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Research Article

Association between time and mortality of patients admitted from Emergency Department to Intensive Care Unit

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Abstract: Increasing patient population and refunds for hospital based health services lead over admissions to hospitals and emergency departments (ED). Increased patient ED admissions thus increased time-spend in ED and over-crowded ED, raised importance of differentiating more critical patients in ED's. The files of patients with different types of complains that consult to emergency service and then transferred and treated in intensive care units of Bakirkoy Dr. Sadi Konuk Training and İnvestigating Hospital in between 1 January 2010 and 31 December 2011 are investigated retrospectively. 380 patients whose planned datas are attained are included in this study. The waiting time in emergency services to be transferred to intensive care units is evaluated to be able to show the mortality rates of intensive care units. The time between admission and transfer to intensive care unit is significantly higher for the patients that die (1,3 ± 356,5 min, 6 hr approximately) than the patients survive (237,8 ± 263,9 min, 4hr approximately). Correlatively the age of paitents that die is also significantly higher (61,5± 19,6) then the patients survive (43,0 ± 22,4) as established in this study. When the waiting time between the admission to ED and transfer to the intensive care unit is higher than 351 minute(5 hour and 51 minute), it leads to the high possibility of patient mortality. Briefly this study conclude that; the patient mortality significantly decreases when the patients' transfer to intensive care units is done in a short time without any delay.
Keywords: Critical patient, Emergency department, Intensive care unit, Waiting time.

INTRODUCTION

Emergency departments (ED) are health units which deliver emergency care and treatment to patients with severe pain, injury and fatal disorders for 365 days and 24 hours year round [1, 2, 3]. Apart from reasons of fast evaluation, stabilization and hospitalization of patients, also due to increase in the number of emergency patients, as well as shortage of beds for accommodating these patients have emergency departments recently turned into units where also advanced treatment and follow-up of patients is carried out [1, 2, 4, 5]. It has been found out that group of critical patients constitute 25 % of a yearly average of hundred million hospital admissions in the USA [6]. Due to massive increase in the number of patients admitted to ED and the shortage of intensive care units (ICU), ED have also begun to serve as units for treatment and follow-up of patients with a need of intensive care [6, 7, 8, 9]. Because of high bed occupancy rates in hospital ICU, ED has come to be an indispensable alternative for patients in need of ICU [10, 11]. Each extra minute these critical patients spend in ED contributes to the mortality of patients. ED and emergency personnel are admittedly sufficient to take care of these emergency patients, but they may not be as diligent and qualified in handling intensive care patients [12, 13]. Moreover, it's known that patients intubated on intensive care admissions have a higher mortality rate than that of non-intubated patients [14, 15]. Independent from all these, critical patients have higher odds of survival if and when they are hospitalized in ICU as soon as possible [16]. The aim of

this study is to evaluate the effect of waiting time in ED for patients who are admitted to emergency units and hospitalized in ICU on the mortality rate of the same.

MATERIAL AND METHODS

Study design and setting

This retrospective and cross-sectional study was performed at the 3rd stage ED, where approximately 240000 yearly ED census. The study took place from January 2010, through December 2010 following the approval by Ethics Committee.

Selection of participants

Patients admitted to ED and transferred from ED to be hospitalized in ICU were included in the study. After a retrospective screening of patients' medical records, 380 adult and pediatric patients were found to be eligible for the study.

Study population was composed of adult patients who were admitted to ED due to trauma, as well as due to non-trauma reasons and hospitalized in an adult ICU, as well as pediatric patients who were admitted to ED due to trauma and hospitalized in an ICU. Non-trauma pediatric patients were not included in the study, as they were evaluated in pediatric emergency departments exclusively by pediatricians.

The patients who were taken up to emergency operation upon admission to ED and hospitalized in ICU; patients who were transferred to ICU in our hospital and referred to another health center's ICU due to lack of free beds in our ICU; patients who were hospitalized in coronary intensive care unit and kept under treatment and follow-up in the same, as well as patients whose detailed medical record files could not be retrieved were excluded from the study.

