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Prevalence and Risk Factors of Spinal Trauma and Spinal Cord Injury in a Trauma Center in Shiraz, Iran

Mahnaz Yadollahi [1], Ali Kashkooe [1, 2, *], Ehsan Habibpour [1] and Kazem Jamali [1]

[1] Trauma Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[2] Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran

[*] *Corresponding author*: Trauma Research Center, Shiraz University of Medical Sciences, Shiraz, Iran. Tel/Fax: +98-7136254206, Email: kashkooe@sums.ac.ir

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Abstract

Background: Spinal trauma is a devastating event which could disturb a person's life.
Objectives: The purpose of this study was to examine the prevalence and risk factors of spinal trauma in Rajaee Trauma Center, Shiraz, Iran.
Methods: Data for this cross-sectional study were gathered from October 2009 to August 2015. The study was conducted through data extraction from the classified data of trauma patients admitted to Rajaei hospital. After performing some inclusion and exclusion criteria, 4630 cases were analyzed. The variables analyzed as the risk factors of spinal trauma included sex, age, cord injury, mechanism of injury, and injury severity score.
Results: The prevalence of spinal trauma among traumatic patients was 7%; also, 3.7% of those with spinal trauma suffered cord injury. The mean age of the spinal traumatic patients was 38.2 $\pm$ 17.8, and male-to-female ratio was 2.394. Car accident, motorbike accident, and fall were the main causes of spinal trauma in this study. The lumbar region was the most common injured site in our study. Old age, cord injury, suicide, and car accident were the main risk factors of mortality among spinal traumatic patients. Risk factors of spinal trauma among traumatic patients were female gender, old age, and fall. The risk factors of cord injury in spinal traumatic patients were male gender, old age, and suicide.
Conclusions: It was found that spinal trauma, spinal cord injury (SCI), and mortality among spinal traumatic patients in Iran depended on some risk factors, which should be reduced through eliminating such risk factors. Fall was the most prominent factor of the occurrence of spinal trauma. The most important factors of mortality in spinal traumatic patients were suicide and cord injury. Finally, suicide played the most important role in occurrence of SCI.

Keywords: Spinal Trauma, Cord Injury, Prevalence, Risk Factors

1. Background

Injuries are a considerable cause of mortality and morbidity in different countries. Spinal cord injury (SCI) is a catastrophic event on a personal and family level, as well as a great financial burden to the society because of its attendant morbidity, high costs, and time-consuming treatment needs (1). Patients with cord injury cost the United States almost $9.7 billion each year (2). According to a study, the United States of America had the highest and Rhone-Alpes region, France and Helsinki, Finland the lowest prevalence of SCI (3). Moreover, in a study done in Tehran, Iran, the prevalence of SCI was 4.4 per 10,000 people (4).

Most studies have shown that the ratio of spinal trauma among the males is higher than the females; also according to these studies people over 20 to 40 years have the highest incidence of spinal trauma (3).

Motor vehicle crashes and falls were considered to be the 2 main causes of SCI (5). Directed violence, such as gunshot wounds and sporting accidents, was also responsible for some cases of cord injury (6, 7).

Cervical spine injuries account for most of spinal injuries in several studies (8, 9); however, a few studies showed that thoracolumbar injuries were the most frequent (10, 11).

SCI is a devastating event with high mortality (7). The elderly and those with severe injuries and multiple traumas at the time of injury are more prone to mortality risks. Additional strong predictors of premature mortality include female gender, alcohol or substance abuse, preinjury cardiovascular disease, ventilator dependency, and psychiatric problems (12).

There have been few studies about the prevalence and

risk factors of spinal trauma and SCI in Iran (4). However, the data of epidemiologic information in traumatic cord injury are available for most developed countries. Therefore, more research should be done to collect information concerning traumatic SCI in developing countries to design new cost- effective programs to prevent its occurrence (13).

2. Objectives

The present research aimed at evaluating the prevalence and risk factors of spinal trauma and SCI in Rajaee Hospital in Shiraz, Iran.

