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Severe Acidemia, Leukocytosis and Low Hematocrit Levels at Admission as Mortality Predictors of Elderly Intensive Care Unit Patients

Yaşlı Hastalarda Mortalite Prediktörü Olarak Yoğun Bakım Yatışında Saptanan Ciddi Asidemi, Lökositoz ve Düşük Hemoglobin Değerleri

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ABSTRACT

Aim: Rapid prediction of prognosis is helpful in reflecting the disease severity and patient mortality. This is especially important in critically ill elderly patients who have high mortality risk. This study aimed to investigate the effects of admission laboratory results and medical histories on the prediction of prognosis in critically ill elderly patients.

Material and Methods: Patients who were ≥65 years and admitted to a medical intensive care unit (ICU) between 2011 and 2013 were retrospectively analyzed.

Results: The study included 449 patients and mortality rate was 47.4%. Nonsurvivors had lower pH, HCO_3 and albumin levels, and lower hematocrit and platelet counts, but higher aspartate aminotransferase, alanine aminotransferase, C-reactive protein (CRP), creatinine, phosphorus, magnesium and bilirubin levels, and higher leukocyte count than survivors. The rates of chronic kidney disease, being in a bedridden state and having cardiopulmonary resuscitation (CPR) before ICU admission were significantly high in nonsurvivors. Multivariate analysis showed that pH <7.20, albumin ≤2 gr/dL, low hematocrit and high CRP levels, high leukocyte count, bedridden state, and CPR were mortality predictors. After including the admission diagnoses and endotracheal intubation into the model, pH <7.20 (odds ratio [OR], 4.31; 95% confidence interval [CI], 1.59-11.70), albumin ≤2 gr/dL (OR, 3.61; 95% CI, 0.99-13.03), hematocrit level (OR, 0.94; 95% CI, 0.91-0.99) and leukocyte count (OR 1.06; 95% CI, 1.01-1.11) retained their prognostic importance for mortality.

Conclusions: Severe acidemia, low albumin and hematocrit levels, and high leukocyte count at admission help clinicians to foresee the prognosis in severely ill elderly patients. They keep their importance even in the presence of other fundamental mortality predictors.

Key words: Comorbidity, elderly patients, hypoalbuminemia, intensive care unit, pH, prognosis

ÖZ

Amaç: Hızlı prognoz tahminin yapılması hastalık ciddiyetini ve hasta mortalitesini belirlemede yardımcı olur. Bu durum özellikle yüksek mortalite riskine sahip olan kritik yaşlı hastalarda önemlidir. Bu çalışmada, kritik yaşlı hastalarda başvuru esnasındaki laboratuvar sonuçları ile medikal hikayenin prognoz üzerindeki etkisinin araştırılması amaçlanmıştır.

Gereç ve Yöntemler: Üçüncü basamak medikal yoğun bakım ünitesine (YBÜ) 2011-2013 tarihleri arasında yatırılan 65 yaş ve üstü hastalar retrospektif olarak incelendi.

Bulgular: Çalışmaya 449 hasta alındı ve mortalite oranı %47.4 idi. Ölenlerin pH, HCO_3, albümin, hematokrit ve trombosit değerleri anlamlı düşük, fakat lökosit, aspartat aminotransferaz, alanin aminotransferaz, C-reaktif protein (CRP), kreatinin ve bilirubin değerleri ise anlamlı yüksek bulundu. Kronik böbrek hastalığı, yatağa bağımlılık ve YBÜ yatışı öncesi kardiyopulmoner resüsitasyon (KPR) oranları ölen vakalarda belirgin yüksek tespit edildi. Çoklu değişken analizinde pH <7.20, albümin ≤2 gr/dL, düşük hematokrit ve yüksek CRP seviyesi, artmış lökosit sayısı, yatağa bağımlılık ve KPR varlığı mortalite prediktörleri olarak saptandı. Hastaların yatış tanıları ve endotrakeal entübasyon varlığı analiz modeline eklendiğinde ise pH <7.20 (odd ratio [OR], 4.3; %95 güven aralığı [GA] 1.59-11.70), albümin ≤2 gr/dL (OR, 3.61; 95% GA, 0.99-13.03), hematokrit seviyesi (OR, 0.94; %95 GA, 0.91-099) ve lökosit sayısı (OR, 1.06; 95GA, 1.01-1.11) birer mortalite prediktörü olarak sebat ettikleri görüldü.

