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Research Article

Computed Tomographic Evaluation of Intracranial Haemorrhage in Patients with Road Traffic Injuries

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ABSTRACT

Background and Objectives: Road traffic accidents (RTAs) are a major global public health concern, accounting for approximately 1.35 million deaths worldwide and representing the leading cause of mortality among children and young adults aged 5–29 years. In Nepal, RTAs are among the leading causes of death and early mortality. This study aimed to evaluate head injury patterns in RTA patients using computed tomography (CT) of the head and to determine the frequency and types of traumatic intracranial hemorrhage, including associated skull fractures.

Materials and Methods: A hospital-based cross-sectional study was conducted over six months from 1st September 2024 to 29th February 2025 at the Department of Radiology, National Medical College and Teaching Hospital, Birgunj, Nepal. A total of 100 patients with a history of road traffic accidents who underwent CT head examination were included. Patients with non-traumatic causes of intracranial hemorrhage were excluded. CT imaging was performed using a 160-slice Canon CT scanner. Data were analyzed using SPSS version 26. Ethical clearance was obtained, and informed written consent was taken from all participants.

Results: Among the 100 patients, 68% were male and 32% were female, with a mean age of 33.19 ± 13.15 years (range: 16–67 years). The most affected age group was 16–30 years (51%), followed by 31–45 years (33%). RTAs occurred most frequently during the evening hours (53%). Two-wheeler accidents were more common

(78%) than four-wheeler accidents (22%). Skull fractures were identified in 31% of patients. Traumatic brain hemorrhage was detected in 44% of cases, including hemorrhagic contusions in 8% and extra-axial hemorrhage in 36%. Among extra-axial hemorrhages, extradural hemorrhage (EDH) was most common (18%), followed by subdural hemorrhage (SDH) (11%) and subarachnoid hemorrhage (SAH) (7%).

Conclusions: The majority of the respondent had high involvement of their husband in antenatal care, but involvement in birth preparedness and complication readiness was quite low; therefore, awareness program on birth preparedness and complication readiness is recommended.

Keywords: Road Traffic Accident; Traumatic Brain Hemorrhage; Computed Tomography; Skull Fracture; Extradural Hematoma; Subdural Hematoma; Subarachnoid Hemorrhage

INTRODUCTION

Road traffic accidents (RTAs) represent a major global public health problem, accounting for approximately 1.35 million deaths worldwide in 2016 and constituting the leading cause of death among children and young adults aged 5–29 years [1]. In Nepal, RTAs were reported as the seventh leading cause of death and the fifth leading cause of premature mortality in 2017 [2]. RTAs remain a common cause of injury and trauma in Nepal, with hospital-based and autopsy studies consistently identifying RTAs as a major contributor to morbidity and mortality [3-8].

Multiple factors contribute to road traffic injuries, including driver behavior, vehicle mechanical condition, road infrastructure, and environmental factors [9-10]. Traumatic brain injury (TBI) is a frequent and serious consequence of RTAs, with approximately two million TBIs occurring annually worldwide [11]. Nearly 65% of RTA patients sustain some form of brain injury [12]. Computed tomography (CT) is the imaging modality of choice for evaluating head injury due to its wide availability, rapid acquisition, and ability to objectively assess structural brain damage [13]. Non-contrast axial CT remains the gold standard for acute head trauma evaluation [14]. CT findings in acute craniocerebral trauma include hemorrhagic contusions, intracerebral and extra-axial hemorrhages, cerebral edema, and diffuse axonal injury [12-15]. Prognosis in traumatic brain injury is often closely related to CT findings [16].

Previous studies have reported varying frequencies of intracranial hemorrhage following head injury, ranging from 0.6% to 15% [17-20]. Given the increasing incidence of RTAs in Nepal due to rapid urbanization, heavy traffic, and poor road conditions, there is a need for region-specific data. This study aimed to determine the frequency and types of traumatic intracranial hemorrhage detected on CT head in RTA patients, along with associated skull fractures, gender distribution, and mode of accident.

