

# PENETRATING TRAUMA VICTIMS IN THREE TEHRAN HOSPITALS, SINA, SHOHADA, FAYAZBAKHSH: EPIDEMIOLOGY AND MANAGEMENT ERRORS

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**Abstract** - This is an observational case series study on penetrating trauma admissions in three teaching hospitals in Tehran from 1996 to 1997. In order to describe the epidemiology and determine the ways of improving treatment of penetrating injuries, we selected 410 patients with penetrating injuries and injury severity scores (ISS) of more than 7 (the maximum ISS is 75) out of 3580 trauma patients, hospitalized in the three hospitals (Sina, Shohada, Fayazbakhsh) since May 1st 1996 during a period of approximately one year. These hospitals were among the ones with the highest load of trauma patients in Tehran. The in-hospital mortality rate was 2% and the rate of permanent disability was 6%. The most frequent injuries were in the extremities; while the most fatal ones occurred in the head and neck region.

The mean  $\pm$  SE injury severity score was  $10.9 \pm 0.23$ . Cutting was the most prevalent mechanism of injury while gunshot was the rarest. The most fatal mechanism of injury was gunshot followed by stab and cutting injuries. Industrial workers comprised the population at the highest risk for other cutting injuries, which can be avoided by utilizing better protection facilities at work.

Our findings show that the improvement of preventive measures in industrial occupations should be considered to be of utmost importance. It seems that faster and direct transportation of patients to appropriate and well-equipped centers, improvement of the technical skills of the emergency staff, appropriate triage of trauma victims and decreasing the time spent in the emergency room can decrease the mortality rate substantially.

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**Key Words:** Trauma, penetrating injury, injury severity, mortality

## INTRODUCTION

In developing countries many lives are lost every year as a result of trauma, which is the most common cause of mortality during the first four decades of life

(1-5). In many third world countries particularly in Asia, information is limited and the impact of trauma is poorly understood (5). While penetrating injuries are a major health problem, is known little about their epidemiologic characteristics in our country. With increasing sophistication, vehicular traffic and social violence trauma is gradually assuming prominence as a major cause of morbidity and mortality. Despite the similarity in the dominant mechanism of blunt trauma (road traffic accidents) in many parts of the world (3,4), it seems that there is a difference between the most frequent mechanisms of penetrating trauma according to the fact that gunshot injuries are more prevalent in western countries (6).

We used all our sources to describe more clearly errors and ways of improving treatment of penetrating injuries in three hospitals in Tehran. It seems that timely, appropriate and efficient diagnostic and therapeutic interventions in penetrating trauma can reduce considerable number of mortalities.

The main focus of our study is details of injuries along with the relevant management, the pitfalls and the outcome of patients in order to suggest practical ways of improvement.

## MATERIALS AND METHODS

This is an observational case series study, confined to penetrating trauma patients in a data registry established by Sina Trauma Research Center, in three hospitals (Sina, Shohada, Fayazbakhsh) which have the highest load of trauma patients in Tehran, since May 1st 1996 for a period of approximately one year. The collection data for this registry was performed prospectively by physicians in charge who covered the emergency departments round the clock, in accordance with another group of physicians who followed the admitted patients. A physician controlled the questionnaires based on fixed protocols and made

corrections when necessary. The collected data included demographic details, circumstances of injury, duration of hospital stay, management and outcome in terms of mortality and long-term morbidity. Collected data was entered in a microcomputer using a data bank made by EPI INFO Version 6 (Center for Disease Control, Georgia, USA, April 1994), and validity of data was evaluated extensively.

There were 58005 trauma visits in the three hospitals during a period of one year since May 1st 1996, among which 54425 cases (93.8%) were managed on an outpatient basis and 3580 cases (6.2%) were hospitalized for further treatment. There were 9988 (17%) penetrating injuries among which we selected those penetrating trauma cases with an injury severity score (ISS) of at least 7. Consequently we excluded patients with trivial injuries from our evaluation in order to gain a better focus on critically ill patients. The sampling method was nonrandom, sequential sampling. We used SPSS for Windows, version 7.5 (SPSS Inc., May 1997) and ANOVA and Chi-square.

