Research Paper:

Traumatic Spinal Cord Injuries Due to Motor Vehicle Accidents

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ABSTRACT

Background and Aim: Spine trauma is an important health problem. Traumatic Spinal Cord Injury (SCI) due to Motor Vehicle Accident (MVA) might have a different epidemiologic pattern in Guilan province of Iran owing to its geographical characteristics. Therefore, the present study was conducted to the study epidemiology of SCI injuries due to road accidents in a trauma referral center in Guilan.

Methods and Materials/Patients: In this cross-sectional study, we used data SCI registry of Poursina Hospital. All the patients with spine trauma, due to MVA, hospitalized in the trauma center of Poursina Hospital, Rasht, Guilan, Iran between March 2015 and March 2018 were studied.

Results: A total of 127 patients with spine trauma due to MVA were reviewed. The Mean±SD age of patients was 38.27±16.22 years. We observed that 93.7%, 1.6%, and 4.7% of the patients had initial Glasgow Comma Scale (GCS ≥13, 9 ≤GCS ≤12, and GCS<9, respectively). SCIs were found several anatomical regions including cervical (n=54, 42.5%), lumbar (n=39, 30.7%), thoracic (n=23, 18.1%), thoracic and lumbar (n=7, 5.5%), thoracic and cervical (n=3, 2.4%), and lumbar and cervical (n=1, 0.8%) regions. Evaluated by Glasgow Outcome Scale (GOS), good recovery, moderate disability, severe disability, vegetative state, and death were found in 114(91.2%), 4 (3.1%), 4(3.1%), 1(0.8%), 2(1.6%) of the patients, respectively. Two patients were discharged by their personal contest.

Conclusion: Spine trauma due to MVA is mostly seen in the young. SCI due to such trauma is mostly found in the cervical region. Good recovery was seen in most of the subjects.

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Highlights

- Out of 127 MVA-induced TSCI patients, 99 (78%) were male and 28 (22%) were female.
- Accident with cars/pickup trucks was the main cause of TSCI among patients (76.9%).
- Drivers and passengers made up 72.1% (n=80) and 27.9% (n=31) of the patients, respectively.
- The most and least common places for accidents to occur were cities (84.3%) and highways (5.5%).
- The most and least common anatomical regions injured due to MVA were cervical (42.5%) and lumbar-cervical regions (0.8%).
- Ninety-three patients (83.8%) used no safety device and 18 (16.1%) used safety belts or helmets.
- The GCS≥13 was reported for 93.7% of patients; 4.7% had GCS <9, and 1.6% experienced 9≤GCS≤12.
- According to Glasgow outcome scale results, good recovery, moderate disability, severe disability, vegetative state, and death were observed in 91.2%, 3.1%, 3.1%, 0.8%, 1.6% of patients, respectively.

Plain Language Summary

Traumatic Spinal Cord Injuries (TSCIs) are health-threatening complications mostly occur due to Motor Vehicle Accidents (MVAs). In order for health system to make plans for TSCI patients' management, it is important to identify epidemiologic pattern of accidents in different geographical regions. Therefore, thorough study of the factors predicting the incidence, types, and locations of accidents and also the types of the associated injuries could be preventive. In the present cross-sectional study, we evaluated TSCI patients' data by using traumatic spinal cord injury (SCI) registry of Poursina Hospital. All the patients who experienced spinal cord injuries due to MVAs in Guilan province between March 2015 and March 2018, were enrolled in this study. Among 127 patients with the Mean±SD age of 38.27±16.22 years, 91 and 36 had collision and overturn accidents, respectively. Among these patients, majority (76.9%) experienced SCI as a result of car/pickup trucks accident, and the accidents were predominantly occurred in cities. Although all of the study subjects suffered from SCI at least in one of their spinal regions, 93.7% of them had good initial Glasgow Comma Scale (GCS≥13). Moreover, indicated by Glasgow Outcome Scale (GOS), we found that 91.2% of the patients had good recovery. Based on our findings, it can be suggested that MVA-induced SCI is mostly observed in the young patients, and the most affected spinal region is cervical region.

