Analysis of Hospital Mortality and Epidemiology in Trauma Patients: A Multi-Center Study

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Abstract

Background: This study evaluated the clinical characteristics of trauma patients in the southeastern coastal area of Turkey and investigated the factors influencing mortality.

Methods: Patients admitted with trauma to the emergency departments of Harran and Gaziantep Medical Schools and to the emergency services of hospitals in Sanlıurfa between June 2008 and December 2008 were enrolled retrospectively in this study. All medical records and follow-up data were reviewed for each patient.

Results: The study evaluated 15,120 trauma patients. The causes of trauma were motor vehicle accidents (38.7%), falls from heights (36.8%), burns (7.8%), knife wounds and gun shots (8.1%), homicides (6.5%), and workplace-related accidents (2.1%). The overall patient mortality rate was 3.8%. The mean patient ages were 47.8 ± 0.9 and 29.7 ± 0.4 among those who died and among those who survived, respectively ($P < 0.01$). The median times to arrival were 130 minutes and 42 minutes among those who died and among those who survived, respectively ($P < 0.01$). Whereas 79.9% of patients were discharged after treatment in the emergency departments, 16.3% were referred to various departments for hospitalization, and 3.8% were admitted to the intensive care unit (ICU). The mean score on the Glasgow Coma Scale was 7.5 ± 0.3 among who died and 12.8 ± 0.6 among those who survived ($P < 0.05$), and the mean Revised Trauma Scores were 8.7 ± 0.5 among those who died and 11.5 ± 0.7 among those who survived ($P < 0.05$). Intubation or cardiopulmonary resuscitation was initiated in 88% of those who died and 43.5% of those who survived ($P < 0.05$). Of those who died, 84% had cranial injuries and 43.5% had thoracic injuries.

Conclusions: Frequent causes of trauma in our region are motor vehicle accidents and falls from heights. Type of trauma, rapid arrival at the hospital, hospital procedures and interventions, age, sex, and trauma scores were predictors of mortality in trauma patients.

Keywords: Trauma; Mortality; Epidemiology; Emergency department

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Introduction

Many trauma patients are admitted through emergency departments every day. Trauma remains the most frequent cause of mortality in young people (aged 1 - 44 years) worldwide [1]. Because 81.8% of the population of Turkey is young, it is important to know how to manage trauma patients in this country [2]. Patients older than 60 who have suffered trauma in motor vehicle accidents and those with craniocerebral, thoracic, or abdominal injuries are at higher risk of in-hospital mortality [3]. Appropriate interventions and rapid transportation of the patients from the site of trauma can prevent mortality and morbidity [4, 5]. This study examined the clinical characteristics and factors influencing mortality in trauma patients in the southeastern coastal region of Turkey.

Materials and Methods

This retrospective observational registry study used trauma registry data from the emergency departments (EDs) of

Table 1. Demographic Characteristics and Types of Injury Among 15,120 Trauma Patients

Data category		n (%)
Sex	Male	10269 (67.9)
	Female	4851 (32.1)
Age Group (years)	0 - 15	977 (26.3)
	16 - 29	3049 (20.1)
	30 - 44	5665 (37.4)
	45 - 59	1607 (10.75)
	60 - 74	723 (4.8)
	> 75	99 (0.65)
Injury mechanism	Motor vehicle accidents	5851 (38.7)
	Falls	5564 (36.8)
	Burns	1179 (7.8)
	Knife wounds and gun shots	1224 (8.1)
	Homicides	982 (6.5)
	Workplace-related accidents	317 (2.1)
Injury severity	GCS (0 - 15)	13 ± 0.6
	RTS (0 - 12)	9 ± 0.4
Injury type	Craniocerebral injury	7405 (49)
	Extremity injury	5413 (35.8)
	Thoracic injury	4491 (29.7)
	Abdominal injury	2661 (17.6)
	Pelvic injury	1633 (10.8)
	Spinal cord injury	1542 (10.2)
Outcome	Death	575 (3.8)
	Survival	14, 545 (96.2)

Data presented as numbers (%) of patients. GCS, Glasgow Coma Scale; RTS, Revised Trauma Score.

Harran and Gaziantep Medical Schools and from the emergency services of hospitals in Sanliurfa collected between June 2008 and December 2008. These four centers provide 24-hour trauma services and receive both direct admissions and transfers from affiliated district hospitals. The registry included all trauma patients sustaining potentially severe injuries during the 6 months under study who warranted an initial evaluation or resuscitation in a trauma resuscitation

Table 2. Surviving and Non-Surviving Patients According to Sex and Route of Admission to Hospital

Characteristics		Survivors (n)	Non-Survivors (n)	Total (n)	Mortality (%)
Sex	Male	9782	487	10269	4.7
	Female	4763	88	4851	1.8
Admission to hospital	ICU	226	349	575	60.7
	Various departments	2280	184	2464	7.5
	Emergency department	12039	42	12081	0.3

Data presented as numbers (%) of patients. ICU, Intensive Care Unit; Various departments, Neurosurgery, Orthopedics, General Surgery, Pediatric Surgery, Plastic and Reconstructive Surgery, Urology.

room, including patients with unstable vital signs or suspected severe injuries. The clinical management of these patients followed a multidisciplinary approach and Advanced Trauma Life Support (ATLS) principles. The age, sex, mechanism of trauma, time of trauma, type of trauma, mode of transportation, time to hospital admission, procedures or interventions, Glasgow Coma Scale (GCS) scores, Revised Trauma Scores (RTS), length of hospital stay, and mortality rates were analyzed in terms of patient outcomes.

