

Traumatic spinal cord injury in southern Saudi Arabia: Patterns, time to surgery and outcomes

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ABSTRACT

Introduction: Spinal cord injury (SCI) is an unbearable neurological disorder, which has a destructive socioeconomic effect on affected individuals, their families and the healthcare systems. Stressful spinal cord damages are caused by road traffic misfortunes, violence, sports or falls. **Methods:** Retrospective study of 112 spinal cord injured patients admitted to Asser Central Hospital (ACH) between the years 2016 and 2018. **Results:** The present study includes 112 cases of TSCI patients who were admitted to Asser Central Hospital and surgically treated, with mean age 32.1 ± 14.12 years. Males were the most affected by almost 90.2%. Lower level of education is seen in 69.6% of patients; while only 30.3% of patients had university education or higher. Motor vehicle accidents (MVA) and falls are the only two causes of spinal cord injuries in this study; however, MVA was the cause of SCI in (79.5%) and 20.5% for falls. **Conclusions:** MVAs are the most source of spinal cord injuries in Southern Saudi Arabia with high male predominance. Despite the lack of significance between shorter time to surgery, and improvement in ASIA score, it was found that shorter time to surgery plays an important role in reducing the post-operative intensive care unit and ward stay, potentially reducing possible long stay related complications and eventually reducing health care cost.

Keywords: Accident, fall, injury, MVA, spinal

Introduction

Spinal cord injury (SCI) is an unbearable neurological condition where the spinal cord is injured from the foramen magnum to the cauda equina, and these injuries can lead to damage and loss of sensation and motor function,^[1] which has a destructive socioeconomic effect on the affected individual, their families, and the healthcare systems. SCIs are classified into two categories: traumatic (TSCI) and nontraumatic injuries. TSCIs result from a

quick impact on the spine that causes cracks and dislocation of vertebrae. Initial mechanical forces that affect the spinal cord at the time of injury-causing bone fragments or ligaments tear are called primary injury.^[2,3] Although traumatic spinal injuries are rare compared to other traumatic injuries, it causes destructive injuries that interrupt the functions performed by the spinal cord distal to the level of injury.^[4]

TSCIs are caused by damage due to traffic accidents, violence, sports, or falls.^[5] However, road traffic seems to be the most frequent cause of TSCI.^[6,7]

TSCIs have a high incidence in developing countries of 25.5 per million per year.^[8] Around the world, between 250,000

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and 500,000 people suffer an SCI per year. The frequency of TSCI was higher in men, with a high tendency to affect the younger age population (i.e., those aged 21 to 40 years). However, it also has a second peak for adults over age 60.^[9] Young adult injuries are more related to higher severity scores, which are caused by car accidents; however, adults over age 60 have worse outcomes, and their injuries are often from falls and age-related bone changes.^[10] There are many studies that research the epidemiological patterns around the world. However, few studies had been conducted locally.

The aim of this study is to describe the epidemiology of SCI in Saudi Arabia, which in turn will help increase awareness and reduce the incidence of SCI. In addition, there is a need to provide good epidemiological characteristics of SCI as epidemiological patterns of SCI in the region are not well characterized.

Materials and Methods

After obtaining the King Khalid University institutional review board approval and after obtaining approval from the Aseer Health Affairs Combined Ethics Committee, the authors conducted a retrospective search of electronic records of the Aseer Central Hospital (ACH) where all government-insured patients receive their treatment in the province. Research was approved from REC of King Khalid University on 28,2018.

Inclusion criteria

The researcher included all patients admitted with TSCI who are surgically treated. Data of patients who were 14 years or older are included, as per hospital age admission policy. All TSCI patients who were admitted to ACH from January 2016 to December 2018 were included.

Exclusion criteria

Total 14 Patients were excluded; these were patients who either have missing data and those who were treated conservatively.

The study question was, does the time from injury to surgery affect neurological outcome? In other words, the primary outcome was the improvement of neurological status at the time of discharge. Also, as a secondary outcome, authors evaluated the effect of time to surgery on duration of intensive care unit stay and the duration of ward stay.

All patients in the study underwent surgery including decompression and instrumentation. Our department had been using sub axial cervical spine injury classification (SLIC) to decide surgery for the cervical spine trauma, taking in mind all patients with cervical trauma had as core of 5 or more. The patients with sub axial cervical injuries were always operated anteriorly by either discectomy and plating with fusion, or corpectomy with plating the fusion. Additional posterior fixation was only considered if the posterior column elements were affected. The use of cervical traction pre-operatively was variable among surgeons.