Sonuç: Yatış esnasında saptanan ciddi asidemi, yüksek lökosit sayısı ve düşük albümin ile hematokrit seviyesi klinisyene kritik yaşlı hastalarda prognozu öngörmede yardımcı olurlar. Diğer önemli mortalite prediktörleri varlığında dahi bu parametreler anlamlılıklarını korumaktadırlar.

Anahtar kelimeler: Komorbidite, yaşlı hastalar, hipoalbünemi, yoğun bakım, pH, prognoz.

Introduction

The prognosis of critically ill patients is generally attempted to be predicted by using illness severity scoring systems, especially the Acute Physiology and Chronic Health Evaluation score (APACHE) that generate prognostic information for patients within 24 hours of admission to the intensive care unit (ICU) (1,2). However, the use of these scoring systems, that combines the functional and physiological characteristics of patients as mortality predictors, is still limited since they don't give information till 24 hours of admission. Although various studies have been done investigating the association between patient parameters and mortality, they mostly aim proposing new scoring systems (3,4). Rapid prediction of prognosis using the tests done routinely on admission, as they are unbiased by clinical evaluation and easily accessible, might be helpful in reflecting disease severity and patient mortality. This is mandatory especially in critically ill elderly patients who need rapid prediction of prognosis because of high mortality risk (3). This study aimed to investigate the effects of admission laboratory results and medical histories on the prediction of prognosis in elderly patients who were admitted to the ICU.

Material and Methods

This retrospective study was conducted in a tertiary medical ICU between January 2011 and December 2013. The study included patients aged ≥65 years old. All patients' demographic characteristics, ICU admission diagnosis, length of ICU stay (LOS), laboratory data on admission including arterial blood gas, complete blood count, creatinine, electrolytes, glucose, albumin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), C-reactive protein (CRP), bilirubin, lactate dehydrogenase (LDH), troponin and international normalized ratio (INR), and comorbidities enlisted in the medical files were recorded. Admission diagnoses were classified accordingly; a diagnosis of infection included primarily sepsis-related admissions which were lung, gastrointestinal, urinary tract, central nervous system, soft tissue and catheter-related infections. A cardiac diagnosis encompassed cardiogenic shock, HF, acute myocardial infarction, rhythm problems and cardiac arrest not precipitated by an underlying disease such as sepsis or respiratory failure. A hepatic diagnosis included admission with chronic/active hepatic failure. A diagnosis of hemorrhage described any kind of bleeding. A diagnosis of neurologic diseases included motor neuron and neuromuscular diseases, status epilepticus and cerebrovascular accident (CVA). A diagnosis of respiratory diseases included chronic obstructive pulmonary disease (COPD) and asthma exacerbation, pulmonary embolism (PE), decompensation of chronic respiratory diseases except COPD and pneumothorax. Surgery encompassed any planned or unplanned surgery. In the event of multiple admissions, the first admission was accepted. Exclusion criterion was being <65 years old. Discharge from the ICU was recorded as survivors and nonsurvivors. Since baseline cognitive or social data were not routinely documented in the medical files, these parameters were not enrolled into the study. Premorbid functional state was only recorded as bedridden or not in the medical files and included into the study. The study protocol was approved by the ethical review board of the university (Number:2015/76).

