



Characteristics of Traumatic Patients Referring to the Emergency Department and their Association with Mortality and Incidence of Surgery Performance

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Received: April 4, 2023

Revised: May 22, 2023

Accepted: May 30, 2023

ABSTRACT

Objective: To identify the distinctive features of acutely injured patients who were presented to the emergency department (ED) and their association with mortality and surgical intervention outcomes.

Methods: This cross-sectional study was conducted on all trauma patients resuscitated in the ED of Shahid Rajaee (Emtiaz) Trauma Hospital (Shiraz, Iran) from May 2018 to June 2019. Demographic information, the mechanism of trauma, trauma type, injured body regions, criteria of abbreviated injury scale (AIS) score, injury severity score (ISS), and surgical intervention were all taken into consideration. The items related to the mortality and surgical performance outcomes among the patients were analyzed.

Results: Of all 1281 cases, 82.9% were men, and the mean age of the patients was 37.9±19.1 years. The most common mechanism of injury was a car accident, and the thorax was the most prevalent injured area of the body. The majority of the patients had moderate blunt trauma. The mechanism of trauma, ISS, and the severity of head trauma were all significantly correlated with operation interventions. Moreover, age, the mechanism and type of trauma, ISS, and the necessity for the surgery were significantly associated with death occurrence. Additionally, head, thorax, and abdomen trauma were significantly related to a high mortality rate.

Conclusion: Age, trauma mechanism and type, ISS, and the necessity for surgery were significantly associated with the mortality rate of injured patients. The severity of the trauma, particularly head injuries and the mechanism of damage were important determinants in concern for surgery the necessity.

Keywords: Trauma; Resuscitation; Injury; Injury Severity Score (ISS); Abbreviated Injury Scale (AIS).

Please cite this paper as:

Hosseini M, Shayan L, Yadollahi M, Karajizadeh M. Characteristics of Traumatic Patients Referring to the Emergency Department and their Association with Mortality and Incidence of Surgery Performance. *Bull Emerg Trauma*. 2023;11(3):132-137. doi: 10.30476/BEAT.2023.97729.1413.

Introduction

Trauma is one of the major causes of life-threatening injuries worldwide. According to metrics and evaluations from the Institute for Health, multiple trauma causes 50 million cases of disability and 5.8 million deaths worldwide annually. Moreover, the mortality rate from acute trauma in developed countries is less than 10%, while it is more than 90% in developing countries [1, 2].

Trauma-related mortality, which can occur during prehospital, emergency department (ED), or hospitalization, is of particular concern in the international literature [3, 4]. There are various challenges in managing patients with traumatic injuries, such as age, severity of injury, type of injury, quality of care, etc. [5]. Prior to patient admission, critically ill patients usually undergo multidisciplinary protocols, including resuscitation and stabilization in the ED and probable surgery intervention. However, these patients remain at risk for further complications as a result of unrecognized injuries or complications associated with initial or ongoing management [6].

Numerous studies highlighted the importance of caring for traumatically injured patients. Despite numerous achievements, there are still numerous unanswered questions in the prehospital and ED settings. The efficiency of resuscitation on the arrival of patients and trauma treatment is directly influenced by a wide range of variables [7, 8]. To provide enhanced resuscitation abilities at the point of injury, it is necessary to evaluate these features and investigate how reported parameters in the ED are related to the patient's outcomes [9]. Therefore, this cross-sectional study was conducted to identify these parameters and determine which factors were associated with death occurrence in trauma patients or the necessity for immediate surgical intervention upon ED presentation.

Materials and Methods

This cross-sectional study was conducted at Shahid Rajaei (Emtiaz) Trauma Hospital, Shiraz, Iran. All trauma patients resuscitated at ED from May 2018 to June 2019 were included in the study. The participants were aged over 18 years old and presented to the level I trauma center according to the Canadian Triage and Triage Acuity System. Data were collected using a census method from the patients' reports who met the inclusion criteria. Individuals who were not interested in continuing their treatment in the relevant hospital and did not require prompt intervention or resuscitation were excluded from the study.

The required data including demographic information (such as age and sex), mechanism of trauma (car accident, attempted suicide, fall height, fall on the same level, etc.), injured body regions

(head, thorax, abdomen, etc.), type of trauma (blunt or penetrating), abbreviated injury scale (AIS), injury severity score (ISS), surgical intervention, and discharge outcome (mortality or survival) were gathered from the hospital reports.

Statistical Analysis

The data were analyzed using SPSS software, version 25.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were expressed as frequency and percentage, and the Chi-Square and Fisher's Exact tests were used to compare these variables. Besides, numerical variables were presented as mean±SD. An independent T-test was used to make comparisons between numerical variables. $p < 0.05$ was considered statistically significant.