Data collection and processing

Information on date, age, gender, presence of comorbidities in patient's medical history, vital signs, time of admission to ED, time-spent in emergency department, whether cardiopulmonary resuscitation (CPR) was carried out in ED prior to hospitalization in ICU, ICU in which the patient was hospitalized, diagnosis at hospitalization, indication for hospitalization in ICU, whether the patient was intubated during hospitalization, diagnosis at discharge from intensive care, whether the patient was dead at the time of discharge from ICU were collected from the medical record files of elected patients and the information gathered was recorded in a patient form prepared for the study.

Outcome measures

In this study, with which we aimed to evaluate the effect of waiting time (time-spent) in ED on the mortality rate of patients, time-spent in ED was employed as the primary outcome measure, whereas age and presence of comorbidities were established as secondary outcome measures for the effect on mortality.

Statistical method and Primary data analysis

In descriptive statistics, categorical variables were expressed in frequency, continuous variables conforming to normal distribution in mean ± SD and variables not conforming to normal distribution in median/IQR. While the distribution of variables was analysed by using Kolmogorov-Smirnov test, mann-Whitney u test was used for the analysis of discrete data, chi-square test and Fischer test were used for the analysis of proportional data and Pearson's correlation analysis was used for the analysis of correlation between variables. Results with 95 % CI and $p<0.05$ were accepted to be statistically significant. Data were analysed using SPSS 19.0 (SPSS Inc, Chicago, IL) software.

RESULTS

From a total of 380 patients included in the study 208 were male (54, 7%) and 172 were female (45, 3%). Mean age was calculated to be 49, 56±2, 31 (minimum 1, maximum 97) year. It was found out that while most of the patients transferred to an ICU from an ED suffered from trauma, patients suffering from a burn represented the smallest group in the study population. Distribution of patients according to their diagnosis at the time of hospitalization is given below in Table 1.

The mean time-spent in the ED before hospitalization in ICU for the patients included in the study was found to be 278 minutes (minimum: 8, maximum: 1364). After an analysis of the effect of mean time-spent in the ED and age of patients on the mortality rate in intensive care unit, it was found out that patients who died had a longer time-spent in the ED before hospitalization in ICU and a higher mean age ($p=0,003$, $p<0,001$) (Table 2).

It was found out that 72,9 % of the patients were intubated, whereas 27,1 % of the patients were not intubated at the time of hospitalization in the ICU and that 45,5 % of the intubated patients and 8,7 % of the non-intubated patients died in the course of the study. The mortality rate of intubated patients was found to be significantly higher than that of non-intubated patients ($p<0,001$). With respect to relationship between gender and mortality is concerned, it was found out that 37,8 % of the female patients and 33,7 % of the male patients died in the course of the study. The variation between gender and mortality was not found to be statistically significant ($p=0,402$) (Table 3).

When the study patients were grouped in decades, it was found that 70-80 age interval constituted the largest group, while 90-100 age groups constituted the smallest group. Moreover, it was also found out that mortality rates increased in patients over 60 years of age. The correlation between age groups and survival

rate was found to be statistically significant (r= 0,382/p=0,000) (Table 4).

Patients included in the study were found to be hospitalized in the ICU with six different indications, among which, impairment of consciousness represented the highest ratio (30,4%), while general poor health represented the lowest ratio (3,4%). The relationship between indications for hospitalization in ICU and mortality rates of patients is summarized in Table 5.

Table 1: The distribution of patients according to their diagnosis

Diagnosis of the diseases	**n (380)**	**%**
Trauma	108	28,4
Neurologic disorders	75	19,7
Pulmonary diseases	54	14,2
Toxicology	41	10,8
Cardiovascular diseases	37	9,7
Gastrointestinal diseases	20	5,2
Renal diseases	9	2,4
Oncologic diseases	9	2,4
Sepsis	5	1,3
Metabolic diseases	4	1,1
Hematologic diseases	3	0,8
Endocrine disease	3	0,8
Obstetrics and gynecology	3	0,8
Coma	3	0,8
Penetrating trauma	3	0,8
Wound ballistics	2	0,5
Burns	1	0,3

