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PATHOS Score as a Predictor of In-Hospital Mortality in Patients with Acute Cardiogenic Pulmonary Edema Presenting to the Emergency Department

Acil Servise Başvuran Akut Kardiyojenik Pulmoner Ödem Hastalarında Hastane İçi Mortaliteyi Öngörmede PATHOS Skoru

Tuğba Sanalp Menekşe[1], Rabia Handan Günsay[1], Ekrem Taha Sert[2], Sibel Güçlü Utlu[3], Kamil Kokulu[2]

[1]Department of Emergency Medicine, Minisrty of Health Ankara Etlik City Hospital, Ankara, Türkiye
[2]Department of Emergency Medicine, Aksaray University Faculty of Medicine, Aksaray, Türkiye
[3]Department of Emergency Medicine, University of Health Sciences Türkiye, Erzurum City Hospital, Erzurum, Türkiye

ABSTRACT

Objective: The platelets, age, troponin, heart rate, oxygenation, and systolic blood pressure (PATHOS) score, was assessed in this study for its ability to predict in-hospital mortality in patients with acute cardiogenic pulmonary edema (ACPE), who were admitted to the emergency department (ED).

Methods: Between March 1, 2023, and 2025, the study was carried out retrospectively in the ED of a tertiary university hospital. Adult patients with an ACPE diagnosis who were at least 18 years old were enrolled. Admission data were used to calculate PATHOS scores and analyze outcomes between survivors and non-survivors.

Results: A total of 622 patients satisfied the inclusion requirements for this investigation. Of these, 531 patients (85.4%) survived hospitalization, while 91 (14.6%) died. In multivariate logistic regression analysis, the PATHOS score emerged as an independent predictor of in-hospital mortality, with an odds ratio of 2.27 [95% confidence interval (CI): 1.47-3.52; p<0.001]. Receiver operating characteristic analysis revealed an area under the curve of 0.814 (95% CI: 0.781-0.844), indicating strong discriminative performance. A threshold value greater than 3 for the PATHOS score yielded a sensitivity of 79.1%, specificity of 74.2%, and a negative predictive value of 95.4% for predicting in-hospital mortality.

Conclusion: The PATHOS score stands out as an effective tool for predicting in-hospital mortality risk among patients presenting to the ED with ACPE. As it can be easily calculated via routine admission data, this score may be utilized for early risk stratification in clinical practice.

Keywords: Emergency service, hospital, hospital mortality, prognosis, pulmonary edema, risk assessment

ÖZ

Amaç: Bu çalışmada, acil servise (AS) başvuran akut kardiyojenik pulmoner ödem (AKPÖ) hastalarında hastane içi mortaliteyi öngörme yeteneği açısından platelet, yaş, troponin, kalp hızı, oksijenasyon ve sistolik kan basıncı (PATHOS) skoru değerlendirildi.

Yöntemler: Çalışma, 1 Mart 2023-2025 tarihleri arasında üçüncü basamak bir üniversite hastanesinin AS'inde retrospektif olarak gerçekleştirildi. Çalışmaya en az 18 yaşında olan AKPÖ tanısı almış yetişkin hastalar dahil edildi. Başvuru verileri kullanılarak PATHOS skorları hesaplandı ve hayatta kalanlar ile kaybedilenler arasındaki sonuçlar analiz edildi.

Bulgular: Toplam 622 hasta çalışmaya dahil edilme kriterlerini karşıladı. Bunlardan 531 hasta (%85,4) taburcu olurken, 91 hasta (%14,6) öldü. Çok değişkenli lojistik regresyon analizinde PATHOS skoru, 2,27'lik bir olasılık oranıyla [%95 güven aralığı (GA): 1,47-3,52; p<0,001] hastane içi mortalitenin bağımsız bir öngörücüsü olarak saptandı. Alıcı işlem eğrisi analizinde eğri altında kalan alan 0,814 (%95 GA: 0,781–0,844) bulundu ve güçlü ayırt edici performans gösterdi. PATHOS skoru için 3'ten büyük bir eşik değeri, hastane içi mortaliteyi tahmin etmek için %79,1'lik bir duyarlılık, %74,2'lik bir özgüllük ve %95,4'lük bir negatif öngörü değeri sağladı.

Sonuç: PATHOS skoru, AKPÖ ile AS'e başvuran hastalarda hastane içi mortalite riskini tahmin etmede etkili bir araç olarak öne çıkmaktadır. Rutin başvuru verileri ile kolayca hesaplanabildiği için, bu skor klinik uygulamada erken risk sınıflandırması için kullanılabilir.