MATERIALS AND METHODS

Study Design and Setting

This cross-sectional observational study was conducted over a six-month period from 1st September 2024 to 29th February 2025 in the Department of Radiology, National Medical College and Teaching Hospital, Birgunj, Nepal. Ethical approval was obtained from the Institutional Review Committee (Ref: F-NMC/595/079-080). Written informed consent was obtained from all participants, and the study adhered to the principles of the Declaration of Helsinki.

Study Population

A total of 100 patients aged 15–75 years with a history of road traffic accidents who were referred for CT head examination were included. Patients with non-traumatic causes of intracranial hemorrhage were excluded.

Sample Size

The sample size was calculated using the formula:

$N = (Z^2 \times p \times q) / e^2$

At a prevalence of 4.5%, 95% confidence interval, and 5% margin of error, the calculated sample size was 65.66. To improve accuracy, 100 patients were included.

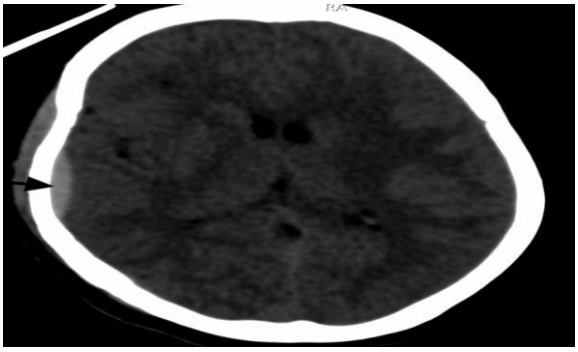

Fig.1 showing EDH in right temporal region

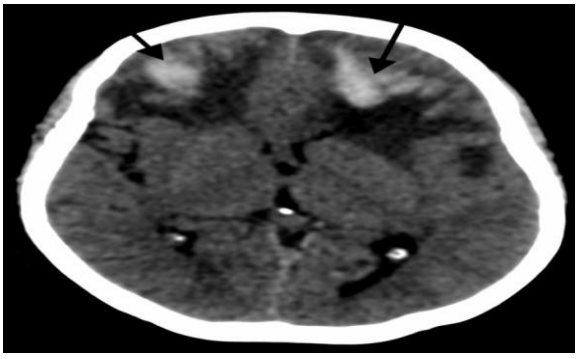

Fig 2. Hemorrhagic contusions in bilateral frontal lobes.

CT Protocol

CT scans were performed using a 160-slice Canon CT scanner. Axial non-contrast CT head images were obtained using 5-mm slice thickness from the skull base to the vertex. Gantry angulation was aligned parallel to the orbitomeatal line with a 15–20° tilt to minimize ocular radiation exposure. Both brain and bone windows were reviewed. Three-dimensional reconstructions and thinner slices were obtained when required.

Data Collection

A structured proforma was used to collect demographic data including age, sex, mode of transportation (two-wheeler or four-wheeler), and time of accident.

Statistical Analysis

Data were analysed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Associations were assessed using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

Among the 100 patients, 68 (68%) were male and 32 (32%) were female, with a male-to-female ratio of 2.8:1. The mean age was 33.19 ± 13.15 years (range: 16–67 years). The most affected age group was 16–30 years (51%), followed by 31–45 years (33%) as shown in Table 1.

Table 2 depicts that two-wheeler accidents accounted for 78% of cases, while four-wheelers accounted for 22%. Most accidents occurred during the evening hours (53%), followed by night-time accidents (26%).

