

Traumatic Thoracic and Lumbar Spine Injury in Adult Population Presenting to a Tertiary Care Hospital

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ABSTRACT

Background: Epidemiology of traumatic thoracolumbar spine injury is a less explored subject in developing/ underdeveloped countries. The number of available studies in Nepal is even smaller. This study aims to establish the epidemiological characteristics of patients with thoracic and lumbar spine injuries presenting to Dhulikhel Hospital, Kathmandu University Hospital in Nepal.

Methods: This is a single-center retrospective observational study. Patients with traumatic thoracolumbar spine injuries admitted to Dhulikhel Hospital, Kathmandu University Hospital from 2015 January to 2019 December were included. International Spinal Cord Injury core data set (version 2) and International Spinal Cord Injury Spinal Column Injury Basic Data Set (version 1.0) were used for data collection.

Results: Three hundred and seventeen patients were included, of which, 50.2% were male and the mean age was 45.5 ± 17 years. Fall was the most common etiology of injury (69.1%). The most common level of injury was L1 (32.5%). Thirty-seven patients (11.7%) had ASIA A neurology. One hundred and seventy-three (54.6%) patients underwent surgical intervention. The median hospital stay of the patients was 7 days (IQR: 3-11) with no recorded in-hospital mortality.

Conclusions: Males and females are equally vulnerable to thoracic and lumbar spinal injuries, with the majority of patients in 46-60 age groups. More than 1/3rd neurologically impaired patients are with ASIA A neurology. The findings of this study can contribute to traumatic thoracic and lumbar spine injury prevention and rehabilitation.

Keywords: Epidemiology; injury; lumbar spine; thoracic spine

INTRODUCTION

Traumatic spine injury (TSI) is a major cause of morbidity and mortality worldwide¹ resulting in expensive treatment costs and long recovery.² The worldwide volume of TSI is still obscure and data regarding TSI in developing countries is even scarcer.¹ Nepal has a high rate of road traffic accidents,³ and fall injuries⁴ resulting in possibly higher rates of thoracic and lumbar spinal injuries, therefore; demanding a meticulous epidemiological evaluation of the same. There is also a shift in epidemiological aspects of TSI with changing trends in patient demographics and etiology in recent years⁵ demanding a recent epidemiological study in thoracic and lumbar spinal injuries which can help in developing national policies focused on injury prevention and creating effective medical care delivery systems.¹ This study aims to evaluate the epidemiological

aspects of traumatic thoracic and lumbar spine injury patients treated in a tertiary care center of Nepal.

METHODS

It is a single-center retrospective observational study conducted in the Department of Orthopedics of Dhulikhel Hospital, Kathmandu University Hospital (DH, KUH). Patients of all age groups admitted in the orthopedics ward from 2015 January to 2019 December with traumatic thoracic and lumbar spine injuries were included. Patients had injury of any morphology at T1 - L5 and with any of the ASIA grades. Pathological thoracic and lumbar spine fractures, non-traumatic thoracic and lumbar spine pathologies, and patients presenting to the emergency department but not admitted for further treatment were excluded.

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Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline was followed.⁶ The major outcomes that were evaluated were patient demographics, injury to hospital arrival/ injury to surgery time (days), etiology of injury, level of injury, neurology (American Spinal Injury Association [ASIA] grading), treatment modality (conservative vs. surgical), mean hospital stay (days), cost of treatment and mortality.

Electronic health record (EHR) was used to extract structured coded data and unstructured narrative data of included patients. Non-electronic hospital records (patient files, scanned documents, and images [x-rays, CT scans, and MRI]) were evaluated for data extraction from the patients with missing data from EHR. International Spinal Cord Injury Core Data Set (version 2)⁷ and International Spinal Cord Injury Spinal Column Injury Basic Data Set (version 1.0)⁸ were used for data collection. The former data set aims to standardize the collection and reporting of information of spinal cord injury patients necessary to evaluate and compare results of other similar studies. It comprises 25 variables. The latter data set facilitates comparisons of spinal column injury data among studies, centers, and countries; it consists of 7 variables. The terminologies used in this study include spinal column, single/multiple level injury, disc injury, posterior ligamentous injury, and translation. These terminologies were defined as per International Spinal Cord Injury Spinal Column Injury Basic Data Set (version 1.0).⁸

The collected data were entered and analyzed using IBM SPSS version 25.0 for Windows (SPSS Inc., Chicago, IL, USA). The Shapiro- Wilk test was used to evaluate the normality of continuous variables. The continuous variables with normal distribution were presented as mean \pm SD and non-normal variables were reported as median (interquartile range [IQR]). Categorical variables were analyzed using the Chi-square test and Fischer exact test. A value of $P < 0.05$ was considered significant. Multiple regression was done to predict injury hospital arrival time from gender, age, geographical distribution (rural/urban, Hill/Terai), and neurology at the time of admission. Complete case analysis was done to address missing data in the study.

