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Comparison of the Effectiveness of LAR and CURB-65 Scores in Determining Hospitalization Decisions in Acute Pneumonia Patients

Akut Pnömoni Hastalarında LAR ve CURB-65 Skorlarının Hastaneye Yatış Kararındaki Etkinliğinin Karşılaştırılması

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ABSTRACT

Objective: This study aims to assess the efficiency of the Lactate/Albumin Ratio (LAR) and CURB-65 scoring in determining the need for hospitalization in acute pneumonia patients in the emergency department.
Methods: Our study was conducted retrospectively in the emergency department of a tertiary hospital from 1 February, 2024, to 1 August, 2024. Patients who presented with lower respiratory tract infections and were diagnosed with acute pneumonia between 01.02.2024 and 01.08.2024 were included in our study. All patient information was collected from electronic medical records.
Results: A total of 77 patients were included in the study, of which 30 were hospitalized. The mean age of the patients was 68.8 ± 12.2 years, and 46.8% (n=36) were male. When comparing patients discharged from the emergency department with those admitted to the hospital, the discharged group had lower respiratory rate, BUN, lactate, CURB-65, and LAR values, which were statistically significant (P<.05). LAR was negatively correlated and statistically significant with SBP, DBP and pH (P<.05). It was positively correlated and statistically significant with lactate and CURB-65 (P <.001).
Conclusion: Our study found that the LAR may be indicative of the need for hospitalization in acute pneumonia patients. However, the CURB-65 scoring system was more successful than LAR in predicting hospitalization.

Keywords: Albumin, emergency medicine, lactate, lactate/albumin ratio, pneumonia,

ÖZ

Amaç: Bu çalışmanın amacı, akut pnömoni hastalarında hastaneye yatış gereksinimini belirlemede Laktat/Albümin Oranı (LAR) ve CURB-65 skorlama sisteminin etkinliğini değerlendirmektir.
Yöntemler: Çalışmamız, 1 Şubat 2024 ile 1 Ağustos 2024 tarihleri arasında bir üçüncül hastanenin acil servisinde retrospektif olarak gerçekleştirilmiştir. Akut pnömoni tanısı konan alt solunum yolu enfeksiyonu ile başvuran hastalar çalışmaya dahil edilmiştir. Tüm hasta bilgileri elektronik tıbbi kayıtlar üzerinden toplanmıştır.
Bulgular: Toplamda 77 hasta çalışmaya dahil edilmiştir; bunlardan 30'u hastaneye yatırılmıştır. Hastaların ortalama yaşı 68,8 ± 12,2 yıl olup, %46,8'i (n=36) erkektir. Acil servisten taburcu edilen, hastalar ile hastaneye yatışı yapılan hastalar karşılaştırıldığında, taburcu edilen grubun solunum hızı, BUN, laktat, CURB-65 ve LAR değerlerinin istatistiksel olarak anlamlı bir şekilde daha düşük olduğu görülmüştür (P<.05). LAR'ın sistolik kan basıncı (SKB), diastolik kan basıncı (DKB) ve pH ile negatif yönde ve istatistiksel olarak anlamlı bir korelasyonu olduğu bulunmuştur (P<.05). LAR, laktat ve CURB-65 ile pozitif yönde ve istatistiksel olarak anlamlı bir korelasyona sahipti (P<.001).
Sonuç: Çalışmamız, LAR'ın akut pnömoni hastalarında hastaneye yatış gereksinimini gösteren bir belirteç olabileceğini bulmuştur. Ancak, CURB-65 skorlama sisteminin hastaneye yatışı tahmin etmede LAR'dan daha başarılı olduğu görülmüştür.

Anahtar kelimeler: Albümin, acil tıp, laktat, laktat/albümin oranı, pnömoni

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INTRODUCTION

Pneumonia is a pathological process characterized by the infection and infiltration of the alveolar, distal airways, and lung interstitial tissue. [1] Despite all advances in the medical field, respiratory diseases account for 30% of deaths each year. [2] Therefore, it is essential to rapidly identify pneumonia patients in emergency departments and determine their need for hospitalization.

