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Original Research Article

An Observational Study to Evaluate the Prevalence, Clinical Characteristics, and Initial Prognosis of Traumatic Spinal Injury

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Abstract

Aim: The aim of the present study was to assess the epidemiology, clinical features and early outcome in traumatic spine injuries at a tertiary hospital in Bihar region.

Material & Methods: The current investigation was a single-center, prospective, observational research undertaken at the Department of Orthopedics. The trial lasted from October 2019 through August 2022. The research had a total of 200 participants.

Results: Among the sample of 200 patients, a significant proportion of individuals were between the age range of 51-60 years (32%) and 41-50 years (30%). The average age of the participants was 53.57 years. The study population consisted mostly of male patients, accounting for 75% of the total, with the remaining 25% being female patients. In the current research, a significant proportion of traumatic spinal injuries were attributed to road traffic accidents (53%), with falls from heights (45%) and incidents of assault (2%) being other causes. The preponderance of spine fractures was seen at the cervical vertebral level (42%), with the lumbar vertebral level accounting for the second highest proportion (28%), and the thoracic vertebral level representing the third highest proportion (20%). The prevalence of injuries at various vertebral levels was as follows: 2% at both the thoracic and lumbar levels, 4% at both the cervical and thoracic levels, 3% at the lumbar and sacral levels, 0.50% at both the cervical and lumbar levels, and 0.50% at both the cervical and sacral levels. Among the sample of 200 patients, it was observed that a majority of 116 patients, or 58% of the total, did not exhibit any concurrent injuries. The prevalent injuries seen in conjunction with the condition were hemoperitoneum (10%), head injury (10%), fracture of the humerus (8%), and fracture of the clavicle (6%). Among a cohort of 200 patients, it was observed that 52% of the patients exhibited no signs of neurodeficit, whereas the remaining 48% of patients had neurodeficit symptoms. During the pre-operative examination, it was seen that 50% of the patients had an ASIA score of E. Additionally, 12% had an ASIA score of D, while 16% had an ASIA score of C. Furthermore, 8% of the patients had an ASIA score of B, and 14% had an ASIA score of A.

Conclusion: Patients who had non-operative treatment experienced greater incidence of complications. Respiratory failure emerged as the primary cause of mortality at the cervical level, whereas secondary problems arising from persistent bed sores were identified as the primary contributors to mortality at the thoracic and lumbar vertebral levels.

Keywords: Traumatic Spine Injury, Road Traffic Accidents, Cervical Vertebral Level, ASIA Score.

Introduction

Spinal trauma is characterized as any severe damage to the spine resulting from an external cause, which may potentially lead to spinal cord injury (SCI). [1-3] Traumatic Spinal Cord damage (TSCI) is a severe neurological damage that results in varying degrees of paralysis, sensory loss, and sphincter malfunction. This condition places a substantial strain on the healthcare system. [4] Patients with spinal trauma have a significantly elevated morbidity rate, particularly when accompanied with

spinal cord injury (SCI), resulting in a majority of patients experiencing motor, sensory, and autonomic impairments. [5] The prevalence of this condition is much higher in males, with a relative risk of three to four times compared to females. This gender disparity accounts for about 76-88% of all afflicted individuals, and the highest incidence is seen within the age range of 34 to 58 years. [6-8] The incidence of spine injuries among trauma patients is reported to be 6%. Among the many types of spinal fractures, it is observed that a significant majority, namely 90%, manifest inside the vertebral region spanning from T-11 to L-4. [9] Individuals with spinal cord injury (SCI) have been shown to have a higher risk of early mortality compared to those without such injuries, with the magnitude of this risk varying depending on the capacity of the healthcare system. [10] Spinal damage often encompasses many vertebral levels that are not contiguous. Approximately 15-20% of individuals with spine injuries exhibit the occurrence of multilevel spine fractures. [11] The occurrence of traumatic spinal cord damage is most prevalent in the cervical area, accounting for 50-64% of cases. [12] Etiologically, the vast majority, specifically over 90%, of cases involving spinal cord injuries are attributed to traumatic events. These events include a range of incidents, including but not limited to road traffic accidents, acts of violence, sports-related incidents, and falls. [9] Spinal cord injury is a biphasic phenomenon characterized by two distinct stages: first damage, which encompasses the original impact and subsequent persistent compression, and Secondary injury, which refers to a cascade of physiological and biochemical alterations after the first mechanical trauma. [13]

