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Evaluation of patients admitted to the intensive care unit from the emergency department

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Abstract

To determine the factors affecting mortality and transfer time in patients admitted from the emergency department to the intensive care unit (ICU). This study was designed as a retrospective cohort study in a tertiary hospital. For patients who were transferred to ICU from the emergency department, the hospital records regarding waiting times in the emergency department, type of ICU admitted, diagnoses/symptoms, demographic characteristics, presence of cardiac arrest at presentation and clinical outcomes were recorded. During the study period, a total of 1.621 patients were admitted to the intensive care unit from the emergency department. The majority of these patients (61%) were male. After admission to the intensive care unit, 12.9% of the patients died. Gender, age, type of ICU admitted, diagnoses/symptoms, and presence of cardiac arrest at presentation were associated with mortality ($p<0.005$). No relationship was found between waiting time in the emergency department and mortality ($p=0.657$). Most of the patients (51.9%) were admitted to ICU within the first hour of presentation. More than half the patients that were admitted to ICU within the first hour (67.1%) had presented with chest pain, and most (70%) were admitted to the cardiology ICU. There were more patients with sepsis and fluid electrolyte disorders that were admitted to ICU at hours 4-12 compared to all the other diagnoses, and this was also associated with mortality ($p<0.001$). Most of the late admissions were older ($p<0.001$). Presence of cardiac arrest at presentation did not affect the transfer time to ICU ($p=0.714$).It was found that gender, age, type of ICU admitted, diagnoses/symptoms, and presence of cardiac arrest at presentation were associated with mortality. Late transfer from the emergency department to ICU did not cause an increase in the mortality rate. However, most of our patients were admitted to ICU within the first four hours.

Keywords: Intensive care, emergency department, mortality, waiting time

Introduction

Emergency departments (ED) are intensive services to which many patients present with different clinical indications. The growing number of critical patients, increase in the elderly population, delays in laboratory and radiological examinations, prolonged consultation period, and lack of sufficient number of beds in the hospital further increase ED crowding [1]. With the overcrowding of emergency services, the rate of admission to the intensive care unit (ICU) is also gradually increasing. In Turkey, comparable to the situation in the world, the growing population, traumas, and elderly population are among important reasons for the increasing requirement of intensive care [2].

Similar to emergency services, ICUs provide 24-hour uninterrupted health services in which advanced technology devices are used and vital indicators are monitored, and they have unique features in terms of patient care and treatment [3]. The limited number of beds in ICU causes delays in patients requiring intensive care. The vast majority of patients requiring intensive care present to emergency services. The decision to transfer a patient from the ED to ICU is made based on priority, diagnosis, and objective parameters [4,5].

There may be delays in intensive care admissions for many different reasons, and this situation results in increasing patient intensity in the ED, which may lead to the delayed administration of antibiotics and analgesics, deferred treatment of patients with acute myocardial infarction, incorrect drug administration, and a decrease in the quality of service provided [6-11]. In addition, it has been shown that among patients that are late to be transferred to ICU, there is an increase in the rate of pneumonia caused by prolonged intubation, and sepsis cases with late admission to ICU have higher in-hospital mortality [12]. It has been observed that the late transfer of patients from wards or the ED to ICU is associated with worse outcomes in critically ill patients [13-15]. When the hospital occupancy rate is above 90%, the risk of death is almost doubled among critically ill patients with delayed hospitalization [15].

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We consider that longer waiting time for ICU transfer is associated with worse outcomes. In this study, the demographic characteristics, waiting times and clinical outcomes of patients transferred from the ED to ICU were examined. Using these data, the aim was to investigate the factors that determined mortality and waiting time in the ED.

Materials and Methods

The study was commenced after obtaining the approval of the Ethics Committee of Adıyaman University (2020/9-13) and conducted in a tertiary healthcare institution that serves patients through many different clinics. Patients who were transferred to ICU from the ED in 2019 were included in the study. Pregnant women, patients under 18 years of age, and those with incomplete information in medical files were excluded from the study. Since it was a retrospective study, no patient consent form was obtained.