Categorical variables were expressed as proportions and compared with the Chi-square or Fisher's exact tests. Normally distributed variables were analyzed by the Student's T test and results were expressed as means with standard deviations. Variables without normal distribution (AST, ALT, LDH, LOS and troponin) were reported as medians with interquartile ranges and compared using the Mann-Whitney U test. A forward stepwise=logistic-regression model was performed to investigate the impact of the measured variables on the mortality. The variables yielding $p < 0.05$ by the univariate analysis were entered into the multivariate logistic regression analysis. The model was first performed without parameters reflecting the admission diagnoses and intubation, following which these parameters were added to the analysis. Hosmer-Lemeshow goodness-of-fit test was performed, and odds ratios with 95% confidence interval were computed. Collinearity between variables was excluded before modeling by computing the Spearmen correlation, with an r >0.5 regarded as significant. A p <0.05 was considered as significant. All calculations were carried out using the Statistical Package for the Social Sciences version 21 (IBM Corp., Armonk, NY, USA).

Results

A total of 748 patients were admitted to the ICU among whom 60% were aged ≥65 years and included into the study. The mean age, APACHE II score and percentage of male patients were 78.9±7.2 years, 26±8.4 and 51.4%, respectively. The main comorbidities were hypertension (61%), hearth failure (45.2%), CVA (33%), diabetes mellitus (29.2%), COPD (24.1%), ischemic heart disease (21.4%), chronic kidney disease (CKD stage 2-5D, 20.3%), malignancy (13.4%) and dementia (12.7%). Among the patients, 9.1% received cardiopulmonary resuscitation (CPR) within 24 hours before the ICU admission, 20.7% were in a bedridden state, 3.1% had metastatic cancers and 56% were accepted to the ICU from the wards.

The ICU mortality rate was 47.4%. There wasn't any statistically significant difference between survivors and nonsurvivors according to sex, age groups, admission sites and comorbidities, except CKD (Table 1). With regard to laboratory parameters, nonsurvivors had lower pH, HCO_3, hematocrit and albumin levels, and platelet count than survivors (Table 2). In contrast, creatinine, bilirubin, AST, ALT, LDH, phosphorus, magnesium and CRP levels, and white blood cell (WBC) count were notably elevated in nonsurvivors, together with high rates of being in a bedridden state and having CPR. Since pH and albumin levels were significantly low in nonsurviors, we categorized pH and albumin levels into three categories where pH <7.20 and albumin ≤2 gr/dL were encountered more in nonsurvivors than in survivors. The patients with admission diagnoses of surgery and respiratory disease had higher survival rates than nonsurvivors. On the other hand, diagnosis of infection was the main cause of death in nonsurvivors. Endotracheal intubation was done in 299 patients and intubation rate was high in nonsurvivors (42.8% vs. 93%, p <0.001). Survivors had shorter LOS than nonsurvivors (4 (2-7) vs. 4 (2-18), p=0.026).

Since APACHE II is calculated from the data gathered within 24 hours and includes the variables of hematocrit, WBC, HCO_3 and pH, we excluded APACHE II from the multivariate analysis.

Table 1. Comparison of demographic and clinical variables between survivors and nonsurvivors

