



Assessment of Causes of Preventable Deaths in Pre-hospital Settings

Changiz Gholipour¹, Bahram Samadi Rad², Samad Shams Vahdati³, Roshan Fahimi⁴, Ghaffar Zad Amir⁴, Laleh Moslehi Far⁴

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ABSTRACT

Objective: Death from trauma is a major problem for the health system. The determination of preventable deaths is a valuable indicator of quality and efficiency in the management of trauma patients. The purpose of our study was to investigate the cause of preventable death in pre-hospital settings in the city of Tabriz.

Materials and Methods: In a cross-sectional study from 2013 to 2014 in Tabriz, all traumatic patients who died at the scene of trauma or during transport and before reaching the hospital were referred to forensics for autopsy studies. For all deaths, data on demographics, mechanism and type of injury, place of death, mode of transportation, injury to the central nervous system (CNS) and results of necropsy were recorded. Preventability of death was defined upon examination of the necropsy report.

Results: In this study, 160 pre-hospital deaths were studied. The commonest mechanism of injury was a vehicular traffic accident (83.8%), and blunt trauma in 98.8% was the commonest type of injury. In total, 80.6% of the deaths were at the scene of trauma and 18.8% on arrival to the hospital. CNS injury was recorded in 71.9% of the cases. The commonest cause of death from the necropsy report was CNS injury (60.6%), exsanguination or breathing problems (28.1%), and CNS injury with exsanguination or breathing problems (11.2%). In this study, death was possibly preventable in 25.6% of the cases, and 21.9% of the deaths were definitively preventable.

Conclusion: Many deaths occurred at the scene of trauma, and traffic accidents are the main mechanism of injury. A high percentage of deaths as seen in the autopsy had CNS injuries, and this was the main cause of death. The high rate of preventable death in the present study compared to that in similar studies in other countries is a significant finding.

Keywords: Preventable death, trauma, pre-hospital

¹Department of General Surgery, Tabriz University of Medical Science, Tabriz, Iran

²Forensic Medicine, Legal Medicine Research Center, Legal Medicine Organization, Tehran, Iran

³Road Traffic Injury Research Center, Emergency Department, Tabriz University of Medical Science, Tabriz, Iran

⁴Department of Emergency Medicine, Tabriz University of Medical Science, Tabriz, Iran

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Correspondence

Samad Shams Vahdati MD,
Department of Emergency,
Tabriz University of Medical
Science - Road Traffic Injury
Research Center, Tabriz, Iran
Phone: +984133352078
e.mail:
sshamsv@yahoo.com

INTRODUCTION

Trauma is the precarious status of human health that can be defined by harmful events caused by mechanical, electrical, chemical, thermal, or radiation energy (1). These days, mortality due to trauma is a major problem in health systems, particularly in countries with large populations and low income. Epidemiology of trauma shows that it causes 5 million mortalities each year worldwide and saddles millions of people with temporary or lifelong disabilities (2). Considering the high rate of traumatic events and traffic accidents in Iran, decreasing the trauma rate and supporting traumatic patients may play a vital role.

A fundamental study performed in San Francisco in 1983 by Trunkey explained a distribution pattern with three stages for mortality due to trauma. According to this pattern, mortalities were classified based on the injury time to death interval. Deaths that happened at the scene of the accidents (50%), early deaths that occurred 4 h or less after trauma in a hospital (30%), and delayed mortalities that occurred more than 4 h after trauma (20%) (3). This categorization encouraged the establishment of traumatic management systems with the aim of reducing traumatic injuries and mortalities at each stage. Thus, traumatic patients should be supported not only in hospitals but also in the first encounter with emergency personnel at the scene of the accident. Pre-hospital emergency medical service (EMS) was proposed from the idea of flying ambulances - horses taking doctors to the patients - which introduced by Dominique-jean Larrey (surgeon of Napoleon) in 1792. Currently, EMS systems follow the same idea (4). Due to the necessity of correct diagnosis and treatment in stressful situations, the probability of medical mistakes or wrong management is high (5). For the first time in 1970, the idea of preventable deaths due to trauma was discussed by Rutstein et al. (6). This included mortalities that were completely or partially preventable with effective health care treatment. Preventable deaths are valuable indicators of quality evaluation and management of patients in health systems (6). Although investigating preventable traumatic deaths is difficult, it includes a wide range of 1 to 45% in multiple studies. To the best of our knowledge, there has been no integrated study related to preventable

deaths in the city of Tabriz. We aimed to evaluate all preventable and potentially preventable deaths, the mechanism of injury, and the rate of death prevention at the scene of an accident with highly effective pre-hospital management.

