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Original Article

Evaluation of Factors Related to Mortality Caused by Firearm Injury: A Retrospective Analysis from Malatya, Turkey

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Abstract

Background: Firearm related injuries continue to increase throughout the world and they become the first or second cause of mortality in worldwide. The present study aimed to determine the factors that affect mortality in firearm injuries.

Methods: The patients which were admitted to emergency service between January 2011 and December 2015 due to firearm injuries, were reviewed from hospital records. The patients were evaluated in terms of their age, sex, event time, admission time, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), the reason of event, type of weapon, the region of the body that injured, department in which they were hospitalized, hospitalization duration and the relation between these parameters and mortality.

Results: A total of 174 patients (86.8% male, 13.2% female) were identified. The mean age of patients was 35.2 years and 30 patients (17.2%) died. Among the cases, 137 were attempted homicide (78.7%), 23 were accidents and the remaining 14 were suicides. The suicidal cases had significantly higher mortality rate than other causes ($P=0.003$). The most frequently used weapon was pistols (73.6%) and the events took place between 18.00 and 24.00 (36.2%) hours mainly. The injuries were mostly on extremities, however many of deaths were seen after head- neck injuries and the mortality rate of head and neck injuries was significantly higher than other regions ($P<0.001$). The mean of hospitalization duration was 9.1 days and it was 10.2 ± 11.7 days for survivors, 4 ± 7.3 days for died subjects. The hospitalization duration of died patients was significantly shorter than survivors ($P=0.042$). The GCS of died patients (4.4 ± 1.7) was significantly lower than those of survivors (13.3 ± 2.8) ($P<0.001$). The ISS score of died patients (49.7 ± 24.1) was significantly higher than those of survivors (13.6 ± 10.6) ($P<0.001$).

Conclusion: It was determined that GCS, ISS, length of hospitalization, injuries due to suicide attempt, the department of hospitalization, injuries to head-neck regions affected mortality significantly.

Keywords: Firearm, Homicide, Mortality, Suicide

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Introduction

Firearm injuries are common throughout the world, especially after the firearm industry demonstrated great advances during the second half of the nineteenth century. Such injuries may cause high morbidity and mortality due to accompanying organ and vessel injuries.[1] Since the bullet is fast, has explosive properties and pivots while advancing, it can damage the organs and the surrounding tissues that it passes through. Furthermore, it may change direction in the body and go to several different locations from the point of entrance. Thus, firearm injuries could cause more damage than anticipated.[2,3]

According to the data from Centers for Disease Control and Prevention (CDC), 11000 murders and 19000 suicide cases, in which firearms are used, occur in the United States each year, making America the leader among developed countries.[4] Death due to firearms is the second cause of death among the injury induced deaths in young populations aged 10–19 years old.[5] Deaths that are attributed to firearms are the second cause of death after traffic accidents.[6] In 2008, 0.3% of deaths in Turkey were due to firearms and similar to other countries, it is an important public health problem now.[7] However, lack of legal regulations, ease of access to weapons, traditions, customs and terrorism increase the prevalence of firearm injuries.[8]

This study aimed to determine the factors that affect mortality due to firearm related injuries by evaluating injury characteristics, demographics of patients, results of physical examination and outcomes of victims.

Materials and Methods

Study Subjects and Design

A retrospective review was conducted on data obtained from 187 patients who were admitted to Inonu University Emergency Medicine Department after firearm injuries, between January 2011 and December 2015. The hospital is a well-equipped trauma center with 90000 patients admitted to its emergency service annually and is located in Malatya province, in the eastern region of Turkey.

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The study data was obtained from the hospital records, which were kept by emergency service doctors. All of the firearm injuries were forensic cases and the detailed reports of patients also were kept by the forensic medicine department. The emergency department records and forensic medicine department records were compared and the correct records for each patient were gained. The patients (n: 13) with incomplete or missing data were excluded from study. We evaluated the patients based on their age, gender, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), admission time, event time, the cause of the event, the region of injury, department where they were hospitalized, hospitalization duration and outcomes. Then, we determined the statistical correlations between these parameters and mortality.

