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Epidemiological and Clinical Features of Cervical Column and Cord Injuries; A 2-Year Experience from a Large Trauma Center in Southern Iran

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ABSTRACT

Objective: To describe the epidemiological characteristics of patients with cervical spine injury admitted to Rajaee hospital, Shiraz, Iran.
Methods: This cross-sectional study includes all patients admitted with impression of cervical column injury with or without cervical cord injury from October 2009 to March 2012 to our level I trauma center in Shiraz. We recorded the patients' characteristics including age, sex, marital status, mechanism of injury, level of injury, concomitant injury, treatment(non-operative or operative) and clinical outcome. The data were described and compared with the international literature.
Results: Among 261 patients referred with impression of spinal cord injury, the diagnosis of spinal column injury (with or without spine cord injury) was confirmed in 206 patients. The mean age of patients was 37.2±15.9 years with Male/Female ratio of 3:1. Car turn-over and car-collisions were the leading causes of injury. The most common spine fracture was C6 vertebra involving 60 (29.1%) patients. Fracture of upper and lower extremities were the most concomitant fractures observed in 31(15.1%) patients. Open surgery was performed in 65(31.6%).Mortality rate was 7.3% (15 patients).Patients with brain, lung and cord injuries had increased risk of death, among 15 deaths,9 patients had brain injury, 5 individuals had lung injury and 10 patients suffered from cord injury.
Conclusion: Cervical spine injuries mostly affect young males, and comprise 206 (10%) cases out of 2100 spine injuries in our country. Preventive measures should be taken to reduce cervical spine injuries especially in young age group.

Keywords: Cervical column injury; Spinal cord injury; Epidemiology; Trauma; Iran.

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Introduction

Traumatic spine injuries are the major cause of morbidity and mortality in many countries [1]. In Canada, the average incidence of spinal column injuries (SCI) is about 52.5cases per million persons per year [2], whereas in United States this estimation is about 40 cases per million individuals [3]. Traumatic

spine injuries can be either spinal column injury (SCI) or spinal cord injury (SI) or both, that result in disability, mortality and imposing heavy financial cost on health care system [4]. Cervical spinal column injury is of greater importance due to concomitant head injury, difficult intubation and the complications such as quadriplegia and paraplegia [5]. An important preventive measure for decreasing this national health problem is to obtain epidemiological data which enables us to identify causes and risk factors associated with SCI and to improve laws and safety guidelines and educate target groups [6,7].

Currently, data regarding the prevalence of SI and SCI in Iran is scarce and few reports have embarked on this important issue. The estimated annual incidence of traumatic SI in Tehran was reported to be 44 per 1,000,000 people [8] and according to another study, it was 16.35 per 100,000 individuals with spinal cord and head injuries being the highest burden of associated contusions of spine fractures [9]. The present study was conducted to evaluate the prevalence of cervical SI and cervical SCI for a period of 2.5 years among those admitted to a level I trauma center in southern Iran. Additionally, the frequency of such injuries was analyzed with respect to age, sex, marital status, mechanism of injury, level of injury, concomitant injury, treatment (non-operative or operative) and clinical outcome.

Materials and Methods

Study population

This was a retrospective cross-sectional study which was conducted during a 30-months period from October 2009 to March 2012 in Rajaee Trauma Hospital, a level I trauma center affiliated with Shiraz University of Medical Sciences, Shiraz, Iran. Shiraz is the capital and main city of Fars province with an estimated population of 1,460,665 according to the recent national census. The age distribution of the Shiraz population is as follow: 525,253 (42.7%) age 18-29 years, 257,048 (20.9%) age 30-39 years, 205,129 (16.7%) age 40-49 years, 125,862 (10.2%) age 50-59 years and 115,424 (49.9%) age ≥60 years. We included all the patients admitted to the emergency department of our center with impression of cervical spinal column and cervical spinal cord injuries. Cervical spine injuries were defined as fractures of the all elements of cervical spines (C0/C1 to C7/T1) diagnosed with cervical X-ray, cervical-CT (frequently supplemented with cervical MRI).The patients with no fracture or cord injury were further excluded from the study. Spinal cord injury was defined as neurological (sensory, motor or sphincter) deficit accompanied by vanished spinal cord reflexes determined by physical examination. The study protocol was approved by institutional review board (IRB) of Shiraz University of Medical Sciences. As this was a retrospective study, the medical research ethics committee of the university did not require informed written consents to be filled by the patients.

