Potential risk factors for patient mortality during admission to the intensive care units

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ABSTRACT

الأهداف: تحديد أهمية وقت الدخول ويوم الدخول ومنفذ الدخول وطريقة الدخول والأجهزة الموصولة للمريض قبل الدخول على التشخيص، وتشخيص المريض والدرجة المسجلة حسب مقياس الفسيولوجيا الحادة المبسطة II أثناء الإدخال .

الطريقة: أجريت هذه الدراسة بأثر رجعي على 545 مريض ادخلوا إلى وحدات العناية المركزة للكبار خلال الفترة من يناير 2006م حتى يناير 2011م. استعملت القواعد البيانية الالكترونية وسجلات المرضى لجمع البيانات. تم جمع البيانات من سجلات المرضى باستعمال نموذج مسح معد ومقياس الفسيولوجيا الحادة المبسطة II. تم تحليل البيانات باستخدام القيم الرقمية والنسب المئوية وتحليل العلاقة الشخصية وتحليل الانحدار اللوجستي وخي– تربيع واختبار t.

النتائج: كان معدل الوفيات 60.4%. حصل المرضى المتوفين على درجة أعلى في مقياس الفسيولوجيا الحادة المبسطة II. كان معدل الوفيات أعلى للداخلين من خلال أقسام الطوارئ (p=0.000) والمرضى الداخلين على النقالات (p=0.000)، وجود أنبوب إلى القصبة الهوائية (p=0.000) وجهاز الرصد (p=0.000)، ومرض الجهاز التنفسي (p=0.000) والعدوى (p=0.000). لم يتم ملاحظة فرق كبير بين يوم الادخال (p=0.761) والوقت (p=0.063).

خاتمة: درجة المريض على مقياس الفسيولوجيا الحادة المبسطة II وطريقة الدخول ومنفذ الدخول ووجود أنبوب إلى القصبة الهوائية وموصل إلى جهاز الرصد والتشخيص عند الدخول وطول فترة البقاء في وحدة العناية المركزة أدت إلى تسريع معدل الوفيات ولكن لم يكن ليوم وساعة الدخول تأثير على الوفيات.

Objectives: To determine the prognostic importance of admission time, admission day, admission source, and route of admission, attached devices before admission, diagnosis of patients, and total Simplified Acute Physiology Score (SAPS) II score during admission on intensive care unit mortality rates.

Methods: This retrospective study was carried out with 545 patients admitted to adult intensive care units between January 2006 and January 2011 at Zonguldak, Turkey. Computerised database and patient records were used for data collection. Data from the patient records was collected by a constructed survey form and SAPS II scale. The data was evaluated by numeric values and percentages, Pearson correlation analysis, logistic regression analysis, Chi-square, and student t-tests.

Results: The mortality rate was 60.4%. The patients who died had a higher SAPS II score. The mortality rate was higher in admissions from the emergency department (p=0.000), admissions of patients on a stretcher (p=0.000), the existence of an intubation tube (p=0.000) and monitor (p=0.001), and in patients with respiratory tract illness (p=0.000), and infection (p=0.000). A significant difference was not found between the admission day (p=0.761), and time (p=0.063).

Conclusion: The SAPS II scores of the patients, the route of admission and admission source, being intubated and connected to a monitor, admission diagnosis, and length of stay in intensive care units was increased to mortality rate. However, the days and hours of admission did not significantly affect mortality.

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Although the intensive care units (ICUs) account for only 2-8% of all beds in a hospital, these units are essential for patient care.[1,2] Patients in the ICU often have multiple-organ abnormalities, are hemodynamically unstable, and have complex problems.[2-4] To increase the quality of care given to patients whose treatments and care are continued for 24 hours, and to minimize the adverse patient outcomes, it is important to recognize the factors affecting mortality, and patients at high risk.[5-8] As patients admitted to ICUs are in different conditions and have complex problems, it is difficult to determine the prognosis and mortality rate.[9] In parallel with the technological opportunities and developments in treatments and care, studies on this topic have gradually increased. The ICUs have the highest mortality rate (16-67%) in the hospital, although the inpatient bed availability of ICUs is less than other units because patients with complex health problems are admitted to the ICUs.[7,9,10] The survival of patients admitted to the ICU is influenced by demographic features of the patient, complex diseases, discharge practices, and severity of illness.[4,8,11-14] In previous studies, complications induced by advanced age, gender, diagnosis of patients in the ICU, existence of chronic diseases such as diabetes, liver disease, and respiratory insufficiency requiring mechanical ventilation, admission on the weekend and during the midnight hours to the ICU.[3,11,13,15,16,17] In addition, invasive treatment applications and approaches, points obtained from prognosis scoring systems, length of stay in the ICU, and insufficiency in diagnosis and treatment in the first hours of admission to the ICU have been reported as causes of high mortality rates.[3,5-7,9,12,15,18-23]

Previous work focused on the relationship between admission day and time, and mortality. In the current study, we aimed to determine the prognostic importance of admission day and time, admission source and route of admission, attached devices before admission, the diagnosis of patients, and the total Simplified Acute Physiology Score (SAPS) II score during admission. We also aimed to determine the relationship between demographic features of patients and mortality rates.

