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ORIGINAL ARTICLE

Patients presenting with Upper Cervical Spine Injury at a Tertiary Care Centre: A Descriptive Cross-sectional Study

Surya Bajra Lama Waiva[1], Rajesh Kumar Chaudhary[1], Ram Krishna Barakoti[1], Deepak Kaucha[1], Babu Kaji Shrestha[1], Saroj Chandra Dahal[1]
[1]Department of Orthopedics, B & B Hospital Pvt. Ltd.

ABSTRACT

BACKGROUND
Upper cervical spine injury involving C1 and C2 vertebrae are severe and at times fatal injury. Such injuries can lead to instability and/or spinal cord injury. These traumatic injuries sometimes can be difficult to diagnose, to manage and to treat. This retrospective study aims at evaluating the demographic profile and management of patients with C1, C2 fracture managed at Tertiary Center Hospital from 2014 September 1st till 2024 August 31st.

METHODS
Retrospective analysis of patients with upper cervical spine injuries managed at Tertiary Care Center in 2014 September 1st till 2024 August 31st were done from data available in the electronic health record system. All the patients managed and discharged from the hospital during the period were screened and those with C1 and/or C2 fractures were included in the study. Their age, sex, mode of injury, duration of injury at the time of presentation, fracture types and treatment offered were analyzed.

RESULTS
There was a total of 26 cases of upper cervical spine injury cases from 2013 August till 2024 September. Out of which 21(80.8%) were male and 5 (19.2%) were female. Mean age was 35.88 ± 13.01 years (16-63 years). Road traffic accidents and Fall injury and road traffic accidents were two most common modes of injury (13 and 12 cases respectively). Injury of C2 vertebra was seen in 24 cases out of which 11 were odontoid fractures, 8 were hangman fractures and 5 were other types of C2 fractures. There were 2 cases involving C1 fracture. 5 cases (21.74 %) were managed conservatively and rest were managed operatively.

CONCLUSION
C2 fractures were more common compared to C1 fractures. The most common mode of injury was road traffic accidents followed by fall from height. Most of the upper cervical spine injuries were managed surgically.

KEYWORDS
C1 atlas vertebra, C2 axis vertebra, Hangman Fracture, Odontoid Fracture, Upper Cervical Spine Injury (UCSI)

INTRODUCTION

Upper cervical spine injury (UCSI) involves injuries of skull base, atlas, and axis, and are commonly the result of high energy trauma in young individuals. The upper cervical spine (UCS) differs from the subaxial spine in terms of its atypical anatomy, vascular supply, proximity to skull base. Additionally, its stability relies heavily on ligaments, making injuries potentially lethal.[1,2] Injury of C1 and C2 account for about 3% of all cervical spine injuries, though some studies report rates as high as 22%.[3] In younger individuals, these injuries are often associated with neurological deficits, whereas in elderly they can occur even after fall from standing height and frequently present with intact neurology.[4,5]

Treatment of such injuries can be conservative or surgical, sometimes combined.[5,6] Assessment of the status of relevant ligamentous structures, the fracture alignment/stability and the presence of neurological deficit are important in determining surgical versus non-surgical treatment for patients with injuries to the craniocervical region.[1,7] Many studies have examined the epidemiology of upper cervical spine injuries.[4,5,8] However, there is paucity of literature evaluating the epidemiology of UCSIs, especially in our part of the world. Hence, this study aims to evaluate demographic characteristics, mechanisms of injury, and various injury patterns in patients presented with UCSIs at a

CORRESPONDENCE
Surya Bajra Lama Waiva
Department of Orthopedics, B&B Hospital, Gwarko, Lalitpur, Nepal,
Tel: +977-9862280276
Email: suryawaiva28@gmail.com

tertiary care center.

