality.

Variables	n	Lactate	p
Length of hospitalization, r	78	-0,065	0,57 ¹
Place of Hospitalization			
Service, median (IQR)	66	2,15 (1,30 – 3,00)	0,64 ²
Intensive care, median (IQR)	12	2,25 (1,85 – 2,50)	
28-day mortality			
Yes, $\bar{x}$ (ss)	22	2,43 (1,69)	0,98 ³
No, $\bar{x}$ (ss)	56	2,42 (1,47)	

1, Pearson Correlation; 2, Mann-Whitney U-test; 3, Independent Sample t-test; IQR, interquartile range; $\bar{x}$, mean; ss, standard deviation.

Association of qSOFA with place of hospitalization, length of stay and mortality

One-way ANOVA test was used to compare the means of different qSOFA groups for the variable “length of hospitalization”. As a result of ANOVA, there was a statistically significant difference between the groups ($F(3, 77) = 2.96$, $p = 0.03$, $\eta^2 = 0.12$). Tukey HSD post-hoc test was applied to determine the specific differences between the groups. However, according to the results of the post-hoc analysis, there was no significant difference between the groups ($p > 0.05$ for all group comparisons). Although this showed that there was a difference between the groups in general for ANOVA, it could not determine which qSOFA groups were different. Although this is not often encountered in analyses, it may be because the overall difference was small or because the post-hoc tests were too sensitive to detect differences between groups. Chi-square test was applied to examine the relationship between qSOFA score and place of hospitalization (ward or intensive care unit). According to the results of the analysis, a statistically significant association was found between qSOFA score and place of hospitalization ($\chi^2(3, N = 78) = 8.99$, $p = 0.03$). However, according to the test assumptions, the expected frequencies of the cells should be at least 5. As a result of the test, it was determined that the expected frequency was below 5 in 37.5% of the cells. Based on this result, the Fisher Exact Test result was reported. The test results showed a significant relationship similar to the Pearson's chi-

square test (FisherExact = 7.68; $p = 0.03$). Adjusted Residual values were also analyzed to determine between which cell blocks the difference was between. According to the results, patients with a qSOFA score of 3 were significantly more likely to be hospitalized in intensive care (a.r. = 2.9) and significantly less likely to be hospitalized in the ward (a.r. = -2.9). The same was true for patients with a qSOFA score of 1. Accordingly, patients with socket 1 were significantly more likely to be hospitalized in the ward (residual = 2.0) and significantly less likely to be hospitalized in intensive care (residual = -2.0). In qSOFA 2 and 0 groups, there was no significant difference between cells.

The relationship between qSOFA and 28-day mortality was again analyzed by Pearson Chi-square test. As a result of the analysis, the Fisher-Freeman-Halton Exact Test result was reported since the expected frequency was below 5 in 37.5% of the cells. Accordingly, a significance value of $p = 0.130$ was obtained. This result suggests that there is no statistically significant association between qSOFA score and mortality. However, the results of the Linear-by-Linear Association test revealed a significant linear association with $p = 0.039$. This finding indicated that there was a significant linear association between qSOFA score and mortality and that the risk of mortality may increase with increasing qSOFA score. The association of qSOFA with place of hospitalization, length of stay and mortality is shown in table 3.

Table 3. Association of qSOFA with place of hospitalization, length of stay and mortality.

Variables	qSOFA				p	Effect Size
	0 (n=8)	1 (n=40)	2 (n=15)	3 (n=15)		
Length of hospitalization, $\bar{x}$ (ss)	7,62 (3,73)	7,85 (7,45)	15,46 (17,25)	15,66 (13,91)	0,03*	0,12 ^a
Place of Hospitalization						
Service, n (%)	7 (87,5)	37(92,5)	13(86,7)	9 (60)	0,03*	0,34 ^b
Intensive care, n (%)	1 (12,5)	3 (7,5)	2 (13,3)	6 (40)		
28-day mortality						
Yes	1 (12,5)	8 (20)	7 (46,7)	6 (40)	0,13	
No	7 (87,5)	32 (80)	8 (53,3)	9 (60)		

a, Eta-Squared (η^2); b, Cramer's V; *, significant at 0.05 level; $\bar{x}$, mean; ss, standard deviation.