Anahtar Sözcükler: Acil servis, hastane, hastane mortalitesi, prognoz, pulmoner ödem, risk değerlendirmesi

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Address for Correspondence/Yazışma Adresi: Tuğba Sanalp Menekşe, MD, Department of Emergency Medicine, Minisrty of Health Ankara Etlik City Hospital, Ankara, Türkiye
E-mail / E-posta: tugba.sanalp@hotmail.com
ORCID ID: orcid.org/0000-0003-3292-6273

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INTRODUCTION

Acute cardiogenic pulmonary edema (ACPE) is a severe cardiovascular emergency characterized by a sudden appearance of pulmonary fluid accumulation, usually due to increased left-sided intracardiac pressures stemming from compromised left ventricular function. It presents abruptly and requires urgent intervention (1,2). This condition, which typically presents with marked hypoxemia and acute respiratory distress, is commonly encountered in emergency departments (EDs) and is considered high-risk owing to its potential for rapid clinical deterioration. Prompt identification of the condition and initiation of appropriate therapy, at an early stage, are crucial to prevent adverse outcomes, minimize the need for escalation to critical care, and ensure a shorter duration of inpatient treatment (3).

The fact that the current reported mortality rates in patients hospitalized with ACPE exceed 10% further underscores the need for early and effective risk stratification, particularly for those patients who are at risk of rapid clinical deterioration (4-6). The time constraints and high degree of clinical heterogeneity inherent in ED settings make the reliable prediction of short-term prognosis a fundamental requirement for treatment success (7). Within this context, clinical scoring systems developed for such settings provide an objective foundation for clinical decision-making and contribute to the standardization of patient care (8). However, since the majority of existing systems are designed for broad patient populations, they may not adequately capture the unique characteristics of syndromes such as ACPE, which exhibit a distinctive clinical course and rapid progression (9).

The platelets, age, troponin, heart rate, oxygenation, and systolic blood pressure (PATHOS) score was initially introduced as a prognostic tool for estimating the likelihood of in-hospital death among individuals diagnosed with pulmonary embolism (PE), and it gained attention due to its clinical utility and ease of use. This model, based on six fundamental parameters provides an objective and rapid tool for risk assessment (10). Initially validated in patients diagnosed with PE, the PATHOS score has subsequently been tested in various patient populations and has demonstrated strong predictive performance for mortality (11).

Given the lack of rapid and reliable prognostic models specifically tailored for ACPE, there is a growing need for simple, objective tools that can be applied upon ED presentation to aid in early risk assessment (12). The PATHOS score encompasses several variables, including hypoxia, hypotension, and myocardial injury markers, which are highly relevant to the pathophysiological features of ACPE, thereby supporting its potential applicability in this setting. Therefore, the objective of this study was to evaluate the relationship between the PATHOS score and 30-day in-hospital mortality in patients presenting to the ED with ACPE.

MATERIALS AND METHODS

Study Setting, Population, and Ethical Considerations

This retrospective observational study was conducted between March 1, 2023, and March 1, 2025, and included patients who presented to a tertiary-level ED, with approximately one million annual visits. The study was approved by the Local Ethics Committee of University of Health Sciences Türkiye, Ankara Etlik City Hospital (approval number: AEŞH-BADEK-2025-0247, date: 12.03.2025). Owing to the retrospective nature of the study, informed consent was not required from the participants. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. The data obtained within the scope of the study were stored in encrypted electronic systems accessible only to the research team, and patient identifiers were anonymized in compliance with confidentiality principles prior to analysis.

This retrospective study was conducted on patients aged ≥18 years who presented to the ED of Ankara Etlik City Hospital and were diagnosed with ACPE. Eligible patients were identified retrospectively through a review of cardiology, intensive care, and pulmonology consultation records initiated by ED physicians for cases of acute dyspnea. Patients were included if they met the diagnostic criteria for ACPE based on clinical presentation, radiological findings, and specialist consultation notes. Patients were excluded if they received palliative care for advanced malignancy, exhibited signs of active infection or sepsis, had a history of trauma, were pregnant, were referred from another healthcare facility, stayed in the hospital for less than 24 hours, or had missing medical records. In cases with more than one hospital admission, only the initial presentation was considered for analysis, while all subsequent visits were excluded.

Definition of Acute Cardiogenic Pulmonary Edema

In this study, ACPE was defined based on the most recent guidelines of the European Society of Cardiology for acute heart failure, incorporating clinical findings, oxygen levels, and radiological assessments (13). By finding interstitial or alveolar infiltrates consistent with edema on chest radiography or computed tomography, the diagnosis was confirmed in patients presenting with a sudden onset of dyspnea, orthopnea, tachypnea, bilateral crackles on auscultation, and oxygen saturation below 90% on room air.