METHODS

A Retrospective analysis of patients with UCSI presenting at a Tertiary Care Center between 1st September 2014 and 31st August 2024 was done following ethical approval from the institutional review committee of the local center (Ref No. IRC-24-319). All patients presenting within the study period were included. Those patients whose clinical records had incomplete information were excluded. Data was extracted using the following key-words: "upper cervical spine injury", "C1 vertebra", "C2 vertebra", "atlas fracture" and "odontoid fracture" using the electronic health record system between 1st September 2014 and 31st August 2024. A convenience sampling technique was employed, including all patients with UCSI within the study period.

Following data were extracted: Age, Gender, duration of injury to hospital presentation, diagnosis of the injury, (in C1 fractures, C2 Odontoid fractures and Hangman's fractures, Gehweiler classification with Dickman modification , Anderson D'alonzo classification and Levine-Edwards Classification were respectively used to classify the injuries), neurological status at presentation, other associated injuries and treatment offered. [9,10,11]

Data were recorded by the principal investigator using predetermined pro forma stored in password-protected Microsoft Excel version 2019 file. The Excel Worksheet was then imported to SPSS version 26.0 with appropriate coding. Data normality was assessed using the Shapiro-Wilk Test. Continuous data were reported in either mean ± SD or Median (IQR) based on their distribution. Categorical data were expressed as numbers (percentages).

RESULTS

Total 32 cases of upper cervical spine injury were identified initially; however, 6 cases were excluded due to incomplete information on the electronic health record system. Among the 26 included cases, 5 (19.2%) were female and 21(80.8%) were male. The mean age of the study population was 35.88 ± 13.01 years (range 16-63 years).

Road traffic accidents were the most common mechanism of injury (50%, n = 13), followed by fall from height (46.2%, n = 12). One case resulted from physical assault (Table 1). Figure 1 illustrates the age distribution of UCSI cases, with middle-aged individuals being predominantly affected. Most patients (n = 9) presented to the hospital within one day of injury (range: 6 hours to 120 days; median: 1.82 days). In three cases, the diagnosis of UCSI was initially missed at other centers, resulting in delayed presentation months later.

Three cases involved C1 fractures (one each of Gehweiler type 2, 3A, and 3B). The remaining 23 cases were C2 fractures: 10 odontoid fractures (38.46% of UCSI cases), 5 hangman's fractures (19.23%), and 8 atypical C2 fractures (30.77%; Table 2). Table 2 details the fracture subtypes, with type IIA being the most common among odontoid fractures and type II the most frequent among hangman's fractures.

Table 1: Demographic characteristic of the patients enrolled in the study.

Variables	Mean ± SD Number(%)
Age	35.88 ± 13.01 years
Sex (F:M)	5:21
Mode of injury	
RTA	13 (50%)
Fall	12 (46.2%)
Physical Assault	1 (3.8%)

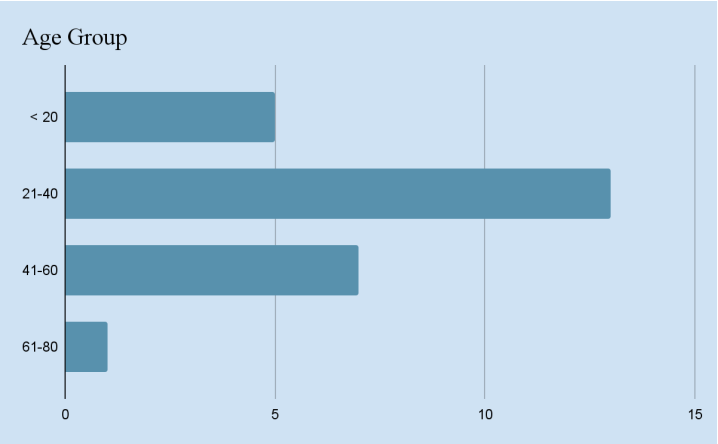

Fig. 1: Age group distribution in upper cervical spine injury cases

Table 2: Distribution of subtypes of C2 fractures

Types of Fracture	**Number (%)**
Odontoid fracture *	38.3%
Type I	1 (3.8%)
Type IIA	5 (19.2%)
Type IIB	1 (3.8%)
Type III	3 (11.5%)
Hangman's fracture**	19.1%
Type II	3 (11.5%)
Type IIA	1 (3.8%)
Type III	1 (3.8%)
Atypical fracture	8 (30.8%)