Methods. *Study design.* The study was carried out as a retrospective and descriptive study. Our method for finding the prior related studies was by searching with the keywords: 'mortality,' 'patient admission,' and 'intensive care unit' in the electronic US National Library of Medicine, National Institutes of Health, databases via PubMed. We designed this study similar to Uusaro et al,[20] and Laupland et al.[24]

Study sample. Our study population consisted of 843 patients admitted to adult internal medicine, surgery, and anesthesia ICUs of a University Hospital located in the center of Zonguldak, in the west of Turkey, between January 2006 and January 2011. The study was carried out with 545 patients. Seventy-four patients admitted to the adult ICUs were excluded from the sample as they were either age <18 years, the ICU stay was <4 hours, or it was a second ICU admission. Patients with missing data on physiologic variables were also excluded. One hundred and seventy-eight patients were excluded due to lack of data, and 46 patients were excluded due to archival documentation problems. No information on admission source, attached devices, PaO_2/FiO_2, and Glasgow Coma Score was available for the excluded group in the computerised medical records. The included group survey did not differ from the excluded group regarding age, gender, admission time, and admission day. The prevalence of trauma and intoxication was higher among the excluded group than the included group (trauma 15%, intoxication 30%).

Data collection. The computerised database and patient records were used for data collection by 4 investigators. These patient records included intensive care medical records and laboratory results of patients and nursing notes. Data in the patient records was collected by a constructed survey form and the SAPS II scale. The constructed survey form consisted of the diagnosis of patients, source, time, and day of admission, the length of stay in the ICU, and attached devices. The patients' admission to the ICUs was categorized as weekdays from Monday 08:00 AM to Friday 16:59 PM, and weekends from Friday 17:00 PM to Monday 07:59 AM. The mortality rates were analyzed with the total score obtained from the SAPS II scale on the first day of the admission to the ICU. The SAPS II total score was obtained from the route of presentation to the hospital, chronic diseases, Glasgow Coma Score, age, systolic blood pressure, pulse rate, body temperature, PaO_2/FiO_2, urine discharge, serum urea/BUN, leukocyte count, potassium, sodium, HCO3, and bilirubin scores. In terms of the laboratory values for the SAPS II scoring system, the worst value among the measurements performed during the first 24 hours was taken into consideration.

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Data was entered into the Statistical Package for Social Sciences version 16.00 for windows (SPSS Inc., Chicago, IL, USA). Categorical variables were expressed as numeric values and percentages. The t-test was used to compare SAPS II total score between deceased and discharged patients. The x^2 tests were performed for qualitative variables between deceased patients and discharged patients. Differences in mortality rates are expressed as odds ratios (OR) and 95% confidence interval (CI). The Pearson correlation test was calculated to determine the association between different variables. A value of $p<0.05$ was considered statistically significant in all analyses.

This study was performed in accordance with the guidelines of the Declaration of Helsinki. The Institutional Review Board of the hospital approved the study. Before the survey, written permission from the head physician of the university, heads of the departments in charge of the ICUs, and verbal permission from the directorate of nursing services, and the directorate of the hospital was obtained.

Results. **Table 1** summarizes the characteristics of patients admitted to the ICU. The maximum number of patients admitted to the ICU was between 2007 (20.7%) and 2008 (20.6%). The patients were mostly admitted on weekdays between 08:00 AM (72.5%) and 16:59 PM (60.0%). The patients were more often admitted to the ICU from the emergency department (63.5%). Almost all patients were admitted to the ICU on stretchers (95.4%), and with peripheral catheters attached (97.4%). Half of the patients were connected to a monitor (49%), and intubated (43.1%). Many patients were admitted to the ICU due to intoxication (**Table 1**).

The mortality rate of ICU patients was 60.4%. The mean SAPS II score of the patients who died (59.37±16.50) was significantly higher than the patients who were discharged (33.70±13.90) from hospital (t=18.85, p=0.000). The mortality rate for patients admitted from the emergency department (53.5%, OR=0.31, 95% CI=0.21-0.46, p=0.000) to the ICU was significantly higher than other places. Admission via stretcher (98.8%, OR=8.75; CI=2.96-25.86, p=0.000) significantly influenced the mortality rate of patients. A significant difference was not found between the days (p=0.761) and the time (p=0.063) of admission and mortality rate. The odds ratio for patients' death admitted to the ICU on weekends was significantly higher than weekdays (OR=1.04, 95% CI=0.79-1.37) (**Table 2**).