Data Collection and Variables

The data analyzed in this study were retrospectively obtained from the hospital's digital health records system. For each patient, demographic information such as age and sex; vital parameters at presentation [systolic and diastolic blood pressure, oxygen saturation, heart rate, Glasgow Coma Scale (GCS)], and comorbid conditions (e.g., hypertension, diabetes mellitus, atrial fibrillation, coronary artery disease, congestive heart failure, and dyslipidemia) were recorded.

Laboratory evaluations included complete blood count, arterial blood gas analysis, serum electrolyte levels, high-sensitivity troponin T, N-terminal pro-B-type natriuretic peptide (NT-proBNP), and renal function tests. To assess the clinical course, additional parameters such as the use of non-invasive mechanical ventilation (NIMV) in the ED, the need for intubation, the length of hospital stay, and early in-hospital mortality within the first 30 days were also analyzed. Patients with missing or inconsistent clinical or laboratory records were excluded from the study.

Venous blood gas analyses were performed using the Siemens RapidLab 1265 (Germany), and complete blood counts were conducted using the Siemens XN-1000 (Germany). The biochemical

parameters were analyzed via a Cabos 8001 instrument (China). The positivity threshold was set at 14 ng/L for hs-Troponin T and 624 ng/L for NT-proBNP.

PATHOS Score Calculation

The PATHOS score is a system developed to provide rapid and effective risk stratification in clinical practice, based on six simple parameters. The score includes the following criteria: platelet count <100 or >400, 10^3/μL, age >80 years, troponin level above the laboratory upper reference limit, heart rate >100 beats per minute, peripheral oxygen saturation <90%, and systolic blood pressure <100 mmHg. Each positive finding is assigned 1 point, and the total score ranges from 0 to 6 (10).

Outcome Measures

The primary outcome of this study was 30-day in-hospital mortality among patients presenting to the ED with ACPE. Secondary outcomes included the need for intubation in the ED, the requirement for NIMV, and the duration of hospital stay.

Statistical Analysis

IBM SPSS Statistics software (version 26.0; IBM Corp., Armonk, NY, USA) was used to conduct statistical analyses. The Kolmogorov–Smirnov test was applied to assess the distribution of continuous parameters. Data with normal distribution were presented as means ± standard deviations, while the rest of the variables were summarized as medians with interquartile ranges. Frequencies and percentages were used to represent categorical data. For group comparisons, normally distributed data were analyzed using the independent samples t-test, while non-parametric variables were analyzed using the Mann-Whitney U test. Associations between categorical variables were assessed using the Pearson's chi-square test or Fisher's exact test where appropriate. Univariate and multivariate logistic regression models identified predictors of in-hospital mortality. To identify independent predictors of mortality, variables were initially examined using univariate logistic regression analysis. Variables with p-value <0.05 in univariate analysis were analyzed with multivariate logistic regression. Prior to establishing the final model, a multicollinearity analysis was conducted. If two or more of the factors retained in the multivariate analysis were highly correlated, then only one factor was selected for further modeling to avoid collinearity. The PATHOS score's discriminative ability was assessed using receiver operating characteristic (ROC) curve analysis. The Youden index was used to identify the optimal threshold after computing sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the area under the curve (AUC). Statistical significance was defined as a p-value <0.05.

RESULTS

A total of 622 patients were included in the final analysis. The process summarizing the inclusion and exclusion criteria for patient selection is presented as a flow diagram in Figure 1. Among them, 91 individuals (14.6%) died during hospitalization, while 531 patients (85.4%) survived. The average age in the mortality group was 79.4±10.6 years, which was significantly higher than that in the survivor group (74.2±11.9 years; p<0.001). Systolic and diastolic blood pressure readings were both significantly reduced in patients who died (130.5±45.0 mmHg and 73.7±23.9 mmHg respectively) compared to those who survived (p=0.005 and p=0.017) (Table 1). Arterial blood gas analysis showed a lower mean pH value of 7.34 (0.15) in the mortality group (p<0.001). Additionally, the median serum lactate concentration was elevated among deceased patients, [2.9 (2.1) mmol/L], relative to survivors [2.6 (1.3) mmol/L] (p=0.022). Similarly, median serum creatinine was higher in the mortality group [1.57 (0.99) mg/dL] than in the survivor group [1.21 (0.70) mg/dL] (p<0.001). Regarding prognostic scoring, the mean PATHOS score was significantly elevated in patients who died (4.09±0.90) compared to those who survived (2.76±1.11; p<0.001). Overall, statistically significant differences were identified between the two groups in terms of age, systolic and diastolic blood pressure, heart rate, oxygen saturation, GCS, arterial pH, lactate and creatinine concentrations, PATHOS score, and the requirement for endotracheal intubation at ED presentation.

