MULTIDETECTOR COMPUTED TOMOGRAPHY (MDCT) EVALUATION OF TRAUMATIC BRAIN INJURY IN HEAD TRAUMA PATIENTS IN TERTIARY HOSPITAL OF EASTERN REGION OF NEPAL

Ajay Kr. Yadav[1], Binit Dev[1], Sushil Taparia[2], Parvez Kumar[3], Rakesh Mandal[3], Bivek Vaidya[4]*

Affiliation

1. *Lecturer, Department of Radiodiagnosis, Birat Medical College and Teaching Hospital, Nepal.*
2. *Senior Consultant, Department of Radiodiagnosis, Birat Medical College and Teaching Hospital, Nepal.*
3. *Senior Consultant, Department of Medicine, Birat Medical College and Teaching Hospital, Nepal.*
4. *Senior Consultant, Department of Neurosurgey, Birat Medical College and Teaching Hospital, Nepal.*

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**** Corresponding Author***
Dr. Ajay Kumar Yadav
Lecturer
Department of Radiodiagnosis
Birat Medical College and Teaching Hospital, Nepal
Email ID: ajaydraiims11@gmail.com
ORCID ID: https://orcid.org/0000-0001-8507-3767

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ABSTRACT

Introduction

Traumatic brain injury (TBI) in patients with head trauma is common cause for emergency visits to hospital affecting all age groups. It is one of important leading cause of death and disability worldwide besides leading to neurological disease burden. Noncontrast enhanced Multidetector computed tomography (MDCT) is imaging modality of choice for detection of various intracranial lesions.

Objectives

This study was done to analyse various imaging findings on MDCT in traumatic head injury patients along with association of CT findings with clinical manifestation and mechanism of injury.

Methodology

In this ethically approved prospective study, CT scan was done in 224 consecutive patients with head injury from November 2020 to February 2021. The various imaging findings seen in CT scan were documented in proforma. The data collected was analyzed with appropriate statistical test and statistical significance was calculated.

Results

Total of 224 patients with diagnosis of head injury were included in the study. The male to female ratio was 2.86 and most common age group involved was between 20-40years (41.1%). The most common mode of injury was road traffic accidents (57.6%) and most of the patients presented with history of altered sensorium (35.7%). About 47.3% patients showed abnormal findings on CT scan with scalp lesion was most common findings (82%) followed by skull fractures (54.7%) and cerebral contusions (43.4%). Patients with history of RTA had more abnormal CT scan (62%) than fall injury and physical assault. Statistically significant association seen between CT scan findings with Glasgow Coma Scale and RTA ($P<0.05$).

Conclusion

The present study showed well documented role of CT scan in diagnosis of TBI besides detection of spectrum of intracranial lesions in patients with head trauma. Road traffic accident is most common mode of head injury with most of the victims are young middle age active male.

KEY WORDS

Computed tomography, head injury, hemorrhage, traumatic brain injury

INTRODUCTION

Head injury (HI) refers to physical damage involving skull or scalp or brain while Traumatic brain injury (TBI) is defined by disruption in the normal function of brain caused by an external force.[1-4] TBI is one of the leading causes of death and disability worldwide affecting all age groups with case fatality rates are up to 40% in severe type and <1% in mild type.[5,6] It is a type of devastating injury. Each year, about sixty-nine million individuals suffer from TBI of all causes worldwide with greatest burden seen in southeast Asia (56%) and western pacific regions (56%) noted. About 1.8lakhs of TBI cases was seen in Nepal during the year of 2016.[7,8] The main cause of head trauma responsible for TBI are road traffic accidents (RTA) accounting for 60% cases while other causes include falls (20-30%), assault (10%), sports and work place related activities (10%).[9] TBI are one of the common causes of emergency hospital admission and is responsible for serious socioeconomic problem and serious public health problem epidemiologically.[10]