3. Methods

3.1. Setting

This cross-sectional study was conducted in Rajaee Hospital, the greatest referral center of traumatic injuries in Shiraz, Fars province, (southwestern Iran). This center has 7 general wards, each with 32 beds, 2 emergency wards, each with 20 beds, and 6 intensive care units each having 9 beds.

3.2. Data Collection and Sampling

The study data were gathered during October 2009 to August 2015. This study was conducted through data extraction from classified data of trauma patients admitted to emergency room of Rajaei hospital. Whenever a patient refers to Rajaee Hospital, a unique 8-digit code will be generated for him/her by the hospital admission unit. This code is then used as a unique identification number for that patient. Both of the admission and medical records units use this identification number to record patients' information upon admission and discharge. The inclusion criteria were as follow: All trauma patients with spinal trauma were included in the study. The specialists working on the cases included only a neurosurgeon, a general surgeon, an orthopedist, a neurologist, and an emergency specialist. The exclusion criteria were as follow: The patients who already had spinal trauma prior to the study and were younger than 15 years were excluded because this center only admits patients older than 15 years. Moreover, the patients who were referred to the hospital due to the need for the debridement or removal of spinal-implanted devices were not included in this study, leaving a total of 4630 spinal traumatic patients to be analyzed. No post-discharge surveillance was performed. The variables examined as the risk factors of spinal trauma included sex, age, cord injury, mechanism of injury, and injury severity score (ISS). In addition, the study protocol was approved by the Institutional Ethics Review Board affiliated to Shiraz University of Medical Sciences (approval number: 94-01-38-10406).

3.3. Definition

The present study used the abbreviated injury scale (AIS) to classify the different types of injuries for each anatomical location. In the AIS, 1 shows "the least severe" and 6 "the most severe". The injury severity score (ISS) was then calculated by adding up the scores of 3 body locations with the most severe injuries (14). In defining spinal trauma, the present study used the international classification of disease, tenth revision, clinical modification (ICD-10-CM) codes (15).

3.4. Data Management and Statistical Analysis

The point prevalence of spinal trauma in the traumatic patients was computed by the frequency of the new spinal traumatic patients divided by all the traumatic patients in the study period. Categorical variables were compared using chi- square test. A univariate analysis was performed to detect the effect of risk factors on mortality in spinal traumatic patients, spinal trauma among trauma patients, and cord injury among spinal trauma patients. Moreover, 95% confidence intervals (CIs) and odds ratios (ORs) were assessed for the independent variables using logistic regression models. The statistical package for social sciences (SPSS), Version 15 (Inc., Chicago), was used for data analyses. Statistical significance was set at $P \leq 0.05$.

4. Results

In the present research, 65,535 traumatic patients were admitted in Rajaee Hospital, among whom 4630 (7%) had spinal trauma. Among the patients with spinal trauma, 171 (3.7%) had SCI. The mean age of the spinal traumatic patients was 38.2 ± 17.8. The ratio of spinal trauma of male-to-female was 2.394. In addition, respectively, 8.38% and 6.63% of the traumatic female and male patients had spinal trauma. Table 1 compares the 2 groups of patients with and without spinal trauma regarding some risk factors. Moreover, the patients with SCI and without SCI were compared in this table.

In our study, the lumbar region was the most common injured site, followed by the thoracic region in all the mechanisms of injury except for suicide that was cervical region (Table 2).

Table 3 displays the risk factors of mortality among spinal traumatic patients. It was shown that patients older than 65, patients with SCI, and patients whose mechanism of injury was suicide or car accident were more prone to death from spinal trauma.