RESULTS

Three hundred and seventeen patients with thoracolumbar spine injuries were included in the study. One hundred and fifty-nine (50.2%) patients were males (M: F=1:1). The mean age of the patients was 45.5 ± 17 years with the majority of patients (30%) falling under the 46-60 age category (Table 1). Two hundred and

ninety-nine (94.3%) patients were from hilly regions of Nepal and the remaining 18 (5.7%) were from the Terai region. Two hundred and twenty-six (71.3%) patients were from rural areas while the remaining 91 (28.7%) patients were from urban regions.

The median injury to hospital arrival time was 8 hours (IQR: 4-48). Among 304 patients whose injury to hospital arrival time was known, 219 (72%) arrived within 24 hours, 43 patients arrived between 1-4 days, 20 arrived between 5-9 days, 6 arrived between 10-14 days and 16 patients arrived after 2 weeks. The median delay in the admission of patients from the Terai region was 48 hours (IQR: 4.75- 198) which was 40 hours more than the median delay of patients from the hilly region [8 hours (IQR: 4-48)]. Similarly, the median delay of admission of females was 10 hours (IQR: 4.13-48) which is 2 hours more than the median delay of male patients [8 hours (IQR: 4-48)]. Among 39 ASIA A neurology patients with known injury to admission duration, more than 40% arrived after 24 hours.

Multiple regression was done to predict injury hospital arrival time from gender, age, geographical distribution (rural/urban, Hill/Terai), and neurology at the time of admission. Gender, Hill/Terai distribution, and neurology at the time of admission added statistically significantly to the prediction ($p < 0.05$) [$F(5,298) = 2.86, p = 0.015, R^2 = 0.046$].

Fall was the major cause of thoracolumbar injury accounting for 69.1% (219 patients) followed by road traffic accidents accounting for 19% (60 patients). At the time of admission, 220 patients (69.4%) had ASIA E neurology followed by 43 patients (13.6%) having ASIA A neurology. Twenty-eight (28.8%) out of 97 patients with neurological impairment had neurological improvement during the hospital stay (Table 2). At the time of discharge, 224 (70.7%) patients had ASIA E followed by 37 (11.7%) patients with ASIA A neurology (Table 1). Two hundred and seventy (85.2%) patients had a single-level injury while 42 patients (13.2%) had a multiple-level injury and 5 patients had spinal cord injury without radiological abnormality (SCIWORA).

The most common level of injury was L1 (103 patients/ 32.5%) followed by T12 (52 patients/16.4%). Ninety-nine patients (31.2%) had other associated injuries along with thoracolumbar injury. One hundred and seventy-three (54.6%) patients underwent surgical management. Fifty-five (17.4%) patients required rehabilitation admission. The median hospital stay of the patients was 7 days (IQR: 3-11). Patients requiring ICU admission were 30 (9.5%). Six patients developed surgical site infections

for which three patients (deep infection) required debridement and the remaining patients (superficial infection) were managed conservatively. Six patients developed grade one bedsore and three patients had

grade two bedsore. All the patients with sores had ASIA A neurology and were managed conservatively. There was no in-hospital mortality.

Table 1. Characteristics of patients with thoracolumbar injury from 2015-2019.

		Year of injury					Total
		2015	2016	2017	2018	2019	
Age category	0-15	0	2	1	1	1	5
	16-30	23	2	13	18	15	71
	31-45	15	20	24	11	15	85
	46-60	15	8	22	30	20	95
	61-75	9	11	13	10	5	48
	>75	2	1	3	3	4	13
Sex	Male	24	29	40	35	31	159
	Female	40	15	36	38	29	158
Injury Etiology	Fall	37	35	59	48	40	219
	Transport	5	9	15	14	17	60
	Assault	1	0	0	0	0	1
	Farm Injury	0	0	0	1	1	2
	Direct Impaction	1	0	2	10	1	14
	Burial	20	0	0	0	1	21
ASIA injury severity at admission	A	10	5	14	6	8	43
	B	4	4	0	2	4	14
	C	2	3	3	4	4	16
	D	7	7	4	5	1	24
	E	41	25	55	56	43	220
Surgery	No	24	16	41	37	26	144
	Yes	40	28	35	36	34	173

Table 2. Neurological improvement among Spinal cord injury patients with thoracolumbar fracture.