The injury occurring at the time of traumatic impact is primary brain injury which includes intracranial haemorrhages, skull fracture, diffuse axonal injury (DAI) and contusions/coup-countrecoup injury. Intracranial haemorrhages include epidural haematoma (EDH), subdural haematoma (SDH), subarachnoid haemorrhage (SAH), intraventricular haemorrhage (IVH) and intracerebral hematoma. Secondary brain injury such hypoxia and hypotension, ischemia, hydrocephalus, cerebral edema, vasospasm and second impact syndrome results from metabolic and physiologic changes that occur at the time of initial injury lasting for hours to days and may complicate primary brain injury. So, one of the main concerns is to prevent secondary brain injury in patients with severe TBI. Most of the TBI patients presents with complain of headache, vomiting, loss of consciousness, skull fractures with scalp hematoma and injury. Glasgow coma scale (GCS) is used for neurological assessment of patients with head trauma and for classifying the severity of TBI. GCS has three components (eye, motor and verbal scales) and its score ranges from 3-15.[11-13]

Radiological examination is the only reliable method to diagnose TBI in current scenario and in acute settings in addition to early clinical suspicion and diagnosis so that aggressive early managements can be done for prevention of secondary complications due to head trauma. Radiological examinations are also done for patient satisfaction in some cases. Besides head trauma, patient is monitored for different clinical symptoms and signs like loss of consciousness, confusion, altered sensation, repeated vomiting, seizure, suspected open or depressed skull fracture, sign of basal skull fracture (Hemotympanum, "Panda" eyes, Cerebrospinal fluid leakage from nose or ear, Battle's sign), Glasgow Coma Scale (GCS) <13 on initial assessment and GCS <15 at 2 hours after the injury, children under 1 year for presence of bruise, swelling or laceration of more than 5cm on the head, age 65 years or older, coagulopathy or patient on anticoagulant, focal neurological deficit, amnesia of events more than 30 minutes after injury. Radiological examination is recommended in these patients.[14,15]

Previously in most of the head trauma patients, skull radiography was done however in current scenario with development in cross sectional imaging, multidetector computed tomography (MDCT) is primary radiological investigation of choice in management of TBI as it detects various brain pathologies related to trauma in addition to its easy availability, having high accuracy, faster scanning modality and is cheaper in comparison to magnetic resonance imaging (MRI).[16] Due to early detection of brain lesions can lead to significant impact on early aggressive and appropriate management along with timely emergency surgical interventions for haemorrhage, hydrocephalus, contusions and mass effect. The purpose of this study is to analyse various imaging findings on MDCT in traumatic head injury patients along with association of CT findings with clinical manifestation and mechanism of injury.

METHODOLOGY

After institutional ethical committee approval, this prospective cross-sectional study was done in all patients with head injury presenting in Birat Medical College Teaching Hospital, one of the tertiary care hospitals of eastern region of Nepal from November 2020 to February 2021. After obtaining informed consent from the patients, information's about clinical features and mode of injury, general physical examination along with GCS assessment was carried out in all patients with diagnosis of head injury meeting the inclusion criteria after initial resuscitation, stabilisation, primary and secondary survey of the patients. In case of unconscious patient, unstable patient and children with head injury, consent was taken from close relatives and immediate CT scan of brain was performed. The inclusion criteria included patients presenting with diagnosis of head injury irrespective of age groups. Patients with prior history of head injury during follow up cases, head injury after child birth and patients with head injury with malignant brain tumors were excluded from the study. On the basis of GCS score, patients with head injury were classified in mild type (13-15), moderate type (9-12) and severe type (3-8). All patients underwent noncontrast computed tomography (NCCT) of brain using 64 slice MDCT scanner (Somatom Perspective, Siemens, Erlangen, Germany) to see the area of brain and scalp involved using standard traumatic protocol of the institute from base of skull to vertex in supine positions using 5mm slice thickness and 32x0.2mm collimation. All the findings were noted in specifically designed proforma and entered in MS excel for further analysis.

Statistical Analysis

Data was analyzed using SPSS 20.0 version software and results were expressed in mean ± standard deviation for continuous data and median for noncontinuous data. Results were also presented in Tables, graphs, Figures and diaphragm where necessary with appropriate statistical test were applied including chi-square test and Spearman's correlation. P values less than 0.05 were considered statistically significant.

RESULTS

A total of 224 consecutive patients with diagnosis of head injury underwent noncontrast CT scan of head were included in this study. Among the total 224 patients, 166 (74.1%) were male and 58 (25.9%) were female giving a male to female ratio of 2.86. The age distribution of the patients included in this study ranged from 6months to 92 years with mean age of 35.9±20.5years shown in table 1. The patients with age group between 21-40 years (41.1%) were seen more frequently encountered group with head trauma.

