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Demography and Outcome of Pediatric Traumatic Brain Injury; Experience from a University Teaching Hospital in Nepal

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ABSTRACT

Introduction

Traumatic brain injury (TBI) is one of the significant causes of disability and death. It is a common cause of emergency neurosurgical consultation. Due to differences in physiology and management strategy, outcomes of pediatric TBI are different. This study purposes to describe the demography, clinical-radiological characteristics, and outcome of patients with pediatric TBI.

Methods

A retrospective study of 112 children of age up to 18 years admitted to the Neurosurgical Department in Tribhuvan University Teaching Hospital following TBI from August 2021 to July 2022 was conducted. Variables analyzed were the demographics, clinical characteristics, imaging findings, management strategies, and outcome.

Results

Median age was 5.5 years. The male-to-female ratio was 2.3:1. Falls followed by road accidents (RTA) were the most common mode of injury. A significant number of patients (62, 55.3%) presented after 24 hours of injury. Vomiting (67, 59.8%) was the commonest symptom followed by loss of consciousness (60, 53.6%). Post-traumatic seizure was observed in 13 (11.6%) of the children; however, had no association with the outcome. Mild, moderate, and severe TBI were seen in 80.3%, 17.8%, and 1.7% respectively. Extra-axial hematomas (40%) were the most common findings followed by skull fractures (33.9%). Intensive care was required in 13 (11.6%) and 34 (30%) required surgery. Craniotomy (30.3%) was the most common procedure. Good outcome at discharge was seen in 107 (95.5%) of patients.

Conclusion

Falls and RTAs were the commonest causes of pediatric TBI. In our study, a significant number of the patients presented after 24 hours of injury. Craniotomy was the most common managment and most of the children had good outcomes at discharge.

Keywords
Computed tomography, extra-axial hematoma, Glasgow outcome scale, pediatric, post-traumatic seizure, traumatic brain injury

INTRODUCTION

Traumatic brain injury (TBI) is "alteration of brain function or other evidence of pathology, caused by an external force".[1] Based on World Health Organization (WHO) estimates, TBI is attributed to 90% of the deaths in low-to-middle-income countries (LMICs) and is the primary cause of trauma mortality globally.[2] An estimated 3 million children, experience TBI each year with increased mortality.[3,4] Non-accidental trauma should be considered in cases of pediatric TBI.[5]

In Nepal, TBI is a leading cause of death and disability. Here, the incidence is estimated to be 382 per 100,000, compared to the global average of 369 per 100,000.[6] Nepal's Children's act 2018 has defined children as those aged less than 18 years.[7] Nepal's population has 40% population below the age of 18 and hence study on pediatric head injury is relevant in the context of Nepal.[8]

Using modified Glasgow coma scale, TBI is classified as Mild with a GCS of 13 to 15, Moderate with a GCS of 9 to 12, and severe with a GCS of 3 to 8 scale.[9-12] There is no uniform consensus on which outcome assessment score is better for children with TBI.[13] However, Glasgow outcome scale (GOS) is used frequently.[14] GOS described outcomes in five grades as death, persistent vegetative state, severe disability, moderate disability, and good recovery.[15]

Though TBI is common in Nepal, there is a relative paucity of data.[16] In a study in Nepal by Newall et al in 2020, a single-center retrospective study, TBI was seen from 8 months to 92 years, more common in less than 15 years.[17] In studies in Nepal, fall was the most common cause, male children were affected more and most were mild TBI. The overall outcome of pediatric TBI was favorable.[16,18,19]

This study aims to explain the demographic, clinical, and radiological characteristics, management strategy, and outcome of pediatric TBI.

METHODS

This is a retrospective analytical study of the children admitted to the Department of Neurosurgery, Tribhuvan University Teaching Hospital, from August 2021 to July 2022 with the diagnosis of TBI. The study was approved by the Institutional Review Committee of the Institute of Medicine. A total of 112 children under the age of 18 years were admitted during the study period. Data were retrieved from in-patient admission registers, hospital charts, discharge summaries, and follow-up notes in the Outpatient department.

Variables analyzed were the demography, etiology, clinical characteristics, GCS at admission, imaging findings, associated system injuries, management (operative vs conservative), and outcome based on Glasgow outcome scale (GOS) at discharge.