A traumatic cervical spinal fracture (TCSF) is often attributed to high levels of violence, particularly when accompanied by a dislocation, which significantly elevates the likelihood of cervical spinal cord injury (CSCI). The intervertebral discs serve the purpose of creating separation between the vertebral bodies and distributing loads uniformly across them. As individuals age, these discs undergo degeneration and exhibit increased vulnerability to damage. [14] The topic of TCSF/dislocation has garnered significant global interest. [15-17] Nevertheless, there is a lack of comprehensive research on the subject of cervical disc herniation and bulging. The posterior ligamentous complex is comprised of many anatomical structures, including the intervertebral disc, ligamentum flavum, and interspinous and nuchal ligaments. This complex assumes a pivotal function in maintaining stability within the cervical spine. [18,19]

The evaluation of neurological impairment is conducted by the use of standardized scoring systems such as the ASIA (American Spinal Injury Association) scoring, the Sub-axial Cervical Spine Injury Classification System (SLICS), and the Thoraco-lumbar injury classification and severity score (TLICS). [20]

Therefore, the current research was conducted to examine the epidemiology, clinical characteristics, and first outcomes of traumatic spinal injuries.

Material & Methods

The current investigation was a single-center, prospective, observational research undertaken within the Department of Orthopedics at Indira Gandhi Institute of Medical Sciences in Patna, Bihar, India. The trial lasted from October 2019 through August 2022. The research had a total of 200 participants.

Inclusion Criteria:

- All patients with traumatic spine injuries attending OPD or admitted in emergency, willing to participate in study

Exclusion Criteria:

- Non traumatic patients with spine ailments

Methodology

The study protocol was thoroughly elucidated to patients and their family, and signed informed permission was obtained from them to ensure their voluntary participation and continued involvement in the study. All patients who were admitted to the emergency department were treated in accordance with the Advanced Trauma Life Support (ATLS) protocol, which included doing a comprehensive assessment, performing primary and secondary surveys to detect any related injuries. The patient underwent a log roll maneuver in order to facilitate assessment of the posterior aspect of the body. An examination was conducted to identify any signs of bruising, swelling, and palpable kyphotic angulations, step-off, and point tenderness. These indicators were seen in injuries affecting the osteo-ligamentous complex. Radiological imaging techniques, including X-ray, computed tomography (CT) scan, and magnetic resonance imaging (MRI), were used. Following a comprehensive clinical and radiological assessment, the healthcare professionals proceeded to formulate further treatment strategies for the patients, which included both operational and non-operative approaches. Prior to surgical intervention, it is customary to conduct a comprehensive preoperative assessment on all admitted patients. This assessment includes various diagnostic tests and evaluations to gather essential information. These tests consist of a complete hemogram, renal function tests, liver function tests, blood sugar level measurements (both fasting and postprandial), PT/PTI/INR analysis, blood grouping, and a neurological evaluation following the guidelines set by the American Spinal

Injury Association (ASIA impairment scale). Additionally, the patient's level of pain, specifically back pain, is assessed using the visual analogue scale (VAS). Furthermore, imaging techniques such as radiographs (AP/Lateral views) of the cervical and thoracolumbar spine to measure vertebral body height, non-contrast computed tomography (NCCT) of the affected spine, and magnetic resonance imaging (MRI) of the affected spine are also employed.

Following physical fitness training, individuals received surgical procedures at our medical facility. All patients received standard post-operative treatment. Patients were released in accordance with the established surgical procedure. All patients who provided reports were thereafter monitored either via in-person visits to the outpatient department or by telephonic communication at four-week intervals for a duration of one year. The study focused on many aspects of patient health, including survivorship, neurological state, nutritional condition, and the occurrence of complications such as bed sores, urinary tract infections, upper respiratory tract infections, and sexual functioning. The patient underwent radiological evaluation to assess the presence of any deformity.