Table 1. Showing age & sex distribution of study population, Mean age- 35.9±20.5 years

Age (Years)	Number	Percentage (%)
≤20	48	21.4
21-40	92	41.1
41-60	54	24.1
61-80	22	9.8
>80	8	3.6
Total	224	100%
Sex		
Male	166	74.1%
Female	58	25.9%
Total	224	100%

In this study, road traffic accidents were most common mode of injuries seen in 129 patients (57.6%) followed by fall injury, physical assault and others as shown in figure 1. Out of 224 patients, majority of the patients (80, 35.7%) had history of altered sensorium as most common presenting complain as shown in table 2. Most of the patients (179, 79.9%) with head trauma had normal or minor neurological problem examined in emergency department with GCS score of 13-15as shown in table 3.

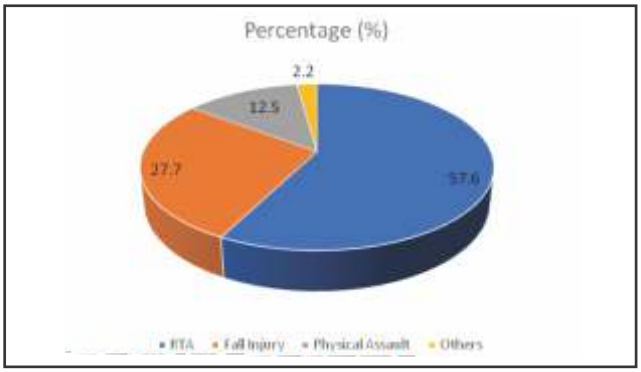

Figure 1: Showing Mode of Injury

Out of 224 patients with head trauma underwent NCCT scan of head, 118 patients (52.7%) had normal findings on CT scan while various spectrum of abnormalities seen on CT scan in 106 patients (47.3%). Scalp injury (Figure 2) was most common abnormalities seen in 87 (82%) patients out of all patients having abnormal CT scan followed by fracture and intracranial hemorrhage shown in table 4. Cerebral contusions were most common findings among intracranial abnormalities (Figure 3). Among the patients with head trauma, statistically significant correlation was found between abnormal CT scan with GCS score (P<0.006). More number of abnormalities seen on CT scan in patients with head trauma in case of RTA (62%) and fall injury (32.3%) and is statistically significant (p<0.009) while there was more chance of normal CT scan in case of physical assault. There was more chance of getting abnormal CT scan in patients who presented with unconsciousness and shock followed by external injury while there was less chance of getting abnormal CT scan in patients with headache. In our study, 15 patients presented with unconsciousness and shock, all had

Table 2. Showing clinical presentation of patients with head trauma

Clinical Presentation	Number	Percentage (%)
Altered Sensorium	80	35.7
External Injury	56	25
Vomiting	34	15.2
Headache	22	9.8
Shock/Unconscious	15	6.7
Ear/Nasal Discharge	12	5.4
Seizure	5	2.2
Total	224	100%

Table 3: Showing grades of head injury with Glasgow coma scale (GCS) score

Grades of Head Injury (GCS Score)	Number	Percentage (%)
Mild (13-15)	179	79.9
Moderate (9-12)	26	11.6
Severe (≤8)	19	8.5
Total	224	100%

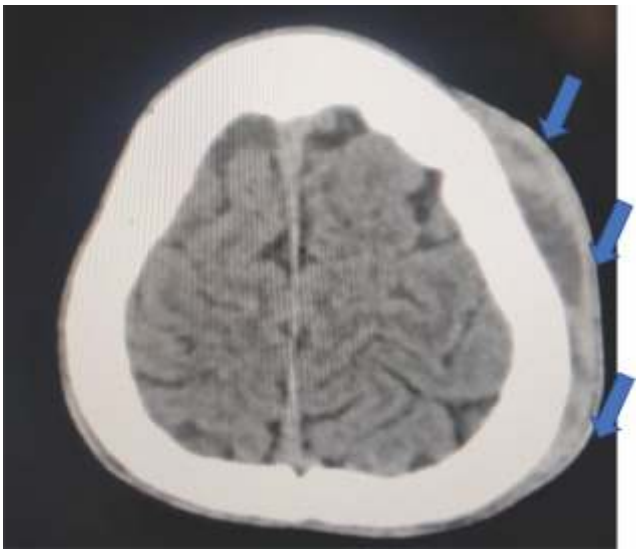

Figure 2. Axial section NCCT scan showing marked scalp soft tissue swelling (thick arrows) with scalp hematoma in left frontoparietal regions