The prognostic performance of the PATHOS score in estimating in-hospital mortality was examined through ROC analysis. The AUC was found to be 0.814 [95% confidence interval (CI): 0.781-0.844], demonstrating strong discriminatory ability. When a threshold value of three or more was applied, the sensitivity reached 79.1% (95% CI: 69.3-86.9), while the specificity was 74.2% (95% CI: 70.3-77.9). The corresponding PPV was 34.4% (95% CI: 28.0-41.3), and the NPV was 95.4% (95% CI: 92.9-97.2) (Figure 2 and Table 2).

In the multivariate logistic regression analysis, endotracheal intubation in the ED, [odds ratio (OR) =1.32; 95% CI: 1.18-3.85; p<0.001], and PATHOS score components were identified as independent risk factors for in-hospital mortality (Table 3).

DISCUSSION

In the ED setting, rapid identification of critically ill patients and timely escalation to the appropriate level of care are crucial for preventing delays in management and improving patient outcomes (14). ACPE, which is associated with a high risk of early mortality and has an abrupt onset, is one of the most prominent examples of high-risk clinical conditions requiring prompt intervention (15). In this study, the performance of the PATHOS score in predicting in-hospital mortality among patients with ACPE who presented to the ED was evaluated. The findings revealed that the PATHOS score was significantly greater in non-survivors than in survivors and that a cut-off value greater than 3 was identified as an independent prognostic factor associated with an approximately 2.3-fold increased risk of in-hospital mortality. Furthermore, ROC curve analysis demonstrated an AUC of 0.814, indicating strong discriminative ability. This prognostic strength suggests that the PATHOS score may serve as a practical and effective decision-support tool, particularly in situations where rapid clinical deterioration is likely to occur.

The PATHOS score was initially developed by Spampinato et al. (10) in a multicenter study to predict short-term mortality risk in patients diagnosed with PE, and it demonstrated statistically robust prognostic performance. In that study, the AUC values for the derivation and validation cohorts were reported as 0.827 and 0.74, respectively. The PATHOS score has demonstrated promising discriminative ability in previous studies, and its prognostic accuracy has been favorably compared with traditional tools, such as the Shock index, Simplified Pulmonary Embolism Severity

Index and Pulmonary Embolism Severity Index (10). Similarly, in a validation study by Alışkan and Kılıç (11) in patients with PE, the PATHOS score, which uses a cut-off value of greater than 2, showed significant prognostic accuracy, with a sensitivity of 70.8% and a specificity of 71.3%. Additionally, a recent retrospective analysis by Sert and Kokulu (16), focusing on the geriatric population, reported

Table 1. Comparison of clinical, laboratory, and prognostic parameters between survivors and non-survivors in patients with acute cardiogenic pulmonary edema

Variable	Survivors (n=531)	Non-survivors (n=91)	p-value
Age, years	74.2±11.9	79.4±10.6	**<0.001**
Sex, male	292 (55.0%)	53 (58.2%)	0.564
Vital signs			
SBP (mmHg)	143.6±41.0	130.5±45.0	**0.005**
DBP (mmHg)	79.8±22.8	73.7±23.9	**0.017**
HR (beats/min)	101±24	116±24	**<0.001**
Oxygen saturation (%)	76±11	73±11	**0.003**
GCS	15.0 (1.0)	15.0 (2.0)	**0.001**
Cardiovascular co-morbidities			
Hypertension	331 (62.3%)	63 (69.2%)	0.207
Diabetes mellitus	353 (66.5%)	62 (68.1%)	0.757
Atrial fibrillation	208 (39.2%)	38 (41.8%)	0.641
Coronary artery disease	327 (61.6%)	60 (65.9%)	0.429
Congestive heart failure	306 (57.6%)	52 (57.1%)	0.931
Dyslipidaemia	72 (13.6%)	9 (9.9%)	0.337
Previous acute pulmonary edema	312 (58.8%)	51 (56.0%)	0.628
Acute myocardial infarction	77 (14.5%)	15 (16.5%)	0.623
Ejection fraction	40.0±10.8	39.9±9.6	0.617
Arterial blood pH	7.38 (0.11)	7.34 (0.15)	**<0.001**
Partial arterial CO_2 pressure	41.5 (13.5)	42.9 (23.1)	0.291
Arterial blood lactate (mmol/L)	2.6 (1.3)	2.9 (2.1)	**0.022**
White blood cells count ($\times10^9$/L)	9.65 (5.07)	10.42 (6.02)	0.076
Hemoglobine (g/dL)	11.4 (3.5)	11.4 (3.1)	0.554
Creatinine (mg/dL)	1.21 (0.70)	1.57 (0.99)	**<0.001**
Sodium (mmol/L)	138 (5)	137 (8)	0.055
Potassium (mmol/L)	4.64 (0.88)	4.81 (1.28)	0.072
NT-proBNP (pg/mL)	7190 (11913)	9895 (12450)	0.092
PATHOS score	2.76±1.11	4.09±0.90	**<0.001**
P: Platelet count <100 or >400×10^3/µL	59 (11.1%)	19 (20.9%)	0.009
A: Age >80 years	200 (37.7%)	57 (62.6%)	**<0.001**
T: Troponin level > cut-off	318 (59.9%)	84 (92.3%)	**<0.001**
H: Heart rate >100 bpm	292 (55.0%)	81 (89.0%)	**<0.001**
O: Oxygenation (SpO_2 <90%)	486 (91.5%)	89 (97.8%)	**0.036**
S: Systolic blood pressure <100 mmHg	114 (21.5%)	45 (49.5%)	**<0.001**
Non-invasive MV at ED	393 (74.0%)	70 (76.9%)	0.556
Endotracheal intubation at ED	29 (5.5%)	84 (92.3%)	**<0.001**
Days of hospitalization	5.0 (5.0)	4.0 (6.0)	0.176

