

Traumatic Cervical spine injury epidemiology: a tertiary care center perspective in Nepal

Bikash Parajuli^{1*}, Rajiv Sharma¹, Sabik Kayastha¹, Jagadish Thapa¹, Dipak Shrestha¹

¹Department of Orthopedics and Traumatology, Dhulikhel Hospital, Kathmandu University Hospital

*Corresponding author: Bikash Parajuli, Email: bikash480@gmail.com

ABSTRACT

Background: The epidemiology of traumatic cervical spine injury is not well documented in developing/underdeveloped countries. There are a few single-centered studies on the epidemiology of cervical spine injury in Nepal.

Objectives: This study aimed to explore the epidemiology of traumatic cervical spine injuries presented at Dhulikhel Hospital, Kathmandu University Hospital, Nepal.

Methods: This was a retrospective study of individuals with traumatic cervical spine injuries admitted to the Department of Orthopedics from 2015 January to 2021 December. Data collection was done by using the International Spinal Cord Injury core data set (version 2) and International Spinal Cord Injury Spinal Column Injury Basic Data Set (version 1.0).

Results: One hundred and forty-four patients were included of which the majority (68.8%) were males. The mean age of the patients was 47.89 ± 17 years. Fall injury was the most common etiology (79.2%). C2 was the most common level injured (28.5%). Patients with ASIA A neurology was 18% and surgical treatment was given to nearly 60%. The patients had a median hospital stay of 9 days (4- 16) and a mortality of 4.2%.

Conclusion: There was a male predominance with a recent increase in the female proportion for traumatic cervical spine injury. Fall was the most common etiology with the majority of patients in their 30s and 40s. Surgical treatment is more preferred recently. The mortality rate was relatively low which needs further investigation.

Keywords: Cervical spine; Injury; Epidemiology; Nepal

1. Introduction

The estimated incidence rate of cervical spine fractures is reported to be 12 [1] to 65 [2] per hundred thousand populations per year. These injuries not only contribute to high mortality but also present huge socioeconomic challenges to families and countries [3]. Management of such trauma in resource constraint countries can affect the global outcome of the injuries [4]. Lack of appropriate pre-hospital management and proper transportation, multiple referrals, and delayed hospitalization/surgery are some of the factors contributing to sub optimal management of cervical spine injuries in a developing country [5].

The epidemiology of traumatic cervical spine injury is not well documented in developing/underdeveloped countries [4]. Availability of such data aids in building new protocols for managing and reducing the disease burden [1]. There are only a few single-centered studies [6-8] on the epidemiology of cervical spine injury in Nepal. This lack prompted us for a retrospective evaluation of cervical spine injury management in a tertiary care hospital in Nepal.

2. Methods

This was a single-centered retrospective observational study conducted in the Department of Orthopedics, Dhulikhel

Hospital, Kathmandu University Hospital (DH, KUH), Nepal. The patients of all age groups who had traumatic cervical spine injury of any morphology at C1 - C7 having any of the ASIA impairment scale (AIS) presenting between January 2015- December 2021 were included. Patients with non-traumatic cervical spine pathologies were excluded.

Ethical clearance was obtained from Kathmandu University School of Medical Sciences, Institutional Review Committee (KUSMS-IRC). The standard guideline for reporting observational studies, namely Strengthening the Reporting of Observational Studies in Epidemiology (STROBE), was followed. The outcomes that were evaluated in this study were patient demographics, injury to hospital arrival/ injury to surgery time (days), etiology and level of injury, neurology (American Spinal Injury Association [ASIA] grading), treatment modality, median hospital stay, complications, cost of treatment, and, mortality.

2.1 Research instruments

Data collection was done by using the International Spinal Cord Injury Core Data Set (version 2) [9] and International Spinal Cord Injury Spinal Column Injury Basic Data Set (version 1.0) [10]. The former data set is a standardized form consisting of 25 variables and is used to collect and report the required

information of spinal cord injury patients. The latter data set has seven variables and it helps to facilitate comparisons of spinal column injury data among studies, centers, and countries.

2.2 Data analysis

The data analysis was done using IBM SPSS version 25.0 for Windows (SPSS Inc., Chicago, IL, USA). Kolmogorov–Smirnov test was used for determining the normality of the continuous variables. For the normally distributed continuous variables, mean \pm SD was used, whereas, the non-normal variables were expressed as median (inter-quartile range [IQR]). Fischer exact test was used for analyzing categorical variables. A value of $P <$

0.05 was considered significant. The predictor of improved neurological outcome by one ASIA grade during the hospital stay was assessed using multiple regression analysis.