Various scoring systems are employed to evaluate the severity of pneumonia and determine the necessity for hospitalization. The Pneumonia Severity Index (PSI) and CURB-65 are the primary scoring systems for evaluating pneumonia severity. PSI consists of 20 variables and can be complex to calculate in emergency services. [3] CURB-65 is another widely used scoring system; however, its performance decreases with advancing ages. [4] Consequently, there is ongoing research to define scoring systems and biomarkers that can assess the severity of pneumonia.

Lactate is considered a pleiotropic bioactive agent that can regulate immune-inflammatory responses, angiogenesis, and fibrosis. [5] Therefore, lactate levels are commonly used as a biomarker in emergency departments, as they indicate hypoxia and poor tissue perfusion and assist in determining the severity of various diseases, such as malignancy and sepsis. [6] Albumin, one of the most important proteins in the body, plays a vital role in maintaining colloidal osmotic pressure, wound healing, reducing oxidative damage, transporting drugs and endogenous substances, and coagulation. Additionally, albumin is one of the negative acute-phase reactants. [7] Due to these properties, albumin levels have been the subject of studies assessing inflammation severity, mortality, and the need for hospitalization in emergency services. [8] In light of the critical role of both albumin and lactate values in patient care, recent studies have also focused on the role of lactate/albumin ratios (LAR) in identifying critically ill patients. [9,10]

For all these reasons, this study aimed to evaluate the usability of LAR in determining the need for hospitalization of acute pneumonia patients in emergency departments and its relationship with CURB-65 scoring.

METHODS

Study Design

Our study was conducted retrospectively in the emergency department of a tertiary hospital from February 1, 2024, to August 1, 2024. This study was approved by the Atatürk University, Faculty of Medicine Clinical Research Ethics Committee. The study was carried out by the Helsinki Declaration (decision number: 7/23, date: October 25, 2024).

Study Population and Data Collection

Patients who presented with lower respiratory tract infections and were diagnosed with acute pneumonia between 01.02.2024 and 01.08.2024 were included in our study. All data of the patients were obtained from electronic patient records. The inclusion criteria were:

1. Age >18,

2. Presentation with acute lower respiratory symptoms (fever, cough, increased sputum, dyspnea, etc.),

3. No additional chronic diseases (diabetes, hypertension, chronic obstructive pulmonary disease, asthma, heart failure, coronary artery disease, chronic kidney disease, chronic liver disease, malignancy),

4. Ability to carry out daily activities independently,

5. Consultation with a pulmonologist (with at least 5 years of professional experience) confirming the diagnosis of acute pneumonia and determining the clinical outcome (discharge or hospitalization),

6. Complete availability of all data.

Patients who presented to the emergency department for a reason other than lower respiratory tract infection, or who had a chronic disease (Lactate and albumin levels may be influenced by factors such as medication use (e.g., metformin) or chronic conditions (e.g., chronic kidney disease, lung diseases associated with hypoxia, chronic liver diseases, etc.). Therefore, patients with chronic diseases have been excluded from the study.), comorbidity, or missing data, and who did not undergo chest disease consultation were excluded from the study. In our clinic, the CURB-65 and PSI scoring systems are used to determine the need for hospital admission in pneumonia patients. Patients with a CURB-65 score of 2 or higher are considered to have an indication for hospitalization and are consulted with the pulmonology department. The decision regarding the need for hospitalization for these patients is made in collaboration with the pulmonology specialist. If the PSI score is used, patients with a PSI score of class 2 or higher are also consulted with the pulmonology specialist to decide whether hospitalization is necessary. For patients falling

outside these criteria, discharge decisions are made based on the patient's individual characteristics. (Figure 1)

Age, gender, systolic-diastolic blood pressure values, pulse rate, fingertip saturation values, presence of confusion, PaO_2, $PaCO_2$, pH, and lactate values in arterial blood gas at the time of presentation to the emergency department were obtained from the electronic files of the patients and recorded in the study form. BUN (blood urea nitrogen), albumin, LAR levels in biochemical tests taken at the time of presentation to the emergency department were obtained from the patients' electronic files and recorded in the study form. The CURB-65 scores calculated by emergency medicine specialists with at least 2 years of experience were also retrieved from electronic files. For CURB-65 calculation, the presence of confusion was defined as 1 point, BUN>19 mg/dL as 1 point, respiratory rate>30 as 1 point, and systolic blood pressure (SBP) <90 mmHg or diastolic blood pressure (DBP) ≤60 mmHg as 1 point. [11] The clinical outcomes of the patients (hospitalization or discharge) were also recorded on the study forms. All data were transferred to electronic media.