The mortality rate was significantly highest among patients with respiratory tract illnesses (26.4%; OR=0.17; CI=0.09-0.32; p=0.000), infections (25.5%; OR=0.16; CI=0.08-0.31; p=0.000), and cardiac, vascular, and bleeding problems (34.3%; OR=0.32; CI=0.21-0.48; p=0.000). There was a positive correlation between the admission source and mortality rate (r=0.12, p=0.003). Also, there was a significant difference between the length of stay in the ICU and mortality between the deceased and discharged patients (t=2.28, p=0.023). Dead patients stayed in the ICU for 10.39±12.46 days, whereas discharged patients stayed in the ICU for 7.62±15.70 days. In addition, there was a positive correlation between the length of stay in the ICU and the SAPS II total score (r=0.18, p=0.000).

Table 1 - Characteristics of patients admitted to the intensive care unit.

Patients characteristics	n	(%)
Admission year		
2006	102	(18.7)
2007	113	(20.7)
2008	112	(20.6)
2009	69	(12.7)
2010	86	(15.8)
2011	63	(11.6)
Admission day		
Weekdays	395	(72.5)
Weekends	150	(27.5)
Admission time		
08:00 - 16:59	218	(40.0)
17:00 - 07:59	327	(60.0)
Admission source		
Hospital ward	166	(30.5)
Emergency department	346	(63.5)
Intensive care unit	33	(6.1)
Route of admission		
On foot	18	(3.3)
On stretcher	520	(95.4)
On wheelchair	7	(1.3)
Devices attached before admission*		
Monitor	267	(49.0)†
Intubation tube	235	(43.1)†
Peripheral catheter	531	(97.4)†
Arterial catheter	80	(14.7)†
Urinary catheter	122	(22.4)†
Oxygen	102	(18.7)†
Nasogastric tube	62	(11.4)†
Other	52	(9.6)†
Admission diagnosis*		
Metabolic/kidney diseases	95	(17.4)†
Cardiac/vascular/bleeding problems	137	(25.1)†
Neurologic diseases	47	(8.6)†
Trauma	22	(4.0)†
Cancer	75	(13.8)†
Respiratory diseases	97	(17.8)†
Infection	93	(17.1)†
Intoxication	143	(26.2)†
Other	91	(16.7)†

*more than one choice was analyzed,
†percentages were obtained according to n (545)

Table 2 - Comparison of patient features with mortality during intensive care units admission.

Variable	Patients died n (%)	Patients discharged n (%)	OR (95 % CI)[b]	*P*-value
Admission source			0.31 (0.21-0.46)	0.000
Hospital ward	126 (38.3)	40 (18.5)		
Emergency department[a]	176 (53.5)	170 (78.7)		
Intensive care unit	27 (8.2)	6 (2.8)		
Route of admission			8.75 (2.96-25.86)	0.000
On foot	3 (0.9)	15 (6.9)		
On stretcher[a]	325 (98.8)	195 (90.3)		
On wheelchair	1 (0.3)	6 (2.8)		
Admission day			1.04 (0.79-1.37)	0.761
Weekdays	240 (72.9)	155 (71.8)		
Weekends[a]	89 (27.1)	61 (28.2)		
Admission time			1.14 (0.99-1.30)	0.063
08:00 - 16:59	142 (43.2)	76 (35.2)		
17:00 - 07:59[a]	187 (56.8)	140 (64.8)		
Devices attached before admission				
Monitor	181 (55.0)	86 (39.8)	0.72 (0.59-0.87)	0.001
Intubation tube	191 (58.1)	44 (20.4)	0.35 (0.26-0.46)	0.000
Peripheral catheter	321 (97.6)	210 (97.2)	0.99 (0.96-1.02)	0.803
Arterial catheter	62 (18.8)	18 (8.3)	0.44(0.26-072)	0.001
Urinary catheter	83 (25.2)	39 (18.1)	0.71(0.51-1.00)	0.049
Oxygen	72 (21.9)	30 (13.9)	0.63(0.43-0.97)	0.019
Nasogastric tube	21 (6.4)	41 (19.0)	2.97(1.80-4.88)	0.000
Other	36 (10.9)	16 (7.4)	0.67(0.38-1.18)	0.169
Admission diagnosis				
Metabolic/kidney diseases	91 (27.7)	4 (1.9)	0.67 (0.25-018)	0.000
Cardiac/vascular/bleeding problems	113 (34.3)	24 (11.1)	0.32(0.21-0.48)	0.000
Neurologic diseases	38 (11.6)	9 (4.2)	0.36 (0.17-0.73)	0.003
Trauma	10 (3.0)	12 (5.6)	1.82 (0.80-4.15)	0.144
Cancer	60 (18.2)	15 (6.9)	0.38 (0.22-0.65)	0.000
Respiratory diseases	87 (26.4)	10 (4.6)	0.17 (0.09-032)	0.000
Infection	84 (25.5)	9 (4.2)	0.16 (0.08-0.31)	0.000
Intoxication	9 (2.7)	134 (62.0)	22.67 (11.80-43.55)	0.000
Other	76 (23.1)	15 (6.9)	0.30 (0.17-0.50)	0.000