3. Results

One hundred and forty-four patients with traumatic cervical spine injury were included. There was an increment in patients with cervical spine injury till 2019 with an increasing proportion of females; however, the number dropped in 2020 and 2021 (Figure 1). The mean age of the patient was 47.89 ± 17 years. The majority of patients were of age 31–60 years (54.9%) (Figure 2). Ninety-nine patients (68.8%) were male.

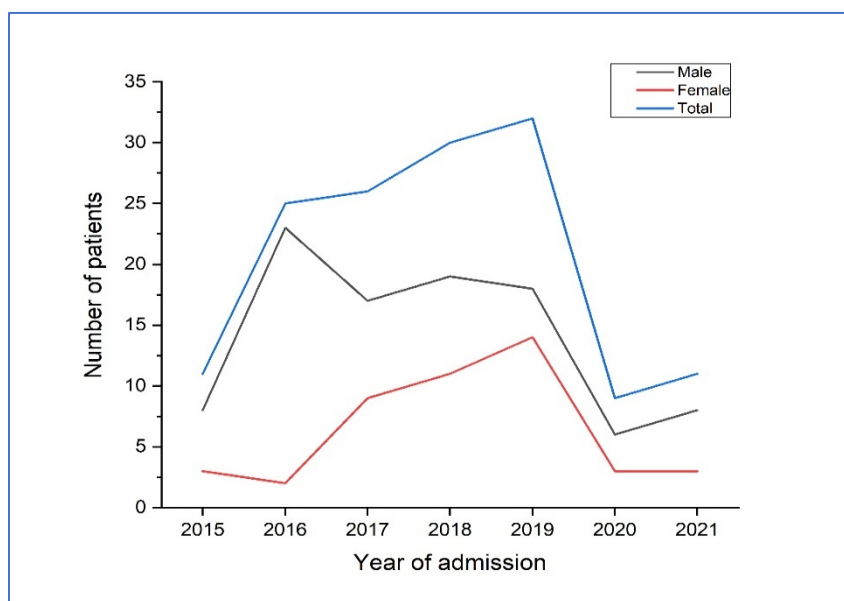


Figure 1: Number of patients admitted from 2015- 2021

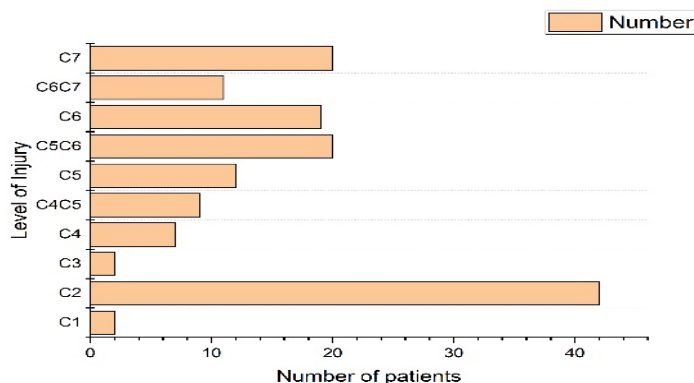


Figure 2: Level of injury

The median injury to hospital arrival time was 24 hours (IQR: 6-84). Among 125 patients with known injury to hospital arrival time, patients arriving within 24 hours, within 4 days, and after 2 weeks was 56.0%, 77.6%, and 8.8% respectively. The median injury to surgery interval was 8 days (5-16), and the median

admission to surgery interval was 3.4 days (IQR: 2-7).

Fall was the major cause of cervical spine injury (79.2%) followed by road traffic accidents (15.3%) (Table 1). More than half of the patients (54.9%) sustaining fall injuries belonged to 31-60 years' category. Forty-eight percent of all patients sustaining RTA were 16 to 30 years of age.