		ASIA injury severity at admission					P value
		A	B	C	D	Total	
Improvement	Yes	6	6	12	4	28	<0.05
	No	37	8	4	20	69	
Total		43	14	16	24	97	

The Government of Nepal provides financial support of Nepalese Rupees (NPR) 100,000 (the US \$784, as per the exchange rate in 2022) for patients with spinal injuries under the Improvised Citizen Treatment Fund (ICTF) which was started in 2013 AD.⁹ DH, KUH was selected as a part of this program in 2018 AD. Before 2018 AD, the median cost of treatment of surgically managed thoracolumbar spine injury was US \$988 (IQR: 927-1141) per patient. The median cost of treatment was reduced to US \$173 (IQR: 81-308) per surgically managed patient after the implementation of this government program. The average number of patients admitted and operated per year in 2015- 2017 were 61.33±16.16 and 34.33 ± 6 respectively which increased to 66.5 ± 9.2 and 35 ± 1.4 respectively in 2018-2019.

DISCUSSION

This study revealed an increasing number of older individuals and females getting involved in thoracic and lumbar spinal trauma. Fall injury is the most common etiology. Females and patients from the Terai region have delayed access to hospital care. However, government financial aids have a major contribution in reducing the financial cost of treatment.

There are studies on traumatic spinal injuries in Nepal. In a systematic review by Parajuli et al. (2020),¹⁰ they concluded that the number of epidemiological studies regarding SCI in Nepal is scanty and there are no studies from the western part of the country. Males are still predominantly involved in SCI, and fall injury is the most common etiology, though, RTA is on the rise in recent years. Similarly, in the study by Kafle et al. done in 2019,¹¹ the most common cause of spine injury was motor vehicle accidents with male predominance. Dhakal et al. (2018),¹² in their study of 91 patients with thoracic and lumbar spine injury, showed a delay in treatment by more than three days but the delay didn't affect the neurological outcome. Shrestha et al. (2013),¹³ in their study of 381 patients with spinal injuries, found a trend of increasing incidence of spinal injuries among physically active males in a productive age group of 21-40 years. More than half of the patients had ASIA A neurology. Similarly, Bajracharya et al. (2007),⁴ in their study of 10 years' analysis of spinal injuries in a predominantly rural population of Nepal, showed the most vulnerable group for spine injury was the group of patients of productive age with late presentation and the majority lacked proper prehospital management. They also showed a change in treatment modalities from conservative to surgical.

Our study showed the average age of the patient was

45.5±17 years with the majority of patients (30%) falling under the 46-60 years age category. There was an equal distribution of thoracolumbar injury among males and females (M: F=1:1) which is in contrast to other studies done in Nepal^{4,12,14} which shows male predominance. The mean age is higher compared to other studies.^{12,15,16} Recent literature also reports similar findings of increasing mean age of spine trauma patients.^{1,5} Similarly, the relative increase in female patients with thoracic and lumbar spine injury is a new trend as compared to other studies done in Nepal and other developing countries.¹ An increase in life expectancy in Nepal and the increasing migration of youth out of the country for employment might be the reasons for the increased mean age of thoracolumbar spine injury in Nepal. There is an average rise in life expectancy of the Nepalese population by 1 year every 2 years.¹⁷ Another reason may be a higher number of youths going to foreign countries for employment.¹⁸ According to Nepal Labor Migration Report 2020,¹⁹ the volume of annual out-migration between the ages of 18 and 35 years was 354,098 in 2017/2018 and 236,208 in 2018/19 with a mean age of 29 years and 39% of total migrants between 18-24 years. Similarly, the possible explanation for an increased proportion of females involved in thoracolumbar trauma could be due to the out-migration of males for employment. Almost 95% of immigrants leaving Nepal for foreign employment were males in the past decade. These factors may have contributed to the rise in the number of older individuals with 20% of total patients being above 60 years of age; and, females getting involved in potentially dangerous activities like climbing trees to gather fodder for the cattle leading to fall-related injuries and subsequently spine injuries.

In our study, fall-related injury accounted for 219 (69.1%) followed by RTA 60 (19%). The other studies done in Nepal,^{4,12} and other developing countries have similar findings.^{20,21} Contrastingly, RTA is the major etiology for thoracolumbar injury in the majority of studies in developed countries.²⁰ In the Nepalese context, climbing trees or cliffs without any safety measures to gather fodder for cattle is still commonly practiced in villages, explaining a higher incidence of fall-related injury.