Statistical Analyses

Data analysis was performed on Statistical Package for the Social Sciences (SPSS, version 22.0, Chicago, IL, USA) software. Data were expressed as percentages, mean ± standard deviation (SD), and median values. Normal distribution of continuous numerical data was determined by evaluating the Kolmogorov-Smirnov test. Kruskal-Wallis test was used for non-normally distributed continuous variables. The chi-square test were used to compare qualitative data. The correlation between investigated variables and mortality was found by using forward multiple regression analysis. $P < 0.05$ was regarded as statistically significant.

Results

We identified 187 patients who were admitted to the emergency service after a firearm injury within 4 years. Thirteen of those were excluded from the study because of missing data in their files. Of the remaining 174 patients, 151 (86.8%) were males and 23 (13.2%) were females. A total of 30 patients died and the remaining 144 patients were discharged upon recovery. The mean age of all patients was 35.2 ± 13.8 years (ranged from 9 to 80 years). The mean age of deceased and alive subjects was 35.4 ± 13.4 and 35.1 ± 13.9 years, respectively. No significant relation was detected between age and mortality (95% CI: 33.11–37.24, $P = 0.933$). 137 cases were identified as homicides, 14 as suicides, and 23 as accidental injuries. It was determined that the suicidal cases had significantly higher mortality rate than homicidal and accidental cases ($P = 0.003$). Hunting rifles were used in 46 cases, and pistols were used in 128. Type of weapon did not affect mortality significantly ($P = 0.380$). Most events (36.2%) occurred between 18.00-24.00 hours and the highest percentage of death (22.9%) was at 06.00-12.00 o'clock period. Time of injury did not affect mortality significantly ($P = 0.297$). A large proportion of the cases (67.2%) reached emergency services within the first hour after the incident and the highest percentage of death (25%) was in 30 minutes after the injury. Hospital arrival time did not affect mortality significantly ($P = 0.197$) (Table 1).

The mean duration of hospitalization for all patients was 9.1 ± 11.33 days and the longest hospitalization was 59 days. The hospitalization duration in died and survived patients was 4 ± 7.3 and 10.2 ± 11.7 days, respectively. Deceased patients had significantly shorter hospitalization duration than patients who survived (95% CI: 1.78–10.59, $P = 0.042$). The mean GCS of deceased subjects was 4.4 ± 1.7 points and it was 13.3 ± 2.8 in survived subjects. The deceased patients had significantly lower GCS than patients who survived (95% CI: 7.76–9.98, $P < 0.001$). The mean ISS of died and survived subjects was 49.7 ± 24.1 and 13.6 ± 10.6 points, respectively. The deceased patients had significantly higher ISS than patients who survived (95% CI: -16.94–22.75, $P < 0.001$) (Table 2).

The highest percentage of injuries were seen on extremities (39.1%), followed by head-neck (18.4%), abdomen (13.8%), multiple regions (13.2%), thorax (8.6%) and pelvis (6.9%) regions. The head and neck injuries had significantly higher mortality rates than other regions of trauma ($P < 0.001$). The patients were followed up mainly by orthopedics (26.4%), general surgery (17.8%), emergency service (16.4%), thoracic surgery (5.2%), cardiovascular surgery (5.2%) and neurosurgery (4.6%) departments. The mortality rate of patients admitted in neurosurgery was significantly higher than other departments ($P < 0.001$) (Table 3).

Table 1. Demographic Characteristics of Participants

Variables	Survived No. (%)	Died No. (%)	*P* Value
Gender			0.984
Male	125 (82.8)	26 (17.2)	
Female	19 (82.6)	4 (17.4)	
Total	144 (82.8)	30 (17.2)	
Causes			0.003
Suicide	8 (57.1)	6 (42.9)	
Homicide	113 (82.5)	24 (17.5)	
Accident	23 (100)	N/A	
Type of weapon			0.380
Rifle	40 (86.9)	6 (13.1)	
Pistol	104 (81.2)	24 (18.8)	
Time of event			0.297
06.00–12.00	27 (77.1)	8 (22.9)	
12.00–18.00	48 (85.7)	8 (14.3)	
18.00–24.00	50 (79.4)	13 (20.6)	
00.00–06.00	19 (95)	1 (5)	
Arrival time			0.197
0–30 min	30 (75)	10 (25)	
30–60 min	63 (81.8)	14 (18.2)	
60–120 min	28 (84.8)	5 (15.2)	
>120 min	23 (95.8)	1 (4.2)	

P value of <0.05 was considered statistically significant.
N/A: Not applicable.

