Assessment of Traumatic Head Injury on Computed Tomography Scan in Tertiary Care Hospital of Kathmandu Nepal

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ABSTRACT

INTRODUCTION: Computed tomography (CT) of head has nowadays become the investigation of choice for the assessment of patient with traumatic head injury (THI). The aim of this study was to describe CT findings of head injury patients.

METHOD: A cross sectional descriptive study was conducted in the Nepal Medical College and Teaching Hospital over a period of one year (August 2016 to July 2017). Epidemiological information, mode of injury and findings in CT head were recorded.

RESULT: Amongst CT scans of 480 patients with head injuries, 243 cases with abnormal CT findings were included in the study. Most cases (62.5%) of head injuries were in adults (16-60 years). The most common mode of head injury was road traffic accident (RTA) (58%) followed by fall injury (29.6%). The most common CT findings in THI was scalp injury (48.6%), skull fracture (27.6%), pneumocephalus (16.4%), subdural hemorrhage (SDH) (11.9%), epidural hemorrhage (EDH) (10.3%), hemorrhagic parenchymal contusion (10.2%) and subarachnoid hemorrhage (SAH) (8.6%). The most common site for fracture was frontal bone (34.3%) and most common intracranial hemorrhage associated with cranial fracture was EDH (67%). SDH was most common in infant (20%) whereas EDH was most common in adults (11.8 %). Frontal region was the most common site for fracture (34.3%), EDH (37.3%) and SDH (43.8%) whereas temporal region was the most common site for cerebral contusion (58.5%) and SAH (63.5 %).

CONCLUSION: CT scan is a frontline imaging modality in assessment of traumatic head injury for early detection and prevention of intracranial complications.

KEY WORDS: Computed Tomography Scan, Head Injury, Road Traffic Accident.

INTRODUCTION

Traumatic head injury (THI) is the spectrum of injury to scalp, skull and brain after trauma. A traumatic brain injury (TBI) while causes disruption in normal brain function following violent contact force or rapid acceleration and deceleration of the head.[1, 2] Amongst all injury, injury to brain is most likely cause of death and lifelong disability.[3] Hence it not just only affects the lives of individuals and families but also significantly impacts society and the economy.[2] Most of the head injuries are minor, however even such mild injuries can result in significant impairments when diagnosis and treatments are delayed. Neuroimaging studies have important role in management of head injury. Computed tomography (CT) is the imaging modality of choice for initial assessment of head injury to identify lesion that warrants prompt surgical intervention from those requiring conservative management.[4]

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Magnetic resonance imaging (MRI) is reserved later for symptomatic patient with modest CT findings.[5]

Head trauma may occur by multiple mechanisms. Falls are the most common cause of TBI in high income countries especially in elderly while road traffic accidents (RTAs) are most common cause in low and middle income countries especially in young populations.[6]

This study was aimed to evaluate the epidemiological data, mechanism of injury and various CT findings in patients sustaining head injury.

METHOD

A cross sectional descriptive study was conducted in the Department of Radiodiagnosis and Imaging, Nepal Medical College and Teaching Hospital (NMCTH), Attarkhel, Kathmandu, Nepal over a period of one year from August 2016 to July 2017. All studies were performed with Toshiba Aquilon 64 slice spiral CT machine with standard protocol of hospital. Volumetric plain CT scan of head was performed and then axial images were reconstructed parallel to the tuberculum sellae-occipital protuberance line (TS-OP line). Tube voltage was 120 peak kilo voltage (KVp), tube current was 210 milliampere second (mAs) and slice thickness was 0.5mm. Cases were reviewed by a single radiologist with more than 3 years experience. Images were studied on 512 x 512 matrixes. Brain window was set for window width (W) of 90 and window level (L) of 40, whereas different window widths and window levels were set for better visualization of a) subdural hemorrhage (subdural window:- W:130-300, L:50-100), b) fracture (bone window:- W:1800, L:400), c) pneumocephalous (lung window:- W:1500, L:600).

The study included head injury cases with positive CT findings of all age group advised for CT scan within 72 hours of injury. Patients with previous head injury, intracranial operation, cerebro-vascular accidents, bleeding disorders or those receiving anti-coagulant therapy were excluded. Findings were noted on structured proforma. The patients were divided into four groups according to age: infants (<1 year), children (1-16 years), adults (16-64 years) and elderly (>64 years). Data was entered in Excel sheet and analyzed using SPSS version 20.

