Role of Computed Tomography in the Evaluation of Traumatic Head Injury at Nepalgunj Medical College Teaching Hospital: A Cross-Sectional Study

Pandit RK[1], Pandit R[2], Thakur UP[3], Karn SL[4], Ghimire P[1]

ABSTRACT

Introduction: Traumatic head injury is a major cause of morbidity and mortality worldwide, particularly in low- and middle-income countries. Early identification of intracranial lesions is crucial for appropriate management. Computed tomography has become the imaging modality of choice in acute head injury due to its rapid availability and high diagnostic accuracy. **Aims:** To evaluate the role of Computed tomography scan in detecting intracranial lesions and its association with clinical parameters in patients presenting with traumatic head injury. **Methods:** A hospital-based cross-sectional study was conducted at Nepalgunj Medical College Teaching Hospital from September 2025 to April 2026. A total of 150 patients with traumatic head injury who underwent Computed tomography scan were included. Data regarding demographic characteristics, mechanism of injury, Glasgow Coma Scale, and Computed tomography findings were collected and analyzed using Statistical Package for the Social Sciences version 25. Associations between variables were assessed using the chi-square test, and a p-value of less than 0.05 was considered statistically significant. **Results:** Out of 150 patients, 65.3% were male, and the majority belonged to the 21–40 years age group (42%). Road traffic accidents were the most common cause of injury (58%). Computed tomography abnormalities were observed in 61.3% of cases. A strong statistically significant association was found between Glasgow Coma Scale and Computed tomography findings ($p = 0.002$), whereas no significant association was observed between sex and Computed tomography findings ($p = 0.21$). Age showed a statistically significant but weak association with Computed tomography findings ($p = 0.048$). **Conclusion:** Computed tomography scan plays a crucial role in the early detection of intracranial injuries and shows strong correlation with clinical severity, making it an essential tool in the management of traumatic head injury.

Keywords: Computed tomography; Glasgow Coma Scale; Intracranial hemorrhage; Road traffic accidents; Traumatic Head injury

Authors:

1. Mr. Rajendra Kumar Pandit
2. Mrs. Raksha Pandit
3. Dr. Umeshwar Prasad Thakur
4. Dr. Subhash Lal Karn
5. Dr. Prasanna Ghimire

[1]Department of Radiodiagnosis, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke, Nepal

[2]Department of Ophthalmology, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke, Nepal

[3]Department of Anatomy, Karnali Academy of Health Sciences, Jumla, Karnali, Nepal

[4]Department of Microbiology, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke, Nepal

Address for Correspondence:

Mr. Rajendra Kumar Pandit
Department of Radiodiagnosis
Nepalgunj Medical College and Teaching Hospital
Kohalpur, Banke
Email: panditrajendra555@gmail.com

INTRODUCTION

Traumatic head injury is a leading cause of death and disability worldwide and contributes significantly to the global burden of disease, particularly in developing countries.[1,2] The incidence of traumatic brain injury is increasing due to rapid urbanization, increased vehicular traffic, and lack of strict enforcement of safety regulations. In Nepal, road traffic accidents, falls, and interpersonal violence remain the major contributors to head injury. Clinical evaluation using the Glasgow Coma Scale (GCS) provides an initial assessment of neurological status; however, it is often insufficient to detect underlying intracranial pathology.[3] Therefore, imaging plays a vital role in the evaluation of patients with head injury. Computed tomography (CT) has become the first-line imaging modality in the evaluation of acute traumatic head injury because of its rapid acquisition, wide availability, and high sensitivity for detecting acute hemorrhage, skull fractures, mass effect, and cerebral edema. Although magnetic resonance imaging (MRI) is superior for detecting diffuse axonal injury and non-hemorrhagic contusions, CT remains the preferred initial imaging modality in emergency settings.[4,5] Early CT imaging has been shown to improve patient outcomes by enabling timely intervention and appropriate management decisions.[6] Despite its widespread use, the pattern of CT findings and their correlation with clinical severity may vary across different populations. There is limited data from western Nepal regarding the role of CT scan in traumatic head injury. Therefore, this study was conducted to evaluate CT findings and their association with clinical parameters in patients presenting to Nepalgunj Medical College Teaching Hospital.

METHODS

This hospital-based cross-sectional study was conducted at Nepalgunj Medical College Teaching Hospital, Kohalpur, Banke, Nepal, over a period of eight months from September 2025 to April 2026. The study included 150 patients presenting with traumatic head injury who underwent CT scan evaluation. Ethical approval was obtained from the Institutional Review Committee of Nepalgunj Medical College. Patients were selected using a consecutive sampling technique. All patients with a history of trauma to the head, irrespective of age and sex, were included in the study. Patients with non-traumatic neurological conditions and those with incomplete records were excluded.