Statistical Analysis

Data was collected and compiled using Microsoft Excel. The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the presentation of the continuous variables was done as mean ± SD and median values. The comparison of the variables which were qualitative in nature were analyzed using Fisher's Exact test using Statistical Package for Social Sciences (SPSS) software version 21.0. For statistical significance, p value of less than 0.05 was considered as significant.

Results

Table 1: Distribution of age (years) in males and females

Age in years	Male (n=150)	Female (n=50)	Total
≤ 20	2 (1.34)	0	2 (1)
21-30	8 (5.33)	2 (4)	10 (5)
31-40	12 (8)	4 (8)	16 (8)
41-50	50 (33.33)	10 (20)	60 (30)
51-60	48 (32)	16 (32)	64 (32)
61-70	28 (18.66)	12 (24)	40 (20)
>70	2 (1.34)	6 (12)	8 (4)
Mean ± SD	54.06 ± 12.58	51.29 ± 12.92	52.58 ± 13.37

Out of 200 patients, most of the patients were in the age group 51-60 (32%) and 41-50 (30%). Mean age was 53.57 years. Majority of the patients were male 75% while 25% patients were female.

Table 2: Distribution of mode of injury, injury level and associated injuries of study subjects

Mode of injury	N	%
RTA	106	53
Fall from height	90	45
Assault	4	2
Injury level		
Cervical	84	42%
Cervical and Lumbar	1	0.50%
Cervical and sacral ala	1	0.50%
Cervical and thoracic	8	4%
Lumbar	56	28%
Lumbar and sacral ala	6	3%
Thoracic	40	20%
Thoracic and Lumbar	4	2%
Associated injuries		
No associated injuries	116	58%
Hemoperitoneum	20	10%
Head injury	20	10%
Fracture humerus	16	8%
Fracture clavicle	12	6%
Others	16	8%

In present study, majority of traumatic spine injuries were due to road traffic accidents (53%), followed by fall from height (45%) and assault (2%). Majority of spine fractures occurred at cervical (42%) followed by Lumbar (28%) followed by thoracic (20%) vertebral level. Other injuries were 2% at both thoracic and lumbar vertebral level, 4% at both cervical and thoracic vertebral level, 3% at Lumbar and sacral vertebral level, 0.50% at both cervical and lumbar vertebral level, 0.50% at both cervical and sacral spine level. Out of 200 patients, 116 patients (58%) had no associated injuries. Common associated injuries were hemoperitoneum (10%), head injury (10%), fracture humerus (8%) and fracture clavicle (6%).

Table 3: Distribution of pre -operative assessment of study subjects

Pre-operative assessment	Frequency	Percentage
Neurological status		
With neurodeficit	96	48%
Without neurodeficit	104	52%
ASIA score		
A	28	14%
B	16	8%
C	32	16%
D	24	12%
E	100	50%

Out of 200 patients, 52% patients had no Neurodeficit and 48% patients had Neurodeficit. On pre -operative assessment 50% patients had ASIA score of E, 12 had ASIA score of D, 16% had ASIA score of C, 8% had ASIA score of B and 14% had ASIA score of A.

Table 4: Distribution of follow up ASIA score of study subjects

Follow up ASIA score	After 2 weeks	After 3 months	After 6 months	After 9 months	After 12 months
A	28 (14%)	16 (8%)	18 (9%)	16 (8%)	3 (12%)
B	16 (8%)	10 (5%)	10 (5%)	12 (6%)	
C	32 (16%)	12 (6%)	8 (4%)	8 (4%)	7 (28%)
D	24 (12%)	30 (15%)	32 (16%)	40 (20%)	
E	100 (50%)	136 (68%)	132 (66%)	120 (60%)	15 (60%)

Follow up ASIA score after 2 weeks in patients was A in 14% patients, B in 8%, C in 16%, D in 12, E in 50%. Follow up ASIA score after 3 months in patients was A in 8% patients, B in 5%, C in 6%, D in 15%, E in 68%. Follow up ASIA score after 6 months in patients was A in 9% patients, B in 5%, C in 4%, D in 16, E in 66%. Follow up ASIA score after 9 months in patients was A in 8% patients, B in 6%, C in 4%, D in 20, E in 60%. Follow up ASIA score after 12 months in patients was A in 12%, D in 28, E in 60%.