The median injury hospital arrival time was 8 hrs (IQR: 4-48) with 98 patients (28%) arriving at the hospital after 48 hrs of injury. Though there are no studies done in Nepal evaluating treatment delay among thoracic and lumbar spine injury patients; however, the proportion of patients arriving after 48 hrs of trauma in traumatic cervical spine injury patients was even higher (60%) in a study done by Dhakal et al.;²² but, it was similar (29%) in

the study by Shrestha et al.²³ The delay in hospitalization in the western countries is attributed to the treatment of other associated injuries in referring hospital and late diagnosis.²⁴ This is in contrast to few studies done in Nepal which show the major cause of delay in hospital arrival to be lack of proper transportation. To speculate, the other causes could be difficult terrain, lack of proximity to hospital facilities, multiple/delayed referrals, and financial constraints. Shrestha et al.²⁵ in their study showed only 31% of patients arrived at the emergency department of a tertiary care center by ambulance. Similarly, Shrestha et al.²³ found only 21% of cervical spine injured patients transported in ambulances. In another study from eastern Nepal, the main cause for patients to defer ambulance facilities was its higher cost.²⁶ Majority of health centers in Nepal lack comprehensive spine care. It is also rare for a patient with an acute SCI to be immobilized in the trauma site and transported by trained personnel (e.g. ambulance).²³ There is no structured referral system for spinal cord injured patients in Nepal which may add up to the delay.

Another important finding of this study was the tendency for the females to arrive later for the treatment as compared to males. Gender inequality in various social aspects is still prevalent in Nepal which is also reflected in the delay in seeking treatment for thoracolumbar injuries in this study. Studies suggest travel restriction, access to and control over financial resources, and household chores are the key gender-based barriers for women and girls to access healthcare services.²⁷ In the study done in India, it was more difficult for women than men to arrange expenses for accessing healthcare services.²⁸ Additionally, women's ability to manage time for their healthcare is hampered by traditional family responsibilities like taking care of children, preparing food, fetching water, and other family needs.²⁹ These findings are also relatable to the Nepalese context which explains females arriving later for treatment.

There was also a notable delay in the treatment of the patients from Terai belts compared to patients from the hilly region. The financial constraint could be one of the major factors for this. According to Non-communicable Diseases and Injuries (NCDI) Poverty Commission National Report 2018, central Terai region had the highest number of people identified as the poorest billion by region in 2011.⁹ Lack of proximity to hospital facilities and multiple/delayed referrals could be other possibilities for such a significant delay in treatment. Similarly, patients with more severe ASIA neurology arrived late for treatment. Usually, patients have trauma away from home. In such a situation, if a patient is paralyzed, there

is a delay for the family members to locate the patient and transport him to a nearby hospital leading to an overall delay in accessing treatment.

The most common level of injury in our study is the L1 vertebra followed by T12 which is consistent with other studies.³⁰ T12 and L1 vertebrae are biomechanically vulnerable to injury because of their transition from a relatively fixed thoracic spine to a more mobile lumbar spine. The average number of patients admitted and operated on for thoracolumbar spine trauma has increased in the latter two years. This rise in the number of patients in 2018 and 2019 coincides with the implementation of government financial aid of a hundred thousand rupees to spinal injury patients in 2018. A patient is eligible for the subsidy if he/she provides a "deprived citizen certificate" from village development committee (VDC) or municipality. Given this provision, all the patients admitted for the treatment of thoracic and lumbar spine injury were eligible for the subsidy. This subsidy has helped in reducing the median cost of surgical management of thoracic and lumbar spine injury per patient by 82.5%.

This study involved only admitted patients. The patients with thoracic and lumbar spine injuries who were discharged or referred from the emergency department were not included which may have produced bias in the results obtained. The retrospective nature of this study itself could be one of its limitations. Being a single-center study, the generalization of the findings to the population may not be accurate. However, this study prompts the establishment of a nationwide spine registry in Nepal. The concept of spine registry has already been formulated as Spine Trauma Registry-Nepal (STR-NP) with the initiatives from Nepal Health Research Council (NHRC) in 2020.³¹ The development of spine registry will definitely help in providing more accurate epidemiological data in thoracic and lumbar spine injury in Nepal.

CONCLUSIONS

There is a recent change in epidemiological trends in thoracic and lumbar spine injury with an increasing proportion of the elderly population above 60 years and females getting involved in such trauma. However, the most common etiology for thoracic and lumbar spine injury i.e., fall from height, remains the same. Another major concern that needs further investigation is females and patients from the Terai region arriving later for treatment. Moreover, the government's financial aid for spinal injury has contributed positively to making the treatment affordable.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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