*Based on Anderson D'Alonzo classification[13]

** Based on Levine-Edwards Classification[15]

Regarding neurological status at presentation (Fig. 2), 9 patients (34.6%) had intact neurology, while 6 (23.1%) were complete paraplegics (ASIA A). Associated injuries were present in 12 cases (46.2%; Fig. 3), including subaxial spine injuries in 6 cases (23.07%), dorsolumbar spine injuries in 4 cases (15.38%), and chest injuries requiring chest tube insertion in 3 cases (11.54%).

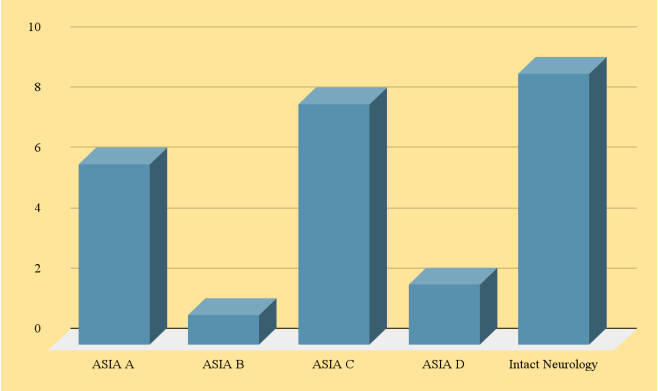

Fig. 2: Neurological status of patients with cervical spine injury at presentation

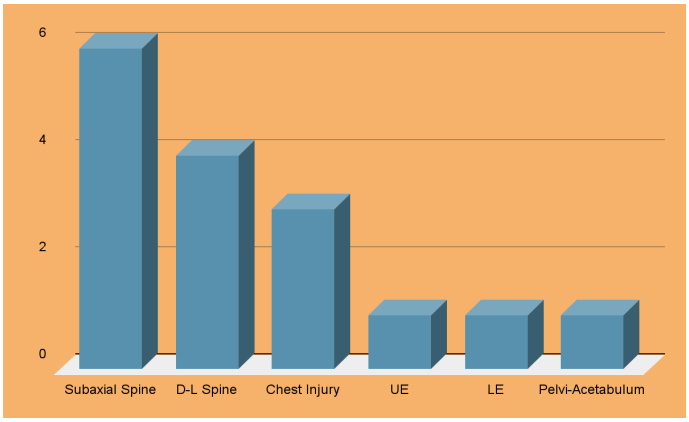

Fig. 3: Associated injuries of patients enrolled in the study

Conservative management was employed in 5 cases (19.2%). Surgical management was performed in the remaining 21 cases (80.8%), including C1–C2 posterior arthrodesis (50%, n = 13), C1–C3 stabilization and fusion (26.92%, n = 7), and anterior plating (3.85%, n = 1; Fig. 4).

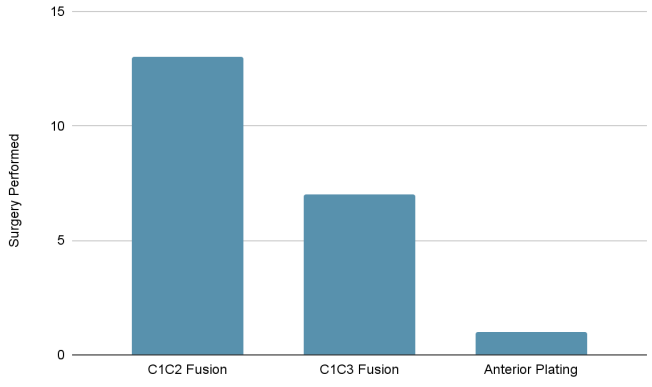

Figure 4: Surgical management options of the patients with cervical spine injury.

