Original article:

Spectrum of various patterns of injuries in cranio-cerebral trauma: CT evaluation

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ABSTRACT

Background: Cranio-cerebral injury secondary to road traffic accidents are the leading cause of head injury in teenagers and young adults. Every trauma victim with altered level of consciousness must be evaluated for brain injury. With the advent of CT, the diagnosis of head injury has significantly improved which facilitates early management and targeted intervention. **Method:** The study was carried out on a prospective basis over a period of six months. After taking informed consent, the detailed clinical history was taken and local & systemic examination was done. The age, sex and the mode of head injury was recorded. Computed tomography (CT) of the head was done on Dual slice CT scanner. The images were viewed in brain and bone windows with multiplanar reconstruction (MPR) in coronal and sagittal planes.

Results: Out of 400 cases, 307 (76.7%) were males and 93 (23.3%) were females. The highest frequency occurred in the 21-30 years age group (29.75%), followed by 31-40 years (24.25%) and 41-50 years (17%). The major causes of head injury were road traffic accidents, fall from height and physical assaults. Cerebral contusion was seen in 58.25%, skull fracture in 57.75%, scalp hematoma/laceration in 53.25%, intraparenchymal hematoma in 52%, cerebral edema in 49.25%, extradural hematoma in 32%, subarachnoid hemorrhage in 31.75%, midline shift in 22.75%, subdural hematoma in 22.25%, intraventricular hemorrhage in 8.25%, pneumocephalus in 7.75% and diffuse axonal injury in 6.5% of cases.

Conclusion: CT scan helps in the evaluation of cranio-cerebral trauma rapidly, accurately and non-invasively and in assessing the nature, site and mode of injury and impending herniation leading to prompt and effective management. The high prevalence of cranio-cerebral trauma and significant CT findings justifies the use of CT in head trauma patients.

KEY WORDS: Cranio-cerebral trauma , Intracranial injuries , Mode of injury , Computed Tomography

INTRODUCTION

Cranio-cerebral injury due to road traffic accidents (RTA) are the leading cause of head injury in teenagers and young adults (1). Cranio-cerebral injuries cause immediate death in 25% of acute trauma victims (2) and more than 50% of the cases are caused by RTA, leading to 70% of all deaths due to brain injury. Amongst the severely injured patients, majority survives with severe disability and few continue to be in a vegetative state. Increasing age is associated with poorer outcome in patients with head injury (3). Computed tomography (CT) has become the diagnostic modality of choice for head trauma due to its accuracy, reliability, safety, and wide availability (4). The changes in microcirculation, impaired auto-regulation, cerebral edema, and axonal injury start as soon as head injury occurs and manifest as clinical, biochemical, and

radiological changes. Proper therapeutic management of brain injury is based on correct diagnosis and appreciation of the temporal course of the disease process. CT scan detects and precisely localizes the intracranial hematomas, brain contusions, edema and foreign bodies. Because of the widespread availability of CT, there is reduction in arteriography, surgical intervention and skull radiography. The present study was conducted to ascertain CT scan findings in head trauma patients and clinical outcomes with different types of head injuries.

The early detection of extra-axial hematomas made possible by CT results in early surgical intervention with marked improvement in morbidity and mortality in head trauma patients. It has been established that the morbidity and mortality associated with significant intracranial injury may be ameliorated by early diagnosis and treatment (5,6). In the past, skull radiographs were indispensable in the management of head-injured patients. The advent of CT in the early 1970s revolutionized the diagnosis and management of head trauma patients. However, despite the frequent occurrence of head injury, diagnostic strategies differ among individual health care providers and their institutions (7,8). Head injury is a major health problem worldwide. In developing countries, the management is further worsened by factors like poverty, lack of medical insurance cover, availability and affordability of investigative and treatment modalities.

MATERIAL AND METHODS:

The study was carried out on a prospective basis in the Department of Radiodiagnosis and Imaging, B.P. Koirala Institute of Health Sciences, Dharan, Nepal over a period of six months from October 2012 to April 2013. After taking informed consent, the detailed clinical history was taken and local & systemic examination was done. The age, sex and the mode of head injury was recorded. The patients presented with head injury referred for computed tomography of the head were subjected to Dual slice CT scanner (Neusoft Philips). Non-contrast CT scan from skull base to the vertex and sequential axial slices of 5 mm in posterior fossa region and 10 mm in rest of the brain was obtained and further thin sections were taken wherever required.

