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Identification of Risk Factors and Mortality Score Values Predicting Mortality in Pneumonia Patients Monitored in Intensive Care Units

Yoğun Bakım Ünitesinde Takip Edilen Pnömoni Hastalarında Mortaliteyi Öngören Risk Faktörleri ve Mortalite Skor Değerlerinin Tespiti

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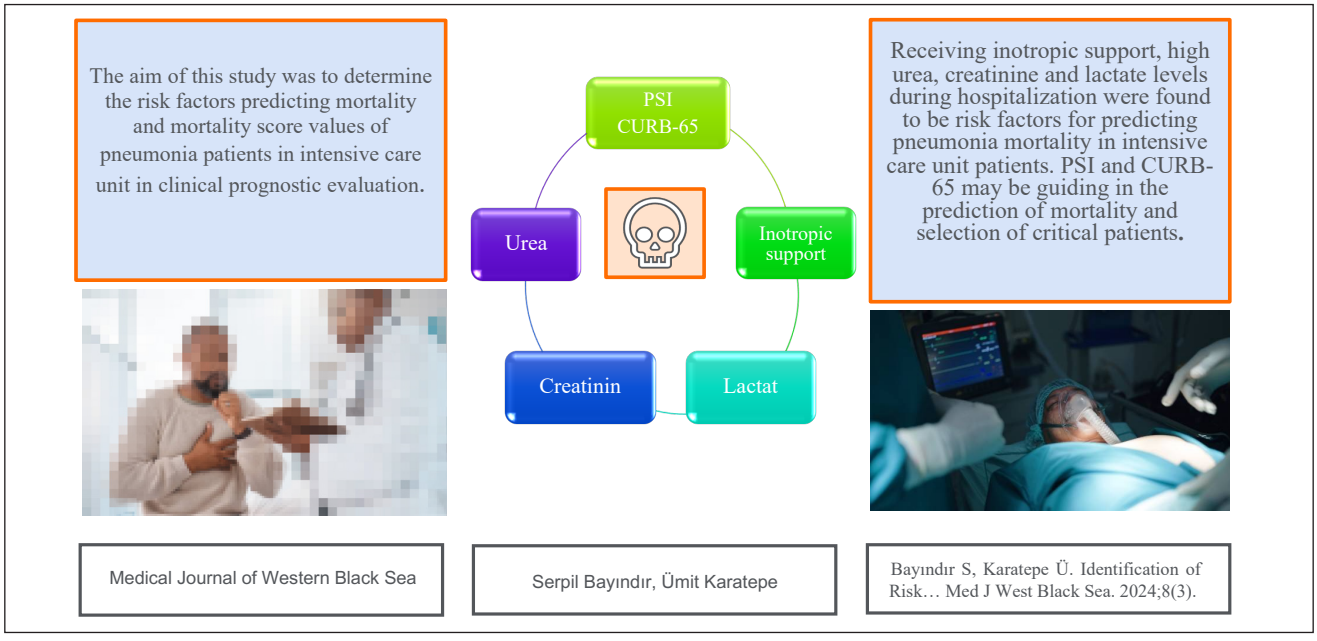
GRAPHICAL ABSTRACT



ABSTRACT

Aim: Predicting the mortality risk of pneumonia patients in the intensive care unit is an important step in the treatment process. A number of scoring systems have been developed to assess the severity of patients and predict prognosis. The aim of this study was to determine the risk factors predicting mortality and mortality score values of pneumonia patients in intensive care unit in clinical prognostic evaluation.