The statistical analyses were performed using SPSS v15.0 (SPSS, Chicago, IL, USA). Intragroup comparisons (survivors *vs*. non-survivors) were performed using the Mann–Whitney U-test and $\chi 2$ test. Data are presented as the means ± SEs (standard errors of the mean), with significance set at $P < 0.05$.

Results

Demographic and clinical characteristics of trauma patients

Approximately 140,000 patients were admitted to the ED during the 6-month study period. Of these, we evaluated 15,120 (10.8%) who had experienced trauma. The majority (67.9%) of patients were male, and the median patient age was 36.8 ± 0.7 (range: 4 - 84) years. Adults and children constituted 73.7% and 26.3% of the patients, respectively. Those 30 - 44 years of age accounted for a plurality (37.4%) of all trauma cases. The median time to arrival was 45 minutes. Motor vehicle accidents (MVAs) were the most common cause of admission to the ED and accounted for 38.7% of all trauma admissions; falls were the second most common

cause of admission, accounting for 36.8% of the cases. Other causes of trauma-related admissions to the ED were knife wounds and gun shots (8.1%), burns (7.8%), homicides (6.5%), and workplace-related accidents (2.1%). The mean GCS and RTS scores were 13 ± 0.6 and 9 ± 0.4, respectively.

Craniocerebral injuries (49%, n = 7405) were the most common injury, followed by extremity (35.8%, n = 5413), thoracic (29.7%, n = 4491), abdominal (17.6%, n = 2661), pelvic (10.8%, n = 1633), and spinal cord (10.2%, n = 1542) injuries. Although 79.9% of the cases (n = 12,081) were discharged after treatment in the ED, 16.3% (n = 2,464) were referred to various departments for hospitalization, and 3.8% (n = 575) were admitted to the intensive care unit (ICU). The most common departments for admission were neurosurgery and orthopedics. The mean lengths of stay in the ICU and clinics were 14.7 ± 0.6 and 9.4 ± 0.8 days, respectively.

Motor vehicle accidents were the most common cause of admission to the ICU and accounted for 47% of trauma-related admissions to the ICU; falls were the second most common cause, accounting for 29% of such admissions. Additional causes of trauma-related admission to the ICU were homicides, knife wounds, gun shots, burns, and other types of injuries. The demographic characteristics of patients and the types of trauma are summarized in Table 1.

Demographic and clinical characteristics of patients who died

The overall mortality rate was 3.8% (n = 575); the mortality rate was 4.7% (n = 487) in males and 1.8% (n = 88) in females (P = 0.005). The median age of those who died was 47.8 ± 0.9 and that of those who survived was 29.7 ± 0.4 years (P = 0.008). The mortality rate increased with age and

Table 3. Predictors of Trauma-Related Death in Patients

Predictors of Mortality	Non-survivors	Survivors	Statistical significance[a, b]
Age	47.8 ± 0.9	29.7 ± 0.4	< 0.01
Sex (male/female)	487/88	9782/4763	< 0.01
RTS	8.7 ± 0.5	11.5 ± 0.7	< 0.05
GCS	7.5 ± 0.3	12.8 ± 0.6	< 0.05
Craniocerebral injury	84%	42.2%	< 0.01
Thoracic injury	43.5%	21%	< 0.01
Arrival to the hospital (min)	130	42	< 0.01
Hospital procedures (intubation and /or CPR)	88%	43.5%	< 0.05

Data are presented as the means ± SEs or numbers (%) of patients. [a]*Chi*-square test (age, sex), [b]Mann–Whitney *U*-test. RTS, Revised Trauma Score; GCS, Glasgow Coma Scale; CPR, Cardiopulmonary resuscitation.

was 25.6%, 27.9%, 31.4%, 44.8%, 60.2%, and 71.3% for those 0 - 15, 16 - 29, 30 - 44, 45 - 59, 60 - 74, and ≥75 years of age, respectively.