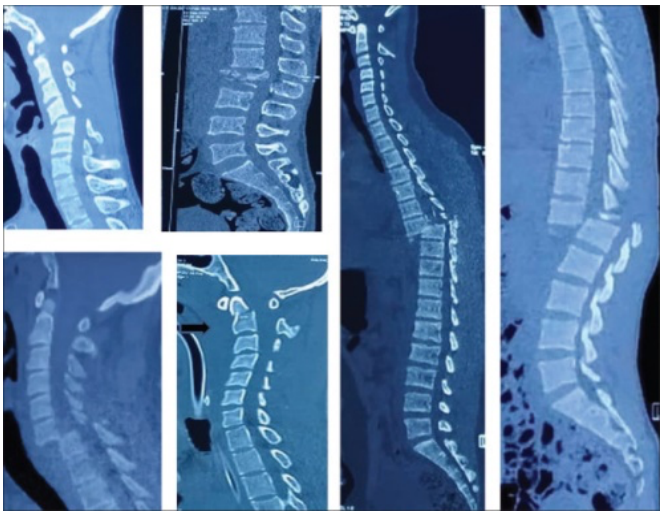

Figure 1: Various types of isolated type of vertebral injury

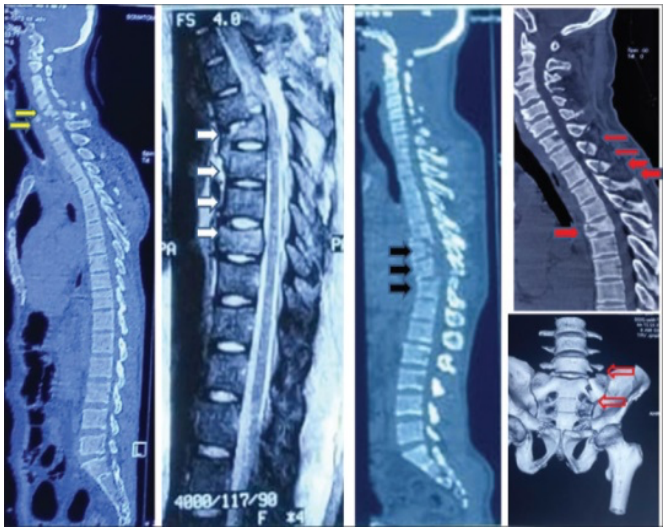

Figure 2: Various types of associated continuous spinal injury. The number of arrows showing the number of vertebral involvement

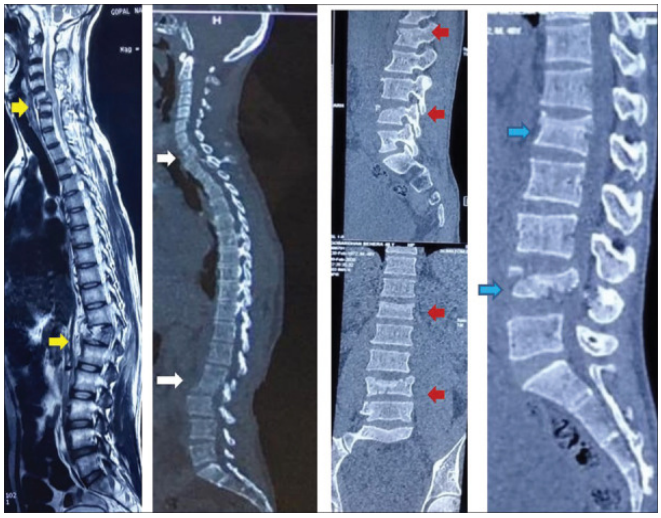

Figure 3: Various types of skip injuries are shown with an arrow marking at the levels of injury