Table 1: Injury etiology and the age of the patients (Years)

Injury etiology	Age category (Years)						Total
	0-15	16-30	31-45	46-60	61-75	>75	
Fall related	1	13	37	33	26	4	114
RTA	1	12	4	1	3	1	22
Farm Injury	0	0	0	0	3	0	3
Direct Impact	0	0	2	1	1	0	4
Burial	0	0	0	1	0	0	1
Total	2	25	43	36	33	5	144

The median hospital stay of the patients was 9 days (IQR: 4-16). Patients requiring intensive care unit (ICU) admission was 62 (43.1%) with a median ICU stay of 2 days (IQR: 1-5). Five patients had spinal cord injury without spinal

column injury. Twenty patients (13.9%) had other associated injuries. Eighty-three patients (57.6%) were operated, of them 27 patients (32.5%) had anterior surgery, 47 patients (56.6%) had posterior surgery (Figure 3) and,

eight patients (9.6%) had both anterior and posterior surgery (Figure 4).

Sixty-six patients (45.8%) had AIS E, 50 patients (34.7%) had AIS B-D, and 27 patients (18.7%) had AIS A during admission. Nineteen patients (24.3%) among 78 with neurological

involvement had an improvement by one ASIA grade during the hospital stay. (Table 2)

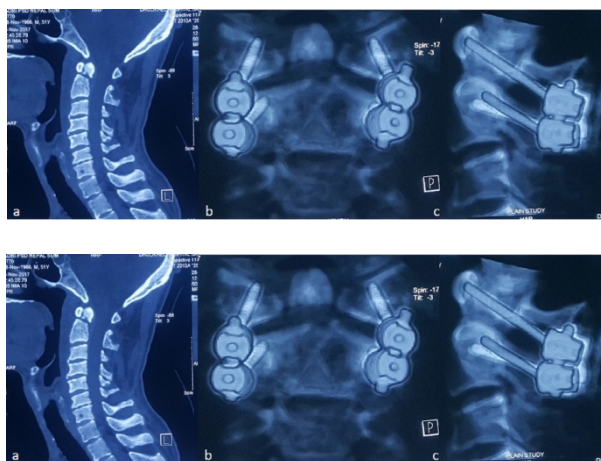


Figure 3 a. Pre-operative CT scan of patient with C2 odontoid fracture; 3 b, c. 3D reconstructed CT showing C1C2 fixation with C1 lateral mass screws and C2 pedicle screws

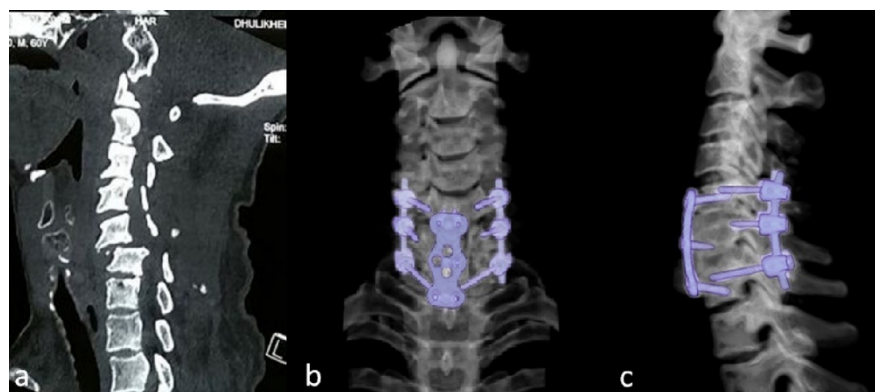


Figure 4 a. Sagittal CT section showing C5 C6 dislocation; 4 b, c. 3D reconstructed post-operative CT image showing anterior and posterior fixation after fracture reduction

Table 2: Improvement and mortality during hospital stay

		AIS at the time of admission				Total
		A	B	C	D	
Improvement	Yes	2	5	5	7	19
	No	19	10	2	21	53
Mortality		6	0	0	0	6
Total		27	15	7	28	78

Multiple regression analysis was done to predict improvement of neurology by one grade (ASIA grade) from injury to surgery interval and admission to surgery interval; these variables were statistically significant, predicting improvement by one ASIA grade [$F(2, 62) = 6.2, p=0.04, R^2= 0.167$].

Admission to surgery interval added significantly to the prediction of improvement ($p=0.001$).

All the patients had blunt trauma resulting in cervical spine injury. One hundred and twenty-three patients (85.4%) had single-level injuries and 16 patients (11.1%) had multiple-level injuries. The most common level of injury was

C2 (29.2%) followed by C5-C6, and C7 (13.9%). Seventy-three patients (58.8%) had disc or posterior elements injury and 65 patients (52.4%) had traumatic translation (Table 3). Twenty-two patients (16.9%) had a complication with sacral bed sore. Six patients (4.2%) with AIS A expired during the treatment. Five patients died of ventilator-associated pneumonia (VAP) and one died of sudden cardiac arrest. All these patients were in ICU prior to their demise; their median ICU stay was 8 days (4-43 days) and median days in mechanical ventilation was 8 days (3-30). Six patients (4.2%) deferred treatment and left against medical advice after admission; of them, four were critical with AIS A or B.