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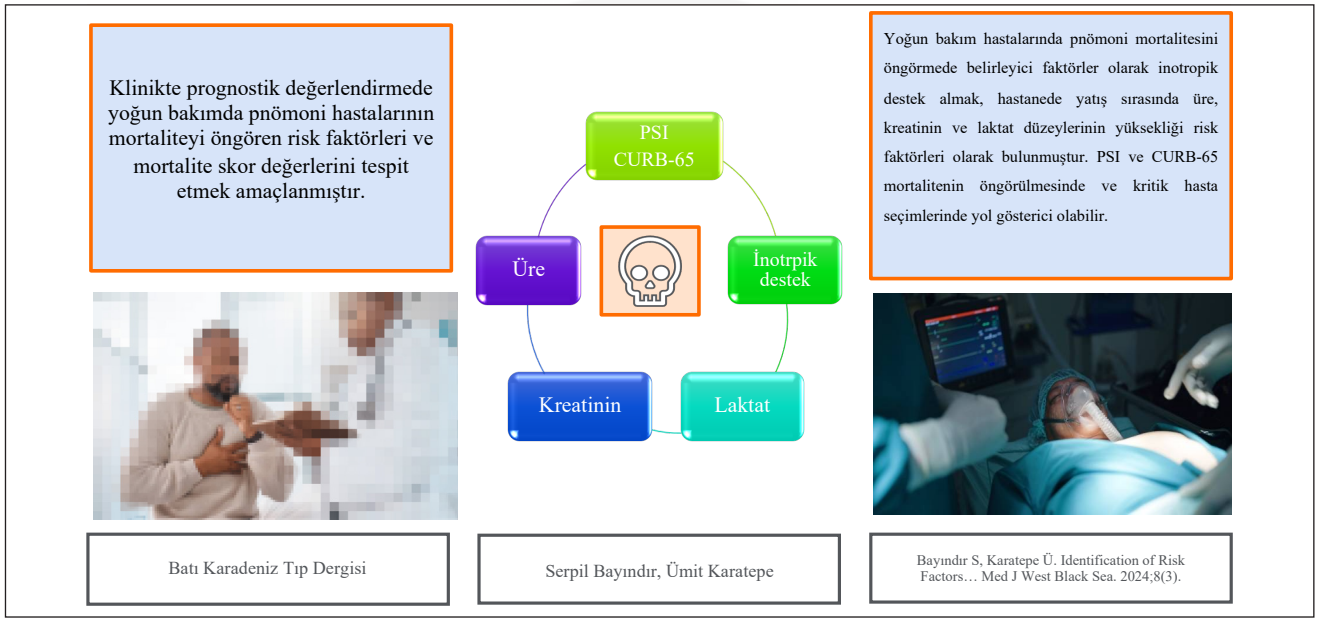
Material and Methods: It was a single-center and retrospective study. Mechanical ventilation, hemodialysis requirement, inotrope support, chest tube insertion, duration of intensive care unit stay, length of hospital stay, and 6-month mortality rates were recorded. SOFA, APACHE II and PSI, CURB-65 and I-ROAD scores were calculated. Procalcitonin, C-reactive protein, albumin, creatinine, urea and lactate values were evaluated by scoring.

Results: Of the 143 patients, 94 (65.7%) were discharged (Group 1: survivors), while 49 (34.2%) died (Group 2: exitus). Urea and lactate showed a stronger correlation with mortality ($p<0.001$), while creatinine showed a weaker correlation ($p=0.011$). CURB-65 and PSI demonstrated a strong association with mortality ($p<0.001$), while I-ROAD supported this association more weakly ($p=0.046$). SOFA and APACHE II did not show a significant association with mortality ($p>0.05$). Patients receiving inotropic support had a significantly higher risk of mortality ($p<0.001$), however, chest tube placement and hemodialysis did not have a statistically significant impact on mortality ($p=0.943$ and $p=0.297$, respectively).

Conclusion: Receiving inotropic support, high urea, creatinine and lactate levels during hospitalization were found to be risk factors for predicting pneumonia mortality in intensive care unit patients. PSI and CURB-65 may be guiding in the prediction of mortality and selection of critical patients.