For the thoracolumbar spine, thoraco-Lumbar Injury Classification and Severity score (TLICS) was used to decide the need of surgery, where patients with score of 4 or more were operated. The surgery in these patients was fixation with pedicle screws of one level above and one level below, if anterior and middle columns are affected, 2 levels or more above the injured level and 2 levels or more below with fusion, if the 3 columns are affected. Laminectomies were only done if evidence of spine compression is seen on imaging.

Data includes patient demographics, causes, clinical presentation, therapeutic intervention, and long-term outcomes on the American Spinal Cord Injury Association (ASIA) impairment scale score, where the baseline score was given after the resolution of expected spinal shock based on presence of bulbocavernosus reflex. The follow up lasted 6 months after discharge, however the post-op ASIA was considered at discharge due to inconsistent entry of data at follow up. The variables were entered into an Excel spreadsheet and analyzed using SPSS software of Statistics fVersion 22.0. (Armonk, NY: IBM Corp.). Descriptive statistics were presented as number and percentage for categorical data and mean and standard deviation for continuous data.

Correlation and predictors analysis between the variables were obtained, and *P* values <0.5 were considered a significant predictor of outcomes.

Results

The present study includes 112 cases of TSCI patients admitted to ACH (mean age, 32.1 years \pm 14.12). Most of the cases were from 21- to 30-year-olds (38.5%), while 33% of them were from 31- to 50-year-olds. In this study, 18.5% of patients were younger than 20 years old, and 10% were older than age 50 [Figure 1].

Males dominated the percentage of cases by 90.2%. Most cases were at high altitude areas (59.8%), and 33.0% were at low altitude areas. More than half of TSCI patients had a lower level of

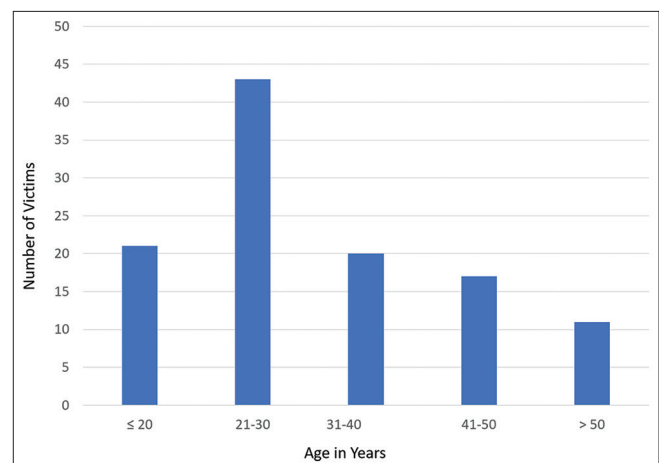


Figure 1: Victims by age

education, as 62.5% of patients had secondary level education or lower, while only 23.2% of cases had a university education or higher. Most of the cases were brought to the emergency room by car ambulance (90.1%), while 9.9% of patients came by other means of transport (e.g., families or bystanders). Patients had been admitted to ACH with cervical, lumbar, and thoracic injuries in 35.7%, 31.3%, and 33% of cases, respectively. According to ASIA classification, most cases at admission were type E (43.8%), while type A was 30.4%, and C, B, D were 14.3, 5.4%, and 6.3%, respectively. At discharge, type E prevalence increased to 59.82%, and D to 8.04% while A, B, C reduced to 25%, 0.89%, and 6.25%, respectively.

39 (34.8%) patients encountered improvement in their ASIA classification by one class or more, 5 (4.5%) patients worsened from their baseline ASIA classification by one class or more, however 68 (60.7%) remained same.

Back pain was the most common symptom expressed by patients (46.8%), while complete paralysis has occurred in 30.4% of cases [Table 1].

Motor vehicle accidents (MVAs) and falls are the two leading causes of spinal cord injuries in our sample; however, MVAs were the most frequent (79.5%, with falls representing the other 20.5%; Figure 2).

The study revealed no impact of time to surgery on the ASIA score, whether done early or late; however, there is a significant negative correlation between time to surgery and the duration of admission to the intensive care unit (ICU) or regular ward, regardless of the reason of delaying surgery [Table 2].