Study protocol

Medical charts of the patients were reviewed and the data were extracted using a standard data collecting form. We recorded the characteristics of the patients age, sex, marital status, mechanism of injury, level of injury, concomitant injury, treatment (non-operative or operative) and clinical outcome. We recorded the concomitant thoracolumbar fracture,neurological deficit at the time of diagnosis (normal, radiculopathy, incomplete SI, complete SI and mortality 1 and 3 months after the diagnosis. Vital status (dead or alive) and time of death were also determined. Neurologic function was assessed according to the American Spinal Injury Association (ASIA) scale from E to A [10].

Statistical analysis

The statistical package for social science, SPSS for Windows, Version 16.0 (SPSS Inc., Chicago, IL, USA) was used for data analysis. Data are reported as mean ± SD and proportions as appropriate. The data were further compared between men and women and the outcome using chi-square test and independent t-test for non-parametric and parametric data respectively. A *p*-values less than 0.05 was considered statistically significant.

Results

Age, Sex, mechanism of injury

There were 261 patients admitted with impression of cervical SCI (with or without SI) over 2.5 years. After re-evaluation of patients' documents and x-rays, 55 subjects were excluded from the study because of not having spine or cord injury, and the remaining 206recruited in the study. The mean age of patients was 37.2±15.9 years. Among 206 patients, 155(75.2%) were males and 51 (24.8%) were females with M/F ratio of 3:1.Table 1 summarizes the demographic information and the mechanisms of injury of 206 patients.

Fracture location

The most common spine fracture was C6 vertebra in 60 (29.1%) cases, and the least injuries were combination C1-C2 fracture found in 8 (3.9%) patients. There were 64 cases with upper cervical (C0-C1-C2) and 205 with lower cervical fractures. The site of fractures is demonstrated in Table 1. The impairment scale according ASIA scale is demonstrated in Table 2.

Table 1. Baseline characteristics of cervical column and cervical cord injuries in 206 patients admitted to our center between October 2009 and March 2012.

Characteristic	Value
Age (years)	37.2±15.9
Gender	
Men (%)	155 (75.2%)
Women (%)	51 (24.8%)
Marital status	
Married (%)	157(76.2%)
Single (%)	49(23.8%)
Mechanism of injury	
Car to Car (%)	45 (21.8%)
Car to Motor (%)	20 (9.7%)
Car to Pedestrian (%)	11 (5.3%)
Motor to motor (%)	4 (1.9%)
Motor to Pedestrian (%)	3 (1.5%)
Car turn-over	79(38.4%)
Motor turn over (%)	10 (4.9%)
Falling down (%)	23 (11.2%)
Blunt (%)	7(3.4%)
Other (%)	4 (1.9%)
Level of Fracture	
Atlas Fracture (%)	9 (4.4%)
Axis Fracture(%)	39 (18.9%)
Combination C1-C2 Fracture (%)	8 (3.9%)
C3 Fracture (%)	28 (12.6%)
C4 Fracture (%)	25 (12.1%)
C5 Fracture (%)	42 (20.4%)
C6 Fracture (%)	60 (29.1%)
C7 Fracture (%)	50 (24.3%)

Table 2. Clinical and fracture characteristics of 206 cervical column and cervical cord injuries included in the current study.

Characteristic	Value
ASIA Scale	
A	28(13.6%)
B	0(0%)
C	12(5.8%)
D	13(6.3%)
E	153(74.3%)
Cord injury	
Complete (%)	29 (14.1%)
Incomplete (%)	25 (12.1%)
Intact (%)	152 (73.8%)
Location of concomitant injury	
Fracture of Face and skull	23(11.2%)
Fracture of upper ext	16(7.8%)
Fracture of lower ext	15(7.3%)
Fracture of chest and pelvic	15(7.3%)
Fracture of other spine	23(11.2%)
Lung Injury	20(9.7%)
Brain Injury	39(18.9%)
Abdomen Injury	1(.5%)
Glasgow Coma Score (GCS)	
Mild	178(86.4%)
Moderate	13(6.3%)
Severe	15(7.3%)
Treatment	
Non-Operative (%)	161(68.4%)
Posterior fixation, fusion decompression (%)	15 (7.3%)
Anterior fixation, fusion decompression (%)	44 (21.4%)
360 degree (%)	1(.5%)
Type 2 odontoid Anterior screw fixed	5 (2.4%)
Outcome	
Discharge (%)	180 (87.4%)
Release (%)	11 (5.3%)
Death (%)	15(7.3%)