Table 2. Age, Trauma Scores and Hospitalization Duration of Deceased and Surviving Patients

Variables	Result	*n*	Mean	SD	*P* Value
Age (y)	Died	30	35.4	13.4	0.933
	Survived	144	35.1	13.9	
GCS (points)	Died	30	4.4	1.7	<0.001
	Survived	144	13.3	2.8	
ISS (points)	Died	30	49.7	24.1	<0.001
	Survived	144	13.6	10.6	
Hospitalization duration (days)	Died	30	4	7.3	0.042
	Survived	144	10.2	11.7	

GCS, Glasgow Coma Scale; ISS, Injury Severity Score; SD, Standart Deviation; *P* value of < 0.05 was considered statistically significant.

Discussion

We determined the mortality rate as 17.2% in our study. The main factors that affected mortality were suicidal injuries, head-neck injuries, neurosurgery service admittance, hospitalization duration, the GCS and the ISS. Firearm injuries are one of the major traumas that affect mortality and morbidity worldwide. High mortality rates were determined in studies conducted on firearm injuries; Omoke et al[9] determined 5.4% mortality, Eris et al[10] determined 15.1% mortality and Karaca et al[3] determined 16.9% mortality in their respective studies. While 17% of American deaths are attributed to firearms in the United States in 2015, this rate rose to 29.6% among youth deaths.[11]

According to the Turkish Statistical Institute 2008 data, firearms were the most common method used in homicide, and the third most common method used in suicide (after poisoning and hanging), but firearms related suicidal deaths exceeded poisonings and became the second most common method in 2011.[7,12] The National Violent Death Reporting System revealed that 51.8% of suicidal deaths and 66.5% of homicidal deaths were related to firearm injuries in 2009.[13] Although it changes by country, homicide was the prominent reason for using firearms in Turkey based on previous studies and suicide was the prominent reason for firearms in Western countries.[7] The death rate in suicides was higher than the rate in homicides and for all other causes.[14] The mortality rate in jumping from a high place to commit suicide was 19.9%, in ingesting toxic substances, it was 2.5%, in suicide with sharp objects, it was 0.7 while it was 60% in suicides using firearms.[15] The rate of homicidal and suicidal deaths was found to be 48.9% and 46.5%, respectively, among firearm related deaths in California between 2010 and 2015.[16] In our study, the use of firearms was ranked as follows: 78.7% in homicide, 13.2% by accident and 8.1% in suicides. 42.9% of those who attempted suicide with firearms died and this rate was very high compared to attempted homicides (17.5%) and accidents.

Table 3. Distribution of Injury Areas and Admitted Wards

Variables	Survived No. (%)	Died No. (%)	*P* Value
Injured regions			<0.001
Head-neck	20 (62.5)	12 (37.5)	
Thorax	10 (66.7)	5 (33.3)	
Abdomen	17 (70.8)	7 (29.2)	
Pelvis	12 (100)	N/A	
Extremity	65 (95.6)	3 (4.4)	
Multiple regions	20 (87)	3 (13)	
Departments			<0.001
Emergency	19 (65.5)	10 (34.5)	
Neurosurgery	4 (50)	4 (50)	
General surgery	24 (77.4)	7 (22.6)	
Orthopedics	46 (100)	N/A	
Eye	6 (100)	N/A	
Ear nose throat	6 (100)	N/A	
Pediatric surgery	4 (100)	N/A	
Thoracic surgery	9 (100)	N/A	
Reanimation	7 (100)	N/A	
Plastic surgery	7 (100)	N/A	
Cardiovascular	9 (100)	N/A	
Urology	3 (100)	N/A	

P value of <0.05 was considered statistically significant.
N/A: Not applicable.