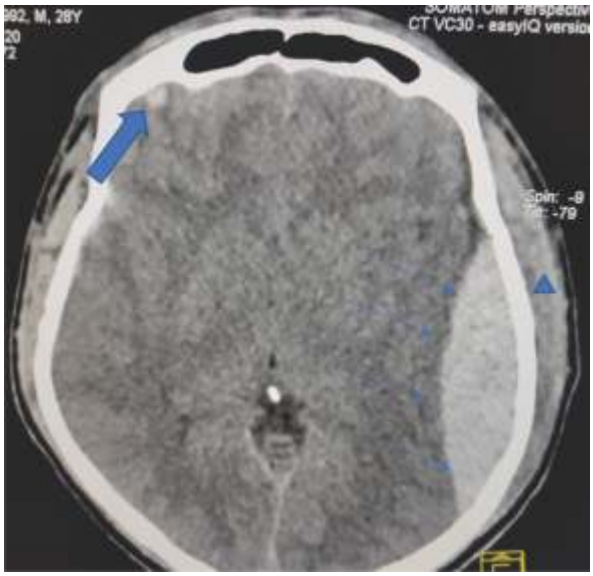

Figure 3: Axial section NCCT scan showing small hemorrhagic cerebral contusion in right basifrontal lobe (thick blue arrow) with large extra-axial hyperdense extradural hematoma (thin blue arrows) in left temporoparietal regions and mild scalp soft tissue swelling (Blue arrow head) with scalp hematoma in left temporoparietal regions.

Table 4: showing spectrum of injuries on NCCT scan of patients with head trauma (Total number of patients with abnormal CT scan=106)

CT Findings	Number	Percentage (%)
Scalp Injury	87	82.1
Skull fractures	58	54.7
Cerebral contusions	46	43.4
Subdural Hematoma	44	41.5
Intraparenchymal Hematoma	39	36.8
Subarachnoid Hemorrhage	38	35.8
Pneumocephalus	36	33.9
Extradural Hematoma	34	32.1
Midline Shift	23	21.6
Intraventricular Hemorrhage	17	16.03
Ventricular Shift	16	15.1
Diffuse axonal Injury	15	14.1
Diffuse cerebral edema	11	10.4

DISCUSSION

Traumatic brain injury (TBI) is a major public health problem worldwide responsible for morbidity and mortality with increase in socioeconomic and financial burden. TBI is responsible for trauma related coma and disabilities with one of the important causes of mortality in patients below the age of 40 years. Higher incidence of TBI is seen in developing countries because of increasing number of RTA, fall injury and physical assault cases.[10,17-19] With advancement in modern technology of CT scan, CT scan plays great role in diagnosis as well as management of TBI and in decision making for cases requiring urgent neurosurgical intervention.[4] CT scan of brain is recommended in patients with head injury with GCS <13 on initial assessment, GCS <15 at 2 hours after the injury, repeated vomiting, Post-traumatic seizure, suspected open or depressed skull fracture, sign of basal skull fracture, children under 1 year for presence of bruise, swelling or laceration of more than 5cm on the head, age 65 years or older, coagulopathy or patient on anticoagulant, focal neurological deficit, amnesia of events more than 30 minutes after injury.[14,15]

Head injury is seen in patients with all age groups more in active age group and more in males than females. In our study, most of the patients are in active age group of 20-40 years who are going for outdoors activities, doing considerable risk related activities like use of motor vehicle and are incoming generating peoples of family making them more prone for accidents and assaults. The male to female ratio in our study is 2.86. As males are more involved in outdoor activity and there is more number of male drivers in comparison to females, more number of head trauma cases is seen in male. These findings are similar to previously published studies.[13,19-25]