1. Introduction

Traumatic Spinal Cord Injury (SCI) is an important health problem imposing an enormous financial burden upon health care system. SCI is disabling and is mostly seen in the young [1]. Prevention of SCI is critical because it is incurable. Understanding epidemiological findings of SCI is vital for prevention and planning clinical services [2]. SCI can result in serious disability and cause dysfunctions in many organs, such as respiratory, gastrointestinal, urinary, and autonomic nervous system, skin, bone, and joints. These may in turn lead to movement disorders, serious complications, and a high mortality rate during both acute and chronic stages of SCI [3]. Almost 17,500 new SCI occur in the United States each year [4].

The mechanisms of these injuries may be traumatic or nontraumatic [4]. The three most common causes of traumatic SCI are transportation (especially road traffic crashes), falls, and violence (including self-harm), respectively. Across all regions, sport and leisure activities account for less than 10% of all cases of traumatic SCI [5]. Studies suggest that the leading causes of nontraumatic spinal cord injuries are neoplastic tumors and degenerative conditions of the spinal column, followed by vascular and autoimmune disorders, tuberculosis and other infectious diseases, congenitally and genetically such as spina bifida [5].

The symptoms of spinal cord lesion depend on the extension of the injury or non-traumatic cause. They include loss of sensory or motor control of the lower limbs, trunk and the upper limbs, and loss of autonomic regulation of body, disrupting breathing, heart rate, blood pressure, temperature control, bowel and bladder control, and sexual function. The higher the level of SCI, the greater the extent of disability. Cervical SCI commonly causes sensory and motor deficit (paralysis) in arms, body, and legs, a condition called tetraplegia or quadriplegia.

Patients with lesions at level of C4 or higher may need to use a ventilator to breathe, because the lesion directly affects the autonomic control. Thoracic SCI typically causes sensory and/or motor loss in the trunk and legs, which is called paraplegia. Lumbar SCI commonly causes sensory and motor loss in the hips and legs. All forms of SCI may also give rise to chronic pain. The SCI extension and severity of sensory, motor and autonomic system loss depends on the level of SCI, and also on whether the lesion is complete or incomplete. According to the International Standards for Neurological Classification of SCI published by the American Spinal Injury Association (ASIA), a complete SCI is defined as if there is no sensory and motor function at S4–S5, while in incomplete SCI, some sensory and or motor function is preserved below the level of injury, such as in the lowest sacral segments (S4-S5) which can still cause severe impairments [5].

Studies have shown that people with SCI die 2 to 5 times as early as people without SCI. Causes of death in SCI vary from urinary tract and cardiovascular disease (mostly ischemic heart disease) and respiratory complications. Causes of death in SCI patients are similar to those in the general population due to improved early medical care, specialized rehabilitation and regular follow-up visits. However, the longevity of patients with SCI is still less than that of general population [6].

Mortality of SCI patients is influenced by neurological level of injury (tetraplegic patients die earlier than paraplegics and cervical SCIs are associated with higher mortality than lumbar SCIs), completeness of the SCI, old age, presence of multisystem trauma, high-energy injury mechanisms. Death is more probable in SCI patients during the first year(s) subsequent to injury. Annual mortality rates are high, with 3.8% of patients dying in the first year after injury, 1.6% in the second year and then 1.2% for every year thereafter [5-7]. Men are at higher risk of TSCI, compared to women however, the gender ratio vary in different regions [2]. The mortality rate of traumatic SCI in men is 3 times higher than in women and the severity of injury in TSCI is approximately 5 times higher than in nontraumatic SCI [8].