Microsoft Excel 2016 and SPSS version 26 were used for data analysis. To summarize the data, mean, median, and mode were used for continuous variables, and proportions were used for categorical variables. Fisher's exact test was used to establish different relations between independent and dependent variables. A confidence interval of 95% with a P value of less than 0.05 was considered statistically significant.

RESULTS

A total of 112 children admitted to our department were included in the study, In the analysis of the Demographic characteristics of the patients, [77, 69%] were males with a male-to-female ratio of 2.3:1. The mean age was 6.1±4.8 years with a range from 1 month to 18 years (Table 1).

Table 1. Clinical profile of patients with pediatric TBI

Characteristics	Number (%)
Age group	
<1 year	11 (9.8)
1 to 5 years	45 (40.1)
5 to 18 years	56 (50)
Mode of injury	
Falls	86 (76.7)
Road traffic accident	21 (18.7)
Physical assault	4 (3.5)
Fan blade injury	1 (0.8)
Time of presentation	
Less than 24 hours	50 (44.6)
24 to 72 hours	52 (46.4)
After 72 hours	10 (9)
Presenting complaints	
Vomiting	67 (59.8)
Loss of consciousness	60 (53.5)
Seizure	13 (11.6)
Diagnosis	
Extradural hematoma	16 (14.3)
Contusion	14 (12.5)
Subdural hematoma	11 (9.8)
Others like SAH	21 (19)
Fractures	55 (61)
Simple linear	38 (34)
Simple depressed	10 (9)
Compound depressed	7 (7)
Scalp laceration	10 (10)
GOS at discharge	
5	94 (84%)
4	12 (11%)
3	5 (4%)
2	1 (1%)
1	0

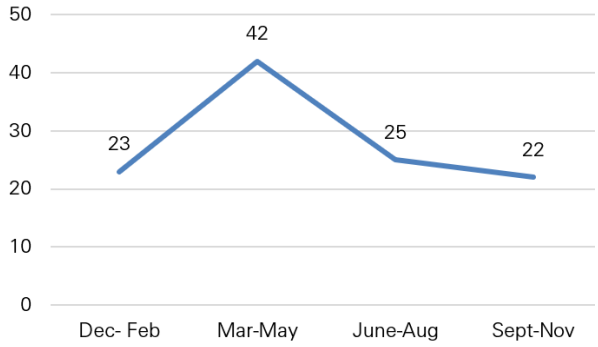

Figure 1. Seasonal variation of pediatric TBI

As shown in Figure 1, based on analysis of the season of the year, most cases [42, 37.5%] occurred during spring, and the least [22, 19.6%] in the autumn seasons. Figure 2 shows the place of origin of the patients. The majority of the patients were from outside Kathmandu valley [68, 60.7%]. Among all patients, [90, 80%] were referred. When this referral pattern was compared with the availability of the neurosurgical facility, it was observed that the districts and provinces with neurosurgical facilities had significantly fewer number of referral.

On analysis of the mode of injury, it was found that falls were the most common mode of trauma accounting followed by road accidents (Table 1). Fall from height was the leading cause in the fall category accounting for [82 (95%)] of the cases. Out of all children with falls, [75 (91%)] of the children had fallen from one story height and 7 (9%) had fallen from two story height. Fall in the sloppy area was seen in 4 (5%) of the patients.

On analysis of the time of presentation after the injury, it was found that 46% of patients presented after 24 hours of injury with 10% presenting even after 72 hours after injury (Table 1). On analyzing the time since injury and outcome, it had no significant correlation (p-value=0.6) Poor outcome were 3 in the early group and 2 in the late presentation group. The time of presentation was evaluated with the outcome, [50 (44.6%)] patients presented within 24 hours whereas [62 (55.4%)] patients presented after 24 hours of injury).

On analysis of clinical presentation, vomiting [67 (59.8%)] followed by loss of consciousness [60 (53.5%)] were the commonest causes (Table 1). The post-traumatic seizure was found in about [13 (11.6 %)] of the cases two (1.7%) of them had a late seizure. Regarding the category of TBI, 80.3% were mild TBI, followed by moderate in 17.8% and severe in 1.9% of the total patients.

Clinical and radiological findings were categorized into scalp or skull injuries and brain injuries (table 5 shows different categories of injuries in our cohort). An underlying brain injury was seen in [72 (64%)] and skull fractures in [55 (61%)] of the patients. Isolated TBI was diagnosed in [104 (93%)]. In patients with multiple injuries, other associated injuries were long bones fracture, ribs fracture, and spinal injury.