Variables	Survivors (n: 236)	Nonsurvivors (n: 213)	*p* value
Age (years)	79.2 ± 7.2	78.6 ± 7.1	0.385
APACHE II	21 ± 6.1	33 ± 6.8	<0.001
Age groups, n (%)			0.931
65-74	70 (29.7)	62 (29.1)	
75-84	109 (46.2)	102 (47.9)	
≥ 85	57 (24.2)	49 (23)	
Male, n (%)	113 (47.9)	118 (55.4)	0.310
Comorbidity, n (%)			
HT	145 (61.9)	128 (60.1)	0.599
HF	106 (44.9)	97 (45.5)	0.894
IHD	48 (20.3)	48 (22.5)	0.571
DM	72 (30.5)	59 (27.7)	0.513
CKD	39 (16.5)	52 (24.4)	0.038
Dementia	24 (10.2)	33 (15.5)	0.098
COPD	64 (27.1)	44 (20.7)	0.122
Malignancy	25 (10.6)	35 (16.4)	0.073
CVA	59 (25)	64 (30)	0.231
CLD	5 (2.1)	11 (5.2)	0.082
Bedridden state, n (%)	40 (16.9)	53 (24.9)	0.030
CPR, n (%)	8 (3.4)	33 (15.5)	<0.001
pH, n (%)[a]			
< 7.20	14 (6)	57 (26.9)	<0.001
7.20-7.39	92 (39.1)	84 (39.6)	0.634
≥ 7.35	129 (54.9)	71 (33.5)	<0.001
Albumin, n (%)[a]			
≤ 2 mg/dL	11 (4.7)	29 (13.8)	0.002
2.01-3.49 mg/dL	162 (96.2)	147 (70)	0.785
≥ 3.5 mg/dL	61 (26.1)	34 (16.2)	0.011
Admission site, n (%)			0.154
Emergency service	110 (46.6)	85 (39.9)	
Ward	126 (53.4)	128 (60.1)	
Admission diagnosis, n (%)			
Infection	92 (39)	150 (70.4)	<0.001
Cardiac disease	20 (8.5)	15 (7)	0.610
Respiratory disease	41 (17.4)	10 (4.7)	<0.001
Neurologic disease	20 (8.5)	18 (8.5)	0.869
Surgery	38 (16.1)	1 (0.5)	<0.001
Hepatic failure	4 (1.7)	7 (3.3)	0.158
Bleeding	9 (3.8)	7 (3.3)	0.520
Others[b]	13 (6.7)	5 (2.3)	0.097

[a]Data of pH and albumin were missing in 2 and 5 patients, respectively.
[b]Others include electrolyte disorders (n:7), hypoglycemia (n:4), acute pancreatitis (n:3), Addison's disease (n:1), intoxication (n:2) and uremia (n:1).
Abbreviations: **APACHE**: Acute Physiology and Chronic Health Evaluation; **CKD:** chronic kidney disease (Stage 2-5D); **CLD:** chronic liver disease; **COPD:** chronic obstructive pulmonary disease; **CVA:** cerebrovascular accident; **DM:** diabetes mellitus; **HF:** heart failure; **HT:** hypertension; **IHD:** ischemic heart diseases; **CPR:** cardiopulmonary resuscitation.

Table 2. Comparison of laboratory parameters between survivors and nonsurvivors

Variables	Survivors (n: 236)	Nonsurvivors (n: 213)	*p* value
pH	7.36 ± 0.10	7.30 ± 0.37	<0.001
HCO_3, mmol/L	23.4 ± 6.9	20.3 ± 7.8	0.015
$PaCO_2$, mm Hg	39.5 ± 18.2	40.1 ± 18.3	0.539
PaO_2, mm Hg	70 ± 40.7	74.1 ± 40.8	0.447
WBC, x10^3/L	10.8 ± 5.6	13 ± 10	0.001
Hematocrit, (%)	34.9 ± 6.9	30.2 ± 6.7	<0.001
Platelet, x10^3/L	217 ± 128	199 ± 119	0.018
Creatinine, mg/dL	1.17 ± 1.4	1.8 ± 1.8	<0.001
Total bilirubin, mg/dL	0.63 ± 1.24	0.78 ± 2.52	0.001
AST, U/L[a]	28 (19-48)	40 (22-99)	<0.001
ALT, U/L[a]	17 (11-33)	24 (12-67)	0.001
LDH, U/L[a]	306 (224-417)	382 (269-559)	0.010
Albumin, gr/dL	3.0 ± 0.6	2.8 ± 0.6	<0.001
INR	1.19 ± 1.44	1.37 ± 3.1	0.002
Phosphorus, ng/mL	3.6 ± 1.7	4.3 ± 2.5	<0.001
Magnesium, mg/dL	1.9 ± 0.4	2.1 ± 0.4	0.001
Calcium, mg/dL	8.3 ± 0.9	8.1 ± 5.2	0.626
Sodium, mEq/L	138 ± 7.2	138 ± 8.8	0.546
Potassium, mEq/L	4.46 ± 0.9	4.38 ± 1.1	0.147
Troponin T, ng/mL[a]	0.2 (0.04-0.28)	0.16 (0.84-0.21)	0.332
Glucose, mg/dL	135 ± 91	135 ± 74	0.340
Uric acid, mg/dL	6.1 ± 3.5	7.2 ± 3.9	0.288
CRP, mg/dL	5.8 ± 9.6	9.2 ± 12	<0.001