Keywords: Pneumonia, intensive care, mortality, scoring

GRAFİKSEL ÖZET



ÖZ

Amaç: Yoğun bakım ünitesinde pnömoni hastalarının mortalite riskinin öngörülmesi tedavi sürecinde önemli bir adımdır. Hastaların ciddiyetini değerlendirmek ve prognozu tahmin etmek için bir dizi skorlama sistemi geliştirilmiştir. Klinikte prognostik değerlendirmede yoğun bakımda pnömoni hastalarının mortaliteyi öngören risk faktörleri ve mortalite skor değerlerini tespit etmek amaçlanmıştır.

Gereç ve Yöntemler: Tek merkezli ve retrospektif bir çalışmadır. Hastaların mekanik ventilasyon, hemodiyaliz ihtiyacı, inotrop desteği, göğüs tüpü takılması, yoğun bakımda yatış süresi, hastanede kalış süresi, 6 aylık mortalite oranları kaydedildi. SOFA, APACHE II ve PSI, CURB-65 ve I-ROAD skoru hesaplandı. Prokalsitonin, C-reaktif protein, albümin, kreatinin, üre ve laktat değeri skorlamalarla değerlendirildi.

Bulgular: 143 hastanın 94'u (%65,7) taburcu olurken (Grup 1: yaşayanlar), 49'u (%34,2) hayatını kaybetti (Grup 2: Yaşamını kaybedenler). Üre ve laktat motalite ile daha güçlü korelasyon gösterirken ($p<0,001$), kreatinin daha zayıf korelasyon göstermiştir ($p=0,011$). CURB-65 ve PSI mortalite ile güçlü bir ilişki gösterirken ($p<0,001$), I-ROAD bu ilişkiyi zayıf desteklemiştir ($p=0,046$). SOFA (0,261) ve APACHE II (0,211) anlamlı ilişki tespit edilmedi ($p>0,05$). İnotrop desteği alan hastalarda mortalite riski anlamlı ölçüde yüksekti ($p<0,001$), ancak göğüs tüpü ve hemodiyaliz uygulamalarının mortalite üzerine etkisi istatistiksel olarak anlamlı bulunmadı (sırasıyla $p=0,943$ ve $p=0,297$).

Sonuç: Yoğun bakım hastalarında pnömoni mortalitesini öngörmede belirleyici faktörler olarak inotropik destek almak, hastanede yatış sırasında üre, kreatinin ve laktat düzeylerinin yüksekliği risk faktörleri olarak bulunmuştur. PSI ve CURB-65 mortalitenin öngörülmesinde ve kritik hasta seçimlerinde yol gösterici olabilir.

Anahtar Sözcükler: Pnömoni, yoğun bakım, mortalite, skorlama

INTRODUCTION

Assessing the mortality risk of pneumonia patients in the intensive care unit (ICU) is essential for guiding treatment decisions. Different scoring systems are used to predict the severity of the disease and treatment outcome in the indications for hospitalization and treatment selection. Pneumonia is an inflammatory disease with high mortality and morbidity due to infections in the lung parenchym. It is known that hospitalized cases have a mortality rate of 12% and cases requiring intensive care support have a mortality rate of up to 40%, and this rate increases if initial treatment is delayed (1). Appropriate symptoms, physical examination findings and infiltrates on lung radiograms are considered sufficient for the diagnosis. However, there are often difficulties in identifying the responsible microorganism, so it is often not possible to identify the agent. (2). The critical decision to be taken after the diagnosis of pneumonia is made is to determine the place where the patient will be treated and the antibiotics to be used. If this decision is made correctly, it directly affects the patient's prognosis. Appropriate antibiotic selection and timely initiation of treatment play a decisive role in the patient's prognosis, but 6-15% of cases with no response despite appropriate empirical antibiotic selection have also been reported. Mortality is significantly higher in cases where treatment is not administered (3,4).

Pneumonia scoring systems provide guidance in establishing the diagnosis, determining the severity, indicating the need for hospitalization, and determining the appropriate treatment protocol. In this way, the urgency of the patients is better understood and their treatment is initiated by hospitalization in the appropriate unit. Scoring systems evaluate the effectiveness of treatment by monitoring parameters such as the patient's mental status, respiratory function, blood gas values and fever, and others. This process helps to determine the point at which the patient is suitable for discharge and to identify possible complications in advance.