Statistical Analysis

Statistical analyses were performed using SPSS version 25 (IBM SPSS Corp. Armonk, NY, USA). The Kolmogorov-Smirnov test was used to assess normal distribution. Descriptive statistics were presented as frequencies (n) and percentages (%) for categorical variables and as means and standard errors for numerical variables. Comparisons between categorical variables were made using the Chi-square test and Fisher's Exact test. For non-normally distributed variables, group comparisons were conducted using the Mann-Whitney U test. Spearman correlation analysis was used to investigate the relationship between non-normally distributed variables.

Receiver operating characteristic (ROC) analysis was performed to evaluate the predictive power of the CURB-65 score for hospitalization and discharge of patients from the emergency department. The area under the curve (AUC) for BUN, lactate, LAR, and CURB-65 scores was calculated. The Youden J index was used to estimate the best cutoff values. Sensitivity and specificity were calculated with a 95% confidence interval (CI). Statistical significance was accepted at $P<.05$.

RESULTS

A total of 77 patients were included in the study, of which 47 were hospitalized. The mean age of the patients was 68.8 ± 12.2 years, and 46.8% (n=36) were male. When comparing patients discharged from the emergency department and those admitted to the hospital, saturation, and PaO_2 values were higher in the discharged group, while respiratory rate, BUN, lactate, CURB-65, and LAR values were lower and statistically significant ($P<.05$). The baseline characteristics of the patients according to the outcome in the emergency department are shown in Table 1.

The correlation of LAR with other data is shown in Table 2. LAR was negatively correlated and statistically significant with SBP, DBP and pH ($P<.05$). It was positively correlated and statistically significant with lactate and CURB-65 ($P<.001$).

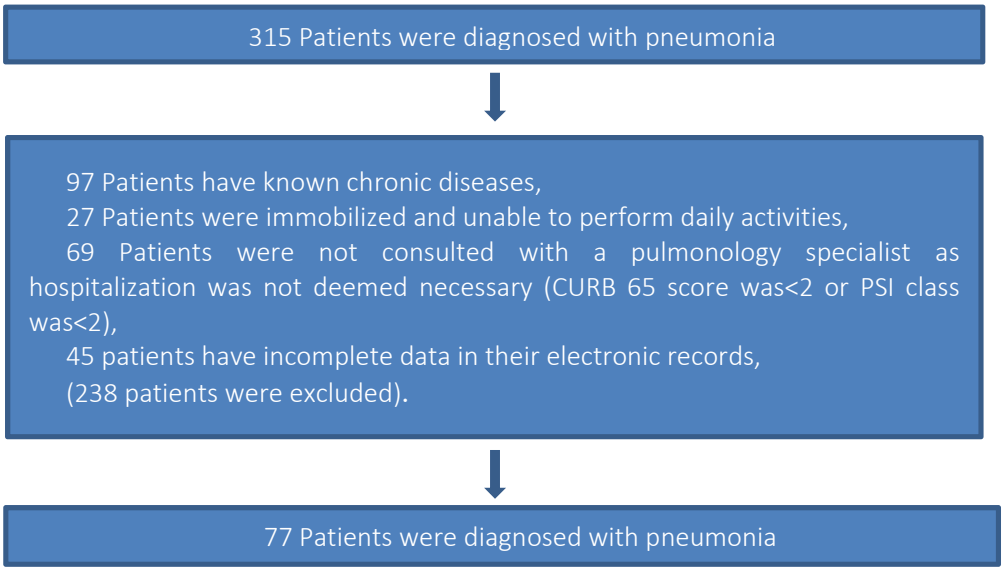

Figure 1: Flowchart for patient selection

Table 1. Baseline characteristics of the patients according to the outcome in the emergency department