Data are presented as mean ± standard deviation, median (interquartile range), or number (percentage), as appropriate
DBP: Diastolic blood pressure, ED: Emergency department, GCS: Glasgow Coma Scale, HR: Heart rate, MV: Mechanical ventilation, NT-proBNP: N-Terminus pro-B-type natriuretic peptide, SBP: Systolic blood pressure

that the PATHOS score independently predicts in-hospital mortality in intensive care patients aged 65 years and older (OR: 3.80, 95% CI: 3.07-4.70), with an AUC value of 0.827. Our results align closely with the existing literature. In the clinical context of ACPE, which is characterized by a high potential for sudden deterioration, a PATHOS score exceeding three was found to be associated with an approximately 2.3-fold increased likelihood of in-hospital death. This rate is similar to data reported for patients with PE, and geriatric intensive care patients, suggesting the PATHOS score's validity extends beyond thromboembolic conditions to various clinical scenarios. Therefore, our study makes a novel contribution to the literature regarding the use of the PATHOS score in ACPE, suggesting that this scoring system may serve as a practical and reliable tool for risk prediction in patients with ACPE. Notably, each component of the PATHOS score showed an independent association with in-hospital mortality in our patient population. This observation not only underscores the clinical importance of these individual parameters but also confirms the internal coherence and reliability of the scoring model. Furthermore, the congruence between their predictive roles and the established pathophysiological mechanisms in ACPE lends strong support to their inclusion within the score.

ACPE, which is associated with a high risk of short-term mortality, clearly highlights the need for rapid and effective risk stratification in EDs. Various scoring systems have been developed to address this clinical need, each based on distinct sets of parameters. For example, the 3CPO score, as described by Gray et al. (17), was designed to predict short-term prognosis in patients with ACPE complicated by acidosis. However, the model's reliance solely on fundamental clinical indicators, while excluding laboratory data, has limited its predictive power and confined its applicability to a specific patient subgroup, thereby restricting its use in general clinical practice. In contrast, the PATHOS score used in this study integrates both vital signs and fundamental laboratory parameters comprehensively, making it a practical risk assessment tool, particularly in patients with ACPE. The Emergency Heart Failure Mortality Risk Grade score,