Various scoring systems exist for assessing the severity of disease severity and predict prognosis in pneumonia patients followed up in the intensive care unit. The most commonly used of these scoring systems are Sequential Organ Failure Assessment Score (SOFA), Acute Physiology Assessment and Chronic Health Evaluation (APACHE) II and "Pneumonia Severity Index (PSI), CURB-65 Scoring, (Confusion, Urea, Respiratory rate, Blood pressure, Age) and I-ROAD score (5). Considering their clinical applicability and reliability, we aim to help us understand the role of these scores in the prognostic evaluation of patients. The aim of this study was to compare the mortality prediction rates of the calculated scores and to determine the risk factors in patients admitted to the intensive care unit with the diagnosis of pneumonia.

MATERIALS and METHODS

Ethical Approval

The study was conducted by retrospectively reviewing the files of patients who were hospitalized and treated with a diagnosis of pneumonia between 2021 and 2023 in the tertiary Anesthesia and Reanimation ICU of Elazığ Fethi Sekin City Hospital. The study was approved by the Ethics Committee of Fırat University (protocol number 2024/09-33) and was conducted in accordance with the principles of the Declaration of Helsinki.

Study Design

Our study was conducted as a single-center, retrospective analysis using data obtained through the hospital's data processing module for the calculation of scores. Study participants were categorized into two groups according to survival outcomes: survivors (Group 1) and non-survivors (Group 2). Demographic data of patients (such as age, weight, height, body mass index, alcohol and smoking addiction, etc.), comorbidities, physical examination findings, chest radiographs, routine laboratory tests, arterial blood gas analysis and culture results were obtained by retrospectively reviewing the ICU follow-up chart and patient files. Duration of mechanical ventilator support, duration of antibiotherapy, hemodialysis, inotropic support, chest tube insertion, duration of intensive care unit stay, duration of hospital stay and 6-month mortality rates were determined by analyzing the records.

The study included patients diagnosed with pneumonia according to the 2021 consensus report on pneumonia diagnosis and treatment from the Turkish Thoracic Society (5). SOFA, APACHE II, PSI, CURB-65, and I-ROAD scores were calculated for each patient. Standardization was ensured by calculating scores using the results of laboratory tests, culture results, and radiological imaging from the time of the initial pneumonia diagnosis.

Laboratory Measurements

Procalcitonin (PCT), C-reactive protein (CRP) and biochemical parameters such as albumin, lactate, creatinine, urea were evaluated together with scoring.

Exclusion Criteria

Patients receiving chemotherapy or radiotherapy for malignancy, patients with active tuberculosis and obstructive pneumonia were excluded. Patients under 18 years of age, patients with severe systemic diseases such as renal or cardiac failure, pregnant women, patients whose diagnosis changed after further evaluation and patients with deficient follow-up were excluded.

Statistical Analysis

The data were uploaded to the SPSS (IBM, SPSS Statistics version 22) program for the analysis of the study, and descriptive statistics were determined for each variable. Descriptive statistics of the study were presented as mean ± standard deviation when necessary for quantitative variables, and as median (minimum-maximum) when required. Frequency and percentage (n(%)) were provided for qualitative variables. The Comparison of two independent quantitative variables was performed by Mann-Whitney U test. The comparison of two independent qualitative variables was performed with Fisher Chi-Square test. Data distribution was evaluated by the Kolmogorov-Simirnov test. The significance level (p) was accepted as 0.05.