Table 1. Bivariate Analysis of Spinal Trauma

Variables	With Spinal Trauma (N=4630)			Without Spinal Trauma (N = 60905)	Total (N = 65535)	P Value[a]
	Without Cord Injury (N = 4459)	With Cord Injury (N = 171)	P Value[b]			
Gender			< 0.001			0.01
Female	1335 (29.9)	29 (17.0)		14908 (24.4)	16274 (24.8)	
Male	3124 (70.1)	142 (83.0)		45997 (75.6)	49263 (75.2)	
Total	4459 (100)	171 (100)		60905 (100)	65535 (100)	
Age			< 0.001			0.89
15 - 44	2951 (66.1)	129 (75.4)		46463 (76.2)	49542 (75.5)	
45 - 64	1059 (23.8)	29 (17.0)		10236 (16.8)	11324 (17.2)	
> 64	449 (10.1)	13 (7.6)		4204 (7.0)	4665 (7.3)	
Total	4459 (100)	171 (100)		60903 (100)	65531 (100)	
Outcome			< 0.001			< 0.001
Survived	4382 (98.2)	148 (86.5)		59947 (98.4)	64477 (98.4)	
Died	77 (1.8)	23 (13.5)		957 (1.6)	1058 (1.6)	
Mechanism of injury			0.003			0.047
Car accident	1853 (41.6)	79 (46.2)		23579 (38.8)	25526 (39.0)	
Motorbike accident	673 (15.1)	13 (18.1)		13304 (21.9)	13990 (21.3)	
Pedestrian accident	406 (9.2)	5 (2.5)		4930 (8.0)	5345 (8.3)	
Assault	133 (2.9)	17 (9.9)		6986 (11.4)	7137 (10.9)	
Falling down	1191 (26.8)	25 (14.6)		8932 (14.7)	10159 (15.5)	
Suicide	7 (0.1)	13 (7.6)		130 (0.2)	137 (0.2)	
Struck by object	196 (4.)	1 (0.6)		3044 (5.0)	3241 (4.8)	
Injury severity score			< 0.001			0.050
1 - 3	26 (0.5)	7 (4.1)		9739 (31.1)	9747 (27.2)	
4 - 8	2392 (53.6)	15 (8.8)		5789 (18.5)	8196 (22.9)	
9 - 15	1760 (39.5)	23 (13.5)		9953 (31.7)	11736 (32.7)	
> 16	281 (6.4)	15(8.8)		5890 (18.7)	6186 (17.2)	
Length of stay, days			< 0.001			< 0.001
< 1	619 (13.9)	56 (32.7)		27564 (45.2)	28239 (43.2)	
1 - 2	1715 (38.5)	37 (21.7)		17811 (29.2)	19563 (29.9)	
3 - 7	1203 (27.0)	28 (16.4)		8853 (14.6)	10084 (15.3)	
8 - 30	816 (18.3)	35 (20.4)		5983 (9.9)	6834 (10.4)	
> 30	106 (2.3)	15 (8.8)		694 (1.1)	815 (1.2)	

[a] Compares the patients with and without spinal trauma.
[b] Compares the patients with and without cord injury.

Table 4 shows the risk factors of occurring spinal trauma among traumatic patients. Females were 1.28 fold more susceptible to spinal trauma. Additionally, spinal trauma increased with increase in age. Also, patients who had fallen down from height had the most possibility to hurt their spine in comparison with other mechanisms of injury.

Table 5 displays the risk factors of SCI in spinal traumatic patients. According to this table, males are 2 times more in danger of SCI. In addition, SCI occurs more in pa-

Table 2. Frequency of Spinal Trauma Region According to Injury Mechanism[a]

Variables	Cervical	Thoracic	Lumbar	Sacrum	Multi-Level	Total
Car accident	408 (21.61)	414 (21.92)	1032 (54.66)	16 (0.0.84)	18 (0.95)	1888 (100)
Motorbike accident	116 (17.33)	140 (20.92)	397 (59.34)	5 (0.75)	11 (1.64)	669 (100)
Pedestrian accident	47 (11.44)	60 (14.60)	292 (71.04)	4 (0.97)	8 (1.95)	411 (100)
Assault	29 (21.16)	42 (30.66)	64 (46.71)	1 (0.73)	1 (0.73)	137 (100)
Fall	114 (9.44)	312 (25.85)	765 (63.38)	8 (0.66)	8 (0.66)	1207 (100)
Struck by object	34 (17.89)	48 (25.26)	108 (56.84)	0 (0.0)	0 (0.0)	190 (100)
Suicide	5 (71.42)	0 (0.0)	1 (14.28)	0 (0.0)	1 (14.28)	7 (100)

[a]Values are expressed as No. (%).