The study shows no relationship between time to spine surgery and the presence of other injuries or the severity of injuries, which meant that patients might undergo spine surgery early or late regardless of other associated injuries. Essentially, the presence of other injuries does not necessarily delay spine

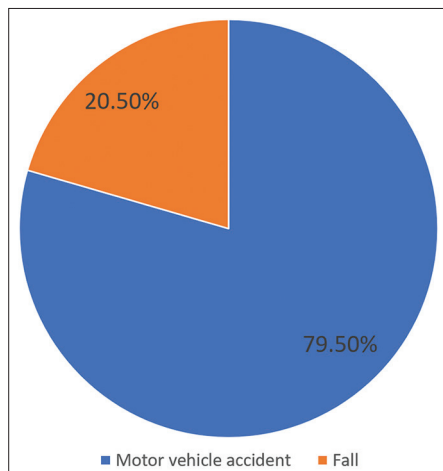


Figure 2: Distribution of causes of spinal cord injuries in Southern Saudi Arabia

surgery. Also, This study found no correlation between the level of SCI and time to surgery [Table 3].

Discussion

A SCI is defined as an injury of the spinal cord due to

Table 1: Demographics of study patients

		n	%
Age in years, Mean and SD	32.1±14.12		
Sex	Female	11	9.8%
	Male	101	90.2%
Residency	High altitude	69	61.6%
	Low altitude	43	38.4%
Level of education	Secondary school or below	87	77%
	University or higher	25	23%
Type of transfer	Car ambulance	101	90.1%
	By ordinary car	11	9.9%
Level of injury	Cervical	40	35.7%
	Lumber	35	31.3%
	Thoracic	37	33%
ASIA type of admission	A	34	30.40%
	B	6	5.40%
	C	16	14.30%
	D	7	6.30%
	E	49	43.80%
ASIA type of discharge	A	28	25.00%
	B	1	0.89%
	C	7	6.25%
	D	9	8.04%
	E	67	59.82%
Symptoms	Complete paralysis	34	30.4%
	Weakness	22	25.9%
	Numbness	9	6.5%
	Back pain	65	46.80%
	Impaired breathing	3	2.20%

ASIA, American Spinal Cord Injury Association; SD, standard deviation. Neurological status is explained by the ASIA score above. A: complete loss of neurological function below affected level. B: Incomplete, sensory but not motor function is preserved. C: Incomplete, Motor Function is preserved below the Neurological Level and more than half of key muscle functions below the Neurological Level of Injury have a muscle grade less than 3. D: Incomplete, Motor function is preserved below the neurological level and at least half (half or more) of key muscle functions below the neurological level injured have a muscle grade ≥ 3 . E: Normal

Table 2: Correlation between time to surgery and postoperative intensive care unit and ward stay

Correlation of variables	Timing to surgery (P)
Duration of ICU stay	0.006
Duration of ward stay	0.009

ICU, intensive care unit. The mean and standard deviation of ICU stay (days) 11, +/- 5. The mean and standard deviation of ward stay (days) 19, +/- 12. The mean and standard deviation of time to surgery (days) 5, +/- 4.

Table 3: Correlation between time to surgery and the presence of other injuries and level of spine injury

Factors influencing time to surgery	Time to surgery (P)
Presence of other injuries	0.97
Level of spine injury	0.65

No statistical difference. Other injuries refer to presence of one or system affected in addition to spinal injury. e.g., chest, abdominal, orthopedic, maxillofacial trauma. The mean and standard deviation of time to surgery for these patients (days) 7, +/- 4

compression, incision, or contusion after traffic accidents, gunshot injuries, falls, and sports injuries.^[11] SCI contribute to other complications such as neurogenic bladder, urinary tract infections, fractures, cardiovascular problems, and depressive disorder. Regardless of whether an SCI is complete or partial, rehabilitation remains a lengthy process requiring patience and motivation.^[11]

SCI is a devastating condition that occurs with an annual incidence of 12.1 to 57.8 cases per million,^[12] and they negatively affect the patient's physical, social, and psychological well-being.^[13] In the US, the incidence of SCI is higher than in other countries, with one study reporting that the US had more cervical injuries and fewer complete injuries incidence than other countries.^[14] While Kang *et al.* noticed that tetraplegia is a more frequent outcome than paraplegia worldwide,^[12] Elshahidi *et al.* reported that complete paraplegia was the most common type of SCI with thoracic level injuries in the Middle-East and North-Africa (MENA) region, which includes countries like Egypt and Saudi Arabia.^[15] The occurrence of TSCI in developing countries about 25.5 per million per year,^[8] and because there is no beneficial treatment for SCI.