Adult patients transferred from the ED to ICU over a year were identified from the hospital archive. Information about these patients, such as age, gender, type of ICU admitted, diagnoses/symptoms, presence of cardiac arrest at the time of presentation, and clinical outcomes was recorded. Patients that were discharged from ICU with recovery and those that died in hospital were identified and compared according to the variables. Furthermore, waiting times in the ED were compared in relation to the demographic characteristics of the patients, type of ICU admitted, and presence of cardiac arrest at presentation.

In the study, four different periods were examined for waiting time in the ED. The first period referred to patients admitted to ICU within the first hour without having waited too long in the ED; the second period referred to ICU admissions at hours 1-4, during which patients underwent certain examinations and consultations in the ED; the third time period marked 4-12 hours; and the last period represented patients with late ICU admissions after waiting for 12 hours or longer in the ED. Statistical differences were investigated by comparing these periods in terms of the characteristics of the patients, such as age, gender, clinical outcomes, type of ICU admitted, diagnoses/symptoms, and presence of cardiac arrest at presentation.

Statistical Analysis

SSPSS version 17.0 was used for statistical analyses. The compliance of continuous data to normal distribution was determined with the Kolmogorov-Smirnov test. Data conforming to normal distribution were analyzed using Student's t-test, and those that were not normally distributed were analyzed with the Mann-Whitney U test. Quantitative data were shown as mean ± standard deviation. The chi-square test was used to compare qualitative data. Categorical variables were specified as numbers and percentages. Percentages were rounded where necessary. P values of <0.05 were considered significant.

Results

During the study period, a total of 1,621 patients, 633 females and 988 males, were transferred from the ED to ICU. The distribution of patients according to age range was as follows: 252 were in the 18-44 years group, 549 were in the 45-64 years group, and 820 were over 65. Of the patients admitted to ICU, 209 died while 1,412 were discharged from ICU after recovery. The type of ICU to which most patients (n = 947) were admitted was the cardiology ICU (Table 1).

The relationship between mortality and gender was found to be significant in patients admitted to ICU ($p = 0.008$), with the male patients having a higher mortality rate (52.6%). The relationship between mortality and age was also significant ($p < 0.001$). The highest rate of mortality (71.3%) was seen in the 65 years and over group. The relationship between the type of ICU and mortality was also significant ($p < 0.001$), with the highest number of deaths occurring in the coronary ICU (37.3%) while the lowest number of deaths seen in the emergency ICU (0.5%). When statistically analyzed in relation to the number of admitted patients, the type of ICU with the highest number of deaths was reanimation (26.8%), followed by internal medicine (22.5%) and surgical (11.5%) ICUs. A significant correlation was found between the presence of cardiac arrest at presentation and mortality ($p < 0.001$). The majority of the patients that died (95.3%) did not present with cardiac arrest; however, when compared to the total number of admissions, the mortality rate was higher among those presenting with cardiac arrest (4.7%), and this was statistically significant. There was also a significant relationship between the diagnoses/symptoms of the patients and mortality ($p < 0.001$). Mortality most occurred in patients with chest pain (34.4%) while it was least seen in those admitted with intoxication (0.5%), and no death was observed in cases of scorpion and snake bites. When analyzed in relation to the total number of admitted patients, the highest number of deaths were due to cerebrovascular disease (CVD) (21.5%), sepsis (13.9%), and fluid and electrolyte disorders (12.4%) (Table 1).