Table 3. Logistic Regression Coefficients and Odds Ratios for Predictors of Mortality Among Spinal Traumatic Patients

Variables	Wald[a]	P Value	OR (95% CI)[b]
Gender			
Female	-	-	1
Male	0.010	0.919	1.02 (0.6 - 1.58)
Age			
15 - 44	-	-	1
45 - 64	4.124	0.042	1.6 (1.0 - 2.6)
> 64	29.204	< 0.001	3.8 (2.3 - 6.2)
Cord injury			
Without cord injury	-	-	1
With cord injury	74.882	< 0.001	8.8 (5.3 - 14.4)
Injury severity score			
1 - 8	-	-	1
9 - 15	1.734	0.188	1.3 (0.8 - 2.1)
16 - 24	0.270	0.603	1.3 (0.4 - 3.7)
> 24	3.587	0.058	2.7 (0.9 - 7.9)
Mechanism of injury			
Fall	-	-	1
Motorbike accident	1.932	0.165	1.6 (0.8 - 3.5)
Pedestrian accident	1.876	0.171	1.7 (0.7 - 4.1)
Assault	0.597	0.440	1.6 (0.4 - 5.7)
Car accident	7.660	0.006	2.2 (1.2 - 4.0)
Struck by object	2.029	0.154	2.1 (0.7 - 5.8)
Suicide	5.478	0.019	13.4 (1.5 - 118.8)

[a]Ration of the squared regression coefficient to the squared standard error.
[b]Odds ratios and 95% confidence intervals.

tients older than 65. Besides, among all mechanisms of injury, suicide makes the spinal traumatic patients more susceptible to SCI in comparison with other mechanisms of injury.

5. Discussion

Acute injuries of the spine and spinal cord are among the most common causes of severe disability and death after trauma (16-18). In a systematic review study, the in-

Table 4. Logistic Regression Coefficients and Odds Ratios for Predictors of Spinal Trauma Among Traumatic Patients

Variables	Wald[b]	P Value	OR (95% CI)[b]
Gender			
Male	-	-	1
Female	56.978	< 0.001	1.28 (1.20 - 1.37)
Age			
15 - 44	-	-	1
45 - 64	163.771	< 0.001	1.60 (1.49 - 1.72)
> 64	92.131	< 0.001	1.65 (1.49 - 1.83)
Mechanism of injury			
Assault	-	-	1
Motorbike accident	91.092	< 0.001	2.38 (1.99 - 2.85)
Pedestrian accident	197.099	< 0.001	3.89 (3.22 - 4.70)
Car accident	245.360	< 0.001	3.82 (3.23 - 4.51)
Fall	444.578	< 0.001	6.35 (5.35 - 7.54)
Suicide	98.819	< 0.001	2.99 (2.41 - 3.71)
Struck by object	5.296	0.021	2.49 (1.14 - 5.42)

[a]Ration of the squared regression coefficient to the squared standard error.
[b]Odds ratios and 95% confidence intervals.

Table 5. Logistic Regression Coefficients and Odds Ratios for Predictors of Cord Injury Among Spinal Traumatic Patients

Variables	Wald[a]	P Value	OR (95% CI)[b]
Gender			
Female	-	-	1
Male	12.799	< 0.001	2.0 (1.3 - 3.1)
Age			
15 - 44	-	-	1
45 - 64	0.007	0.973	1.07 (0.8 - 1.7)
> 64	0.051	0.048	1.3 (0.5 - 2.1)
Mechanism of injury			
Pedestrian accident	-	-	1
Motorbike accident	3.208	0.073	2.3 (0.9 - 6.1)
Car accident	6.749	0.009	3.3 (1.3 - 8.1)
Assault	3.381	0.066	2.5 (0.9 - 6.9)
Fall	3.906	0.048	2.6 (1.0 - 6.8)
Struck by object	7.672	0.006	4.3 (1.5 - 12.0)
Suicide	3.517	0.061	7.8 (0.9 - 67.6)

[a]Ration of the squared regression coefficient to the squared standard error.
[b]Odds ratios and 95% confidence intervals.

cidence rates of traumatic SCI in Asia ranged from 12.06 to 61.6 per million (19). In developing countries, the rate of SCI incidence was 25.5/million/year (5) and SCIs constituted 23.3% of all spinal injuries (9). In our study, the prevalence rate of spinal trauma among all traumatic patients was 7%. Also, in our survey, among the patients with spinal trauma, 3.7% had SCI. According to these results, the prevalence of SCI in our survey was much lower than the others.