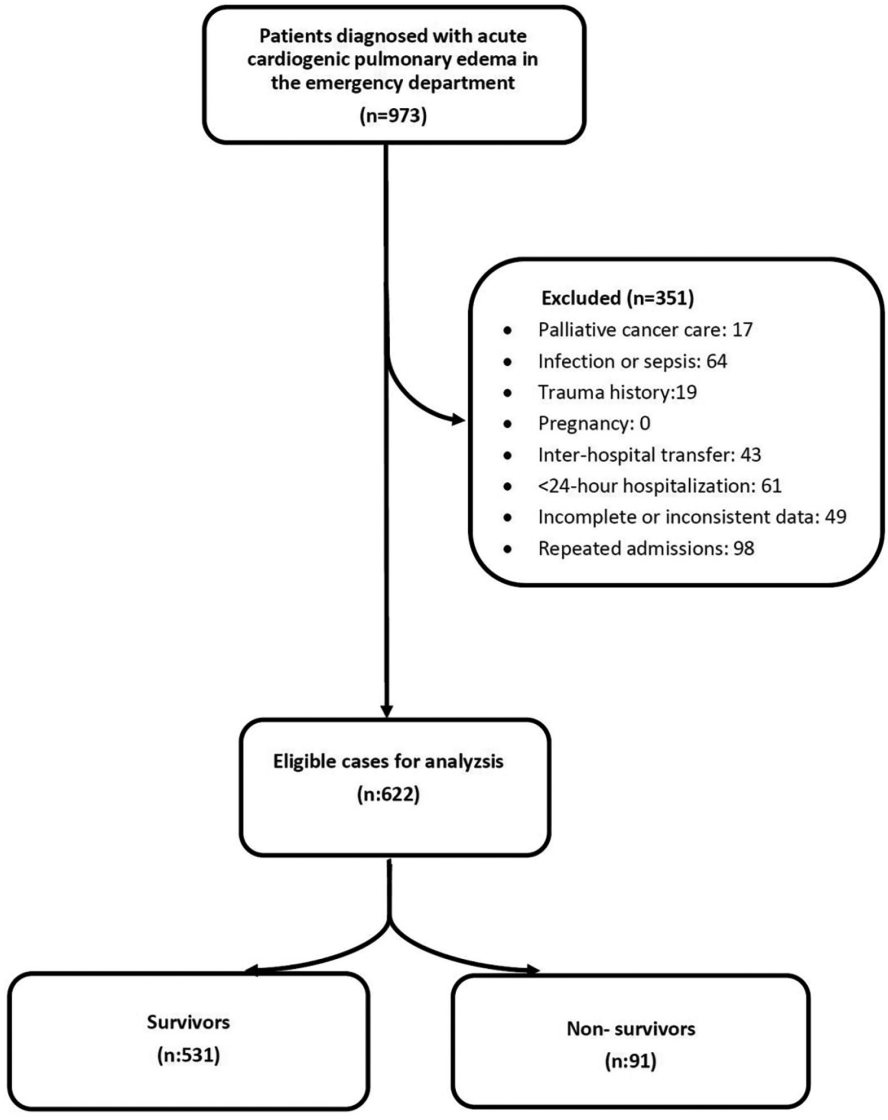

Figure 1. Flowchart of patient selection based on predefined inclusion and exclusion criteria

developed by Lee et al. (18), is a comprehensive system aimed at predicting 7-day mortality in patients presenting to the ED with heart failure. It incorporates numerous parameters, including age, vital signs, troponin, creatinine, and potassium levels, as well as a history of active malignancy. However, this model may lack sufficient specificity and sensitivity in certain clinical scenarios, such as ACPE. In contrast, the PATHOS score has been tested exclusively in a patient group with ACPE, and individuals with a history of malignancy were excluded from the study, allowing for a more targeted and streamlined assessment.

Another model proposed by Zhao et al. (19) demonstrated high accuracy in predicting short-term mortality by incorporating biomarkers such as NT-proBNP and creatinine. However, the applicability of this score may be limited in some EDs due to the need for advanced laboratory tests. In contrast, the PATHOS score, which includes commonly used biomarkers such as troponin, relies primarily on basic clinical and laboratory parameters, offering a straightforward structure that is easily applicable across different healthcare settings. This characteristic provides a functional advantage in facilitating rapid decision-making during emergencies.

Table 2. Prognostic performance of PATHOS score in predicting in-hospital mortality at different cut-off levels

Cut-off values for PATHOS score	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	AUC (95% CI)
≥0	100 (96-100)	0 (0-1)	-	-	-
>0	100 (96-100)	2 (1-3)	15 (12-18)	100 (66-100)	-
>1	99 (94-100)	14 (11-17)	16 (13-20)	99 (93-100)	0.52 (0.33-0.70)
>2	97 (91-99)	39 (35-43)	21 (18-26)	99 (96-100)	0.73 (0.66-0.92)
>3*	79 (69-86)	74 (70-78)	34 (28-41)	95 (93-97)	0.81 (0.78-0.84)
>4	29 (20-39)	95 (93-97)	50 (36-64)	88 (85-91)	0.65 (0.52-0.69)
>5	5 (2-12)	99 (98-100)	71 (29-96)	86 (83-87)	0.46 (0.28-0.75)

*Cut-off level was calculated using Youden's index
AUC: Area under curve, CI: Confidence interval, NPV: Negative predictive value, PPV: Positive predictive value, PATHOS: Platelets, age, troponin, heart rate, oxygenation, and systolic blood pressure