Concerning transfer times, most of the patients (n = 842) were admitted from the ED to ICU within the first hour of presentation. The relationship between transfer time and gender was significant ($p = 0.041$). More than half the patients admitted to ICU within the first hour (63.9%) were male. A significant relationship was also found between transfer time and age range ($p < 0.001$). It was determined that the patients in the 18-44 years group were mostly admitted to ICU after the first 12 hours (31.3%), those aged 45 to 64 years within the first hour (39.1%), and those over 65 at hours 4-12 (57.8%). There was a significant relationship between the type of ICU to which patients were admitted and waiting time in the ED ($p < 0.001$). The waiting time was determined to be up to 1 hour for most of the patients admitted to the cardiology ICU (70%), 1-4 hours for 18.5% of those admitted to the reanimation ICU (18.5%), and more than 12 hours for 37.5% of those admitted to the emergency ICU. The relationship between the diagnoses/symptoms of the patients and waiting time in the ED was also significant ($p < 0.001$). The patients with chest pain were generally admitted within the first hour (67.1%), those with shortness of breath (12.1%), sepsis (22.6%) or fluid electrolyte disorders (16.5%) were admitted at hours 4-12, and those with CVD (11.5%) at hours 1-4. Most of the patients transferred to ICU after 12 hours had presented with chest pain (31.3%), snake-scorpion bites (18.8%), and dyspnea (18.8%). No significant relationship was found between waiting time in the ED and mortality ($p = 0.657$), and the majority of patients (87.1%) were discharged with recovery from the ICU to which they had been admitted. There was no significant relationship between presence of cardiac arrest at presentation and waiting time in the ED ($p = 0.714$) (Table 2).

Table 1. Variables associated with mortality

Variables	Mortality (n) (%)	Discharged (n) (%)	Total (n) (%)	P value
Gender				
Female	99 (47.4)	534 (37.8)	633 (39.0)	0.008
Male	110 (52.6)	878 (62.2)	988 (61.0)	
Age, years				
18-44	12 (5.7)	240 (17)	252 (15.5)	
45-64	48 (23)	501 (35,5)	549 (33.9)	<0.001
65 and over	149 (71.3)	671 (47,5	820 (50.6)	
Type of ICU admitted				
Emergency	1 (0.5)	164 (11.6)	165 (10.2)	
Surgical	24 (11.5)	96 (6.8)	120 (7.4)	
Internal medicine	47 (22.5)	128 (9.1)	175 (10.8)	<0.001
Cardiology	78 (37.3)	869 (61.5)	947 (58.4)	
Cardiovascular surgery	3 (1.4)	18 (1.3)	21 (1.3)	
Reanimation	56 (26.8)	137 (9.7)	193 (11.9)	
Cardiac arrest at presentation				
Yes	9 (4.3)	10 (0.7)	19 (1.2)	<0.001
No	200 (95.7)	1402 (99.3)	1602 (98.8)	
Diagnosis/symptom				
Chest pain	72 (34.4)	798 (56.5)	870 (53.7)	
Rhythm disorders	4 (1.9)	34 (2.4)	38 (2.3)	
Dyspnea	22 (10.5)	107 (7.6)	129 (8)	
Sepsis	29 (13.9)	55 (3.9)	84 (5.2)	
Abdominal pain	2 (1)	15 (1.1)	17 (1)	
Trauma	7 (3.3)	84 (5.9)	91 (5.6)	<0.001
CVD	45 (21.5)	112 (7.9)	157 (9.7)	
Fluid and electrolyte disorders	26 (12.4)	99 (7)	125 (7.7)	
Intoxication	1 (0.5)	54 (3.8)	56 (3.4)	
Snake-scorpion bite	0 (0)	48 (3.4)	48 (3)	
Other	0 (0)	6 (0.4)	6 (0.4)	
Total	209 (12.9)	1412 (87.7)	1621 (100)	

ICU, intensive care unit; CVD, cerebrovascular disease

Discussion

In a study conducted by Santos et al. [16], it was stated that elderly patients had longer waiting times in the ED before their transfer to ICU. Forero et al. [17] reported similar results showing that elderly patients stayed longer in the ED, and they also had a higher mortality rate. Similarly, in our study, the older patient group waited longer in the ED and advanced age was found to be associated with mortality. The reason for the late ICU admission of elderly patients may be related to the necessity of more consultations due to the comorbidities of these patients or the attitude of physicians concerning this patient population. Considering the overcrowded nature of emergency services, it may be appropriate to designate separate teams and areas for the evaluation of trauma cases and geriatric patients. We suggest that providing geriatric services starting from the time of presentation to the ED might be beneficial for elderly patients that may need special care.