The images were viewed in brain and bone windows with multiplanar reconstruction (MPR) in coronal and sagittal planes. Patients with normal CT findings and associated systemic injuries or patients with previous head injuries were excluded from this study.

RESULTS

In this study, 400 cases were subjected to CT head. Out of 400 cases, 307 (76.7%) were male and 93 (23.3%) were female. Male to female ratio was 3.3:1. Ages ranged from 2 to 78 years. The highest frequency of head trauma occurred in the 21-30 years age group (29.75%), followed by 31-40 years (24.25%) and 41-50 years (17%). Distribution according to age and sex are summarized in **Table 1.** The major causes of head injury were road traffic accidents (56.75%), fall from height (27%) and physical assaults (16.25%) **(Table 2).** The common clinical presentations were history of altered sensorium (54.75%) followed by vomiting (49.5%), headache (16.25%), convulsions (9%), nasal/aural discharge (7.25%), shock (6%) and respiratory distress (4.5%). The various clinical presentations are summarized in **Table 3.** The associated injuries in our study were maxillary or mandibular fracture, long bone or pelvic bone fractures, chest injury, abdominal visceral injury and spinal injury.

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On CT scan, cerebral contusion was seen in 58.25% of cases **(Figure 1),** skull fracture in 57.75%, scalp hematoma/laceration in 53.25%, intraparenchymal hematoma in 52%, cerebral edema in 49.25%, extradural hematoma in 32%, subarachnoid hemorrhage in 31.75% **(Figure 2)**, midline shift in 22.75%, subdural hematoma in 22.25%, intraventricular hemorrhage in 8.25%, pneumocephalus in 7.75% **(Figure 3)** and diffuse axonal injury in 6.5% of cases. The distribution of different CT findings are summarized in **Table 4.** The highest proportion of skull fractures was found in the temporal region followed by frontal and parieto-occipital regions **(Figure 4).** Epidural hematoma was present in temporo-parietal region followed by frontal and parieto-occipital region while subdural hematoma was common in temporo-parietal regions followed by fronto-temporal and parieto-occipital regions **(Figure 5)**. Intraparenchymal hematoma was commonly seen in temporal regions followed by fronto-temporal and parieto-occipital region **(Figure 6)**.

Table 1: Distribution according to age and sex

Age in years	Male	Female	Total	Percentage (%)
<10	5	1	6	1.5
11-20	28	8	36	9
21-30	82	37	119	29.75
31-40	72	25	97	24.25
41-50	56	12	68	17
51-60	36	6	42	10.5
>61	28	4	32	8
Total	307 (76.7%)	93 (23.3%)	400	100

Table 2: showing mode of injury.

Mode of injury	Number of patients (n=400)	Percentage (%)
Road traffic accidents	227	56.75
Fall from height	108	27
Physical assault	65	16.25

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Table 3: showing the common clinical presentation of patients

Clinical presentations	Number of patients	Percentage (%)
History of altered sensorium	219	54.75
Vomiting	198	49.5
Headache	65	16.25
Nasal/aural discharge	29	7.25
Convulsions	36	9
Shock	24	6
Respiratory distress	18	4.5

Table 4: showing CT findings in cranio-cerebral trauma.

CT findings	Number of patients	Percentage (%)
Cerebral contusions	233	58.25
Skull fractures	231	57.75
Scalp hematoma/laceration	213	53.25
Intraparenchymal hematomas	208	52.0
Diffuse cerebral edema	197	49.25
Extradural hematomas	128	32.0
Subarachnoid hemorrhage	127	31.75
Midline shift	91	22.75
Subdural hematomas	89	22.25
Intraventricular hemorrhage	33	8.25
Pnemocephalus	31	7.75
Diffuse axonal injury	26	6.5

Photographs/Figures:

Figure 1: Axial CT image showing cerebral contusion with surrounding edema in right temporal lobe along with depressed fracture of right temporal bone.