Table 3: Neurological involvement and disc/posterior element injury

		Disc and/or posterior element injury		Total	P value(Fisher exact test)
		No	Yes		
AIS at admission	A	4	22	26	<0.05
	B	4	11	15	
	C	4	4	8	
	D	9	19	28	
	E	37	30	67	
Total		58	86	144	

For the treatment of traumatic spinal cord injury patients, the Government of Nepal (GoN) provides Nepalese Rupees (NPR) 100,000 (US \$787, as per the exchange rate in September, 2022) under Improvised Citizen Treatment Fund (ICTF), started in 2013 AD.11 DH/KUH was enrolled in this program in 2018 AD. The median cost of treatment of surgically

managed cervical spine injury was \$808 (\$705-\$963) per patient before 2018 which reduced to \$166 (\$28- \$423) per surgically managed patient after financial aid provided by GoN. The average number of patients admitted and operated per year in 2015- 2017 were 20.6 ± 8.3 and 12.3 ± 4.7 respectively which increased to 31 ± 1.4 and 17 ± 5.6 respectively in 2018-

2019 after the implementation of governmental financial aid. But the average number of patients admitted and operated during COVID 19 (Years 2020 and 2021) dropped to 10 ± 1.4 and 6 ± 4.2 respectively.

4. Discussion

The average age of patient was 47.89 ± 17 years and the majority of patients (30%) were in 31-45 years' age category. Age distribution did not show bimodal distribution in the current study unlike the study of Marco et al. [12]. The mean age was higher by more than half a decade compared to other studies done in Nepal [6-8] which is alarming. Similar finding of increased mean age was documented in a recently published systematic review of spinal cord injury in Nepal [13]. The possible reason for increased mean age may be higher number of youths going to foreign countries for employment [14, 15]. The Nepal Labor Migration Report 2020 reported the mean age of individuals who migrated to foreign countries from 2017-2019 was 29 years and 39% of total migrants were between 18-24 years [16]. The other possible reason might be due to increased life expectancy in Nepal where there is an average rise of life expectancy by 1 year in every 2 years [17]. These could be the contributing factors for the increasing numbers

of older individuals with cervical spine injuries.

There was a steady increment in the number of patients admitted for cervical trauma in the initial five years (average admission of 24.8 per year) which declined to 10 ± 1.4 admission per year during the COVID years. Similarly, the number of traumatic cervical spine surgery declined from 14.2 ± 5 per year to 6 ± 4.2 per year during the COVID years. This shows a 60% decline in admission and a 58% decline in traumatic cervical spine surgery during the COVID years. This is similar to the finding by Kayastha et al., where there was a 56% decrease in surgically managed orthopedics patients during the lockdown compared to the previous year [18]. Similarly, Hashmi et al., in their study on the effects of the COVID-19 pandemic in a developing nation during the upsurge, 50% of surgical procedures decreased in COVID era as compared to pre-COVID era, and trauma procedures reduced by 40% in the COVID era [19]. The reduction in admissions and surgery is due to disrupted transportation facilities during the nationwide lockdown. Even after the lockdown ended, patients still deferred visiting hospitals due to the fear of contracting COVID-19.

In this study, the number of males accounted for more than two-thirds (68.8%), but the proportion of females involved in cervical

trauma (31.2%) compared to other studies done in Nepal is higher. Females comprised of 25%, 25%, and 10% in the studies done by Shrestha et al., [7] Munakomi et al., [8] and Dhakal et al. [6] respectively.

Due to the nature of their work, they are at higher risk of falling from trees and house roofs. Women in developing countries like Nepal, on the other hand, are more engaged in home-based activities, hence reducing the risk of fall-related injuries [20]. But the recent trend of increased female proportion in cervical spine trauma is worth mentioning. This finding is also directly related to a high number of out-migrating populations for work, with more than 95% being males, [16] leading to an increased proportion of females who are left behind for potentially risky activities for cervical spine trauma.