In a study conducted by Cardoso et al. [13], no relationship was found between mortality and gender or waiting time in the ED. In our study, the male patients were admitted to ICU earlier than the female patients. Although mortality was higher among the male patients, the mortality rate was higher for the female gender when analyzed in relation to the total number of admissions. We consider that the relationship between gender and mortality may be related to the diagnoses/symptoms of the patients. In addition, there may have been more patients without real intensive care indications in the male group.

Table 2. Factors affecting waiting time in the emergency department

	<1 hour n (%)	1-4 hours n (%)	4-12 hours n (%)	>12 hours n (%)	Total n (%)	P value
Gender						
Female	304 (36.1)	228 (40.9)	95 (46.1)	6 (37.5)	633 (39)	0.041
Male	538 (63.9)	329 (59.1)	111 (53.9)	10 (62.5)	988 (61)	
Age, years						
18-44	123 (14.6)	98 (17.6)	26 (12.6)	5 (31.3)	252 (15.5)	
45-64	329 (39.1)	155 (27.8)	61 (29.6)	4 (25)	549 (33.9)	<0.001
65 and over	390 (46.3)	304 (54.6)	119 (57.8)	7 (43.8)	820 (50.6)	
Outcome						
Mortality	108 (12.8)	77 (13.8)	23 (11.2)	1 (6.3)	209 (12.9)	0.657
Discharged	734 (87.2)	480 (86.2)	183 (88.8)	15 (93.8)	1412 (87.1)	
Type of ICU						
Emergency	63 (7.5)	73 (13.1)	23 (11.2)	6 (37.5)	165 (10.2)	
Neurosurgery	66 (7.8)	45 (8.1)	8 (3.9)	1 (6.3)	120 (7.4)	
Internal medicine	54 (6.4)	85 (15.3)	36 (17.5)	0 (0)	175 (10.8)	<0.001
Cardiology	589 (70)	243 (43.6)	107 (51.9)	8 (50)	947 (58.4)	
Cardiovascular surgery	12 (1.4)	8 (1.4)	1 (0.5)	0 (0)	21 (1.3)	
Reanimation	58 (6.9)	103 (18.5)	31 (15)	1 (6.3)	193 (11.9)	
Diagnosis/symptom						
Chest pain	565 (67.1)	210 (37.8)	91 (44.2)	5 (31.3)	870 (53.7)	
Rhythm disorders	19 (2.2)	14 (2.5)	5 (2.4)	0 (0)	38 (2.3)	
Dyspnea	34 (4)	67 (12)	25 (12.1)	3 (18.8)	129 (8)	
Sepsis	27 (3.2)	38 (6.8)	19 (22.6)	0	84 (5.2)	
Abdominal pain	3 (0.4)	10 (1.8)	3 (1.5)	1 (6.3)	17 (1)	
Trauma	30 (3.6)	50 (9)	10 (4.9)	1 (6.3)	91 (5.6)	<0.001
CVD	84 (10)	64 (11.5)	8 (3.9)	1 (6.3)	157 (9.7)	
Fluid and electrolyte disorders	36 (4.3)	54 (9.7)	34 (16.5)	1 (6.3)	125 (7.7)	
Intoxication	23 (2.7)	23 (4.1)	8 (3.9)	1 (6.3)	55 (3.4)	
Snake-scorpion bite	18 (2.1)	24 (4.3)	3 (1.5)	3 (18.8)	48 (3)	
Other	3 (0.4)	3 (0.5)	0 (0)	0 (0)	6 (0.4)	
Cardiac arrest at presentation						
Yes	10 (1.2)	8 (1.4)	1 (0.5)	0 (0)	19 (1.2)	0.714
No	832 (98.8)	549 (98.6)	205 (99.5)	16 (100)	1602 (98.8)	
Total	842 (51.9)	557 (34.4)	206 (12.7)	16 (1)	1621	