Discussion

A spinal cord injury refers to a traumatic event that causes a disruption, whether temporary or permanent, in the typical motor, sensory, or autonomic functioning of the spinal cord. Traumatic Spinal Cord Injury (TSCI) is a severe neurological trauma that results in varying degrees of paralysis, sensory impairment, and dysfunction of the sphincter muscles. This condition places a substantial strain on the healthcare system. [4] The global incidence rates of traumatic spinal cord injuries vary between 10.4 and 83 incidents per million individuals, exhibiting notable disparities across various nations or areas. [21] The prevalence of traumatic spinal cord injury (TSCI) in poor nations is reported to be 25.5 cases per million individuals per year. [9] Individuals with Spinal Cord Injury (SCI) exhibit a much higher risk of early mortality compared to those without such injuries, with a likelihood ranging from two to five times greater. The extent of this elevated risk is contingent upon the capacity and effectiveness of the health-care system in place. [22] The etiology of spinal cord injuries is mostly traumatic, accounting for over 90% of occurrences. These injuries are often caused by various incidents, including road traffic accidents, acts of violence, sports-related incidents, or falls. [9] The occurrence of spinal cord damage may be seen as a two-step process, including main injury, which encompasses both the original impact and the following ongoing compression, and Secondary injury, which refers to a series of physiological and biochemical changes that follow the main mechanical injury. [13]

Among the sample of 200 patients, a significant proportion of individuals were under the age brackets of 51-60 years (32%) and 41-50 years (30%). The average age observed in the study was 53.57 years. In the study conducted by Chamberlain and colleagues, a total of 932 patients were included. The male to female ratio observed in this series was

1.88:1. The average age of those with tetraplegia was found to be 53.5 years, whereas those with paraplegia had an average age of 43.8 years. The average age of the whole population was 48 years. [23] In the study conducted by Johansson et al., it was observed that out of a total of 346 patients, 72.3% were identified as males, while the remaining 27.7% were identified as girls. The study population consisted mostly of male patients, comprising 75% of the total sample, with the remaining 25% being female patients. [24] In the current research, a significant proportion of traumatic spinal injuries were attributed to road traffic accidents (53%), with falls from heights accounting for the second highest cause (45%), and incidents of assault comprising a smaller proportion (2%). The preponderance of spine fractures was seen at the cervical level (42%), with the lumbar level (28%) and thoracic level (20%) following suit. The prevalence of injuries at various vertebral levels was as follows: 2% at both the thoracic and lumbar levels, 4% at both the cervical and thoracic levels, 3% at the lumbar and sacral levels, 0.50% at both the cervical and lumbar levels, and 0.50% at both the cervical and sacral levels. Among the sample of 200 patients, it was observed that a majority of 116 patients, or 58% of the total, did not exhibit any concurrent injuries. The prevalent injuries seen in conjunction with the condition were hemoperitoneum (10%), head injury (10%), fracture of the humerus (8%), and fracture of the clavicle (6%). In research conducted by Ahuja et al. [25], a total of 313 individuals were examined. Of these patients, 182 had early surgical intervention within 24 hours, whereas the remaining 131 patients underwent surgery beyond the first 24-hour period. The main outcome measure assessed in this study was the alteration in the American Spinal Injury Impairment Scale (AIS) over a period of 6 months. Among the cohort of patients who had surgical intervention within a 24-hour timeframe, a total of 19.8% exhibited a notable improvement of two or more grades in AIS (American Spinal Injury Association Impairment Scale) at the six-month mark. In contrast, only 8.8% of patients who underwent surgery beyond the 24-hour threshold displayed a similar level of recovery.