Moreover, average age of patients with SCI varies in different countries. More recently, several studies have reported an increase in average age of patients with SCI in the USA as the median age of general population of the USA has increased by approximately 9 years since the mid-1970 [9]. In the National Spinal Cord Injury Statistical Centre Database of USA, the average age of patients with SCI has increased from 28.7 years during the 1970s to 41 years since 2005 [9]. The proportion of people who are injured after the age of 60 increased from 5 % to 13 % during the same period [10]. In a retrospective study in Tehran from 2010 to 2011 the mean age of patient with TSCI was 33.2±14.3 years [11]. Children are less likely to be affected by spinal injuries, compared to the adult [12].

It has been demonstrated that the motorcycle riders have more severe injuries, more extremity traumas and a high mortality rate than car drivers and the patterns of spinal injury are consistent with forced hyperflexion of thoracic spine in that, in car occupants, prominence of cervical injuries and higher incidence of neck and facial injuries may reflect abdominothoracic seat belt restraint [13].

Post-SCI disabilities place a huge burden on the patient and their family, as well as being heavy financial burden on the society and the health care system [14]. The differences in culture and climate and also urban texture can have a direct impact on the incidence of SCI and even their types and levels [15]. Road traffic crashes are the leading cause of traumatic SCI, according to WHO [5]. In Iran, the prevalence of road traffic crashes decrease from north to south of Iran, with the highest pooled road traffic crashes rate in Guilan province (79.80% [95% CI=79.1%-80.5%]) [16]. However, only a few studies on the epidemiology of traumatic SCI. Epidemiology of SCI due to road crashes is a less divulged topic in Iran. In addition, Guilan attracts travelers because of climatic conditions, especially in Nowruz holidays and summer, it appears to have a different pattern in terms of road accidents, and presumably SCI. Therefore, the present study was conducted to study epidemiology of SCI injuries due to road accidents in a trauma referral center in Guilan.

2. Methods & Materials/ Patients

In this cross-sectional study, we used data SCI registry of Poursina Hospital. All the patients with spine trauma due to motor MVA, confirmed by CT scan or MRI, who had been hospitalized in the trauma center of Poursina Hospital, Rasht, Guilan, Iran between March 2015 and March 2018, were studied. Data regarding demographic information, type of vehicle in accident, anatomical location of SCI, accident location, the type of the injured person in the accident, accident type, use of safety devices, Glasgow Comma Scale

(GCS) level, associated cardiac and respiratory diseases, complications during hospitalization, pain, duration of ICU stay, comorbid injuries and Glasgow Outcome Scale (GOS) during discharge were extracted. Descriptive statistics were calculated.

3. Results

A total of 127 patients with TSCI injuries due to MVA were reviewed. The Mean±SD age of patients was 38.27±16.22 years. Seventy-eight percent of the patients were male (n=99) and 22% were female (n=28). Male/female ratio was 3.54: 1. Ninety-one patients (71.7 %) and 36 (28.3%) patients had collision and overturn accidents, respectively. The patients had accident with car/pickup truck (76.9%), objects (15.4%), truck (4.4%), motorcycle (2.2%), and transient object/animal (1.1%). Sixty-two (48.8%) patients were car passengers; 41 (32.3%) patients were motorcyclists; 16 (12.6%) patients were pedestrians; 4 (3.1%) patients were cyclist; one (0.8%) patient was bus passenger, two patients (1.6%) were pickup truck passenger; and one (0.8%) patient was truck passenger. Drivers and passengers accounted for 72.1% (n=80) and 27.9% (n=31) of the patients, respectively. There were 107 accidents (84.3%) in cities, 13 accidents (10.2%) in rural places, and 7 accidents (5.5%) in highways.