ICU, intensive care unit; CVD, cerebrovascular disease

Santos et al. [16] reported no relationship between long waiting time in the ED and mortality, which is consistent with our work. However, contrary to our study, Singer et al. [18] showed that waiting for a long time in the ED increased mortality. Similarly, Chalfin et al. [19] stated that waiting in the ED for more than 6 hours increased the length of stay in ICU and led to higher mortality. This may be caused by many factors such as the physical conditions of emergency services, availability of adequate and equipped personnel, and diagnoses of patients.

Simchen et al. [20] reported the most common reason for ICU admission as diseases related to the pulmonary, cardiac and neurological systems. In another study, Mullins et al. [21] found that the most common diagnoses were coronary artery disease, congestive heart failure, and pneumonia. In the current study, we observed that the most common reason for ICU admission was chest pain. Cardoso et al. [13] reported that there was a significant delay in the hospitalization of patients with a diagnosis of sepsis. In our study, patient diagnoses were associated with waiting time in the ED and mortality. The patients with chest pain were mostly admitted to ICU within the first hour, while those with sepsis and fluid and electrolyte disorders had delayed admissions. The reason for the patients with chest pain being admitted to ICU earlier is the need to perform percutaneous coronary angiography (PCA) in this patient group. Another finding from our study was that the patients admitted with CVD and sepsis had higher mortality rates, and these patients had waited longer in the ED before being admitted to ICU. Similarly, Yergens et al. [22] found a higher in-hospital mortality rate among patients with sepsis who had been previously admitted to the ED. We consider that it would be beneficial for patients with sepsis and fluid electrolyte disorders to be hospitalized earlier to receive special intensive care. We also suggest that physicians should be careful to start early antibiotic and fluid treatments in the emergency department for this group of patients considering that their transfer to ICU may be delayed.

The mortality rate is expected to be higher among patients transferred to ICU after presenting to the emergency department with cardiac arrest. In a study conducted by Oguzturk et al. [23], the mortality rate was reported to be 74.3% among patients with the return of spontaneous circulation after a cardiac arrest. In our study, the mortality rate was higher among patients presenting with cardiac arrest, which is expected. However, the waiting times of cardiac arrest patients did not differ from those of other patients. Considering the possible consequences, it is not favorable for cardiac arrest patients to wait in the emergency department for the same duration as other patients. It has been reported that ventilator-associated pneumonia is common among patients waiting in the emergency department on a ventilator for a long time [24]. Therefore, patients presenting with cardiac arrest should be immediately transferred to ICU after performing necessary tests and observing the return of spontaneous circulation in the emergency department.

In their thesis study, Aslaner et al. [25] found that the emergency department patients were mostly transferred to the ICUs of the cardiology and surgical departments. In our study, the type of ICU that most received referrals from the emergency department was cardiology. In terms of transfer time, the earliest admissions to ICU were seen in referrals to the cardiology ICU. This may be because our hospital is the only center in our city where PAG is performed. The significance of the relationship between the type of ICU and mortality may be due to the diagnoses/symptoms requiring admission to different ICUs.

Conclusion

The gender, age, type of ICU admitted, diagnoses/symptoms, and presence of cardiac arrest at presentation were associated with mortality. Longer waiting time in the emergency department did not result in an increase in mortality in ICU. However, when considered in terms of diagnosis, elderly patients with infection/sepsis and fluid electrolyte disorders had longer waiting times in the emergency department, and this group had a more mortal course. For patients with advanced age and sepsis, there should be a separate team that provide geriatric services and appropriate treatments in all units of the hospital from the emergency department to ICU.

Conflict of interests
The authors declare that they have no competing interests.

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Ethical approval
Ethics Committee of Adıyaman University (2020/9-13)

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