In a five-year period, Sommer et al. conducted a study in which they presented the epidemiology, therapeutic, clinical, and radiological outcomes of 283 individuals with spine fractures. The surgical success rates varied, with cervical spine operations achieving a rate of 42%, thoracic spine operations achieving a rate of 9%, and lumbar spine operations achieving a rate of 24%. The researcher obtained favorable radiographic outcomes in relation to the treatment of wedge compression and collapse of the lumbar vertebral body by the use of an internal fixator. After a follow-up period ranging from 2 to 5 years, it was shown that around 80% of patients who had conservative or surgical treatment continued to have persistent back pain. [26] In a study conducted by Shamim MS et al. [27], a cohort of 54 patients with complete spinal cord injury (SCI) was examined. Among this cohort, 50% of the patients had surgical intervention. The findings of this study revealed that the group who got surgical therapy experienced a prolonged duration of recovery. Additionally, the patients who had the intervention experienced an extended duration of hospitalization. Moreover, they exhibited a higher incidence of complications, particularly those pertaining to infections. Furthermore, the cost of their treatment was much greater in comparison to the conservatively treated group. In research conducted by Pandey Vk et al. [28], it was determined that patients who had surgery for spine fractures experienced a mortality rate of 17% over a 23-month average follow-up period. Notably, all deaths occurred subsequent to the patients' departure from the hospital.

Among a sample size of 200 patients, it was observed that 52% of the patients exhibited no signs of neurodeficit, whereas the remaining 48% of patients had neurodeficit symptoms. During the pre-operative examination, it was observed that 50% of the patients exhibited an ASIA score of E, while 12 individuals had an ASIA score of D. Additionally, 16% of the patients had an ASIA score of C, 8% had an ASIA score of B, and 14% had an ASIA score of A. The subsequent ASIA score, assessed two weeks later, revealed that 14% of patients achieved an ASIA score of A, 8% achieved a score of B, 16% achieved a score of C, 12% achieved a score of D, and 50% achieved a score of E. The subsequent ASIA score, assessed three months post-treatment, revealed that 8% of patients achieved an ASIA score of A, 5% achieved a score of B, 6% achieved a score of C, 15% achieved a score of D, and 68% achieved a score of E. The subsequent ASIA score after a period of 6 months in the patient population revealed that 9% of patients achieved an ASIA score of A, 5% achieved a score of B, 4% achieved a score of C, 16% achieved a score of D, and 66% achieved a score of E. The subsequent assessment of the American Spinal Injury Association (ASIA) score at the 9-month mark revealed that 8% of patients achieved an ASIA score of A, 6% attained a score of B, 4% obtained a score of C, 20% were classified as D, and the majority, 60%, were categorized as E. The subsequent assessment of the American Spinal Injury Association (ASIA) score at the 12-month mark revealed that 12% of patients achieved an ASIA score of A, 28% achieved a score of D, and 60% achieved a score of E. According to the findings of the research, it was observed that 70% of patients who were originally diagnosed with ASIA A did not undergo conversion, while 90% of patients identified with ASIA D also did not experience conversion. In aggregate, a majority of 68% of the whole patient population did not experience

conversion, whilst 30% of patients shown improvement and a minority of 2% exhibited deterioration. [29] In a study conducted by Middendrop et al. [30], a total of 273 individuals were examined. The findings revealed that out of these patients, 161 were classified as ASIA A, 37 as ASIA B, 43 as ASIA C, and 32 as ASIA D. A total of 42 individuals, accounting for 26% of the sample, were converted from ASIA A. Similarly, 27 individuals, representing 73% of the sample, were converted from ASIA B. Additionally, 32 individuals, comprising 75% of the sample, were converted from ASIA C. Lastly, 5 individuals, constituting 16% of the sample, were converted from ASIA D.

Conclusion

Patients who had non-operative treatment exhibited increased incidence of complications. Respiratory failure emerged as a prominent factor contributing to mortality at the cervical level, whereas secondary problems arising from persistent bed sores were identified as the primary causes of death at the thoracic and lumbar vertebral levels. Despite the restricted availability of sources, the results seen in spinal cord injury (SCI) patients in India seem to be favorable, as shown by clinical improvements and low fatality rates. In nations such as India, road traffic accidents are the predominant cause of spinal cord injury (SCI) among the younger population. The implementation of comprehensive traffic education and heightened public knowledge on traffic laws and road safety measures has the potential to effectively mitigate the occurrence of road traffic accidents (RTAs). There is a need to establish physical rehabilitation programs in order to optimize functional results and limit the occurrence of secondary problems. Additionally, it is important to make concerted efforts to enhance the follow-up of patients with spinal cord injuries.

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