Location concomitant injury and GCS

The concomitant injuries were categorized as brain, lung and abdominal injuries. Craniofacial fractures (23, 11.2%) and fracture of other parts of spine (23, 11.2%) represented the most prevalent concomitant fractures. Thirty-nine (18.9%) patients suffered brain injury and 20 (9.7%) patient had injury to the lung. One patient had internal bleeding and hemodynamic instability due to abdominal trauma and liver laceration that required urgent operation. Glasgow Coma Score (GCS) of all patients in the study group was documented on admission, and 178 out of 206 (86.4%) patients suffered mild brain injury (GCS 13–15). Thirteen (6.3%) subjects had moderate (GCS 9–12) and 15 (7.3%) had severe brain injuries (GCS≤8).

Treatment Methods

The most common type of operation was anterior decompression, fixation and fusion in 44 patients (21.4%) followed by Posterior decompression, fixation and fusion in 15 patients (7.3%). Five (2.4%) patients had Type 2 odontoid fracture and

Table 3. Factors associated with mortality in 206 patients with ervical column and cervical cord injuries included in the current study.

	Alive (n=191)	Dead (n=15)	*P*-value
Age (years)	36.8±15.6	42.2±15.3	0.182
Length of Stay (days)	6.9±8.3	16.8±14.1	<0.001
Brain injury	30 (15.7%)	9 (60.0%)	<0.001
Lung injury	15 (7.8%)	5 (33.3%)	0.008
Facial fracture	19 (9.9%)	4 (62.6%)	0.070
Other spine fracture	19 (9.9%)	4 (62.6%)	0.070
Cord injury	44 (23.1%)	10 (66.6%)	0.001
Axis fracture	39 (20.4%)	0 (0.0%)	0.080
C5 fracture	36 (18.8%)	6 (40.0%)	0.087

underwent anterior screw fixation and one case had 360-degree fixation. The remaining 161 (68.4%) patients had non-operative management.

Outcome

Fifteen patients (7.3%) expired during hospital stay. Eleven patients (5.3%) were released before completion of recovery and went to private hospitals on their own request and 166 (87.4%) patients with total recovery were discharged from hospital accompanied by relatives. As shown in Table 3, comparison was made between 9 factors in two groups of survived and expired patients. Of these, 4 were associated with increasing risk of death including longer hospital stay (p=0.001), brain (p<0.001) and lung injury (p=0.008) and cord injury (p=0.001). However, facial fracture, other spine fractures, cord injury, axis fracture and C5 fracture, were not associated with increasing risk of death. Positive correlation was found between other factors which included age, hospital stay, GCS and ASIA scale. These were ASIA scale (from E to A) and length of hospital stay (p<0.001).There was negative correlation between GCS and length of hospital stay (p=0.003).

Associated injuries

Of 206 patients, 89 had associated injury (AOSI). These included brain, lung and abdominal injuries, fracture of upper and lower extremities, fracture of rib cage, pelvic, face, skull and other spine fracture. Uni-variant analysis showed that C7 fracture and death differed significantly (p=0.021) between patient with and without ASOI (Table 4). Other factors such as age, gender, cord injury and C6 fracture did not differ significantly.

Discussion

The aim of this study was to overview the epidemiological features of cervical spine injuries in our center over 30-month period. During this period, 2100 patients were admitted with impression of spine injury of which 265 patients were suspected of having cervical spine fracture. Diagnosis of SCI with or without SI was confirmed in 206 patients. These 206 patients sustained 269 cervical spine fractures. Majority of patients were men (155, 75.2%). The most common fracture was C6 vertebra (60 patients, 29.1%). ASIA E was the most common ASIA scale (153, 74.3%). About 39% of patients underwent surgery during their hospital stay and overall mortality rate was 7.3% (15 patients).The mean age of patients was 37.2±15.9 years that was consistent with Santos *et al.*, [11] study that reported mean age of 36.75 years. However, Clayton *et al.*, [12] documented mean age of 32.5 years that is less than that of our study that can be due to different age distribution. In Taghipour *et al.* study in Shiraz in 2002 the mean age of patients with SCI was 35 years that is very similar to our finding [13]. In our

Table 4. analysis comparing patients with and without associate injuries (ASOI).