DISCUSSION

Acute exacerbations in COPD patients are directly related to mortality (8). Furthermore, exacerbations have negative effects on patients' quality of life, readmission rates and disease progression (9). Therefore, appropriate management of acute exacerbations is recommended by national and international organizations (10). Modified forms of existing scores are recommended to predict clinical deterioration and mortality in patients with chronic respiratory disease (11). One of these scoring systems is qSOFA. qSOFA has been used in the literature to evaluate many diseases, especially sepsis (12, 13). However, studies examining the performance of qSOFA on the prognosis of patients with COPD exacerbations are limited. Dogan et al. in a study in which they examined the prognostic values of early warning scores in patients admitted to the emergency department with COPD exacerbation, they showed that qSOFA had a high positive probability rate in mortality prediction (14). In our study, unlike the literature, no statistically significant relationship was found between qSOFA score and mortality. However, our study showed that there was a linear relationship between qSOFA score and mortality and that the risk of mortality may increase with increasing qSOFA score. In the most recent Sepsis-3 consensus, it was suggested that the qSOFA score could be used as a good predictor of intensive care unit hospitalization (15). In the study by Su et al. the overall performance of qSOFA in predicting the need for intensive care support in COVID-19 patients was in line with the Sepsis 3 consensus (16). In our study, in line with the literature, patients with a qSOFA score of 3 had a high need for intensive care, while patients with a qSOFA score of 1 had a low likelihood of intensive care hospitalization. In our study, a significant correlation was found between qSOFA and the duration of hospitalization in patients admitted to the Emergency Department with COPD exacerbation. Sayar et al. found a significant difference between qSOFA score and total length of hospital stay in a study (17). In the study conducted by Singer et al. (18) on 22,530 patients, it was shown that the qSOFA score was directly related to the duration of intensive care unit stay and hospital stay in patients with and without suspected infection who applied to the emergency department. Lactate, the end product of anaerobic respiration, is considered an important prognostic marker in the risk assessment of patients admitted to the emergency department. It has been proven in many studies on different patient groups that lactate level is a valuable prognostic parameter in critically ill patients (19, 20). The literature review revealed a limited number of studies on lactate levels in patients with COPD exacerbation. In a study by Sakalli (21), lactate levels of patients admitted to the Emergency Department with COPD exacerbation were com-

pared with patients' hospitalization in the intensive care unit, mortality rates and length of hospital stay and statistically significant results were obtained. In addition, in a study conducted by Chukwulebe et al (22) on patients followed up with a prediagnosis of sepsis, a significant difference was found between the lactate level checked at admission and hospitalized patients and patients discharged from the emergency room. In our study, inpatients had higher lactate values than discharged patients, consistent with the literature. However, in our study, no significant relationship was found between lactate in the hospitalized patient group and place of hospitalization, mortality, and length of hospital stay. In acute conditions, elevation of plasma lactate level starts after the sixth hour, but it is not clearly known in which time interval the high plasma level is best detected (23). Therefore, studies examining the relationship between lactate levels and patient prognosis recommend serial lactate measurements instead of a single plasma lactate measurement (24). In our study, plasma lactate level was measured only at the time of admission and only once in patients admitted to the emergency department with COPD attack. This may be the reason why lactate in the hospitalized patient group was not significantly correlated with the place of hospitalization, mortality and length of hospital stay.

The limitations of our study are that it is retrospective, lactate levels were measured only once, and other pathologies that may cause hyperlactatemia were not evaluated. Prospective studies involving larger patient populations are needed to understand whether qSOFA and plasma lactate levels have prognostic significance in patients with COPD exacerbations. Serial plasma lactate level evaluation would be useful in prospective studies on this subject.

Conclusion

COPD has become a serious economic burden with repeated emergency room visits due to frequent exacerbations, hospitalizations and increasing treatment costs. The increasing number of applications every day makes emergency services more busy and crowded. In this context, the need for parameters that can provide insight into patients' emergency service and hospital processes, that can be determined quickly, are easy to calculate and have low cost, is increasing. In this context, qSOFA and lactate calculation stand out as easily accessible parameters. According to our study, we think that qSOFA score and lactate level may be useful parameters for physicians in making hospitalization or discharge decisions in patients admitted to the emergency department with COPD exacerbation. Our study also showed that qSOFA score was associated with the need for intensive care, length of hospital stay and mortality in patients admitted with COPD exacerbation.

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