RESULT

A total of 480 patients who underwent CT scan after head injury were assessed, out of which 283 (59%) were male and 197 (41%) were female with male to female ratio of 1.44:1. Amongst 480 patients, the total number of cases with positive findings in CT were 243 (50.6%) out of which 153 (62.6%) were male and 91 (37.4%) were female with male to female ratio of 1.68:1. The age of the patients with positive CT findings ranged from 6 months to 94 years with mean age of 35.54±22.87 years and median age of 32 years. The mean age for male was 33.04±20.58 years and the mean age for female was 35.54±22.8 years. Most cases of head injuries were in adults (62.5%), followed by children (17.6%), elderly (15.8%) and infants (4.1%).

The most common mode of traumatic head injury was RTA accounting for 58% followed by fall injury (29.6%), physical assault (9.9%) and others (2.5%) as shown in Table 1.

The findings in patients who had undergone CT scan of head for THI were scalp lesion (48.6%), fracture (27.6%), pneumocephalus (16.4%), subdural hemorrhage (SDH) (11.9%), epidural hemorrhage (EDH) (10.3%), hemorrhagic parenchymal contusion (10.2%), subarachnoid hemorrhage (SAH) (8.6%) and hemosinus (7.8%) as illustrated in Figures 1, 2 and 3 of Table. Intraventricular hemorrhage (IVH) and diffuse axonal injury (DAI) were the least common findings which accounted for 1.7% of the cases as illustrated in Figures 4 and 5.

The most common cranial fracture was linear fracture (68.7%) followed by comminuted fracture (19.4%) and depressed fracture (11.9%). The most common site for fracture was frontal bone (34.3%) followed by temporal bone (23.85%), parietal bone (20.8%), occipital bone (7.4 %) and bones of the skull base (13.4 %) (Table 3).

The most common traumatic intracranial hemorrhage was SDH (26.9%) followed by EDH (23.1%); hemorrhagic parenchymal contusion (23.1%), SAH (19.5%), IVH (3.7%) and DAI (3.7%). The most common intracranial hemorrhage associated with cranial fracture was EDH (67%) followed by hemorrhagic parenchymal contusion (64%), SDH (51.7%), IVH (50%), SAH (47.6%) and DAI (25%) (Table 4). Approximately 10.3% of patients with SDH had concurrent EDH.

SDH was most common in infant (20%), followed by elderly (15.8%) and it was least common in children

(4.7%) whereas EDH was most common in adults (11.8%) and least common in elderly (2.6%).

In this study frontal region was the most common site for fracture (34.3%), EDH (37.3%) and SDH (43.8 %) whereas temporal region was the most common site for cerebral contusion (58.5%) and SAH (63.5%). RTA was the most common cause for fracture (57%), EDH (56%), SDH (55%) and SAH (52%).

Table 1 : Age group and mode of injury (N=243)

Age group	RTA	Fall injury	Physical assault	Others	Total
Infant	3	7	0	0	10
Children	25	14	2	2	43
Adult	95	35	18	4	152
Elderly	18	16	4	0	38
Total	141	72	24	6	243

Table 2: CT scan findings in study subjects (N=243)

Findings **	Frequency	Percentage (%)
Scalp lesion	118	48.6
Fracture	67	27.6
Pneumocephalus	40	16.4
Subdural hemorrhage	29	11.9
Epidural hemorrhage	25	10.3
Hemorrhagic parenchymal contusion	25	10.3
Subarachnoid hemorrhage	21	8.6
Intraventricular hemorrhage	4	1.7
Diffuse axonal injury	4	1.7
Hemosinus (sphenoid, frontal & ethmoid)	19	7.8

**Multiple response

Table 3: Frequency of fracture and types of intracranial hemorrhage based on location

Site	Fracture (N=67)	SDH (N=29)	EDH (N=25)	Contusion (N=25)	SAH (N=21)
Frontal	23 (34.3 %)	12 (41.5%)	11 (44%)	6 (24%)	5 (23.8%)
Temporal	16 (23.8%)	7 (24.1%)	2 (8%)	11 (44%)	8 (38%)
Parietal	14 (20.9%)	7 (24.1%)	2 (8%)	1 (4%)	4 (19%)
Occipital	5 (7.4%)	1 (3.1%)	5 (20%)	2 (8%)	1 (4.7%)
>one region	9 (13.4 %)	2 (6.8%)	5 (20%)	5 (20%)	3 (14.2%)

Table 4: Intracranial hemorrhage with fracture

Type of hemorrhage	Frequency	Number with fracture	Percentage with fracture
SDH	29	15	51.7
EDH	25	17	67
Hemorrhagic contusion	25	16	64
SAH	21	10	47.6
IVH	4	2	50
Diffuse axonal injury	4	1	25