RESULTS

A total of 143 patients (69 females; 74 males) aged between 27 and 96 years who were hospitalized with a diagnosis of pneumonia in the ICU within a 1-year period were included in the study. Of the total, 94 patients (65.7%) were discharged and the remaining 49 patients (34.2%) died. The mean age was 70.60±12.44 (27-96) in Group 1 and 69.80±13.52 (28-94) in Group 2. There were no statistically significant differences observed in terms of demographic data, including gender, age, weight, height, BMI (Body Mass Index), and smoking usage between the two groups (p>0.05). The demographic characteristics of patients, including gender, age, weight, height, BMI values, and smoking usage, are presented in Table 1. Comorbid conditions of patients included in the study: HT (48.9%), COPD (31.9%), DM (22.3%), CAD (28.7%), CRF (23.4%), LVH (26.6%) in Group 1 ; HT (49%), COPD (26.5%), DM (26.5%), CAD (28.6%), CRF (26.5%), LVH (22.4%) in Group 2. The distribution of other comorbid disease conditions according to the groups are presented in Table 2. Hypertension (48.9%) was more common comorbidity in the both groups. The intensive care unit stay was found to be 9.05±4.22 days for survivors and 8.63±4.59 days for non-survivors (p=0.319) (Table 1).

The biochemical parameters of patients (urea, creatinine, albumin), arterial blood gas analysis (lactate), and infection parameters (WBC, CRP, procalcitonin) values were compared between two groups. Non-survivors exhibited significantly elevated urea and lactate levels compared to survivors with a high degree of statistical compatibility (p<0.001), and they were statistically associated with mortality predic-

Table 1. Comparison of demographic and clinical characteristics of the groups

Variables	Group-1 (n=94)	Group-2 (n=49)	p value
Age (years)	70.60 (27-96)	69.8 (28-94)	0.868
Sex (Male/Female)	48/46 (51.1-48.9)	26/23 (53.1-46.9)	0.724
BMİ (kg/cm^2)	23.1 (20-29)	22.97 (21-26)	0.321
Smoking (Yes/No)	32/62 (34/66)	16/33 (32.7/67.3)	0.842
Duration of ICU stay (days)	9.05 (20-26)	8.63 (21-26)	0.319
Duration of hospital stay (days)	12.56 (6-28)	12.93 (6-28)	0.956
Duration of mechanical ventilator support (days)	2.44 (0-17)	2.42 (3-21)	0.949
Duration of antibiotherapy (days)	6.38 (3-12)	5.97 (3-12)	0.245
Inflammatory and biochemical parameters			
CRP (mg/dL)	66.85 (6-258)	71.15 (15-211)	0.349
Procalsitonin (mcg/L)	0.87 (0-5.27)	0.50 (0.02-2.56)	0.24
WBC (×10^9 L)	15.47 (4.10-36.9)	14.53 (4.12-30)	0.395
Urea (mg/dL)	55.53 (17-259)	75.59 (23-155)	**<0.001**
Creatinine (mg/dL)	1.23 (0-4.8)	1.62 (0.63-4.8)	0.011
Albumin (g/dL)	26.71 (14-39)	25.53 (20-33)	0.085
Lactat (mmol/L, median (minimum-maximum)	2.05 (0.6-9.9)	2.6 (1.2-4.60)	**<0.001**
Scores,median (minimum-maximum)			
SOFA	9.39 (2-21)	9.83 (5-15)	0.261
APACHE2	45.57 (18-89)	49.26 (24-84)	0.211
PSI	3.68 (3-5)	4.48 (3-5)	**<0.001**
CURB65	3.81 (3-5)	4.44 (3-5)	**<0.001**
I-ROAD-a/b/c	10/51/33(10.63/54.25/35.10)	1/22/26(2.04/44.89/53.06)	0.046

tion. Creatinine levels showed less compatibility, but were observed to be statistically elevated (p=0.011).

Pneumonia Severity Index, CURB-65 SOFA, APACHE II and I-ROAD scores of patients were recorded at admission. When the effectiveness of the CURB-65 and PSI scores in determining pneumonia mortality was compared between the groups, CURB-65 and PSI scores were found to have a very good level of agreement and were statistically significant (p<0.001). The mean value of CURB-65 in Group 2 was 3.81±0.74, while the mean value of PSI was 3.68±0.67.