Results

The study included 1281 patients, of whom 1062 (82.9%) were men, and 219 (17.1%) were women. The mean age of the study participants was 37.9 ± 19.1 , and the mean length of hospitalization was eight days. Car accidents were the most common mechanism of injury, accounting for 325 cases (25.4%). Furthermore, thorax injuries were the most frequent diagnostic trauma, which was documented in 715 cases (55.8%), followed by head trauma in 671 cases (52.4%). The blunt injury was the most frequent type of injury, affecting 91.6% of all study subjects. Notably, based on AIS criteria, 509 traumatic diseases (39.7%) were diagnosed for major thorax with $\text{AIS} \geq 3$. According to ISS criteria, the mean of ISS was 16.3 ± 11.28 , with moderate injury accounting for 342 cases (26.7%) and severe injuries affecting 324 cases (25.3%). Moreover, 991 cases (77.4%) of all trauma patients required surgical interventions (Table 1).

The analysis of the collected data from patients who underwent surgery revealed a significant association between operation and injury mechanism ($p < 0.0001$), classification of ISS ($p < 0.0001$), and AIS_{head} ($p = 0.012$), indicating that the majority of surgeries were for a car accident (266 cases, 26.8%). Moreover, despite the fact that patients with attempted suicide had the lowest rate of urgent surgeries compared to other mechanisms, 90% of these cases required emergency surgery. Accordingly, 29.4% of trauma patients who had surgical procedures had moderate injuries. Furthermore, 32.7% of patients who underwent surgery were classified as $\text{AIS}_{\text{head}} \geq 3$ (Table 2).

According to the findings indicated in Table 1, the mean age of deceased patients was significantly higher than that of survived individuals ($p < 0.0001$). In addition, the results of the present study revealed a significant association between the mechanism and type of injury, ISS classification, operation, and the outcome of the accident ($p < 0.0001$). Among the mechanisms of injury, pedestrian accidents had the highest death rate (32.4%). Concerning the ISS criteria, patients with profound ISS had the highest mortality rate (49.5

Table 1. The characteristics and distribution of injured patients who underwent resuscitation based on survival and death outcome

Variables	Total N=1281	Outcome		P value	
		Survival	Death		
Age (year, mean±SD)	37.9±19.1	35.28±17.16	54.35±22.2	<0.0001 ^d	
Sex					
Male	1062 (82.9)	916 (82.9)	146 (83)	0.54 ^d	
Female	219 (17.1)	189 (17.1)	30 (17)		
Mechanism of trauma N (%)					
Car accident	325 (25.4)	289 (26.2)	36 (20.5)	<0.0001 ^e	
Motor accident	278 (21.7)	247 (22.4)	31 (17.6)		
Pedestrian accident	203 (15.8)	146 (13.2)	57 (32.4)		
Accident ^a	33 (2.6)	27 (2.4)	6 (3.4)		
Fall on the same level	109 (8.5)	85 (7.7)	24 (13.6)		
Fall height	86 (6.7)	75 (6.8)	11 (6.3)		
Stabbing	92 (7.2)	89 (8.1)	3 (1.7)		
Gunshot	16 (1.2)	13 (1.7)	3 (1.2)		
Assault	63 (4.9)	61 (5.5)	2 (1.1)		
Self-injury	17 (1.3)	17 (1.5)	0 (0)		
Attempted suicide	10 (0.8)	10 (0.9)	0 (0)		
Other	49 (3.8)	46 (4.2)	3 (1.7)		
Type of trauma N (%)					
Blunt	1173(91.6)	1003(90.8)	170(96.6)	0.01 ^e	
Penetrating	108(8.4)	102(9.2)	6(3.4)		
Injured body regions N (%)					
Head trauma	671 (52.4)	552(50)	119(67.6)	<0.0001 ^f	
Face trauma	256 (20)	223(20.2)	33(18.8)	0.659 ^e	
Thorax trauma	715 (55.8)	598(54.1)	117(25.49)	0.002 ^e	
Abdomen trauma	234 (18.3)	191(17.3)	43(24.4)	0.023 ^e	
Extremity trauma	565 (44.1)	480(43.4)	85(48.3)	0.228 ^e	
External trauma	409 (31.9)	347(31.4)	62(35.2)	0.312 ^e	
AIS ^b N (%)					
Head	<2	834 (65.1)	755 (68.3)	79 (44.9)	<0.0001 ^f
	≥3	445 (34.9)	348 (31.5)	97 (55.1)	
Face	<2	1256(98)	1088(98.5)	168(95.5)	0.007 ^e
	≥3	25(2)	17(1.5)	8(4.5)	
Thorax	<2	772 (60.3)	684 (61.9)	88 (50)	0.02 ^e
	≥3	509 (39.7)	421 (38.1)	88 (50)	
Abdomen	<2	1186 (92.6)	1028 (93)	158 (89.8)	0.088 ^e
	≥3	95 (7.4)	77 (7)	18 (10.2)	
Extremity	<2	1037(81)	900(81.4)	137(77.8)	0.258 ^e
	≥3	244(19)	205(18.6)	39(22.2)	
External	<2	1272(99.3)	1099(99.5)	173(98.3)	0.08 ^e
	≥3	9(0.7)	6(0.5)	3(1.7)	
ISS ^c N (%)					
Minor (<9)	305 (23.8)	288 (26.1)	17 (9.7)	<0.0001 ^e	
Moderate (9-15)	342 (26.7)	316 (28.6)	26 (14.8)		
Severe (16-24)	324 (25.3)	273 (24.7)	51 (29)		
Profound (≥25)	308 (24)	226 (20.5)	92 (46.6)		
Operation N (%)					
Yes	991 (77.4)	976 (88.3)	15 (8.5)	<0.0001 ^e	
No	290 (22.6)	129 (11.7)	161 (91.5)		