Table 3. Univariate and multivariate logistic regression analyses of risk factors associated with in-hospital mortality in patients with acute cardiogenic pulmonary edema

Risk factor	Univariate logistic regression			Multivariate logistic regression		
	OR	95% CI	p-value	OR	95% CI	p-value
Age	1.04	1.02-1.67	<0.001	-		
Gender, male	0.87	0.55-1.37	0.564	-		
SBP	0.68	0.40-0.88	0.008	-		
DBP	0.81	0.34-0.95	0.024	-		
HR	2.29	1.44-3.18	<0.001	-		
Oxygen saturation	0.57	0.28-0.94	0.005	-		
GCS	0.79	0.67-0.92	0.003	1.05	0.65-1.32	0.384
Arterial blood pH	0.41	0.15-0.78	<0.001	0.50	0.012-2.66	0.229
Arterial blood lactate	1.30	1.14-1.49	0.022	-		
Creatinine	1.20	1.02-1.41	<0.001	1.44	0.68-1.96	0.393
Endotracheal intubation at ED	1.54	1.37-4.63	<0.001	1.32	1.18-3.85	**<0.001**
PATHOS score						
P: Platelet count <100 or >400×10^3/μL	1.56	1.21-2.98	0.011	1.44	1.17-2.36	**<0.001**
A: Age >80 years	1.74	1.34-3.65	<0.001	1.16	1.05-3.81	**0.03**
T: Troponin level > cut-off	2.68	1.85-4.40	<0.001	1.32	1.11-4.58	**<0.001**
H: Heart rate >100 bpm	3.15	1.64-5.57	<0.001	2.33	1.46-6.18	**<0.001**
O: Oxygenation (SpO_2 <90%)	1.52	1.09-2.02	0.039	1.29	1.11-3.04	0.05
S: Systolic blood pressure <100 mmHg	2.18	1.58-2.67	<0.001	1.96	1.37-3.16	**<0.001**

CI: Confidence interval, DBP: Diastolic blood pressure, ED: Emergency department, GCS: Glasgow Coma Scale, OR: Odds ratio, PATHOS: Platelets, age, troponin, heart rate, oxygenation, and systolic blood pressure, SBP: Systolic blood pressure, HR: Heart rate

On the other hand, the model developed by Leela-Amornsin et al. (20) was specifically designed to predict extubation success in patients receiving non-invasive positive pressure ventilation (NIPPV). This model is based on six key clinical indicators: age, systolic blood pressure, heart rate, level of consciousness, urine output, and the presence of pneumonia. Although this approach is beneficial for anticipating the success of ventilation, its applicability is limited compared to the PATHOS score, as it is limited to patients undergoing NIPPV and does not provide an overall mortality prediction for broader clinical conditions such as ACPE. Additionally, our study revealed a significant difference in endotracheal intubation rates between survivors and non-survivors, with intubation performed considerably more frequently among patients who did not survive. This finding suggests that elevated PATHOS scores may reflect not only the risk of mortality but also the need for advanced airway management and intensive care support. From this perspective, the PATHOS score may serve not only as a prognostic tool but also as a valuable guide in planning critical care interventions.

The recently proposed SABIHA score has enriched the literature by targeting the identification of patients with ACPE who are at elevated risk of short-term mortality. This model is based on six key parameters-systolic blood pressure <110 mmHg, age ≥75 years, blood urea nitrogen ≥33 mg/dL, need for intubation, heart rate ≥110 bpm, and presence of anemia-and was developed using a large, multicenter patient cohort. It showed strong prognostic performance across both the model development and external validation stages, achieving AUC scores of 0.879 and 0.840, respectively, which reflect high discriminatory capability (9). In particular, the SABIHA score has drawn attention as an effective tool for early mortality risk stratification. However, the need for clinical intervention data (e.g., intubation) makes its calculation relatively complex in ED settings, where rapid decision-making is critical. At this point, the PATHOS score stands out as an effective alternative in busy clinical environments such as EDs since it can be calculated using only basic vital signs and routine biochemical parameters available at admission. In this context, our study expands the scope of the literature by demonstrating the prognostic value of the PATHOS score in a clinical scenario characterized by high mortality and an urgent need for interventions, such as ACPE. Owing to its simple structure, rapid applicability, and strong discriminatory performance, the PATHOS score is thought to have significant potential as a decision-support tool for time-sensitive patient management in EDs.