## RESULTS

Among 58005 injury visits to the emergency departments, we had 9988 in-patient cases (17%) with penetrating injuries, which is higher than other studies (7). We selected 410 patients with an ISS of at least 7 among which the male: female ratio was 8:1 and the mean  $\pm$  SE age was  $27.19 \pm 0.62$  years. 74.8% of injuries were to the limbs, 10% to the face, head and neck, 8% to the abdomen, 7% to the chest, and 0.2% to the spine (Table 1). The extremities were the most frequently injured areas, in spite of causing the least mortality. The abbreviated injury scale scores were from 1 to 5 and the ISS ranged from 8 to 41 with a mean  $\pm$  SE of  $10.9 \pm 4.6$ . The ISS for abdomen was the highest followed by thorax, face, head and neck, spine and extremities with a significant difference between all of them. 13 (3%) cases were hypotensive in admission. Multiple injuries (in > 2 body regions) occurred in 84 (21%) of patients and the in-hospital mortality rate was 2% (N = 10). Permanent disability was seen in 6% and the average days of absences from work (mean  $\pm$  SE) was  $19.35 \pm 1.68$ . Amputation of extremities occurred in 12% of which the majority (39%) were industrial workers who were injured at work. The mean duration of bed occupancy was  $5.09 \pm 0.51$  days and 6% of patients were admitted to intensive care units (ICUs). Trauma to the thoracic and abdominal regions was responsible for prolonged hospitalization. ICU admissions were mostly due to penetrating injuries in the thoracic, head and neck and abdominal regions. The frequency of operation was 28% and the most

frequent injury ending up in surgery was abdominal penetrating trauma.

Most of the injuries occurred at home and work place comprising 35% and 39% of cases respectively (Table 2). Most of the injuries occurred as a result of cutting while gunshot injury was the rarest. The most fatal injury was gunshot followed by stab and cutting injuries (Table 3). Survival rate was 294 of 297 (99%) in cutting injuries and 99 of 102 (97%) in stab injuries, 7 of 11(64%) in gunshot injuries, with an overall survival rate of 400 of 410 patients (98%).

Table 1. The frequency of injured body regions

Body region	No. (Frequency)	Percent of operation	Mean ISS	Mortality (Frequency)
Head and neck	36(8%)	36%	14.3	6(46%)
Face	7(2%)	29%	16.4	1(8%)
Thorax	31(7%)	45%	16.5	3(23%)
Abdomen	36(8%)	56%	17.2	1 (8%)
Spine	1 (0.2%)	0%	13.0	0
Extremities	320(74.8%)	23%	9.7	2(15%)
Total	410			13

Extremities, despite of being the most susceptible part to penetrating injuries, were responsible for the least mortality which was due to arterial injury. The highest mortality due to penetrating injury in head and neck occurred as a consequence of open fracture of vault. The other fatal injuries were cerebral laceration, intracranial hemorrhage, tracheal laceration, laryngeal laceration or fracture, and carotid artery laceration. 7 (19%) penetrating head trauma patients had a GCS of less than 12 and 36% of patients with head trauma underwent operation. The most frequent injury in the thoracic area was pleural penetration, whereas the fatal injuries were: expanding intraparenchymal lung hematoma, intercostal artery or vein injury, penetrating tangential myocardial wound with tamponade and pulmonary hilar vessel disruption. Arterial and venous trauma of the thoracic region continues to present challenging problems for the surgeon, despite advances in vascular diagnostic and surgical technique (8).

Table 2. The frequency of the place of injury

Place	Frequency (percent)
Home	157 (39%)
Work place	140 (35%)
Street	91 (23%)
Sport and leisure facilities	10 (2%)
Out of the city	6 (1%)
Total	404 (100%)

The most frequent abdominal injury was abdominal wall muscle rupture, and the fatal injuries were 2-10 cm diaphragmatic lacerations and splenic laceration involving hilar vessels. As major abdominal vascular

injuries are associated with significant morbidity and mortality, a high index of suspicion is critical in diagnosing occult injuries (9).