The most common cause of head injury in our study is road traffic accident (57.6%)which is similar to other published studies.[21, 24-25] The poor road conditions, driving under the influence of alcohol and other addictive drugs, high speed and old poorly maintained vehicles are the main reason for head injury caused by road traffic accidents.[26,27] The most common clinical presentation of patients with head injury in our study is altered sensorium (35.7%) followed by external injury (25.0%)and vomiting (15.2%) which is similar to study done Adhikari K et al[23], Bhandari et al[28] and Ahmad et al[29] where they mentioned altered sensorium (39.2%, 66.7% and 54.8%) as most common clinical presentations followed by vomiting (20.1%, 46.3% and 49.5%). Minor head injury with GCS score between 13-15 was seen in most of the patients (79.9%) in our study which is similar to other published study by Adhikari K et al[23], Bhandari et al[28] where it is seen in 70.9% and 77% respectively. In case of patients with low GCS score, chance of mortality is more and there will be long duration of hospital stay leading to socioeconomic and financial burden. These findings of our study are similar to other published studies.[13,30]

In our study, normal CT scan was seen in 52.6% of patients with head trauma and in 47.3% of patients with head trauma showed various abnormalities of TBI including SDH, SAH, EDH, IVH, intracerebral hematoma, diffuse brain edema, DAI along with scalp lesions and skull fracture. These abnormalities either in the absence of proper immediate management or in case of delayed treatment can cause progression of neurological deteriorations and secondary brain injury. Scalp injury (82%) were most common CT findings followed by skull fracture (54.7%) and cerebral contusions (43.4%) in our study while diffuse cerebral edema and diffuse axonal injury were less common. A study done Adhikari K et al[23] showed scalp injury (24%) as most common CT findings followed skull fractures (19.8%) and cerebral contusions (17.1%) while study done by Ahmad et al[29] showed skull fracture (42%) as most

common findings followed by cerebral contusions (32.8%) while subdural hematoma (14%) as less common findings. The most findings seen as cerebral contusion (53%) followed by skull fracture (52%) in study done by Bhandari et al[28]andAkanji et al[31] while diffuse axonal injury was less common findings.

In our study, there was more findings in CT scan in patients with low GCS score while there was fewer findings in patients with high GCS score and the correlation was statistically significant ($p<0.006$) which is similar to study done by Adhikari K et al[23], Komolafe et al[32], Sanei et al[33] and Morgado et al.[34] In our study, 15 patients present with unconsciousness and shock with GCS score of less than 8 and all (100%) patients had abnormal findings in CT scan of head. Abnormal CT findings are seen more in patients with injury due to RTA (62%) and fall (32.3%) than the patients with history of injury from the physical assault (21.4%) in our study which findings were similar to study done by Adhikari K et al[23] where positive CT findings seen in 59.7% of RTA cases and 46.5% of fall injury cases. Positive CT findings seen in 73.6% of RTA cases followed by physical assault (50%) and 46.5% of fall injury cases seen in study done by Akanji et al.[31] There was statistically significant association seen between abnormal CT findings with injury due to RTA and fall ($p<0.05$) while no statistically significant association seen between different modes of injury with CT findings in a study done by Alharthy et al.[35]

CONCLUSION

Majority of the patients in this study have normal CT scan of brain. Most common mode of injury responsible for traumatic brain injury in patients with head trauma is RTA affecting active young middle age groups mostly male due to more outdoor activities. GCS is important clinical parameters for assessing neurological assessment of patients in emergency. CT scan is important diagnostic imaging modality to find out various abnormalities of patients with head injury so that early intervention can be started without any delay in case of patients with positive CT findings. Scalp injury is more common abnormal CT scan findings followed by skull fracture and cerebral contusions. Majority of RTA patients showed abnormal findings on CT scan. All the unconscious patients showed abnormal findings on CT scan of brain.

RECOMMENDATIONS

CT scan of brain is recommended in all patients with history of trauma with GCS <13, signs of focal neurological deficit, repeated vomiting, seizure and unconscious patients so that various abnormalities related to traumatic brain injury can be detected early and managed accordingly with aim of prevention of delayed neurological complications and secondary brain injury. In case of minor head injury with GCS score of 13-15 can be observed and if necessary, CT scan of brain can be done during observation.

LIMITATIONS OF THE STUDY

The limitations of the study are inclusion of all cases with history of head trauma even the patients had normal CT scan and had normal GCS score (15). Another limitation of this study is not taking account of time interval between the injury and time of doing CT scan as many cases have normal CT scan initially and later showed abnormal findings in repeat CT scan. Also, this is a single centre study.

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CONFLICTS OF INTEREST

None

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