^aOther accidents include bicycle accidents, skating accidents, accidents at work, and accidents involving animals. ^bAIS: Abbreviated injury scale; ^cISS: Injury severity score; ^dIndependent T-test; ^eChi-square test; ^fFisher's Exact test.

%). The most common type of trauma that resulted in mortality was blunt trauma, which accounted for 96.6% of all cases. Remarkably, the mortality rate among individuals who underwent an operation was 8.5%. Besides, the head, thorax, and abdomen were all significantly associated with the mortality rate, with head trauma being the most frequently injured site

reported from deceased cases (67.6%). There was a significant correlation between the consequence of the accident with AIS_{head} ($p<0.0001$), face ($p=0.007$), and thorax ($p=0.02$). Accordingly, 55.1% of head injuries and 50% of thorax damages that resulted in death had AIS \geq 3. Meanwhile, 4.5% of facial trauma cases that ended in death had AIS \geq 3 (Table 1).

Table 2. The characteristics and distribution of traumatic patients who underwent operation surgeries following resuscitation

Variables	Operation		P value
	Yes N=991	No N=290	
Mechanism of trauma N (%)			
Car accident	266 (26.8)	59 (20.3)	<0.0001 ^c
Motor accident	232 (23.4)	46 (15.9)	
Pedestrian accident	138 (22.4)	65 (13.9)	
Accident	27 (2.7)	6 (2.1)	
Fall on the same level	66 (6.7)	43 (14.8)	
Fall height	68 (6.9)	18 (6.2)	
Stabbing	79 (8)	13 (4.5)	
Gunshot	11 (1.1)	5 (1.7)	
Assault	50 (5)	13 (4.5)	
Self-injury	14 (1.4)	3 (1)	
Attempted suicide	9 (0.9)	1 (0.3)	
Other	31 (3.1)	18 (6.2)	
AIS ^a N (%)			
Head	<2	666 (67.2)	0.012 ^d
	≥3	324 (32.7)	
Face	<2	974(98.3)	0.259 ^c
	≥3	17(1.7)	
Thorax	<2	585 (59)	0.1 ^c
	≥3	406 (41)	
Abdomen	<2	918 (92.6)	0.89 ^c
	≥3	73 (7.4)	
Extremity	<2	800(80.7)	0.70 ^c
	≥3	191(19.3)	
External	<2	985(99.4)	0.44 ^c
	≥3	6(0.6)	
ISS ^b N (%)			
Minor (<9)	219 (22.1)	86 (29.7)	<0.0001 ^c
Moderate (9-15)	291 (29.4)	51 (17.6)	
Severe (16-24)	261 (26.3)	63 (21.7)	
Profound (≥25)	219 (22.1)	89 (30.7)	

^aAIS: Abbreviated Injury Scale; ^bISS: Injury Severity Score; ^cChi-square test; ^dFisher's Exact test; a) Chi-square test; b) Fisher's Exact test.

Discussion

We conducted a retrospective descriptive study on severely injured patients who presented to the ED for resuscitation. Our findings indicated a significant relationship between operation interventions and the mechanism of trauma, ISS, and the severity of head trauma. Moreover, age, the mechanism and type of trauma, ISS, and the necessity for surgery were all significantly associated with death occurrence. Additionally, head, thorax, and abdominal trauma were all significantly associated with a high mortality rate.