[a]Nonparametric tests were used since they were not normally distributed.
Abbreviations: **ALT:** alanine transaminase; **AST:** aspartate aminotransferase; **CRP:** C-reactive protein; **INR:** international normalized ratio, **LDH:** lactate dehydrogenase; **WBC:** white blood cell.

The first model showed that pH <7.20, albumin ≤2 gr/dL, high WBC count, high CRP level, low hematocrit level, having CPR and being in a bedridden state were mortality predictors. After the inclusion of admission diagnoses of infection, respiratory disease and surgery, and intubation into the model, pH <7.20, albumin ≤2 gr/dL, hematocrit level and WBC count remained as mortality predictors along with respiratory disease, surgical operation and intubation, while high CRP level, having CPR and being in a bedridden state lost their significance (Table 3).

Discussion

The number of elderly patients admitted to the ICU increases every day. A study done by Blot et al. revealed that the number of patients aged ≥75 years increased by 33% between 1992-1996 and 2002-2006 (5). An annual rise of 5.6% in critically ill patients aged ≥80 years was reported by Bagshaw et al (6). This increased need results from high mortality risk since elderly patients have various comorbidities (6). A study done in the US in 2000 and examining the use of ICU in patients who were ≥65 years showed that 27% of all hospitalized elderly patients used ICU and these patients had a mortality rate of 17% (7). Another study reported an ICU mortality rate of 37% in medical patients, 34% in unplanned surgery and 10.6% in planned surgery (8). In our study, 60% of the patients admitted to the ICU were aged ≥65 years and we had

Table 3. Mortality predictors in the multivariate logistic regression (Model 1 & Model 2)

Variables	Model 1[a]				Model 2[b]			
	B	Wald	p	OR (95% CI)	B	Wald	p	OR (95% CI)
pH <7.20	1.65	14.94	<0.001	5.19 (2.25-11.97)	1.46	8.23	0.004	4.31 (1.59-11.70)
Albumin ≤2 gr/dL	1.10	4.66	0.031	3.00 (1.11-8.14)	1.28	3.83	0.050	3.61 (0.99-13.03)
WBC	0.05	8.94	0.003	1.06 (1.02-1.09)	0.06	6.40	0.011	1.06 (1.01-1.11)
Hematocrit	-0.04	4.35	0.037	0.96 (0.93-0.99)	-0.05	5.52	0.019	0.94 (0.91-0.99)
CRP	0.03	5.21	0.022	1.03 (1.01-1.05)	0.03	3.33	0.068	1.03 (0.99-1.06)
CPR	1.32	8.03	0.005	3.73 (1.50-9.27)	0.42	0.70	0.402	1.52 (0.57-3.99)
Bedridden state	0.60	4.34	0.037	1.83 (1.04-3.23)	0.43	1.34	0.247	1.52 (0.74-3.18)
Intubation					2.94	58.71	<0.001	18.85 (8.89-39.96)
Respiratory disease					-1.63	8.52	0.004	0.20 (0.07-0.59)
Surgery					-3.91	10.53	0.001	0.02 (0.002-0.21)