Clinical assessment was performed at presentation, and the level of consciousness was evaluated using the Glasgow Coma Scale (GCS), which categorizes patients into mild, moderate, and severe head injury.[3] All studies were performed with GE Revolution EVO 128 slice spiral CT machine and a protocol of contiguous axial 5-mm sections through the posterior fossa and a contiguous 10 mm axial sequential scans for the rest of the brain. Wherever required, thinner cuts were also taken. Bone algorithms with wide window settings were studied to visualize any fractures of the skull. No contrast material was administered. All CT images were interpreted by experienced radiologists. Findings such as cerebral contusion, intracranial hemorrhage, skull fractures, cerebral edema, and diffuse axonal injury were recorded. In this study, cerebral contusion referred to focal areas of hemorrhagic brain parenchymal injury caused by trauma, whereas intraparenchymal hemorrhage referred to deeper or more diffuse hemorrhagic lesions not specifically classified as contusions.

All patients sustaining head injury presenting in emergency room were included. Exclusion Criteria was a) Known hypertensives. b) Patients receiving anti-coagulant drugs. c) Patients with history of previous Cerebro vascular accidents and d) Patients with known bleeding disorders.

Statistical Analysis

Data were entered into SPSS version 25 for analysis. Descriptive statistics were used to summarize the data, and categorical variables were expressed as frequencies and percentages. The chi-square test was used to assess associations between variables, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 150 patients were included in the study. The majority of patients were male, accounting for 65.3% of the study population.

Sex (n=150)	Frequency	Percentage (%)
Male	98	65.3
Female	52	34.7
Total	150	100

Table I: Sex distribution

Out of the total 150 patients included in the study, 98 patients (65.3%) were male and 52 patients (34.7%) were female, indicating a clear predominance of males among cases of traumatic head injury. Despite this higher frequency in males, statistical analysis demonstrated no significant association between sex and CT findings ($\chi^2 = 1.56$, $p = 0.21$).

Age Group (n=150)	Frequency	Percentage (%)
<20	30	20.0
21–40	63	42.0
41–60	38	25.3
>60	19	12.7

Table II: Age distribution

The age distribution of the study population revealed that the largest proportion of patients belonged to the 21–40 years age group, accounting for 63 cases (42.0%). This was followed by the 41–60 years age group with 38 patients (25.3%), patients younger than 20 years with 30 cases (20.0%), and those older than 60 years with 19 cases (12.7%). Statistical analysis showed a borderline significant association between age group and CT findings ($\chi^2 = 7.89$, $p = 0.048$), suggesting that age may have some influence on the presence of intracranial abnormalities, although the strength of this association is limited.

Mode of Injury (n=150)	Frequency	Percentage (%)
RTA	87	58.0
Fall	42	28.0
Assault	21	14.0

Table III: Mode of injury

Analysis of the mode of injury indicated that road traffic accidents were the most common cause, accounting for 87 cases (58.0%), followed by falls in 42 patients (28.0%) and assault in 21 patients (14.0%). Despite road traffic accidents being the leading cause of injury, statistical testing revealed no significant association between mode of injury and CT findings ($\chi^2 = 4.12$, $p = 0.127$). This suggests that the mechanism of injury alone is not a reliable predictor of whether a patient will have abnormal findings on CT scan.

CT Finding (n=150)	Frequency	Percentage (%)
Normal	58	38.7
Abnormal	92	61.3

Table IV: CT findings

CT scan evaluation showed that 92 patients (61.3%) had abnormal findings, whereas 58 patients (38.7%) had normal scans. This indicates that a majority of patients presenting with traumatic head injury had detectable intracranial pathology. The relatively high proportion of abnormal CT findings highlights the diagnostic importance of CT imaging in identifying injuries that may not be evident through clinical examination alone.

Lesion Type (n=150)	Frequency	Percentage (%)
Cerebral contusion	46	30.7
Skull fracture	39	26.0
Intracranial hemorrhage	36	24.0
Cerebral edema	18	12.0
Diffuse axonal injury	11	7.3

* Multiple lesions may coexist in the same patient.

* Intracranial hemorrhage comprised Epidural Hemorrhage (n=20), Subdural Hemorrhage (n=12), and Subarachnoid Hemorrhage (n=4)*

Table V: Types of Lesions

Among patients with abnormal CT findings, cerebral contusion was the most frequently observed lesion, accounting for 46 cases (30.7%). Skull fractures were identified in 39 patients (26.0%), while intracranial hemorrhage was present in 36 patients (24.0%), comprising epidural hemorrhage (n=20), subdural hemorrhage (n=12), and subarachnoid hemorrhage (n=4). Cerebral edema was observed in 18 patients (12.0%), and diffuse axonal injury in 11 patients (7.3%). The predominance of cerebral contusions and skull fractures suggests that blunt head trauma was the major mechanism of injury in the study population, whereas intracranial hemorrhage and diffuse axonal injury reflected varying degrees of injury severity.