I-ROAD scoring was statistically significant (p=0.046), but had less agreement than CURB-65 and PSI. When SOFA and APACHE II scores were compared between groups, no significant difference was found (p>0.05) (Table 1). When the effectiveness of the CURB-65 and PSI scores in determining pneumonia mortality was compared between the groups, CURB-65 and PSI scores were found to have a very good level of agreement and were statistically significant (p<0.001).

It was found that there was a significant difference between the groups in the patients receiving inotropic support. In Group 2, 69.4% (n=34) of the patients received inotropic support, whereas this rate was 39.4% (n=37) in Group 1 . Those with chest tubes and those with hemodialysis treatment have no significant values in mortality prediction (p=0.943, p=0.297) (Table 2).

DISCUSSION

Evaluation, diagnosis and early treatment of pneumonia patients are important in terms of prognosis. Approximately 1.9% of hospital admission consist of pneumonia patients and 1.5% have a mortal course (6). When reviewing the health statistics of our country in the year 2004, it was found that pneumonia-related deaths ranged from 1% to 60%, especially with higher mortality rates (10.3%-60%) among pneumonia patients treated in hospitals (7). Pneumonia scoring systems provide guidance in establishing the diagnosis, determining the severity, indicating the need for hospitalization, and determining the appropriate treatment protocol.

Pneumonia Severity Index is a commonly used index calculated based on twenty variables (demographic, clinical and laboratory findings) and recommended for use in treatment guidelines (8). It is mainly guiding in deciding the unit where the patient will be treated according to the mortality risk (9, 10). It is a prognostic model used to predict the 30-day mortality rate by dividing pneumonia patients into five groups according to their mortality risk. Metlay et al. emphasized that PSI is a safe and effective guide in the follow-up of patients (11). In this way, it has been shown to reduce hospitalization rates, the cost of treatment of inpatients and the risk of hospital-acquired complications. Validation studies have demonstrated that PSI is more effective at distinguishing between patients with different mortality risks and prognosis compared to CURB-65, but its use is difficult and impractical. Confusion, Urea, Respiratory rate, Blood pressure, Age-65 is a scoring system defined to differentiate high-risk patients and is practically applicable in primary care. In our country, for guiding physicians, the Turkish Thoracic Society recommends an algorithm for the approach and treatment protocol of pneumonia patients in steps using PSI and CURB-65 scoring in the Diagnosis and Treatment Consensus Report on Pneumonia Developed in the Community in Adults. Many studies have been published with various results regarding the effectiveness of mortality prediction. İlhan et al. compared PSI and CURB-65 scores for hospitalization and discharge in community-acquired pneumonia patients presenting to the emergency department (12). Both scores indicated a significant concordance in terms of the necessity for hospitalization in the 109 cases (p<0.001). When A-DROP (13), PSI and CURB-65 scores

Table 2. Distribution of the comorbidities and the clinic conditions between the groups

	Group Survivor (n=94)	Group Mortal (n=49)	p
	n (%)	n (%)	
Hypertension	46 (48.9)	24 (48.97)	0.641
Chronic Obstructive Pulmonary Disease	30 (31.9)	13 (26.53)	0.122
Diabetes Mellitus	21 (22.34)	13 (26.53)	0.578
Coronary Artery Disease	27 (28.7)	14 (28.57)	0.342
Chronic Renal Failure	22 (23.4)	13 (26.53)	0.122
Cerebrovascular Disease	25 (26.5)	11 (22.44)	0.189
Hemodialysis	23 (24.5)	16 (32.7)	0.297
Inotropic support	37 (39.4)	34 (69.4)	**<0.001***
Chest tube insertion	8 (8.5)	4 (8.2)	0.943

Group-1 : Survivors of pneumonia patients, Group-2: Non-survivors of pneumonia patients, n: Number of the patients, p< 0,05.