Variables	Total (n=77)	Discharged (n=30)	Hospitalization (n=47)	*P*
Age, year	68.8±12.2	63.4±13.1	72.3±10.4	.540
Gender, male	36 (46.8%)	14 (46.7%)	22 (46.8%)	.990
Confusion	10 (13.0%)	1 (3.3%)	9 (19.1%)	**.045**
SBP, mmHg	120.6±26.6	126.8±16.4	116.7±30.9	.111
DBP, mmHg	73.5±16.6	77.9±9.8	70.6±19.8	.052
Heart Rate, /min	107.1±22.1	101.4±16.5	110.7±24.5	.057
Saturation, %	81.6±7.3	84.1±7.5	79.9±6.7	**.007**
Respiratory rate, /min	20.8±5.6	18.6±4.1	22.3±6.0	**.008**
Albumin, g/dL (3.5- 5.2 g/dL)	3.5±0.5	3.6±0.5	3.5±0.5	.768
BUN, mg/dL (6- 22mg/dL)	24.7±14.0	17.5±10.7	29.2±14.1	**<.001**
pH (7.35- 7.45)	7.42±0.06	7.44±0.04	7.42±0.06	.061
Lactate, mmol/L (0.5- 1 .6 mmol/L)	1,91±1.13	1.55±0.84	2.13±1.23	**.011**
PaO_2	60.28±10.35	65.07±9.51	57.23±9.78	**.001**
$PaCO_2$	34.30±6.04	33.31±5.69	34.94±6.23	.306
CURB-65	1.95±1.22	0.87±0.86	2.64±0.87	**<.001**
LAR	0.55±0.45	0.40±0.21	0.64±0.53	**.006**

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; min: minutes PaO_2: Partial arterial oxygen pressure: $PaCO_2$; Partial arterial carbon dioxide pressure: LAR; Lactate/albumin ratio

Table 2. Correlation of LAR with other data

LAR	SBP	DBP	HR	Sat	RR	Alb	pH	PaO_2	$PaCO_2$	Lac	CURB-65
r	-0.378	-0.386	0.219	-0.202	0.221	-0.057	-0.359	-0.126	0.027	0.880	0.475
p	**.001**	**.001**	.055	.077	.054	.624	**.001**	.275	.819	**<.001**	**<.001**

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate; Sat: Saturation; RR: Respiratory rate; Alb: Albumine: LAR: Lactate/albumin ratio; PaO_2: partial arterial oxygen pressure: $PaCO_2$; partial arterial carbon dioxide pressure: Lac; Lactate.

Table 3. Optimal cut-off points of variables for predicting patients' hospitalization in the emergency department

Variables	Cut off	AUC	SE	Sensitivity (%)	Specificity (%)	95% CI	*P*
BUN	>19.5	0.800	0.053	78.7	73.3	0.696-0.905	**<.001**
Lactate	>1.34	0.672	0.063	72.3	53.3	0.548-0.796	**.011**
LAR	>0.35	0.687	0.061	72.3	53.0	0.568-0.807	**.006**
CURB-65	>1.50	0.931	0.035	95.7	86.7	0.862-1.000	**<.001**

AUC: area under the curve; SE: Standard error; CI: Confidence interval; LAR: Lactate/albumin ratio

The AUC values of BUN, lactate, LAR, and CURB-65 score on the ROC curve were 0.800, 0.672, 0.687, and 0.931, respectively, and were statistically significant (*P* <.05). When the cut-off value of LAR was 0.35, its sensitivity and specificity were 72.3% and 53.0%, respectively (AUC=0.687, *P* =.006) (Figure 2, Table 3)

DISCUSSION

Our study found that the LAR may be indicative of the need for hospitalization in acute pneumonia patients. However, the CURB-65 scoring system was more successful than LAR in predicting hospitalization. This discrepancy may be due to our relatively small sample size. In addition, the fact that albumin levels were close to the normal range because chronic patients were excluded during our study may have affected this result.

Studies conducted with LAR generally aim to assess mortality. However, conflicting results have been encountered. [12] In a study evaluating LAR, the LAR value was found to be valuable in predicting in-hospital mortality in patients with pneumonia. [13] However, the main outcome of this study was the prediction of in-hospital mortality and the number of patients was much higher than in our study. In addition, chronic patients were not excluded in this study. Another study that evaluated CURB-65 and lactate levels

was similar to our study in terms of number of participants, but lactate levels showed better results than CURB-65 in this study. [14] In this study, the mean age was older than in our study, and patients with chronic diseases were not excluded. The fact that we both excluded patients with chronic diseases and studied a younger age group is aimed at avoiding the influence of chronic diseases on lactate and albumin values. In this respect, the results of our study are indicative for younger patients.