DISCUSSION

In our study, as in others, UCSI was predominantly observed in males.[5,8] The most common mode of injury was RTA (50%), followed by fall from height (46.2%). There was a single case of physical assault resulting in UCSI. In studies done by Faye M et al and Gleizes V et al RTA was reported to be the most common mode of injury.[4,5] But in geriatric population simple fall injury can be the common mode of injury.[11]

Most of the individuals (34.6 %) visited our center within the first day (mode = 1 day) of the injury (range 6 hours to 120 days, Median:1.82 days). This huge range is due to the 3 cases (11.54%) who presented late up to 120 days following injury as their diagnosis were missed at first visit at primary care center. Although, plain X-rays are the first modality of radiological investigations to detect an injury in the upper cervical spine region sometimes Computed tomography (CT) with multiplanar slices and 3D reconstructions may be required for precise measurement of the complex relationships between anatomical landmarks, thereby establishing the diagnosis of UCSI. In many a case, magnetic resonance imaging (MRI) may also be required to evaluate spinal cord or brain stem injury as well as the integrity of the discoligamentous structures and the facet joints.[1] A detailed radiological diagnostic criteria for craniocervical traumatic injuries have also been described in literatures.[12]

UCSI is comparatively more common among young individuals. In this study, the mean age of the population was 35.88 ± 13.01 years. In extremes of age such injuries were rare. Most of the individuals were in their third and fourth decade of lives. Similar findings were noted in other studies as well.[5,13]

In this study, out of 26 cases, 23 cases were of C2 vertebra injuries and among them 10 cases had odontoid fractures. Between C1 and C2 vertebrae, C2 injury appears to be more common, among C2 injuries, fractures of the odontoid process account for most of the injuries.[4,5,13] The C1C2 arthrodesis surgery was performed in 13 cases while in 7 cases C1 to C3 fixation were done. There was one case in which anterior plating was done. C1C2 arthrodesis via posterior approach is the most commonly performed surgery in UCSI cases in other various studies.[7,13] Ulrich JA Spiegl et al in their systematic review have stated that non-operative treatment with a cervical orthosis is a feasible treatment option in the majority of patients with stable C2 fractures. In our study, 5 cases were managed conservatively with cervical orthosis. Among conservatively managed cases, 2 cases were atypical fractures of C2 vertebra involving laminae and spinous processes while 2 cases were odontoid fracture (type I and type IIA) and 1 case was C1 fracture (Gehweiler type 2). In C1 vertebra injuries, conservative management is often successful if the transverse atlantal ligament is intact.[11] Lieu et al in their prospective observational multicenter study with The French Society of Spinal Surgery (SFCR) on UCSI, transverse ligament was intact in 53.9% of cases; therefore, nonoperative management was done in 63.5% of cases.[14]

In our study, 34.6 % of the total UCSI cases had intact neurology and 23.1% had ASIA A neurological status. In upper cervical spine injury, complete neurological deficit is rare.[4,13]

UCSI can have associated injuries to other body parts. In this study, 12 (46.2%) cases had other associated injuries. Most of them had injury to the subaxial spine (6 cases) and 4 cases also had dorsolumbar spine injury. Chest injuries and injuries to the

extremity were also not rare.[4]

This study has some limitations. As cross-sectional study design, it has inherent design-related limitations. Convenience sampling was used, posing risk of selection bias. It was a single center study, so there is a lack of external validity.

CONCLUSION

Traumatic injuries to the upper cervical spine predominantly affect young males. The most common mode of injury was road traffic accidents followed by fall from height. C2 fractures are more common compared to C1 fractures in upper cervical spine injury. Neurology may remain intact in most of the cases. Most of the upper cervical spine injuries were managed surgically. In C1 vertebra injuries, conservative management is often successful if the transverse atlantal ligament is intact. In UCSI, injury to other regions of the spine is also a common occurrence.

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