MATERIALS and METHODS

In our study, all traumatic patients who died at the scene of the accident and during transport or died before reaching to the hospital were assessed during in a period of one year, March 2013 – March 2014. Injuries due to asphyxiation, inhalation of harmful substances, burning, hanging, drowning, electrical events, intoxication, and overdose were not evaluated because no autopsies were performed on those cases. Demographic data and all causes of death recorded by the forensic medicine institution were collected and the preventability of death in each case was investigated. Mortalities associated with 1. Protrusion of brain and cerebral peduncle detachment; 2. Cerebral edema, cerebral hemorrhage and skull fractures; and 3. Pneumothorax, hemothorax, tamponade, and hypovolemic shock were classified into groups of non-avoidable, potentially preventable and certainly preventable deaths, respectively. Collected data were analyzed by SPSS (SPSS Statistics Version 15.0, IBM, Armonk, New York).

RESULTS

In total, 160 deaths caused by trauma were investigated.

Age

According to the findings of this study, the youngest death belonged to a 5 day old neonate, and the oldest was 90. The mean age of study population was 42.88 ± 20.9 .

Sex

Among 160 deaths, 134 (83.8%) of them were male and 26 (16.2%) were female.

Mechanism and type of injury

In this study, two common mechanisms of injury were traffic accidents (83.8%) and falling from heights (10.6%). The common type of injury resulting in death was blunt trauma (98.8%).

Traffic accidents (83.6%), penetrating trauma (100%), falling from heights (82.4%), explosions (66.7%), and hard material crashes (100%) were the mechanisms of trauma that were predominant in males.

Place of death and transferring patients

Among the 160 deaths, 129 of them happened at the scene of the accident and before arrival of EMS. 30 deaths occurred during transport to the hospital. In one case, the information was not recorded.

The average age for death at the scene of the accident and pre-hospital groups were 44.50 and 36.60, respectively. Other results recorded in Table 1.

Central nervous system (CNS) injury

115 cases (71.9%) were reported with CNS injury and 45 cases (28.1%) were without CNS injury. 64.4% (103 cases) of the cases suffered damage in only one organ. In 94.2%, the only injured organ was CNS. 35.6% (57 cases) had multi-organ damage.

Autopsy results

In autopsy examination, 60.6% of mortality cases were related to CNS injury. About 28.1% were hemorrhage (ventilation difficulties) and 11.2% involved both CNS injury and airway difficulties.

Ability of avoiding death

Among 160 pre-hospital deaths, 84 cases were non preventable deaths, 41 cases were probably preventable deaths and 35 deaths were certainly preventable.

DISCUSSION

In this study, demographic characteristics, mechanism of injury, place of death, method of traumatic patient transfer, and CNS injury of 160 cases of pre-hospital deaths have been evaluated. According to the findings of this study, the youngest death belonged to a 5 day old neonate and the oldest was 90. The mean age of the study population was 42.88 ± 20.9 . 134 (83.8%) of them were male and 26 (16.2%) were female. Male dominance was similar to another study done by Wilson et al. (7) in Brazil (83.6%). The mean ages of death at the scene of the accident and pre-hospital groups were 44.50 and 36.60, respectively.

In another study about pre-hospital deaths performed by Limb et al. (8) in the Yorkshire health region, the mean age of instant death was higher in comparison to our study. Also, the mean age difference in our study (about 8 years) was higher than similar studies including Limb's study in England, which had a 1 year difference (8). In this study, 83.8% of traumatic patient deaths were due to traffic accidents, 1.9% from hard material crashes, 10.6% from falling from heights, 1.9% from explosions, 1.2% from a penetrating wound and 0.6% from other mechanisms. In all cases, male death was dominant. Traffic accident in England and Hussain et

Table 1. Demographic and frequency of causes of death in pre-hospital settings (per place)

EMS Mortality	Pre-hospital Mortality	Scene of the accident Mortality	
22	30	129	Number
38.27	36.60	44.50	Age (mean)
77.3%	80%	84.5%	Sex (male)
100%	96.7%	99.22%	Blunt trauma
72.7%	73.3%	71.3%	CNS involvement
68.2%	63.3%	59.7%	CNS injury
27.3%	26.7%	28.7%	Hemorrhage/ Airway problems
4.5%	10%	11.6%	CNS injury and hemorrhage
22.7%	20%	22.5%	Certainly preventable deaths
31.8%	33.3%	23.3%	Probably preventable deaths
45.5%	46.7%	54.3%	Non-preventable deaths
EMS: emergency medical service; CNS: central nervous system			