SCIs were found several anatomical regions including cervical (n=54, 42.5%), lumbar (n=39, 30.7%), thoracic (n=23, 18.1%), thoracic and lumbar (n=7, 5.5%), thoracic and cervical (n=3, 2.4%), and lumbar and cervical (n=1, 0.8%) regions. Ninety-three patients (83.8%) used no safety device; 17 patients (15.3%) used safety belt; and only 1 patient (0.8%) used crash helmet. GCS≥13 was scored in 93.7% of patients; 4.7% of the patients had GCS <9, and 1.6% experienced 9≤GCS≤12 (Figure 1). One hundred patients (94.5%) showed no cardiovascular disease; five patients (3.9%) experienced high blood pressure; one patient (0.8%) had stroke; and one patient (0.8%) had palpitation. One hundred twenty-six patients (99.2 %) showed no respiratory disease; even so, only one patient (0.8 %) had asthma. Most of the patients (124 patients) showed no complications after hospitalization; two patients had fever; and one patient suffered from CSF leakage (97.6%, 1.6%, 0.8% respectively).

According to VAS, Mean±SD pain score of the patients was 5.39±1.14. Mean±SD duration of hospitalization in ICU was 6.40±10 days (Median=2, Range=35). Evaluated by GOS, good recovery, moderate disability, severe disability, vegetative state, and death were seen in 114 (91.2%), 4 (3.1%), 4 (3.1%), 1 (0.8%), 2 (1.6%) patients, respectively (Figure 2). Two patients were discharged by their personal Consent.

4. Discussion

The aim of this investigation was to evaluate epidemiology of traumatic spine injuries due to motor vehicle accidents during in Poursina Hospital of Guilan. Poursina Hospital is a referral therapeutic center for trauma. According to the results of the present study, the Mean±SD of age of patients was 38.27±16.22 years. In a hospital-based investigation in Tehran, the Mean±SD of age was 33.2±14.3 years [11]. In a cross-sectional study in China the Mean±SD age was 40.5±13.8 years [17].

These results show that traumatic spine is mostly seen in the young, rather than in the elderly. In this study the male/female ratio was 3.54: 1. In Iran, Taghipoor et al. and Fakharian et al. [18, 19] reported a male/female ratio of 4: 1 and 3.7: 1, respectively. In agreement with other studies [17, 20], males were shown to suffer from SCI more than females in our investigation. Type of accident for 71.7 % of the patients

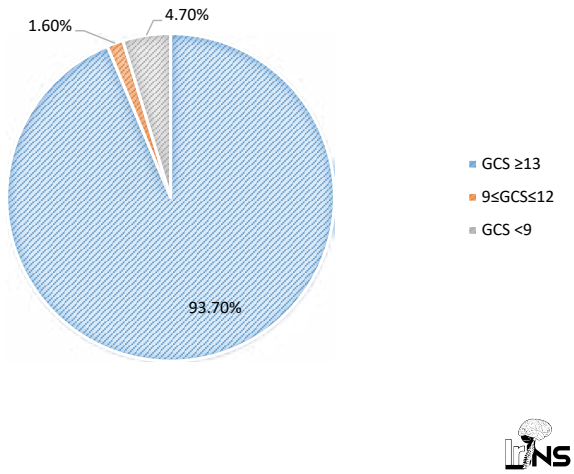

Figure 1. GCS in the patients with traumatic spine in motor vehicle accidents

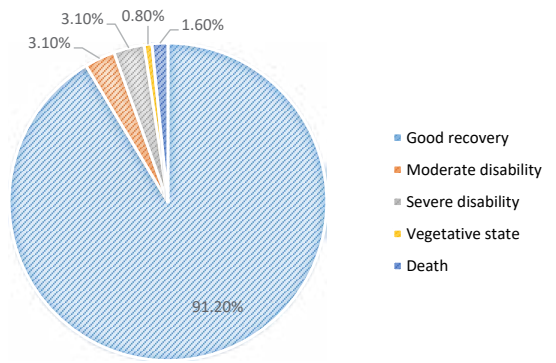

Figure 2. GOS in the patients with traumatic spine in motor vehicle accidents

was collision; nevertheless, 28.3% of them overturned. Thurman et al. showed that during 1989-1991, among car and truck passengers with SCI, 70% were involved in a vehicle rollover [21]. In the present study, the most common objects to hit were car/pickup truck (76.9%) and objects (15.4%). Car passengers, motorcyclists and pedestrians were involved in 48.8%, 32.3%, and 12.6% of accidents leading to traumatic spine. In the Thurman's study [21], 49% of persons injured in motor vehicle accidents were automobile passengers; 25% were occupants of light trucks, including pickup trucks, vans, and utility vehicles; 8.2% of the patients were motorcyclists and 8.2 % were pedestrians. Drivers and passengers made up for 72.1% and 27.9% of the subjects with traumatic spine.