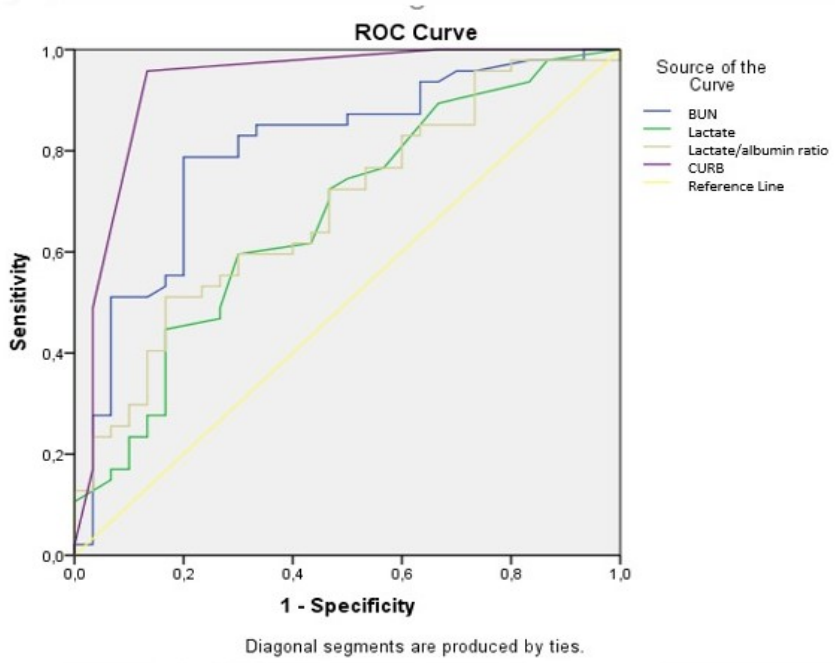

Figure 2: Receiver operating characteristic curve (ROC) for predicting hospitalization of patients in the emergency department using the lactate/albumin ratio (LAR).

One of the key parameters used to assess clinical severity in patients presenting with pneumonia is confusion. However, confusion does not always reflect the severity of the disease. In our study, even though only one patient exhibited confusion, they were ultimately discharged. This patient presented to the hospital with high fever and signs of dehydration. After receiving hydration and starting antibiotic treatment in the emergency department, the patient's confusion resolved once their fever subsided. When evaluated using the CURB-65 and PSI scoring systems, the patient was determined to be at low risk, and as their oxygen saturation remained above 92% without oxygen support, the patient was discharged.

Consistent with the literature, we observed a negative correlation between LAR and arterial pH, as well as SBP and DBP. This suggests that increased lactate levels indicate hemodynamic instability. This correlation between arterial blood pressure and lactate levels has also been observed in previous studies. [15,16] Reduced arterial blood pressure caused impaired perfusion and increased lactate levels. As a result of increased anaerobic mechanisms, arterial pH decreased. This finding is similar to other studies in the literature. [17,18]

The fact that our study included a limited number of patients and was single-center limited our study. In addition, the exclusion of chronic diseases that would affect lactate and albumin levels reduced the number of patients included in the study. This resulted in the older population being included in our study with fewer patients.

CONCLUSION

Our study indicates that in acute pneumonia patients without chronic diseases, the LAR shows lower performance than the CURB-65 scoring system in determining the need for hospitalization.

Ethics Committee Approval: This study was approved by the Atatürk University, Faculty of Medicine Clinical Research Ethics Committee (decision number: 7/23, date: October 25, 2024).
Informed Consent: Informed consent was deemed unnecessary for this retrospective study
Conflict of Interest: The author have no conflicts of interest to declare.
Financial Disclosure: The author declared that this study has received no financial support.