were compared in terms of predicting mortality in community-acquired pneumonia cases, AUC 0.772 (95% CI 0.666-0.878, p<0.001) was found to be similar in 30-day mortality prediction. It was emphasized that it is a useful option for mortality prediction. Zhang et al, 1902 of a total of 2841 patients diagnosed with pneumonia admitted to the emergency department for two years were included in the study. The 30-day mortality rate for patients was 15.7%, with an ICU admission rate of 5.8%, and a hospital stay duration of 4 days, with an interquartile range (IQR) between 2-8 days. The PSI group (class I-III) included 42.6% of the patients with a mortality rate of 1.9%; CURB-65 (score 0-1) included more patients (52.0%) with a significantly higher mortality rate (7.3%, p<0.001) (14). However, in a study conducted in Korea between 2009 and 2011 in 883 patients for 30-day mortality prediction, it was emphasized that the PSI was better than the CURB-65 for critically ill patients and these variations should be taken into consideration when using it (15). In our study, the mean value of CURB-65was 3.81±0.74, while the mean value of PSI was 3.68±0.67 in Group-2. The statistical data we obtained showed that PSI and CURB-65 scoring were highly significant in determining the mortality of pneumonia patients in intergroup comparison (p<0.001) (Table 1).

Infectious Diseases Society of America/ American Thoracic Society 2007 consensus report (IDSA/ATS 2007) includes two major and nine minor criteria to identify cases of pneumonia requiring ICU. A 2011 meta-analysis of 1062 pneumonia patients reported that the IDSA/ATS 2007 criteria were the best discriminative scoring system to identify severe pneumonia, with a sensitivity of 65%. These criteria were found to be effective in predicting 30-day mortality and demonstrated similar efficacy to PSI and CURB-65. In univariate analysis, each of the nine minor criteria was associated with an increased risk of septic shock requiring mechanical ventilation or vasopressor support and 30-day mortality (16). IDSA/ATS updated guidelines (2016) stated that mortality will decrease when the decision to start antibiotherapy is based on clinical criteria. Li et al., in a prospective two-center cohort study (n=385), found that 38.6% mortality increased in patients with PaO2/FiO2 ≤ 250 mmHg, confusion and uremia in pneumonia patients (p<0.001). It was reported that these three predictive findings were positively associated with organ failure assessment scores at 72 hours, longer hospital stay and higher costs. In our study, urea, one of the biochemical parameters, was found to be 75.59 mg/dL in Group-2 and was statistically significantly higher in patients with pneumonia who died compared to those who survived (p<0.001). Creatinine was statistically significant at an acceptable level (p=0.011) (17). In a study by Phua et al., the predictive value of IDSA/ATS minor criteria for pneumonia severity was evaluated (18). The study found that the minor criteria were more specific than PSI and more sensitive than CURB-65 in predicting both hospital mortality and the need for ICU admission in patients with pneumonia who did not require immediate critical care interventions. These findings suggest that the IDSA/ATS minor criteria can be a useful tool for risk assessment and clinical decision-making in pneumonia patients.Our study demonstrated a significant association between inotropic support and mortality. This result indicates that patients who required inotropic therapy had a higher risk of death. Of the deceased patients, 69.4% received inotropic therapy, while 39.4% of the survivors did.