**Table 3.** The frequency of the mechanisms of trauma

Mechanism	Frequency		
		Mortality	Survival rate
Cutting	297 (72%)	3	99%
Stab	102 (25%)	3	97%
Firearm	11 (3%)	4	63%
Total	410	10 (2%)	98%

Stab wound injuries most commonly (51%, N=48) occurred on streets, during fighting (61%), and they were more common in low socioeconomic classes of society, especially among industrial workers. Firearm injury was the most fatal mechanism (mortality rate =36%). Gunshot patients were mainly victims of armed robbery or members of armed forces. It mostly occurred at work or on the streets. The low exposure to firearms in our community plays an important role in lowering the incidence of gunshot injuries. Cutting injuries occurred most commonly at home (45%), and work (40%). Industrial workers comprised the population at the highest risk for cutting injuries which showed that these injuries could be avoided by the utilization of better protection facilities. 66% of victims were injured unintentionally, assaults comprised 26% of injuries and suicide was responsible for 8% of injuries. There is a low incidence of gunshot injuries in this region. Of 11 gunshot victims surviving to reach hospital, 2 had multiple trauma and 4 died.

Studying our 10 fatal cases, we found the following results: The mean  $\pm$  SE of the time of prehospital transportation was  $2.70 \pm 0.12$  hours and the mean duration of stay in the emergency department was  $2.10 \pm 0.10$  hours. Five patients out of 7 who were admitted alive to the hospital did not undergo operation until their death. Six cases (60%) of mortalities were referred from other centers. Only 50% of them were transported by an ambulance and the ISS of these patients ranged from 9 to 41 with a mean  $\pm$  SE of  $21.2 \pm 0.55$ . We also found that a number of mortalities were due to insufficient management of airway, exsanguinations and volume contraction.

## DISCUSSION

The high rate of amputation of extremities and its high prevalence at work shows that the improvement of preventive measures in industrial occupations should be considered of utmost value in decreasing the number of accidents, economical burden and duration of absentees from work. While we had no children with gunshot

injuries, there have been studies from other countries which state that this age group has the fastest-rising firearm-related death rate (10). The low rate of mortality in this study should be interpreted with caution because of the fact that the dominant mechanism of penetrating injury in our country is cutting, while in western countries gunshot and stab wounds are more prevalent (6).

Reviewing our mortality cases we found that there were three main categories of defects in patient management. The first and the most important one lies in the negligence and delay in prehospital management which is mainly dependent on emergency medical technicians, relevant equipment and protocols. Based on high frequency of repetitive patient referrals we concluded that the second problem is the erroneous triage protocol, which is based on transportation of patients to the nearest hospital in vicinity irrespective of the facilities available at that center. Consequently this will consume a lot of time in numerous referrals to inappropriate centers. The last one is delay and negligence in diagnosis and performing emergency operations at the emergency departments.

We found that some of trauma mortalities can be prevented by faster and direct transportation of patients to appropriate and well equipped centers, and improvement of technical skills of the emergency staff; especially some measures of basic life support like airway management, hemostasis and aggressive fluid therapy in critically injured patients demand more attention. Almost half of all trauma deaths occurred at the scene. It is important to determine if these deaths can be prevented (11). Prehospital blood transfusion is justified in certain trauma patients, especially when long prehospital transport is required. Blood may be safely maintained and used by physicians with little experience in care of major trauma (12). Appropriate triage of trauma victims not only decreases the time of prehospital transportation, but also can prevent the negligence and mismanagement which may happen due to lack of relevant specialties and equipment. Application of these measures can substantially decrease the rate of prehospital mortalities.

Another factor, which should be considered, is decreasing the time wasted in the emergency room, in case the patient needs an emergency operation. Lack of critical specialties such as neurological, cardiac and thoracic surgical facilities have contributed greatly to mortalities. Implementation of strategies to reduce preoperative time delays and the usage of damage control principles for the management of massive trauma should be evaluated as methods of reducing mortality (13). A selective approach, a high index of suspicion, prompt resuscitation, and immediate definitive surgical management are recommended in order to increase the survival rate for frequently lethal

injuries (14).

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