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Hasta Onamı: Bu retrospektif çalışma için hasta onamı gerekli görülmemiştir.
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REFERENCES

1. Ehsanpoor B, Vahidi E, Seyedhosseini J, Jahanshir A. Validity of SMART-COP score in prognosis and severity of community acquired pneumonia in the emergency department. *Am J Emerg Med.* 2018;37(8):1450-1454. doi:10.1016/j.ajem.2018.10.044
2. Hespanhol V, Bárbara C. Pneumonia mortality, comorbidities matter? *Pulmonology*. 2019;26(3):123-129. doi:10.1016/j.pulmoe.2019.10.003
3. Ramirez JA, File TM. How to assess survival prognosis in patients hospitalized for community-acquired pneumonia in 2024? *Curr Opin Crit Care*. 2024;30(5):399-405. doi:10.1097/mcc.0000000000001189
4. Shirata M, Ito I, Ishida T, et al. Development and validation of a new scoring system for prognostic prediction of community-acquired pneumonia in older adults. *Sci Rep*. 2021;11(1). doi:10.1038/s41598-021-03440-3
5. Certo M, Llibre A, Lee W, Mauro C. Understanding lactate sensing and signalling. *Trends Endocrinol Metab*. 2022;33(10):722-735. doi:10.1016/j.tem.2022.07.004
6. Wardi G, Brice J, Correia M, Liu D, Self M, Tainter C. Demystifying Lactate in the Emergency Department. *Ann Emerg Med*. 2019;75(2):287-298. doi:10.1016/j.annemergmed.2019.06.027
7. Manolis AA, Manolis TA, Melita H, Mikhailidis DP, Manolis AS. Low serum albumin: A neglected predictor in patients with cardiovascular disease. *Eur J Intern Med*. 2022;102:24-39. doi:10.1016/j.ejim.2022.05.004.
8. Eckart A, Struja T, Kutz A, et al. Relationship of Nutritional Status, Inflammation, and Serum Albumin Levels During Acute Illness: A Prospective Study. *Am J Med*. 2019;133(6):713-722.e7. doi:10.1016/j.amjmed.2019.10.031
9. Lau KK, Hsiao CT, Fann WC, Chang CP. Utility of the Lactate/Albumin Ratio as a Predictor for Mortality in Necrotizing Fasciitis Patients. *Emerg Med Int*. 2021;2021:1-5. doi:10.1155/2021/3530298
10. Chebl RB, Geha M, Assaf M, et al. The prognostic value of the lactate/albumin ratio for predicting mortality in septic patients presenting to the emergency department: a prospective study. *Ann Med*. 2021;53(1):2268-2277. doi:10.1080/07853890.2021.2009125
11. Patel S. Calculated decisions: CURB-65 score for pneumonia severity. *Emerg Med Pract*. 2021;23(Suppl 2):CD1-CD2. Published 2021 Feb 1.
12. Zhang L, Li Y, Lv C, et al. Predictive value of arterial blood lactate/serum albumin ratio for myocardial injury in elderly patients with severe community-acquired pneumonia. *Medicine (Baltimore)* 2022;101(4):e28739. doi:10.1097/md.0000000000028739
13. Xu C, Liu H, Zhang H, et al. Predictive value of arterial blood lactate to serum albumin ratio for in-hospital mortality of patients with community-acquired pneumonia admitted to the Intensive Care Unit. *Postgrad Med*. 2022;135(3):273-282. doi:10.1080/00325481.2022.2110769
14. Baek MS, Park S, Choi JH, Kim CH, Hyun IG. Mortality and Prognostic Prediction in Very Elderly Patients With Severe Pneumonia. *J Intensive Care Med*. 2019;35(12):1405-1410. doi:10.1177/0885066619826045
15. Terlecki M, Kocowska-Trytko M, Dadański E, et al. Prognostic accuracy of mean arterial pressure and serum lactate level among patients with acute myocardial infarction. *Kardiol Pol*. 2024;82(5):527-533. doi:10.33963/v.phj.100271
16. Beske RP, Søndergaard FT, Møller JE, et al. Treatment effects of blood pressure targets and hemodynamics according to initial blood lactate levels in comatose out-of-hospital cardiac arrest patients – A sub study of the BOX trial. *Resuscitation*. 2023;194:110007. doi:10.1016/j.resuscitation.2023.110007
17. Janotka M, Ostadal P. Biochemical markers for clinical monitoring of tissue perfusion. *Mol Cell Biochem*. 2021;476(3):1313-1326. doi:10.1007/s11010-020-04019-8
18. Qi J, Bao L, Yang P, Chen D. Comparison of base excess, lactate and pH predicting 72-h mortality of multiple trauma. *BMC Emerg Med*. 2021;21(1). doi:10.1186/s12873-021-00465-