Wang et al. demonstrated that in China, patients involved in motor vehicle accidents were car drivers (27.1%), pedestrians injured by cars (22.2%), and car passengers (20.8%) [17]. In our study 84.3% of the accidents occurred in cities, while 10.2% and 5.5% of them occurred in villages and highways, respectively. Thurman et al. reported that 55% of accidents occurred in urban areas, notwithstanding 45 % occurring in rural places [21]. Moreover, 26% of the accidents occurred in highways and 74% in roads or streets [21].

Anatomical locations of SCI in our study were cervical (42.5%), lumbar (30.7%), thoracic (18.1%), thoracic and lumbar (5.7%), thoracic and cervical (2.4%), lumbar and cervical (0.8%) regions. O'Corner's [22] reported that SCI occurred mostly in the cervical region, [particularly in C4 (18%), C5 (17%), and C6 (9%)], lumbar region [L1 (11%)], and lower thoracic region [T12 (6%)]. In a study carried out by Thompson et al. [23], 831 patients with traumatic spine were assessed and 63.4% of the injuries was found in cervical region, as well as 26.5% in thoracic and 10.5% in lumbar regions. Thurman et al. illustrated that Cl-C4 SCI was in 43% of their cases, in addition 40% of SCI in CS-C6 [21]. The remaining cervical SCI affected segments below C6 (8%) or did not have a precise neurologic deficit (9%). Moreover, 27% of SCI involved thoracic spinal cord; 13% involved lumbar segments; and 1% involved sacral segments.

In our study, 83.8% of the patients used no safety devices; 15.3% used safety belts; and 0.8 % used helmet. Stein's et al. pointed out that amongst patients with cervical SCI and spinal column SCI, 64.4% used safety belts [24]. They also reported that 67.4% of the patients deployed airbag. We observed that 93.7%, 4.7%, and 1.6% of our patients had GCS≥13, GCS<9, and 9≤GCS≤12, respectively. Moreover, 94.5% of patients had no cardiovascular co-disease, while 3.9%, 0.8%, and 0.8% had high blood pressure, stroke, and palpitation, respectively. Chamberlain's et al. [25] found that persons with SCI experienced mortality rates due to cardiovascular disease 2.7 times greater than that of the general population. In the present study, 99.2% of the patients was found to have no respiratory diseases and 0.8% of them had asthma.

Furthermore, most of the patients had no complications in their hospital stay and 2.4% experienced fever and CSF leakage. The Mean±SD VAS score of the patients in our study was 5.39 ±1.14. The Mean±SD duration of hospitalization in ICU was 6.4±10 days (Median=2 days, range=35 days). In a study performed by Galicia et al. [26], during 1995- 2014, 41.2% of their patients were hospitalized in ICU. Elsewhere, Maharaj showed that the median ICU length of stay was 3 days [27]. In this study approximately 90% of patients were discharged with good recovery according to GOS.

5. Conclusion

The evidence from the present study suggests that spine trauma due to MVA is mostly seen in the young. SCI due to such trauma was mostly found in the cervical region. Good recovery was seen in most of the subjects. Understanding the epidemiology of TSCI due to MVAs can be helpful for healthcare providers planning preventative strategies.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by institutional ethics committee (IR.GUMS.REC.1397.518)

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Authors contributions

Sasan Andalib and Zahra Mohtasham Amiri (co-first authors) contributed equally to the paper. All authors met ICMJE criteria.

Conflict of interest

The authors declare no conflict of interest with respect to the present paper.

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