The I-ROAD scoring system, was established by the Japanese Respiratory Society in 2009, and uses lung radiographs and CRP values to determine disease severity. The system categorizes patients into three groups: Group A (Mild), Group B (Moderate), and Group C (Severe). This classification determines mortality risks at rates of 12.1%, 24.9%, and 40.9%, respectively, and is used for prognosis (19). Ito et al. compared 30-day mortality prospectively in community-acquired and hospital-acquired pneumonia patients using scoring systems such as PSI, A-DROP, (IDSA)/ATS, and I-ROAD. They found that, except for PSI and I-ROAD, the predictive abilities of other scoring systems for mortality were significantly low. They highlighted PSI (0.717, 95% confidence interval 0.673-0.761) as the most useful pneumonia severity score among the evaluated ones (20). In a study conducted to validate prognostic prediction scores for severe pneumonia in elderly patients and to compare the risk factors associated with in-hospital mortality of severe pneumonia, 160 patients aged ≥80 years were retrospectively analyzed over 6 years. Pneumonia severity was assessed using CURB-65, PSI, SOFA, A-DROP, I-ROAD, UBMo index, SOAR score and lactate. Chronic lung disease, mechanical ventilation, hemodialysis and albumin were shown to be associated with in-hospital mortality (25%) of pneumonia. The study found that in predicting mortality, the SOFA score and lactate values were more correlated than CURB-65, PSI, A-DROP, I-ROAD, UBMo index, and SOAR score (21). Our study demonstrated a strong correlation between mortality and lactate levels as measured by blood gas analysis (p<0.001). This result suggests that lactate is a crucial biomarker for predicting mortality. Conversely, no statistically significant correlation was found between SOFA score and mortality (p=0.261).

SOFA (Sequential Organ Failure Assessment) and APACHE II (Acute Physiology Assessment and Chronic Health Evaluation II) are commonly used to predict patient outcomes in the ICU (1). A study by Kaymak et al. analyzed 4188 ICU patients in Turkey, revealing a 46.3% mortality rate, higher than the APACHE II predicted rate of 37.2% (22). The standardized mortality ratio was 1.28, indicating a greater risk of death than expected. This variation in outcomes across

ICUs highlights the importance of considering factors like comorbid conditions, mechanical ventilation rates, and advanced age when assessing patient risk. Two-center study conducted in Spain, the capacity of clinical scoring tests to predict community-acquired pneumonia was calculated using artificial intelligence. As a result, SeF-ML demonstrated significantly higher predictive power for 30-day mortality than CURB-65 and qSOFA, while the AUC values for PSI and SOFA, although high, were not statistically significant (23). We investigated the relationship between APACHE II and SOFA scores, which are frequently used in critically ill patients, and mortality. No significant correlation was found between these scores and mortality. While numerical differences were observed between groups requiring invasive treatments like chest tube and hemodialysis, these differences did not reach statistical significance.

Among the methodological limitations of this study is its single-center, retrospective design. Although the sample size decreased due to missing data, the results obtained were consistent with previous studies and robust in terms of identifying factors predicting the need for intensive care.

This study aims to identify determinants in predicting pneumonia mortality among patients admitted to the ICU. The receipt of inotropic support, elevated levels of urea, creatinine, and lactate during hospitalization have been identified as risk factors for mortality in this patient group. PSI and CURB-65 scoring systems can be utilized as guiding tools in predicting mortality and making critical patient selections. Computer-aided scoring provided by hospital information systems should be regularly employed and continuously improved for enhanced prediction and decision-making support.

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None.

Author Contributions

Concept, Constructing hypothesis or idea of research and/or article: **Serpil Bayındır,** Design and planning methodology to reach the conclusions: **Serpil Bayındır,** Data Taking responsibility for patient/follow-up, collection of biological data materials, data management, and collection or reporting, execution of the processing experiments: **Serpil Bayındır,** Taking responsibility for logical analyses interpretation and conclusion of the results / Analysis or Interpretation: **Serpil Bayındır, Ümit Karatepe,** Reviewing the literature for the study: **Serpil Bayındır,** Writing: **Serpil Bayındır, Ümit Karatepe,** Approval: **Ümit Karatepe, Serpil Bayındır**

Conflicts of Interest

The authors declare no conflict of interest in this study.

Financial Support

There was no financial support in our study.

Ethical Approval

The study was conducted in accordance with the rules of the Declaration of Helsinki and approved by the Ethics Committee of Fırat University (Date: 24 June 2024-FÜ-GOAEK-2024-33)

Review Process

Extremely and externally peer-reviewed.

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