The median time to hospital arrival was 130 minutes among those who did and 42 minutes among those who survived (P = 0.003); the mean GCS score was 7.5 ± 0.3 among those who died and 12.8 ± 0.6 among those who survived (P = 0.026); and the mean RTS score was 8.7 ± 0.5 among those who died and 11.5 ± 0.7 among those survived (P = 0.038). Mortality occurred most frequently in the ICU (60.7%, n = 349), whereas the mortality rate was 7.5% (n = 184) at various departments. A small proportion of patients (0.34%, n = 42) died in the ED (P = 0.007). Of those who died, 84% had cranial injuries (P = 0.003) and 43.5% had thoracic injuries (P = 0.006). Hospital procedures or interventions (*e.g.*, intubation or cardiopulmonary resuscitation) were performed on 88% of those who died and on 43.5% of the survivors (P = 0.029). Survival and mortality according to sex and hospital admission were presented in Table 2. Predictors of trauma-related death were summarized in Table 3.

Discussion

Injuries are a major and preventable public health problem in terms of morbidity, premature mortality, or disability. About 5.8 million people worldwide die annually from injuries, and the projections for 2020 show that 8.4 million deaths are expected annually [6, 7]. The ED plays a vital role in managing injuries. Trauma requires an immediate and precise diagnosis [8] and is a significant problem in southeastern Turkey. According to our data, 10.8% of the 140,000 patients admitted to the ED during the 6-month

study period had suffered trauma. Most injuries were suffered by those 16 - 44 years of age (57.6%), especially those 30 - 44 years of age (37.46%). By contrast, patients > 75 years of age accounted for only 0.65% of all admissions. Similar findings have been reported by other studies [9-11]. It is also clear that the involvement of those 16 - 44 years of age, the most productive group in society, in trauma-related injuries constitutes a huge economic loss to the country.

The preponderance of males among those injured is consistent with data from the World Health Organization (WHO) and the studies conducted by Ghaffar *et al*. [12], Mock *et al*. [13], and Moshiro *et al*. [14]. Similar to other findings, more males than females suffered from all types of injuries; our study identified 10,262 (67.9%) injured males and 4851 (32.1%) injured females.

Motor vehicle accidents are among the 10 leading causes of death and disability worldwide and have emerged as a serious public health concern [15]. According to a literature review, falls from heights were the most common cause of admission to the ED and the fourth leading cause of trauma-related death [16]. Additionally, falls from heights are a preventable health problem among adults [17]. In our study, MVAs were the most common cause of admission to the ED, and falls were the second most common cause. To ensure a safe environment, continuing health education programs focused on injury and prevention should be directed at parents and children, and legal measures to prevent injuries should be enacted.

The first 60 minutes after trauma is called the "golden hour" [18]. In our study, the median time to hospital arrival was 45 minutes: 130 minutes among those who died and 42 minutes among the survivors. We suggest that the hospital mortality rate for trauma-related patients has dropped be-

cause of the early administration of appropriate treatment. According to the WHO data for 2000, an estimated 5.2 million injury-related deaths occurred worldwide, comprising almost 9% of all deaths [19].

Most studies in which data have been analyzed according to sex have shown that both fatal and nonfatal injuries occurred more frequently among males than females [20, 21]. The overall mortality rate in our study was 3.8%, similar to that reported by Murray *et al*. [22] and close to the 4% reported by Bulut *et al*. [16] and the 2% reported by Meller and Shermeta [23]. According to our data, the ratio of the mortality among males to that among females was 2:7.

Tan *et al*. [24] demonstrated that increasing age was a risk factor for mortality after trauma. We also found that the mortality rate increased with age and identified the highest mortality rate (71.3%) among those 75 years and older and the lowest mortality rate (25.6%) among those 0 - 15 years of age. In our study, the mean age of those who died was 47.8 ± 0.9 years, and the mean age of those who survived was 29.7 ± 0.4.

Several studies have reported that the head region was the most commonly injured in the body [16, 25]. Bulut *et al*. [16] reported that injuries to the extremities were the second most common injury and that pelvic and vertebral injuries were seen less frequently. In our study, craniocerebral injuries were the most common type of injury, comprising 49% of injuries. Injuries to the extremities were the second most common injury, comprising 35.8% of injuries. Pelvic and spinal cord injuries were rather rare (10.8% and 10.2%, respectively). Head and thoracic injuries were related to significant rates of mortality (84%) in our study, and most of these involved severe craniocerebral injuries. The incidence of thoracic injuries was 43.5% among those who died and 21% among those who survived. Agalar *et al*. [26] found significant relationships between mortality and the Injury Severity Score (ISS), age, and RTS. In our study, the mean RTS and GCS score were significantly lower in non-survivors (both comparisons, $P < 0.05$) than survivors.

Conclusion

Hospital emergency-department-based injury registries are very useful in epidemiological studies of injuries. Frequent causes of trauma in our region are traffic accidents and falls from heights. Type of trauma, mechanisms of trauma, rapid arrival at the hospital, hospital procedures or interventions, age, and trauma scores can be used to predict mortality in trauma patients. The majority of trauma patients who present to the ED are treated at this location. Thus, observations in the ED may reveal details of injuries and demographic characteristics and can contribute to the prevention of mortality-related trauma and the development of more organized systems of trauma care.

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