Table 2: The effect of time-spent in the ED and age on the mortality rate

	State of patient at discharge		p
	Dead (n=135)	Alive (n=245)	
	Mean ± SD	Mean ± SD	
Time-spent before hospitalization (minutes)	351,3 ±356,5	237,8±263,9	0,003
Age	61,5 ±19,6	43,0±22,4	0,000
Mann-whitney u test 95% confidence interval			

Table 3: The distribution of mortality associated with the presence of institutions and intubation in patients

			n	%	
Intubation	Yes	Death	126	33,2	p<0,000
		Survived	151	39,7	
	No	Death	9	2,4	
		Survived	94	24,7	
Sex/gender	Death	Male	70	18,4	p<0,402
		Female	65	17,1	
	Survived	Male	138	36,3	
		Female	107	28,2	

Table 4: Mortality rates by age groups

Results							
		Death		**Survival**		p	r
		n	%	n	%		
Age Groups	0-10	0	0,0	13	100,0	0,000	0,382
	10-20	6	17,1	29	82,9		
	20-30	5	10,0	45	90,0		
	30-40	11	22,4	38	77,6		
	40-50	17	38,6	27	61,4		
	50-60	15	30,0	35	70,0		
	60-70	23	53,5	20	46,5		
	70-80	37	63,8	21	36,2		
	80-90	20	54,1	17	45,9		
	90-100	1	100,0	0	0,0		
Total		135	35,5	245	64,5		
Pearson correlation							

Table 5: Mortality rates of patients according to ICU admission indications

Results					
		Death		**Survival**	
		n	%	n	%
ICU admission indications	Intoxication	2	1,5	34	13,9
	Hemodynamic follow	14	10,3	63	25,7
	General poor health	4	3	9	3,7
	Impairment of consciousness	48	35,6	66	26,9
	Pulmonary failure	46	34	58	23,7
	Post – CPR*	21	15,6	15	6,1
Total		135	100	245	100

***CPR:** Cardiopulmonary Resuscitation

DISCUSSION

Due to increase in the number of emergency patients, as well as shortage of beds for accommodating these patients have ED recently turned into units where treatment and follow-up of patients in need of ICU is also carried out [6, 7, 8, 9]. Moreover, the increase in the number of critical patients admitted to ED's is also a decisive factor in augmenting the need for ICU [17]. However, due to high bed occupancy rates in hospital intensive care units, ED's have come to be an indispensable alternative for patients in need of ICU [10, 11]. Independent from all these, critical patients have higher odds of survival if and when they are hospitalized in ICU as soon as possible without any time delay [16]. At the end of this study, with which we aimed to evaluate the effect of waiting time in the ED prior to hospitalization in ICU on the mortality rate of the patients, we came to the conclusion that patients who died had a longer time-spent until hospitalization and higher mean age.

While for the patients admitted to ED the mean time-spent in the ED prior to hospitalization in ICU was found to be varying between 285 and 390 minutes, in our study the mean time-spent for the same patients turned out to be 278 minutes [23, 24, 25]. In one of these studies the reason for the longer time-spent was examined and lack of free beds in the intensive care unit was found to be responsible for the longer duration of stay in 30 % of patients [18]. On the other hand, according to Goldstein *et al.;* [19], increase in the number of patients admitted to ED, difficulties in diagnosis, latency in getting the laboratory results, prolongation of primary care and initial stabilization and shortage of free beds in ICU are the major reasons responsible for a longer time-spent in ED. In a study including patients diagnosed with septic shock at admission to an emergency department, targeted early treatment was initiated immediately after diagnosis and a significant decrease in mortality rate was attained [20]. Yet in another study, survival rate was found to be higher in patients who are swiftly admitted to a fully-equipped trauma centre [21]. Likewise in our study, the reason for the longer time-spent in the ED was found to be in conformity with the literature, the prevalent reason being established as the shortage of free beds in intensive care units. In addition, it was found that patients who died had spent 5 hours 51 minutes and patients who survived had spent 3 hours 57 minutes in ED.

In a study which was carried out in England and which compile data from 12162 patients, mortality rates in different ICU were found to be varying between 24%-41% [22].

In a study carried out in intensive care station of a University Hospital in Turkey, on the other hand, mortality rate was found to be 43% [23]. In our study, mortality rate in patients hospitalized in ICU was found to be in conformity with the literature with % 35.