Efforts at prevention must start at an exploration of the many causes of SCI, and while common causes include sports injuries and physical violence, MVAs and falls remain the top two common causes of TSCI.^[6,7,12,14,15] Our findings aligned with the literature, in that 79.5% of TSCI cases treated at ACH were MVA related, and 20.5% were from falls. This again raises the concern of the safety of driving on roads in our country; the implementation of new traffic rules may help reduce the number of TSCI cases.^[16]

Worldwide, men are more prone to MVAs than women (77% of cases are men), and men are more likely to get injured at the cervical level of the spine.^[12,15] Our findings align with this, but it is important to note that, in our country, women were not entitled to a driver's license until 2017, which helps explain the higher percentages noted in male patients.

Many studies have shown that adults (i.e., those aged 20 to 40 years) are the most vulnerable to SCIs due to MVAs, with few incidences seen in children and older people.^[17] These results are also similar to our results, given that 56% of cases in our study were in adults aged 20 to 40 years; however, the 20- to 30-year-old age group experienced the largest proportion of SCI cases of any age group (38.5% of total cases). In MENA region, the mean age at the time of injury was 31.32 years, with an incidence of 23.24 for each million per year.^[15]

Education level appears to be a factor in TSCI, as well. We found that most TSCI patients' highest level of education was high school or lower (77%), whereas 23% of patients had a university education or higher. A lower educational level may play a role in adherence to established safe driving practices and rules.^[18,19]

There is a recent advancement in the medical administration of SCI to advance diagnosis, stabilization, neurological outcomes, survival rate, and well-being after surgery.^[20] The timing of surgery in TSCI patients remains a hot topic in the spine literature. Many studies have advocated that early surgical decompression (<24 hours from the time of injury) is the most effective clinical treatment to control tissue damage following a primary injury of the injured spinal cord.^[21,22] However, the evidence that supports such a claim is not yet strong, and the data are contradicting or, at best, lack strong statements on outcome.^[17,22] Some studies limit the benefit of early surgical intervention and its potential neurological recovery in the first eight hours of the trauma.^[23]

Our study shows that neurological recovery was not dependent on the timing of the surgery; rather, it found that the recovery was also happening in late intervention as well where recovery in spinal cord injuries in general takes up to one year or more. However, the delay in surgical intervention may lead to other complications related to immobilization like deep venous thrombosis, pulmonary embolism, and chest infections.^[24] The association between delayed surgical intervention and prolonged ICU and ward stay aligns with other studies that addressed this potential risk, who reported non-neurological complications and increases in health care costs.^[24,25]

The lack of randomized controlled trials in this topic is not unique; it is a common finding in many emergency surgical pathologies, and we found it either hard to randomize patients for delayed vs. late intervention or may find difficulty convincing centers to participate in such a study, bearing in mind the parachute concept (i.e., randomizing people jumping from airplane to the ground with parachutes versus a group with empty backpacks).^[26]

The fact that most of the study patients are reaching emergency rooms by ambulance is a strong positive result, which indicates the awareness among the public that transfer by ordinary car by family or bystanders may worsen the spine injuries in trauma patients.^[27]

This study was limited by its retrospective design, in addition to the missing data or incomplete cases that were not included in the study. However, the retrospective design is preferred by some authors as it is quite revealing of true nature of the clinical practice and reflects real-life scenarios. Injuries due to falling from altitude is one of the major reason of Spinal cord injuries.^[28,29]

One of the important facts is that, the manuscript is highlighting the causes of spinal cord injuries in our population. The most common causes in the study were found to be motor vehicle accident and falls. Major attention and awareness programs have to be shouldered by family health care practitioners to reduce the impact of such burden by addressing these causes.

Another fact is the outcome, as some of spinal cord injury patients remain disabled throughout the rest of their life, special care from family health care practitioner's towards their needs is crucial.

Conclusions

Spinal cord injuries are life-altering, with high prevalence among young men due to MVAs. Surgical intervention is paramount in treating patients, and time plays a critical factor that determines hospital length of stay after surgery, which, in turn, affects health care costs and efficiency level. This study highlights a concerning debatable topic in the spine literature: whether TSCI patients may benefit from early intervention in terms of recovery from their spinal injuries or not. According to our findings, early intervention in TSCI may not have an impact on neurological recovery.

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Conflicts of interest

There are no conflicts of interest.

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