The most affected region in firearm injuries is the extremities.[3,9,17] However, injuries to the head and neck region cause the highest mortality rate. Several autopsy studies provided consistent findings.[6-8] But, abdominal injuries have higher mortality rates in some studies[17] and 46% mortality rate was determined in another study about firearm related head injuries.[18] In our study, most injuries were observed on the extremities, and the highest mortality rate was observed in head and neck (37.5%) injuries. Based on the region of injury, most patients were admitted to the orthopedics department. The count of deceased patients who were admitted to the neurosurgery department was significantly higher than those admitted to other departments.

In the present study, we determined the mean hospitalization duration 9.1 ± 11.33 in days. In a study conducted in Nigeria,[19] it was 18 days, in another study conducted in the United Kingdom,[20] it was 12.4 days. There are different rates as specified. Additionally, in the developing countries, the information about firearm injuries are scarce and the data is unreliable.[19] But it was specified that firearm related injuries required multiple

operations, long hospitalizations, rehabilitation and many morbidities unfortunately.[17] We thought that the hospitalization duration was prolonged in case of post-operative complications, re-operation requirement and hospital-based infections. There were several patients in our study who were discharged from the emergency service after one day hospitalization. It was considered that short hospitalization duration in our study might be due to lack of complications and infections in inpatients.

There are several studies on the correlation between the trauma scores (GCS, ISS, RTS and TRISS) and mortality in firearm injuries. These scores influence the treatment of patients and outcomes.[3,21] GCS is the most commonly used scoring method in head traumas in the emergency service and significantly determines the prognosis. The mortality rate of patients with a GCS of 3–8 was 88% in non-surgically treated and 45% in operated patients.[18] A study conducted in Iran revealed highest ISS score for firearm related injuries among trauma patients.[22] In the present study, GCS was low, ISS was high in deceased patients and GCS was high and ISS was low in surviving cases, compatible with the literature.

Young males are the most affected group in traumas and this result is also valid for firearm injuries.[10] Odhiambo et al[17] found the average age as 29.7 ± 10.9 and the number of male to female ratio was 7.5/1. Peek-Asa et al[11] determined that 80% of cases were in the 15–44 age group and male to female ratio was 9/1. In our study, the majority of our subjects were young males (M/F ratio 6.6) and the mean age was 35.2 ± 13.8 years. Generally, men are exposed to trauma more often than women because men are more active in outdoor life and also different physique and viewpoint make them more prone to traumas and firearm injuries.

The peak period of firearms related injuries is reflective of lifestyle of that area. Omoke et al[9] found that the firearm injuries occurred between 00.00–06.00 mostly when people are at home sleeping or between 18.00–24.00 when people are on their way home. In a study conducted in Kenya, the highest number of firearm injuries occurred between 19.00–24.00 (55.5%) with less police patrols seen.[17] Most of the cases in our study occurred between 18.00–24.00 and 12.00–18.00, respectively. The findings of our study demonstrate that people are often shot while awake in daily life and or active in nightlife.

After the incident, it is very important to get the case to the hospital and make the necessary interventions without losing time. This is because time lost directly affects the likelihood of infections and mortality.[10] Sachan et al[23] found 31.82% of deaths occurred in the first hour and 33.33% of deaths in 12 hours after the injury. Most of our victims (67.2%) arrived at the hospital within the first hour. However, the highest mortality (80%) was also observed in the first hour and as mentioned before, many of deaths occurred due to head-neck injuries. This suggested that the subjects who were exposed to head-neck trauma due to firearms, had less chance to survive. Nevertheless, the first hours after firearm injuries are important for mortality.

The most commonly used weapons in firearm injuries in Turkey and worldwide are pistols. The most important factor is the fact that pistols are inexpensive and could be obtained and transported easily.[7,11,24,25] In the present study, pistols were involved in most cases (73.6%) and also caused more deaths compared to rifles.

In conclusion, it was determined that the major factors that affected mortality in firearm injuries were head and neck injuries, GCS, ISS, length of hospitalization, suicidal injuries, and the department of hospitalization.

Authors' Contribution

KT and AG contributed to study conception and design, and interpretation of data, and drafting of the manuscript. HO and TG contributed to study conception and design and critical revision. All authors contributed equally to this work and approved the final version of the paper.

Conflict of Interest Disclosures

The authors have no conflicts of interest.

Ethical Statement

The study was performed retrospectively by analyzing patient records in hospital archive. So no ethical approval was obtained.

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