In a systematic review, the mean age of traumatic SCI ranged from 26.8 to 56.6 years (19). Also, Oliver M et al. showed that the frequency of SCI increases when people grow older (2). In addition, our results showed that SCI increases with increase in age. This can be justified by the fact that the spines get more osteoporotic with increase in age, increasing the possibility of SCI (20, 21).

According to our study, the ratio of spinal trauma of male-to-female was 2.394. This is because of the higher number of traumatic male patients than traumatic female patients. Also, other studies show that male injury was markedly more than female injury (16, 18, 21). On the other hand, 8.38% of the traumatic females and 6.63% of traumatic males had spinal trauma, and according to our results, females were 1.28 more prone to spinal trauma than males.

The most common causes of spinal injuries in most studies were motor vehicle accidents (52%) and falls (43%) (22-24). Car accident, followed by fall and motorbike accident were the main causes of spinal trauma in our study. This may be because of more prevalence of car accident in Iran than other mechanisms of trauma (25, 26).

The cervical region was the most common region of spinal injury in various studies (17, 18, 23). However, a few studies showed that thoracolumbar injuries were the most frequent ones (10, 11). Also, in our study, the lumbar region was the most common injured site, followed by thoracic region in all the mechanisms of injury except suicide.

In recent years, there has been an increase in the studies on the risk factors for mortality of traumatic SCIs that may ultimately become the focus of prevention strategies (27). According to previous studies, SCIs in an elderly patient is associated with higher mortality (8, 10). Also, our research indicates that patients older than 65 are 3.8 fold more prone to death from spinal trauma; this result is consistent with previous studies mentioned above. Besides, occurrence of SCI in the spinal traumatic patients was another risk factor for mortality. Suicidal attempt was another important risk factor of mortality in spinal traumatic patients in our survey. In addition, patients, whose mechanism of injury was car accident, were 2.2-fold more susceptible to death in comparison with other mechanisms of injury. Also, in a study done in Tianjin, China, most of dead spinal traumatic patients had been injured in a motor vehicle collision (8).

There are some risk factors for SCI in traumatic patients. According to our results, males were 2 times more in danger of cord injury than females. This result is similar to another study that was done in Guangdong, China (28). In addition, our study showed that cord injury occurred more in patients older than 65 in Iran and this result was repeated in a study that in the United States (29). In contrast with our survey, Wang H et al. revealed that young people were more prone to SCI in China. Thus, patients younger than 15 years were not included in our study. Moreover, we found that among all mechanisms of injury, suicide makes the spinal traumatic patients more susceptible to cord injury compared with other injuries, our finding was in contrast to another study that introduced high falls as the major mechanism for SCI (30).

This study had some strong points. One of them was inclusion of all the patients who referred to Rajaee Hospital in the study period. In addition, this study was performed on a large sample size in 5 years, thus making the results more accurate and reliable. On the other hand, the present research had some limitations, such as not including patients younger than 15 years and those who were dead on the scene of accident and had not arrived in the hospital. So, further studies are recommended to be conducted. Moreover, future studies in other provinces of Iran are highly recommended to find more accurate and comprehensive results.

5.1. Conclusion

According to our research, spinal trauma is associated with some risk factors that can be reduced by eliminating them. Fall was the most prominent factor in occurrence of spinal trauma. Also, mortality in spinal traumatic patients can be reduced by considering the fact that the most important risk factors of mortality are suicide and cord injury. Finally, SCI and its predisposing factors are the other devastating events that were discussed in this study. It should be noted that suicide played the most important role in occurrence of SCI.

Footnotes

Conflict of Interests: None.

Ethical Approval: The study protocol was approved by the Institutional Ethics Review Board affiliated to Shiraz University of Medical Sciences (approval number: 94-01-38-10406).

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