Table 1: Distribution of patients according to age and sex

Age Group Years	Sex		Total	%	Age Min.	Age Max.	Mean/ Standard deviation
	Male	Female					
16-30	34	17	51	51	16 years	67 years	33.19/13.153
31-45	22	11	33	33			
46-60	8	3	11	11			
≥ 61	4	1	5	5			
Total	68	32	100	100 %			

Table 2: Distribution of timing and mode of accident

Timing	Mode of accident		Total	Percentage (%)
	2 wheeler	4 wheeler		
Morning (4 am to 10 am)	13	0	13	13
Afternoon 10 am to 4 pm)	6	2	8	8
Evening (4 pm to 10 pm)	40	13	53	53
Night (10 pm to 4 am)	19	7	26	26
Total	78	22	100	100

Table 3: Distribution of traumatic brain haemorrhage in study population

Age Group	Hemorrhagic contusions	EDH	SDH	SAH	Total
16-30	3	5	6	5	19 (19%)
31-45	4	10	4	1	19(19%)
46-60	1	2	1	0	4 (4%)
≥ 61	0	1	0	1	2 (4%)
Total	8	18 (18%)	11 (11%)	7 (7%)	44 (44%)

Table 4: Correlation of skull fracture with Brain hemorrhage (including both intra and axial hemorrhage)

Fracture	Brain hemorrhage		Total	P value (Chi-Square)
	No	Yes		
No	54	15	69	0.00001
Yes	2	29	31	
Total	56	44	100	

Out of 100 study population, skull fractures were identified in 31% of patients. Traumatic brain hemorrhage was detected in 44% of cases, including hemorrhagic contusions (8%) and extra-axial hemorrhage (36%).

Among extra-axial hemorrhages, extradural hematoma (18%) was the most common, followed by subdural hematoma (11%) and subarachnoid hemorrhage (7%) as shown in Table 3.

Table 4 depicts that statistically significant association was observed between skull fractures and traumatic brain hemorrhage ($p < 0.00001$). Skull fractures were also significantly associated with traumatic subarachnoid hemorrhage ($p < 0.00001$).

DISCUSSION

In present study, out of 100 patients, 68 (68%) were male and 32 (32%) were female with male and female ratio is 2.8: 1.0 indicate that male involvement is more than female due to aggressive driving activity which is supported by Hamed Al-Reesi and Abdullah Al-Maniri study showed male involvement in RTA was common [21-23]. In another similar study 77.8% of RTA victims were males, consistent with findings from earlier studies in India and other nations [24].

Among mode of accident in present study, there were 2-wheeler 78 (78%) involvement like bike and scooter is more than 4-wheeler 22 (22%) involvement , like car and bus which is supported by a study on RTA in the Karnali province of Nepal on 2024 found that motorcycles and scooters, while making up 77.27% of registered vehicles were involved in the vast majority of accidents [25]. More accident cases seen in this study is evening (4 pm to 10 pm) which is 53 (53%) followed by night 26 (26%) and least in afternoon time 8(8%) which is due heavy traffic congestion as people commute home from work. Factors like driver fatigue, stress, distraction, and the urgency to get home contribute to the high collision rates in the evening time.

In present study, out of 100 patients with RTA 44 (44%) have traumatic brain hemorrhage including both intra and extra-axial hemorrhage, among which 8 have hemorrhagic contusions (18.2%) and 36 (81.8 %) have extra-axial hemorrhage. Among 36 extra-axial hemorrhage, 18 (50%) have extradural hematoma, 11 (30.6 %) have subdural hematoma and 7 (19.4 %) have subarachnoid hemorrhage which is slightly higher value as compare to study conducted by Ummara Siddique Umer [19] showed 25 (15.3%) traumatic intracranial hemorrhage. Out of 25 patients, 09 (36%) had subdural hemorrhage (SDH), 05 (20%) had subarachnoid hemorrhage (SAH), 07 (28%) had epidural hemorrhage (EDH) and 04 (16%) had intra parenchymal hemorrhage (IPH) possibly due to severity of accident is common in our area.