[a]Hosmer-Lemeshow, X^2: 7.9, df:8, p=0.448.[b]Hosmer-Lemeshow, X^2: 6.5, df:8, p=0.595.
Abbreviations: **CPR:** cardiopulmonary resuscitation; **CRP:** C-reactive protein; **CI:** confidence interval; **OR:** odds ratio; **WBC:** white blood cell.

a higher mortality rate than other studies. This is most probably due to demographic properties of our city harboring high number of state nursing care facilities and mostly sheltering retired people who live in their villages. Since it is not legal to limit therapy in our country, all patients who need ICU support can admit to an ICU, irrespective of the end-stage diseases or poor cognitive and functional states. Therefore, the physicians must legally give medical support to all patients whether they can benefit from the ICU or not. In this study population, 20.7% were in a bedridden state due to chronic diseases and 3.1% had metastatic cancers. While the rate of bedridden state in our population was high compared to the literature, the rate of metastatic cancer was similar to the literature (9-10). Metastatic cancer patients who have theoretically indication for chemotherapy were accepted into the ICU in these studies (10). In contrast, 60% of metastatic cancer patients in the present study had the decision of chemotherapy withdrawal. Old patients with end-stage disease and/or bedridden state more frequently lose their lives in the ICU as happened in our patients where 79% of metastatic cancer and 43% of bedridden patients died in the ICU (11,12). Other reason for high mortality rate was the inclusion of a considerable number of the patients with CPR (n=41 [9.1%]) before ICU admission and 82% of these patient were died. It is well known that survival rate of cardiac arrest in older patient decreases significantly with age (13).

In this study, nonsurvivors had lower pH levels than survivors and a plasma pH <7.20 was found to be a mortality predictor. Acidemia is a potentially life-threatening condition frequently seen in critically ill patients and it reflects the seriousness of underlying disease (14). Severe acidemia is described as plasma pH <7.20 (15). This term is important because severe acidemia itself causes organ dysfunction as decrease in cardiac output, arrhythmia, arterial dilatation with hypotension, worse neurologic outcome and respiratory muscle dysfunction (15-17). These patients have high rates of vasopressor treatment, mechanical ventilation (MV) and disease severity indexes (17,18). Patients with severe acidosis were reported to have high mortality rates as demonstrated in our study (14,17,18). WBC count was significantly associated with mortality in this study. Leukocytosis was disclosed to be a mortality predictor in many disease states including acute coronary syndrome, trauma, acute kidney injury and burn (19-21). In addition, in-hospital mortality was reported to be high in patients whose leukocyte count was elevated at emergency admission (4). Leukocytosis is a hallmark of systemic inflammation. It is also a component of systemic inflammatory response syndrome (SIRS) characterized by excessive immune-inflammatory cascade activation (22). Patients with ≥2 SIRS criteria have high mortality rates (20,23). Thus, our result is compatible with the literature that elevated WBC is an important aspect of disease severity and mortality. Low hematocrit level, an additional mortality predictor in this study, should result from inflammation-related decrease in production and/or decreased erythrocyte half-life reported in critical care patients (24). The decrease in hemoglobin shows the severity of the illness, and a negative correlation between hemoglobin and APACHE II was demonstrated by Nguyen et al (25). The study done by Corwin et al showed that two thirds of general ICU patients had hemoglobin levels <12 gr/dL on day one, decrements in hemoglobin levels over time were demonstrated, irrespective of the admitting hemoglobin levels, and baseline hemoglobin levels of ≤10 gr/dL were associated with higher disease severity scores and mortality rates (26). Albumin, another mortality predictor in the present study, is a negative acute phase reactant which decreases in case of inflammation. In a study done by Reinhardt et al., increases in morbidity and mortality were shown with hypoalbuminemia where the serum albumin concentration of 3.4 g/dL or less was associated with a 30-day mortality rate of 24.6% and increased to 62% if the serum albumin concentration was <2 g/dL (27). In this study, even after the inclusions of admission disease diagnoses, intubation and CPR into the multivariate analysis, pH, hematocrit, WBC and albumin stayed as mortality predictors which reinforce the importance these laboratory parameters as alarming indications for mortality.