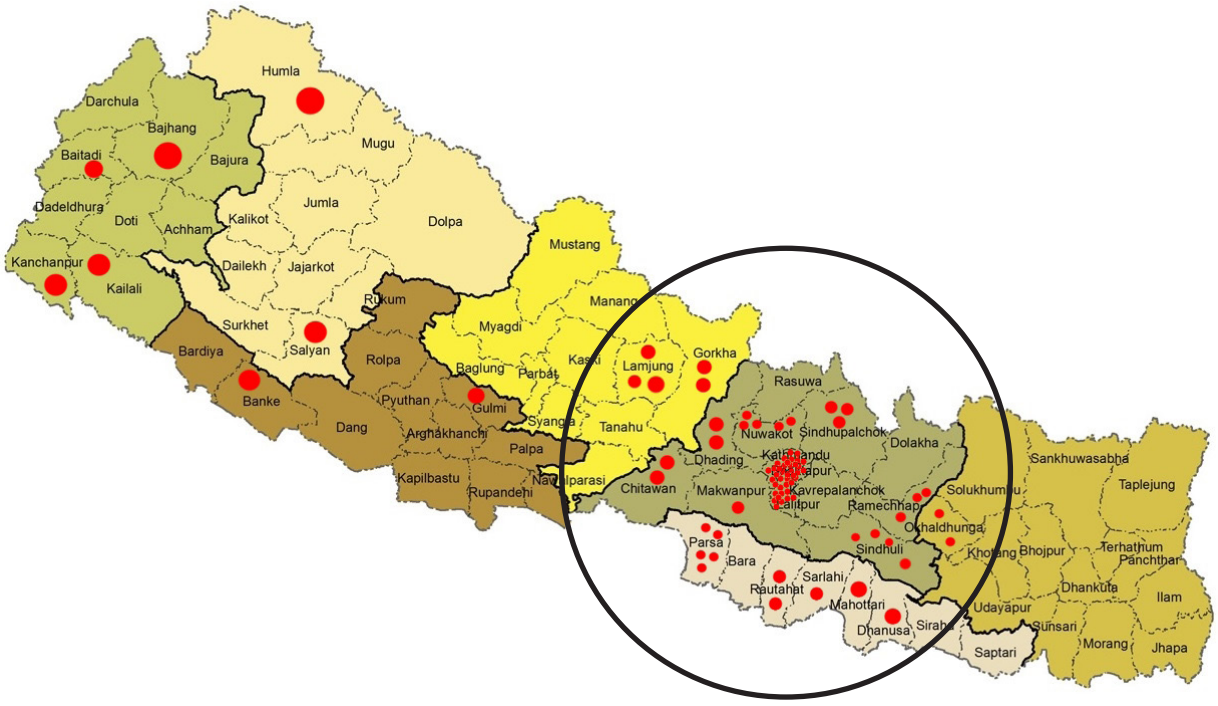

Figure 2. Schematic diagram showing the place of origin of patients with pediatric TBI

The majority of the patients [50 (44.6%)] were admitted to the neurosurgical wards, [48 (42.8%)] to high dependency units (HDU), and [13 (11.6%)] required Intensive Care Unit (ICU) admission. Mean ICU and hospital admission days were 2 and 7 days respectively.

On analysis of treatment received, surgical interventions were required in [34 (30.3%)] of the patients. Craniotomy with hematoma evacuation was the most common surgery in [20 (58.8%)] patients, followed by debridement and suturing for major scalp lacerations in [12(35.2%)] of the total operated cases. Two patients required decompressive craniectomy.

As shown in Table 1, a good outcome defined as GOS of 4 and 5 at discharge was noted in 106 (95.5%) of the cases. The majority [109 (97.3%)] of the patients were discharged to home and the remaining 3 (2.7%) required referral to rehabilitation facilities. There was no mortality in our series.

Analyzing health resource utilization, Pediatric TBI accounted for 735 hospital beds, and 224 ICU beds in one year. It accounted for 10% of the total and 20% of all the pediatric neurosurgical operations done that year.