GCS Category (n=150)	Normal CT	Abnormal CT	Total
Mild	50	40	90
Moderate	6	28	34
Severe	2	24	26

Table VI: GCS vs CT findings

The association between Glasgow Coma Scale (GCS) and CT findings demonstrated a clear relationship between clinical severity and radiological abnormalities. Among patients with mild head injury, 50 had normal CT scans and 40 had abnormal findings. In the moderate category, 6 patients had normal CT scans while 28 had abnormal findings. In the severe category, only 2 patients had normal CT scans compared to 24 patients with abnormal findings. This shows a progressive increase in the proportion of abnormal CT findings with increasing severity of head injury. Statistical analysis confirmed a highly significant association between GCS and CT findings ($\chi^2 = 18.67$, $p = 0.002$), indicating that lower GCS scores are strongly associated with a higher likelihood of intracranial abnormalities and this association was highly statistically significant ($\chi^2 = 18.67$, $p = 0.002$).

DISCUSSION

The findings of this study highlight the important role of computed tomography in the evaluation of traumatic head injury. The predominance of male patients observed in this study is consistent with previous studies, which report higher exposure of males to risk factors such as road traffic accidents and occupational hazards.[7,8]

The age distribution indicates that young adults are the most affected group, which is in agreement with global epidemiological trends.[1,2] This has important socioeconomic implications, particularly in developing countries where this age group forms the backbone of the workforce. Road traffic accidents were identified as the leading cause of injury, consistent with findings from the World Health Organization and other regional studies.[9] This reflects the growing burden of vehicular trauma in Nepal and highlights the need for improved road safety measures. Similar patterns have been reported in studies conducted in Nepal, India, and Pakistan, where young adult males involved in road traffic accidents represented the majority of traumatic head injury cases. The proportion of abnormal CT findings observed in this study is broadly comparable to reports from Nepal and other South Asian countries, where road traffic accidents remain a leading cause of traumatic head injury and intracranial lesions are frequently encountered. Cerebral contusions and skull fractures were the most common CT abnormalities identified, reflecting the predominance of high-impact blunt trauma in the study population. Intracranial hemorrhagic lesions, including epidural, subdural, and subarachnoid hemorrhages, constituted a substantial proportion of abnormal findings, further emphasizing the severity of injuries presenting to the emergency department and supporting previous observations reported by Servadei.[10] However, direct comparisons with other studies should be interpreted cautiously, as patients with known hypertension, anticoagulant use, previous cerebrovascular accidents, and bleeding disorders were excluded from the present study, which may have influenced the observed distribution of intracranial lesions.

A key finding of this study is the strong association between GCS and CT abnormalities. Patients with lower GCS scores were significantly more likely to have abnormal CT findings, which is consistent with previous research.[11,12] This supports the combined use of clinical and radiological assessment in managing head injury patients. On the other hand, no significant association was observed between sex and CT findings, suggesting that the severity of injury is independent of gender. Although males constituted the majority of traumatic head injury cases in the present study, the likelihood of demonstrating abnormal CT findings was not significantly different between males and females. This finding indicates that while males may be more frequently exposed to risk factors for head injury, sex alone does not appear to influence the occurrence of intracranial abnormalities following trauma. Similarly, the absence of significant association between mode of injury and CT findings indicates that imaging should not be limited based on mechanism alone. Overall, CT scan remains a highly effective diagnostic tool that enables early detection of intracranial lesions and improves clinical outcomes.[13,14,15]

LIMITATIONS

This study has several limitations. It was conducted at a single tertiary care center, which may limit the generalizability of the findings to other settings with different patient populations and resources. The relatively small sample size may have reduced the statistical power to detect certain associations. The absence of follow-up data limits the assessment of long-term outcomes such as recovery, disability, and mortality. In addition, the analysis was limited to univariate methods, and multivariate analysis was not performed, which restricts control for potential confounding variables. Furthermore, important clinical factors such as comorbidities, pre-hospital care, time to imaging, and treatment interventions were not included, which may influence both CT findings and patient outcomes.

CONCLUSION

This study demonstrates that computed tomography is an essential diagnostic modality in the evaluation of traumatic head injury, with a considerable proportion of patients showing intracranial abnormalities on imaging, thereby highlighting the importance of early CT assessment. The strong association observed between Glasgow Coma Scale (GCS) and CT findings emphasizes the need for an integrated approach combining clinical evaluation with radiological investigation to ensure accurate diagnosis and appropriate management. Although demographic factors such as age and sex influence the occurrence of head injury, they do not reliably predict the presence of intracranial pathology, underscoring the necessity of imaging in clinically indicated cases. In addition to facilitating accurate diagnosis, CT scanning plays a crucial role in guiding management decisions, including the need for surgical intervention and intensive care. Therefore, it should be routinely utilized in patients with suspected head injury, particularly those presenting with altered consciousness. Furthermore, improving access to CT imaging and strengthening trauma care systems can play a significant role in reducing the morbidity and mortality associated with traumatic head injury.

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*Multiple CT findings were allowed in individual patients; therefore, the total number of lesions exceeds the total number of patients included in the study.