Our data showed that patients with admission diagnosis of respiratory failure secondary to COPD, asthma, PE and pneumothorax have high survival rates. In a European survey, mortality rates of the patients with acute respiratory failure plus other organ dysfunction and with only respiratory failure were 31% and 7% (28). A study done by Flaatten et al. also showed that hospital mortality rate was 14.7% among the patients with only acute respiratory failure whereas it was 40.5% in the patients with additional organ failures (29). We also included patients with only respiratory failure in the group, not the ones with other organ dysfunction, and mortality rate was 13.5%. Of these patients, 36 patients had COPD exacerbation and they had a mortality rate of 13.8%, similar to the literature. General in-hospital mortality rate in COPD patients were reported to be around 10%, and it increased to 14% among severe COPD patients not requiring MV and to 24% among very severe COPD patients requiring MV in the ICU (30,31). In our cohort, 22 COPD patients had invasive MV and 22.7% of them were died. We included 8 patients with PE and 3 of them (37.5%) died. Our mortality rate secondary to PE was in accordance with the mortality rates gained in studies done on patients admitted with massive PE to the ICU (32). Rapid intervention causes higher survival rates in patients with pneumothorax as seen in our two patients. In this study, surgical patients had a high ICU survival rate. Mortality rate in elderly surgical ICU patient is lower than in elderly medical ICU patients. Even when patients are classified as planned and unplanned surgical admissions, mortality rate is still lower in emergency surgical patients than in medical patients (6,8).

Multiple studies trying to find new scoring systems investigated the relationship between laboratory data and mortality. Asadollahi et al. showed that laboratory data routinely collected on admission can predict mortality (3). Another study done by Froom et al. in order to predict hospital mortality rates found that a logistic regression model including age and admission laboratory data could predict mortality (33). Similar to these studies, admission pH, WBC count, and albumin hematocrit levels were shown to be significantly associated with mortality in the present study. The important difference of this study is to displace these laboratory parameters as important predictors even after the inclusion of admission diagnoses, CPR before ICU admission and endotracheal intubation into the regression model which are well known determinants of outcome in severely ill elderly patients (6,8,11). Therefore, our results underline the importance of severe acidemia and inflammation on the ICU outcome.

The study has some limitations. First, this was a single centered retrospective study with limited number of patients. Socioeconomic biases may be present so results may not represent the general population. Second, only the laboratory data, medical history and admission diagnoses obtained at ICU admission were taken into account. The complications developed during ICU stay that might be effective on mortality, especially in the patients followed for longer duration were disregarded. Third, we did not take organ support therapies such as invasive or noninvasive mechanical ventilation, renal replacement therapy, plasmapheresis and vasoactive drug use into account which are important severity indicators and mortality predictors among critically ill patients.

Conclusion

The risk of death in critically ill older patients can be predicted by routinely retrieved laboratory parameters on admission to the ICU along with medical history and admission diagnosis. These easily accessible data may help clinicians rapidly foresee the risk of mortality, and decide on an efficient treatment protocol for the patients. Apart from leading their treatment, clinicians can inform patients' family accordingly.

AUTHOR CONTRIBUTIONS:

Concept: TA,EŞT,BÖ; **Design:** TA,EŞT,FTS,BÖ; **Supervision:** TA,DMK,BÖ; **Resources:** TA,BÖ,DMK,FTS; **Materials:** TA,BÖ,DMK; **Data Collection and/or Processing:** TA,EŞT,HYT,FTS; **Analysis and/or Interpretation**: TA, EŞT, DMK, BÖ; **Literature Search:** TA, EŞT, HTY, FTS; **Writing Manuscript**: TA, EŞT, HTY, BÖ; **Critical Review:** TA, BÖ,FTS, DMK.

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