DISCUSSION

TBI is a significant public health issue globally and is more common in LMICs.[3] Understanding the clinical and epidemiological pattern of disease will help us better prevent and treat the problem. In our study, we found that the majority of the children affected were from 1 to 5 years. The children are the most active in this age group. Children under 1 year are well protected by their parents, and elders could protect them to some extent. A similar finding was seen in studies done in Nepal by Agrawal et al[18] and Karmacharya et al.[19] However mean age was higher than our study in the study by Kafle P et al.[20]

In this study, males are affected more which is similar in other studies as well [16,19,20] and adults too.[21,22] according to Chiaretti et al. higher incidence of TBI in boys is most likely attributed to their larger head circumference, more muscular, and increased physical activities compared to girls.[23]

The most common mechanism of trauma was falls, similar to other studies from Nepal.[16,18,19,24] but different compared to the studies from other countries, RTA was the leading cause.[3,21] Most common sites of fall were from story windows followed by falls on sloppy areas. Most cases occurred during the spring season (March-May). It might be because the weather is good and children mostly go out to play. It is also the season when parents are in the field to work. The least occurs in the autumn, the festival season when the majority of the immigrant population has gone outside Kathmandu. Similar seasonal occurrence is found in other studies as well, however, some studies show a second peak during October-November.[25,26] RTA is not a common cause in our study presumably because children tend to travel less than the adult population, and our country has poor access to transportation due to difficulty geography.

In our series, more than half of our patients presented after 24 hours after injury. This reflects the difficult geography of Nepal, difficult roads, and even bad weather for airlifts. Tanzania is also LMIC like us, yet the mean time to the hospital is about 4 hours.[27] This finding is similar to that observed by Mukhida et al in 2006 in the same setting.16 time has evolved and the transportation system is claimed to improve, but the time to hospital is similar in 2022 as it was in 2006. This time to arrive at the hospital after trauma is worrisome and differs significantly from the data in developed countries like France where the mean time is 70 minutes.[28] 10% of the children even presented after 72 hours. However, the duration of presentation after injury was not associated with the bad outcome. This is because, those cases which are referred are either primarily stabilized in primary centers before referral, or those with severe injury might have died in the way.

In the presenting symptoms, vomiting was the most common presentation followed by loss of consciousness, similar to the study by Karmacharya et al.[19] Seizure was present in about 11.6% of children with an immediate and early seizure that required anti-convulsant therapy for one week. Only 2 children had late seizures requiring medication for 3 months. It is similar to the study by Petridis et al.[29] However, like other studies, post-traumatic seizure was not associated with poor outcomes or mortality.

Clinically, mild TBI was most common, followed by moderate and severe injury, similar to other studies.[16,19,22] Scalp or skull injury was present in 60% of the population, and abnormal CT was present in 64% of the population. Most of the children fell from one story, and this low magnitude of injury correlates with the finding that the majority of cases are mild TBI. The most common injuries were hematomas and simple linear fractures. The compound depressed fracture was seen in 5% of the cases. In this study, 40% of the patients with skull fractures have abnormal brain CT, while other studies mention 15-30%.[30]

In our study, about one-third of the cases required surgical management. The most common indication was craniotomy for evacuation of extra-axial hematoma followed by debridement with suturing for major scalp laceration and compound depressed fractures. Two cases required decompressive craniectomy, for hemispheric infarction, and multiple

hemispheric contusions with brain herniation. In a similar study in Nepal, 16% required surgery[20], and in Tanzania, 21% required so.[27] Majority of cases of EDH were not associated with underlying bone fracture (13 out of 16 cases).

Isolated head injuries accounted for more than 90% of the cases with associated injuries being ribs and spine fractures. This is consistent with other studies.[16,24]

Good outcome was seen in 95% of cases; 97% children were sent home, and others to rehabilitation facilities. There was no mortality. A similar outcome was noted in other studies too.[16,18-20]

This is a single-center retrospective study. We had less number of patients with bad outcomes, which was not sufficient for subgroup analysis. Larger prospective studies with a larger sample size can be done for subgroup analysis of different factors contributing to outcomes.

CONCLUSION

Falls and RTAs were the commonest causes of pediatric TBI. Despite progress in transportation and health services, more than half of the patients presented after 24 hours of injury. Craniotomy with hematoma evacuation was the most common surgical managment. Most of the children had a good outcome at the time of discharge. Pediatric TBI not only utilizes health resources but also gives significant morbidity and mortality to children.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

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