In present study out of 100 study population there are 31 (31 %) have skull fracture which is slightly lower than study conducted by in Pakistan which is accounting 75(68.2%) of skull fracture out of 110 population. The skull fracture is strongly associated with extra-dural hematoma but in our study skull fracture is statistically significant associated with overall traumatic brain hemorrhage (extra and intra-axial hemorrhage) ($P < 0.00001$) and not statically correlated with epidural hematoma (p 0.16) [18]. But our study found that skull fracture is statistically significant correlates with traumatic subarachnoid hemorrhage ($P< 0.00001$) which is supported by study conducted by Faried A et al. [26].

In the present study, males constituted the majority of road traffic accident (RTA) victims, accounting for 68% of cases, while females represented 32%, resulting in a male-to-female ratio of 2.8:1. This predominance of male involvement suggests greater exposure to risk factors such as aggressive driving behaviour and increased outdoor activity. Similar findings have been reported by Hamed Al-Reesi and Abdullah Al-Maniri which documented higher male involvement in RTAs [21–23]. Additionally, a study documented that 77.8% of RTA victims were male, consistent with observations from India and other countries [24].

Regarding the mode of accident, two-wheeler involvement was predominant in the present study, accounting for 78% of cases, compared to 22% involving four-wheelers such as cars and

buses. This pattern aligns with a 2024 study from Karnali Province, Nepal, which reported that motorcycles and scooters, despite constituting 77.27% of registered vehicles were involved in the majority of RTAs [25]. The higher vulnerability of two-wheeler riders can be attributed to limited physical protection and increased exposure to high-risk traffic environments.

The temporal distribution of accidents revealed that most RTAs occurred during the evening hours (4 pm to 10 pm), accounting for 53% of cases, followed by nighttime accidents (26%). The lowest incidence was observed during the afternoon period (8%). The increased frequency of evening accidents may be explained by heavy traffic congestion during peak commuting hours, along with contributing factors such as driver fatigue, stress, distraction, and urgency to return home, all of which increase collision risk.

In this study, traumatic brain hemorrhage was observed in 44% of RTA patients, including both intra-axial and extra-axial hemorrhages. Among these, hemorrhagic contusions were identified in 18.2% of cases, while extra-axial hemorrhages accounted for 81.8%. Of the extra-axial hemorrhages, extradural hematoma was the most common (50%), followed by subdural hematoma (30.6%) and subarachnoid hemorrhage (19.4%). These findings demonstrate a higher prevalence of intracranial hemorrhage compared to a study conducted by Umer et al. [19] which reported traumatic intracranial hemorrhage in only 15.3% of patients. In that study, subdural hemorrhage was the most frequent (36%), followed by epidural hemorrhage (28%), subarachnoid hemorrhage (20%), and intraparenchymal hemorrhage (16%). The higher hemorrhage rate in the present study may reflect greater accident severity or delayed access to trauma care in the study region.

Skull fractures were identified in 31% of patients in the present study, a lower prevalence compared to the findings of Khan and Nadeem, who reported skull fractures in 68.2% of cases in a study [18]. While Khan and Nadeem observed a strong association between skull fractures and extradural hematoma, our study demonstrated a statistically significant association between skull fractures and overall traumatic brain hemorrhage (both intra- and extra-axial) ($P < 0.00001$). However, skull fractures were not significantly associated with epidural hematoma alone ($p = 0.16$). Notably, a strong statistical correlation was found between skull fractures and traumatic subarachnoid hemorrhage ($P < 0.00001$), a finding supported by the study conducted by Faried et al. [26].

CONCLUSIONS

Road traffic accidents remain a significant cause of traumatic brain injury in Nepal, particularly among young adult males and two-wheeler users. CT head examination plays a critical role in the early detection of intracranial hemorrhage and skull fractures. Extra-axial hemorrhages, especially extradural hematomas, were the most common findings. A strong association was observed between skull fractures and traumatic brain hemorrhage. Early CT evaluation is essential for timely management and improved outcomes in RTA patients.

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