OR - odds ratio CI - confidence interval, [a]The reference group, [b]Odds ratios for died patients admitted to the intensive care unit

Discussion. Intensive care patients bear a high risk of mortality. Although it is known that many factors affect mortality among these patients, it is still not known which is the most important one. For this purpose, scoring systems consisting of various parameters have been developed to measure the severity of disease. One of these scoring systems is SAPS II. According to the SAPS II scale, it is acknowledged that the higher the patient scores on this scale, the higher they bear the risk of mortality.[25]

In previous studies carried out in Turkey, it was reported that mortality rate among intensive care patients differs from one ICU to another, and ranges between 27-60%.[7,9,19] Whereas, it ranges between 8-36% around the world according to the literature.[20,21,26-28] In our current study, the mortality rate was 60.4%. Not surprisingly, the SAPS II score was confirmed as an important mortality factor in this study. The total SAPS II score in deceased patients (59.37±16.50) was significantly higher than the discharged patients (33.70±13.90). Similarly, Uusaro et al[20] reported that the total SAPS II score was significantly higher in deceased patients. The current study confirmed that patients admitted from the emergency department have a higher mortality than admissions from hospital wards and directly to the ICU. Previous studies also reported that the mortality rate was significantly accelerated in patient admissions from the emergency department (p=0.000) to the ICU.[25,29] Major causes of mortality included failure of organisation, lack of knowledge of team, failure to appreciate clinical urgency, and lack of health care professionals. Invasive treatment and applications such as intubation (p=0.000) and invasive hemodynamic monitorization (p=0.001) affect mortality. This result is also supported by various previous studies.[24,30,31] According to the results of this study, admission time was not considered a risk factors for mortality. In many previous studies, it was reported that admission time affected mortality rate, and mortality rates significantly increase in admissions in the evening or night.[20,21,24,25,27,28] However, other studies

showed that nighttime admission was not related to mortality.[3,24,31] In the present study, we concluded that weekend admission versus weekday admission were not related to mortality, as described in the report by Arias et al,[13] Ju et al,[17] Laupland et al,[24] and Maggs and Mallet.[25] However, some other study results showed that admission to the ICU on the weekend significantly increased mortality.[3,20,26]

In our study, respiratory insufficiency and infection was the most important risk factors for mortality. The results showed similarity with previous studies. In these previous studies, the lowest survival rate was seen among patients with respiratory insufficiency,[5,30] and severe pneumonia.[7,9] These problems are major contributors to mortality. The current study showed that mortality occurs in approximately 10 days among the intensive care patients, and discharged patients stay in the ICU for a shorter period (approximately 7 days). Altıay et al[7] reported that deceased patients stay approximately 9.5 days in the ICU, and the discharged patients stay for 7 days. According to the results of another study,[9] the deceased patients in the ICU stayed statistically significantly longer stay than the discharged patients.

We identified 3 major limitations of this study. First, this study was retrospective, with many confounding factors and selection bias. Second, the present study has a limited number of risk factors examined in a single hospital. Third, the patients under 18 years old were excluded from the study, and the sample size was small. In this context, it may not be possible to generalize the study results.

In conclusion, the SAPS II scores of patients who are admitted to the ICU, the route and source of admission, being intubated and connected to monitor, health problems occurring before admission, and length of stay in the ICU were increased to mortality rate. However, the days and hours of admission did not significantly affect mortality. Hence, healthcare personnel should carefully analyze the patients taking these risk factors in consideration with written protocols during admission. If necessary, patients should be immediately transferred to the ICU. This study has important implications for the use of clinical practice guidelines for the management of patients who are admitted to ICUs. Early identification of patients at risk both before admission and during their stay in the ICU, may allow treatment to decrease mortality. Further prospective studies on this issue are needed to assess ICU mortality, and to confirm the prognostic importance of patient features during admission. New studies should be performed on larger patient groups.

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