al. (9) study was 56.6%, in Mac Leod Jana's study (the American journal of surgery) 47% and 43%, in Brazil 22.4% and in a secondary data analysis in Tanzania was 28% comparing to ours (83.8%) (7, 9-12). In our study, due to its low rates (2 cases) penetrating trauma was not evaluated. In our study of 158 cases, 98.8% of the injuries resulting in death were related to blunt trauma and 2 cases (1.2%) were related to penetrating trauma, which was very low in comparison to other studies. Among the 160 deaths, 129 of them (80.6%) happened at the scene of the accident and before the arrival of EMS and 30 cases (18.8%) of mortality occurred during transport to the hospital. 73.3% (22 cases) and 20% (6 cases) were transported by EMS and other vehicles, respectively. This mortality rate was a little more than other studies including Lim's in England (62%), Mac Leod's in the USA (78%), Mark Gunst's in the USA (61%), and Meel's in South Africa (74%) (8, 10, 12, 13). Patients who had transferred by EMS were the main way of achieving to Artesh hospital (62%) and Shohadaye hafome tir hospital (48%) (14, 15). In the current study, 71.9% (115 cases) were reported to have CNS involvement. 64.4% (103 cases) suffered damage in only one organ and in 94.2% of these cases, the only injured organ was the CNS. 35.6% (57 cases) had multi-organ damage. In Mac Leod's study (trauma deaths in the first hour), 28% brain damage and 34% multi-organ damage were reported (10). According to the findings by Enderson in England (causes of death following multiple traumas), 65% of mortality was related to CNS injury (16). In Flaconer's study in New Zealand, 39% had head and neck injuries, which was lower than our study's rate of individual brain injury (60.6%) (17). In autopsy examination, mortality of 97 cases (60.6%) was related to CNS injury. In 45 cases (28.1%), hemorrhage or airway and ventilation difficulties lead to death and in 18 cases (11.2%) both CNS injury and hemorrhage (with airway difficulties) were cited as causes of death. According to the results of Stewen's study in the USA, 51% of the mortality rate was because of CNS injury, 21% from hemorrhage, 16% from CNS injury with hemorrhage, and 9% from multi-organ damage (16). In Mark Gunst's study in the USA, 40% and 23% of mortality were caused by CNS injury and multi-organ damage, respectively (12). Mortality of traumatic patients were classified in 3 groups: 1. Non-preventable deaths with a rate of 52.5% (84 cases), 2. probably preventable deaths with a rate of 25.6% (41 cases), and 3. Certainly preventable deaths with a rate of 21.9% (35 cases). Thus, the total rate of preventable deaths was estimated at 47.5%. Certainly preventable deaths in Limb's study in England were reported to be 1-2%, in Sandall's study in the USA this was 0.7%, and in Falconer's study in New Zealand this was 10%. Thus, the rate in our study was the highest (8, 17, 18). Hussain and Redmond (9) declared the total rate of pre-hospital preventable deaths in England to be 39%, Mac Leod to be 7%, Mark Gunst to be 24%, Wilson in Brazil to be 1%, Meel to be 12% and Flaconer's in Newsland to be 45% (7, 10, 12, 13, 17). In this study, two factors had significant correlation, the age and the reason of death in the autopsy. The mean age in the cases of CNS injury, hemorrhage, and both CNS injury and hemorrhage were reported to be 37.53, 49.65, and 54.83. Severe injuries and multi-organ damage was prevalent in older ages. In this study, sex and preventable deaths had a significant relation ($p=0.008$). Males accounted for not only 91% of the non-preventable deaths but also 75% of the preventable deaths. This correlation was not found in previous literature. A p value less than 0.001 has been obtained for the correlation

between CNS injury and avoidability of deaths. Among 76 cases of preventable deaths, 50% (38 cases) had CNS injury whereas 91% of non-preventable deaths had CNS injuries.

CONCLUSION

The findings of this study indicate that the most pre-hospital deaths due to trauma happen in males in the age range of 20-29 years old. The vast majority of mortality takes place at the scene of the accident. The main mechanism and most important cause of injury were traffic accidents and blunt trauma, respectively. From autopsies, a high percentage of deaths have been shown to involve the CNS. Although there was no significant correlation between age, mechanism of injury, and type of injury with preventable deaths, CNS involvement and sex were obviously connected with preventable deaths. Putting this in words, males with CNS involvement had a higher rate of non-preventable deaths.

Ethics Committee Approval: This study protocol was approved by the Ethics Committee of Tabriz University of Medical Sciences.

Informed Consent: Informed consent was prepared by Tabriz university of medical science rule and approved by Legal Medicine Organization. All data were keep secure.

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