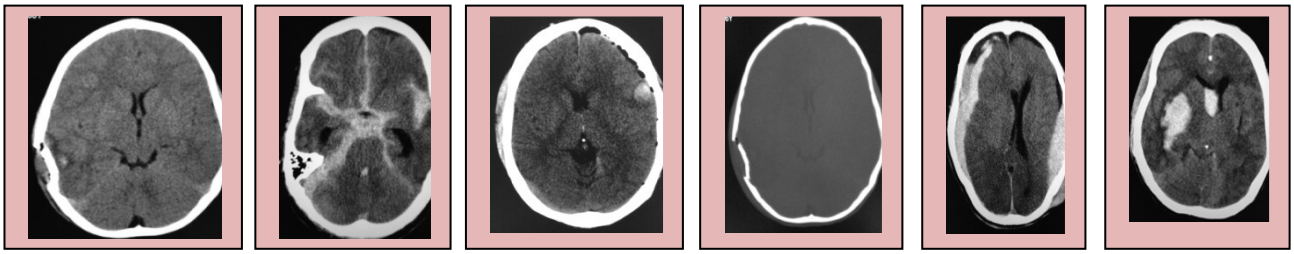
Figure 2: Axial CT image showing extensive subarachnoid hemorrhage along the basal cistern, sylvian fissures, cortical sulci, falx and tentorium with extension into the fourth ventricle along with diffuse cerebral edema.

Figure 3: Axial CT image showing cortical contusion with surrounding edema in the left temporal lobe and pneumocephalus.

Figure 4: Axial CT image showing depressed fracture of the right temporal bone.

Figure 5: Axial CT image showing subdural hematoma along the right fronto-temporal lobe convexity with mass effect and midline shift.

Figure 6: Axial CT image showing intraparenchymal hematoma in the right temporal lobe with surrounding edema with minimal mass effect along with intraventricular extension.



Photographs 1to 6

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DISCUSSION

Cranio-cerebral trauma is one of the major causes of death and disability. Its incidence in developing countries is progressively increasing due to excessive traffic and other factors such as falls and ballistic injuries (9,10,11). With the advent of CT, the diagnosis of head injury has significantly improved which facilitates early management and targeted intervention. In our study, the majority of the patients were found to be in the second and third decades of life, as this age group is highly active and productive group and are more likely to be exposed to physical, occupational and social risks. 76.7% were male and 23.3% were female in our study and the male:female ratio was 3.3:1. Our study is consistent with previous studies done by Bharti et al (12) who reported that 64% patients sustain head injury in road traffic accidents and males were frequently involved (85%). Reverdin (13) reported that 60-70% of head injuries occurred in young people. In our study, 54% of the patients belonged to the 20 to 40 years age group and the most common reason is that this age group is frequently involved in physical activities like driving and hence is most susceptible for injuries.

In our study, the common clinical presentations were history of altered sensorium (54.75%) followed by vomiting (49.5%), headache (16.25%), convulsions (9%), nasal/aural discharge (7.25%), shock (6%) and respiratory distress (4.5%). In the present study, the highest proportion of skull fractures was found in the temporal region followed by frontal and parieto-occipital regions. Epidural hematoma was present in temporo-parietal region followed by frontal and parieto-occipital region. Subdural hematoma was common in temporo-parietal regions followed by fronto-temporal and parieto-occipital regions. Zimmerman stated that epidural hematoma was most common (65%) in temporo-parietal region (4). Samudrala et al stated that epidural hematomas are associated with skull fracture in more than 90% of patients (14). The epidural hematomas are frequently associated with linear fracture according to Phonprasert (15).

According to Hirsh, intracerebral hematoma of frontal and temporal lobe was commonest in head injuries (16). In the present study, the intraparenchymal hematoma was seen in 52% of cases in which temporal regions was commonly affected followed by fronto-temporal and parieto-occipital region. MacPherson and Jennet reported the occurrence of cerebral contusion varied from 30% to 40% (17), in our study cerebral contusion was seen in 58.25% of cases. Subdural hematoma occurred in approximately 5% to 22% of patients with severe head injury as reported by Seeling et al (18) and is consistent with our study, it was found in 22.25% of the patients.Wei et al stated that the coronal reformations improve the detection of intracranial hemorrhage over axial images alone, especially for lesions which lie in the axial plane immediately adjacent to bony surfaces and should be considered in the routine interpretation of head CT examination for evaluation of head injury victims (17).

CONCLUSION:

CT scan helps in the evaluation of cranio-cerebral trauma rapidly, accurately and non-invasively and in assessing the nature, site and mode of injury and impending herniation leading to prompt and effective management. The high prevalence of cranio-cerebral trauma and significant CT findings justifies the use of CT in head trauma patients.

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