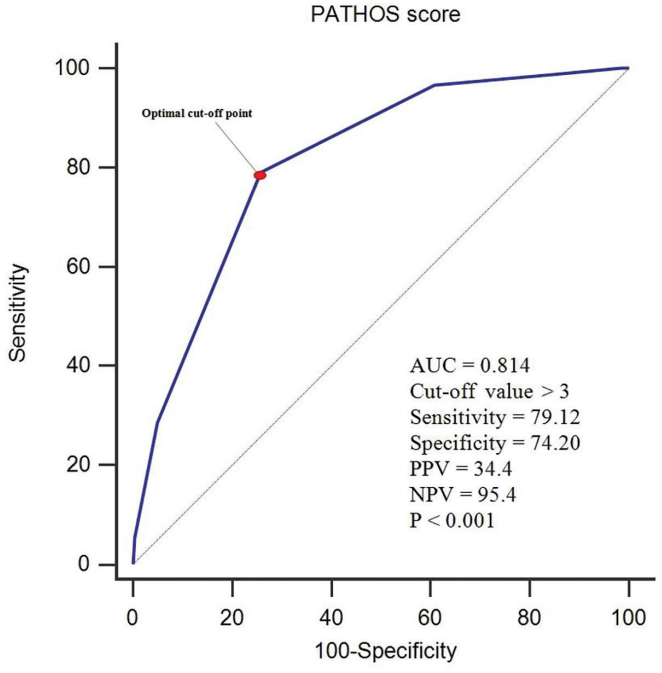

Figure 2. Receiver operating characteristic curve illustrating the prognostic performance of the PATHOS score in predicting in-hospital mortality

AUC: Area under curve, NPV: Negative predictive value, PPV: Positive predictive value, PATHOS: Platelets, age, troponin, heart rate, oxygenation, and systolic blood pressure

In this context, transparent reporting of cut-off selection is essential for enhancing the reproducibility and comparability of prognostic scoring systems across diverse clinical settings (21). Beyond its prognostic utility, a high PATHOS score at admission may assist emergency physicians in making informed triage decisions by identifying patients who would benefit from closer observation, expedited intensive care unit consultation, or more intensive monitoring. Moreover, its reliance on readily available parameters at the time of initial evaluation allows for seamless integration into existing emergency care protocols without impeding urgent treatment decisions. In resource-limited or high-volume settings, such integration may help standardize care and enhance early recognition of clinical deterioration.

Study Limitations

This study has certain methodological constraints that must be acknowledged when evaluating the results. Primarily, its retrospective and single-center nature may restrict the extent to which these findings can be extrapolated to broader clinical settings and diverse patient groups. Additionally, since the data were retrospectively obtained from hospital information management systems, some clinical and laboratory variables may have been incompletely, non-standard, or heterogeneously recorded. Only routinely assessed parameters were included in the study, and advanced biomarkers such as NT-proBNP were excluded. Furthermore, the analysis was limited to mortality occurring during hospitalization; outcomes such as long-term survival after discharge, readmission, or the development of complications were not evaluated. The lack of systematic examination of treatment protocols and interventional differences among patients could be confounding factors affecting short-term outcomes. The study also did not include timing variables, such as the interval between symptom onset and presentation. Additionally, the exclusion of patients with a hospital stay of less than 24 hours may have limited the ability to assess the specificity of the PATHOS score. Some of these patients may have been clinically stable and discharged early, and their exclusion could have led to an underestimation of the score's false-positive rate. Finally, no subgroup analysis was performed according to different etiological subtypes of ACPE (e.g., ischemic, hypertensive, or valvular causes). For these reasons, multicenter, prospective, and interventional studies are needed to validate our findings and extend their applicability to broader clinical settings.

CONCLUSION

ACPE is an emergency condition characterized by sudden-onset respiratory failure and hemodynamic instability; it poses a significant threat to patient survival. This study evaluated the performance of the PATHOS score, based on readily available basic clinical and laboratory findings at admission, in predicting short-term in-hospital mortality. These findings indicate that the PATHOS score may offer a practical approach to early risk stratification in patients with ACPE. Its simple structure and rapid calculation suggest that the score has the potential to contribute to clinical decision support, particularly in the timesensitive environment of the ED.

Ethics

Ethics Committee Approval: The study was approved by the Local Ethics Committee of University of Health Sciences Türkiye, Ankara Etlik City Hospital (approval number: AEŞH-BADEK-2025-0247, date: 12.03.2025).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: T.S.M., Concept: T.S.M., R.H.G., E.T.S., Design: T.S.M., R.H.G., Data Collection or Processing: T.S.M., R.H.G., Analysis or Interpretation: T.S.M., E.T.S., K.K.K., Literature Search: T.S.M., S.G.U., Writing: T.S.M., S.G.U.

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