In many of the studies carried out, a higher incidence of admission to ED was observed for geriatric patient group (>65) and mortality rate was found to increase with age [23, 24, 25, 26]. Accordingly, in our study, 70-80 age intervals constituted the largest group of patients when patients were classified in decades, wherein 31, 8 % of total population of patients was comprised of geriatric patients. Again in our study, patients who died had a mean age of 61,5±19,6 as compared to surviving patients with a mean age of 43,0±22,4 and this difference was found to be statistically significant. A significant correlation was observed between age groups and survival rates in the study. While the ratio of surviving patients to dying patients was in favor of survival up to an age of 60, this ratio was found to increase in favor of dying patients after 60 years of age. Results conform to literature data.

While in a study carried out by Wong *et al.;* [27] including 1960 patients, most frequently recorded reason for intensive care hospitalizations was multiple-trauma and second most frequently recorded reason was respiratory disorders, in a study by Gold hill *et al.;* [22] including 11940 intensive care patients, the most frequent reason for hospitalization was reported to be respiratory disorders. Also in our study, the most frequent reason for intensive care hospitalization was found to be trauma with a ratio of 28, 4 %. Although the number of cases in our study was less in comparison to other studies carried out, it was comparable to that in literature in terms of frequency of diagnosis at the time of intensive care hospitalization. We think that the difference between the most frequent reasons for hospitalization in both studies arises from the method of

selection for patients. While in the study by Wong *et al.;* [27], trauma was recorded to be the most frequent reason for hospitalization due to exclusion of intensive care patients with cardiovascular, neurosurgical and cardiological symptoms, we think that in the study by Goldhill *et al.;* [22] the most frequent reason for intensive care hospitalizations turned out to be respiratory disorders basically due to fact that from the patients admitted to the ED and hospitalized in ICU only those patients who were exclusively evaluated by emergency department doctors were included in the study, whereas multiple trauma patients not evaluated by emergency department doctors were excluded from the study.

In a variety of studies, the relationship between indication of intubation and mechanical ventilation in the intensive care patients and mortality rate was investigated and it was found out that patients presenting with a need of mechanical ventilation at hospitalization in ICU had a lower chance of survival than those patients with spontaneous respiration [14, 15]. Also in a study carried out by Dur *et al.;* [29], the mortality of intubated patients was found to be 52, 1%. Likewise in our study, the mortality rate in intubated patients (% 45,5) was found to be significantly higher than that of non-intubated patients (8,7 %). The results we obtained were in agreement to those in the literature, which in turn demonstrates that intubated patients have a rather more critical state and that they show a higher mortality rate.

In a retrospective study on 178 patients carried out in Canada [28], the intubation rate in critical patients was found to be 70,2% as compared to 72,9% found in our study, the rate in our study displaying conformity with the literature in spite of the difference in the number of patients included in the respective studies. While the fact that intensive care follow-up of intubated patients demonstrate an increased rate of mortality is known, it's also known that critical intensive care patients admitted to an ED frequently present with a need of aggressive intubation [28].

LIMITATIONS

The major limitaton of our study was that it was impossible to access some of the patient records due to the retrospective nature of the study or that some of the patients had to be excluded from the study because of missing data in the the files. The results can not be extrapolated to general population due to low number patients included in the study.

In our opinion, the fact that emergency pediatric trauma patients were attended rather in our adult emergency department and that the other pediatric patients were taken care of in pediatric emergency departments played a decisive role in our results which were in favor of trauma and had a decisive influence on the mean age. Apart from this, the fact that coronary intensive care units are separated in our hospital and that only cardiac patients are hospitalized might have led to a less number of patients in our study group.

CONCLUSION

It is concluded that the time-spent in ED for critical patients who are need of hospitalization in ICU upon initial care and stabilization in the ED may be associated with an increased mortality rate. It's for this reason that we think critical patients may be hospitalized and treated in a most suitable ICU as soon as possible. Moreover, we also think that solution of problems which prevent an early admittance of patients to intensive care units such as delay of consultations and diagnostic tests could decrease mortality rate.

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