This study was conducted in one of the largest trauma centers in the south of Iran, which provided a comprehensive analysis of reports obtained from trauma patients who were referred to the ED. Consistent with previous studies [10-13], our sample consisted of middle-aged men with a mean ISS ≥ 16 who had experienced trauma. When examining which mechanisms inflicted multiple injuries, we found that car accidents frequently occurred among injured patients, which was consistent with previous

reports [12-14]. In the meantime, a study found that Iran is among the first countries in the world with the highest number of road traffic fatalities [11, 15]. In addition, Difino *et al.*, in a nine-year study on 6065 patients, found that road accidents were the most common cause of trauma, and 94% of injuries were blunt [16], which was consistent with our findings about blunt trauma being more prevalent (91.6%) than penetrating trauma. We also found that blunt traumas accounted for the majority of deaths among study cases, which contradicted earlier research demonstrating penetrating trauma was associated with a higher risk of mortality than blunt injury, both in the prehospital setting and the ED [17].

Besides, the majority of traumatic injury victims were men, and there was a strong relationship between the consequences of the accident and the age of the patients, with the mean age of the deceased patients being around 54 years old. Remarkably, the highest fatality rate among critically injured patients was related to pedestrian accidents, which were associated with the elderly and involved the greatest mortality rate in our study population. Another study found that

elderlies had worse outcomes following trauma [18], which was the same as our findings. Demissie *et al.*, also stated that male drivers and pedestrian errors were risk factors for fatal accidents [19].

Moreover, thorax trauma was identified as the most frequent diagnostic damage in our study, and 39.7% of patients with thorax injuries had $AIS_{thorax} \geq 3$. The most lethal injury, however, was head trauma. This was consistent with earlier findings on trauma patterns in deaths in the ED, which reported that head and chest injuries were responsible for more than half of all deaths [20-23]. Besides, Herman *et al.*, indicated that head trauma was a frequently reported cause of mortality or hospitalization [24]. In line with our findings that 55% of head injuries and 50% of thorax damages leading to death had $AIS \geq 3$, Ryan *et al.*, reported that the most severe trauma was frequently diagnosed in the head or thorax region [21]. Previously, Lichtveld *et al.*, showed that the mortality of severely injured accident patients was related to age, and the head injury appeared to be the most important cause of death in the first 24 hours following an accident [25].

Moreover, we found that there was a significant association between the mechanism of injury, ISS classification, operation, and accident outcome. On the contrary, Copass *et al.*, asserted that ISS was not an appropriate predictive marker for a patient's survival, while the mechanism of injury was related to the individual's survival [26]. Meanwhile, ISS was shown to be one of the predictors of mortality in traumatically injured patients, and it can estimate the collective effects of the multiply-injured body regions of patients regardless of the AIS score [11, 27, 28]. Besides, urgent operation intervention was predominantly seen in car accidents, indicating the severity of injuries that occurred in road traffic accidents. Noticeably, serious head injuries were prevalent among patients who required surgery; highlighting the importance of a professional neurosurgical team in the ED of trauma hospitals.

The limitation of this study was that the variables were selected based on previously recorded data from the injured patients. Therefore, it was probable that some data were missed. Moreover, as a retrospective type of study and secondary

data analysis of hospital resources, some data might be excluded due to incomplete registration. Thus, multi-center studies on a larger population that provide dense and coherent results of the factors affecting mortality or surgical treatment in critically injured patients referred to the ED are recommended.

Our findings indicated that car accidents, thorax injuries, $ISS \geq 16$, and blunt traumas were the most significant predictors of the occurrence of trauma injuries. Age, mechanism, type of trauma, ISS, and the necessity for surgery were significantly associated with the mortality rate of injured patients. The severity of the trauma, particularly head injuries, and the mechanism of injury were important factors in determining the necessity for surgery. Recognizing the relative elements of death and determinants associated with urgent surgeries in traumatic patients might help enhance ED's safety policies and initiatives.

Declaration

Ethics approval and consent to participate: This study was approved by the Institutional Review Board of Shiraz University of Medical Sciences 98-01-38-20748 (Code: IR.SUMS.REC.1398.933).

Consent for publication: Not applicable.

Conflict of Interests: The authors declare no conflict of interests.

Funding: This study was supported by the Shiraz University of Medical Sciences (Grant number: 17939)

Authors' Contributions: Study concept and design by MY, MH, acquisition of data by MK, analysis, and interpretation of data by LSH, drafting of the manuscript by MH, critical revision of the manuscript for important intellectual content by MH.

Acknowledgment: The authors want to thank the Research Vice-Chancellor of Shiraz University of Medical Sciences for financially supporting the research (Grant number: 17939).

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