Fall-related injury was the most common etiology followed by RTA. This is similar to the studies done in other developing countries [4, 6, 7] as well as in a developed country, Norway [1]. The majority of patients sustaining fall injuries in Norway are elderly with a mean age of 65 years and fall from a height of <1-meter accounting for 57% of injury. Unlike in Norway, RTA is the major etiology for cervical spine injury in developed countries [21-23]. In Nepal, gathering fodder for cattle by climbing trees or cliffs without any safety measures is

still commonly practiced which can explain the higher incidence of fall related injury.

Cervical spine fracture associated with spinal cord injury was 77 (53.5%) and 26 patients (18.1%) had AIS A. This finding is nearly similar to a recent study done by Dhakal et al [6] where 60% had a neurological deficit and 23.3% had AIS A. Contrastingly, in a study done around a decade back by Shrestha et al. [7], the patients with neurological involvement were 77% and 36% had AIS A. This clearly speaks to the fact that both neurological involvement and AIS A have declined in the past decade. The decline might be because of some improvement in pre-hospital management of cervical spine injury patients in recent years. Yet, this figure is overwhelmingly large compared to the figure in Norway [1]; only 21% had neurological involvement and 2% had AIS A. Three major reasons –advanced pre-hospital, in-hospital care and post injury rehabilitation explains the lesser proportion of neurologically impaired patients in developed country as compared to Nepal.

Our study showed C2 as the most common level of injury in cervical spine. This finding is similar to the finding in the study done by Fredo et al, [1] Passias et al, [23] and Khanpara et al. [24]. But in the study done in the Nepalese context such as by Munakomi et al [8] and Shrestha et al, [7] the most common level of

injury is C4/C5 and C5, respectively. Dhulikhel hospital is one of the referral centers for upper cervical injuries in Nepal which may explain the higher number of C2 fractures presenting here.

The median injury hospital arrival time was 24 hours (6-84). Forty-eight patients (38.4%) among 125 patients whose injury to hospital arrival time was known arrived at the hospital after 48 hours of injury. The study by Dhakal et al [6] showed an even higher number of patients (60%) arriving after 48 hours of trauma; however, the percentage was lesser (29%) in the study by Shrestha et al. [7] In the developed countries, the referring hospital treating the associated injuries before referring for the cervical spine injuries and late diagnosis are the major causes of delay in arriving at the tertiary care center [25]. However, the causes of delay in Nepal could be difficult geographical terrain hampering patient transportation, lack of proximity to a hospital facility, multiple/ delayed referrals, and financial constraints. The lack of comprehensive spine care in the majority of primary health centers and the absence of a structured referral system for spinal cord injured patients adds up to the delay. There is a possibility that a fraction of cervical spine-injured patients living in remote areas never reach a hospital for treatment, but no study has

been done yet to evaluate it All the patients with cervical spine injuries admitted in DH, KUH were eligible for financial aid by GoN which helped in reducing the median cost of surgical management per patient by 83%. In a study done in the same center among patients with thoracolumbar fractures, [26] the median cost of surgical management was reduced by 82.5% after the government aid which is similar to the finding in this study. Six patients (4.8%) with cervical spine injury died during treatment in our study with the highest being five patients with AIS A. This is comparable to the mortality reported by Shrestha et al [7] (4%); however, the mortality reported by Munakomi et al [8] is substantially less (1.98%). But, in comparison to the studies done in developed countries [1, 27, 28], the mortality rate is less. The lower hospital death rate might be due to the tendency of the family to request early discharge from the hospital speculating no further improvement or due to financial limitations obliging the families to early withdrawal from treatment. The above explanation could also justify why six patients left against medical advice (four patients deferred treatment despite being critical) after hospital admission.

One of the limitations of this study is the patients with cervical spine injuries who were discharged or referred from the emergency

department were not included. This may have produced selection bias in the results obtained.

5. Conclusion

The vulnerability of males to cervical spine injury is higher but the proportion of females is increasing in recent years. Fall from height is the most common etiology but RTA is proportionately higher in the younger population. There is a recent increasing trend of older individuals getting cervical spine

injuries. Delay in hospital arrival and surgery time appears high. The mortality rate is relatively low, the cause of which should be further evaluated. The financial aid by GoN for spinal injury has made the treatment of cervical spine injuries affordable to patients. Understanding the epidemiology of traumatic cervical spine injury can contribute not only in defining risk groups for prevention but also to managing the health care system

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