Variable	ASOI (n=89)	No ASOI (n=117)	*P*-Value
Age	38.5 ± 15.5	36.1 ± 15.6	0.227
Gender (M:F)	65:24	90:27	0.625
Cord injury	25 (28.1%)	29 (24.7%)	0.633
C6 fracture	32 (35.9%)	28 (23.9%)	0.065
C7 fracture	29 (32.6%)	21 (17.9%)	0.021
Death	12 (11.1%)	4 (2.6%)	0.007

study the number of male patients was more than females. This is in agreement with the results of previous studies [11,12,14].

Vehicle accidents was the most common cause of injury (179 patients, 83.5%) and car turn-over was the most frequent type of accident with 79 (38.4%) patients. Fredиш HL *et al.*,[14] declare falls as the major causes of trauma as in 60% and car accidents in 21% in their studypopulation, which was comparable with that of Santos EA *et al.* report [11]. Clayton JL *et al.* documented motor vehicle collision as the cause of 50% of cervical spine injury [12]. It is worthy of mention that regulation of car driving, quality of roads, driving license issuing process and driving fines could not prevent car accidents in Iran.

The most frequent injured level was C6, followed by C7 and C2, which is not in agreement with previous studies [15,16]. About 25% of fractures were upper cervical (C0,C1,C2 and combination C1-C2) and the remaining 75%involved lower cervical (C3-C7) which is nearly similar to those of previous reports [11,15]. In our study, 54 (26.2%) patients had cordinjury, whose mean age was 39.6 years which was different from46.82 years reported by Erdoөan MIJ *et al.* in their study in Haydarpaşa Numune Training and Research Hospital, Turkey [17]. Previous studies from Iran reported 38.2 and 31 years that is similar to our finding [8,18].

We had 62 (30%) patients with head injuries including brain injury and craniofacial fractures compared with 26% observed by Leucht P*et al.* in their study. Extremity fracture was found in15% of our patients with cervical spine injury which was different from 36% observed in the study of Leucht P *et al.* who reported spine injury at any level [19]. Therefore we had more head injury and less extremity fracture. Rush JK *et al.* found thoracic injury to be the most common associated injury followed by 45% multi-level spinal fracture. All individuals in their study were less than 19 years, and with short stature; Hence, the lung and vertebrae were more prone to pedestrian trauma resulting from car accident [20]. These 206 individuals had 269 cervical spine fractures that equaled 1.3 cervical fractures per patient; besides 23(11.2%) subject shad vertebral fractures other than cervical. Thus in patients with neck trauma, evaluation of the whole spine is very important, since this would help rule out upper or lower cervical fracture after detecting a cervical spine fracture.

A total of 60 operations on cervical spine were done aiming at decompression and stabilization of cervical spine; however seven of these patients died at hospital due to general poor condition associated with trauma and brain and lung contusions. Additionally, 53 cases were discharged after relative recovery. Brain, lung and cord injuries were all significantly associated with death and their respective *p*-values were 0.000, 0.008 and 0.001, while we found no GCS associated mortality. Thus it is necessary to perform complete primary examination of neck trauma patients, beside back support and vertebral immobilization, especially with respect to brain and lung surveys.

The limitations of our study included uncertainty about impression of cervical spine fracture, beside incomplete data in some files.

In conclusion, our study provided epidemiological features of cervical spine injury at the largest trauma center of southern Iran. Cervical spine injury is not infrequent in our country and our province. Car accidents and falls are the main causes of cervical column fracture involving 26% of patients with cord injury. Young men are the most common age group suffering from this injury in our center. We also concluded that there is a strong association between brain, lung and cord injury and death which calls for wearing crash helmet and fastening seat belt to protect these vital organs and reduce mortality.

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Conflict of interest: None declared.

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