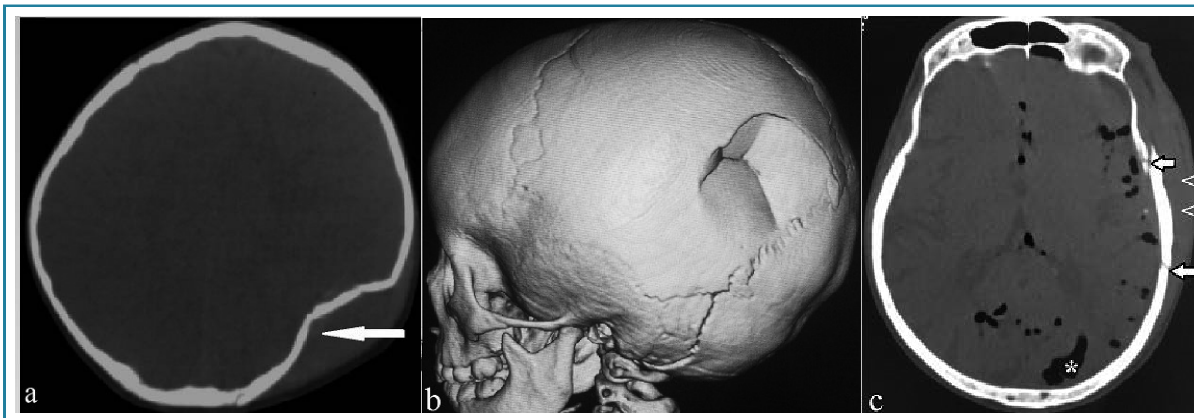

Figure 1: (a,b) CT images of 3 years old female child after fall from height. (a) Axial CT bone window image demonstrates depressed fracture (arrow) with scalp hematoma (b) 3D VRT image shows fracture. (c) Axial CT bone window of 79 years old male after RTA showing left temporal region fracture (white arrow); subgaleal hemorrhage (<) and pneumocephalous (*). No intracranial hemorrhage was seen in these two cases

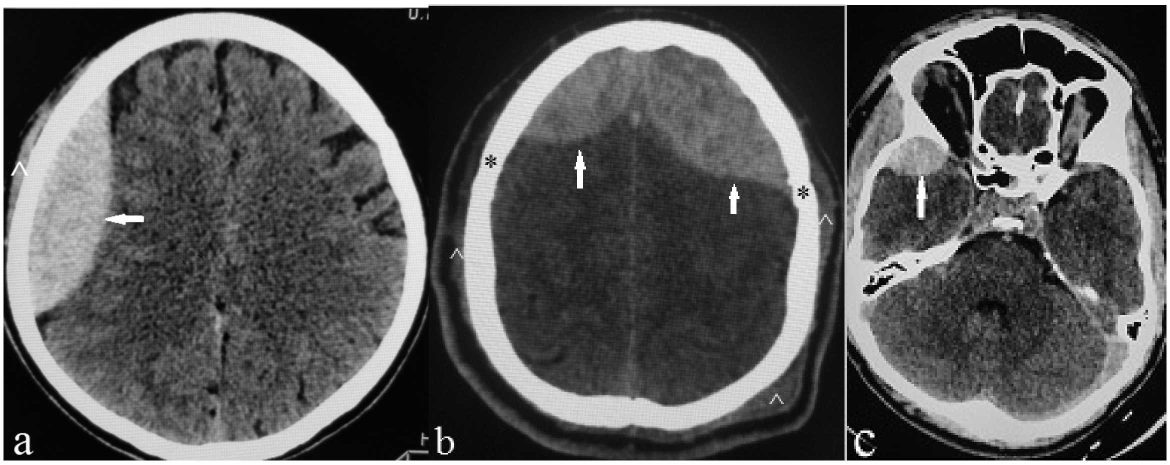

Figure 2: Different types of EDH (arrow) in axial non-contrast CT images. (a) Extra-axial biconvex (lenticular) hyperdense collection consistent with classic EDH from injury of middle meningeal artery or its branches in 23 years old male after RTA. It was associated with a fracture (not shown). (b) Bi frontal EDH in a 19 years male following fall injury. EDH crosses midline but limited by coronal suture (*). No fracture was identified. Source of bleeding is likely from injury of anterior sagittal sinus. (c) Anterior temporal EDH in 22 years old male following RTA. No fracture was identified. This EDH could be due to injury of sphenoparietal sinus or its major draining veins. Subgaleal hemorrhage (^)

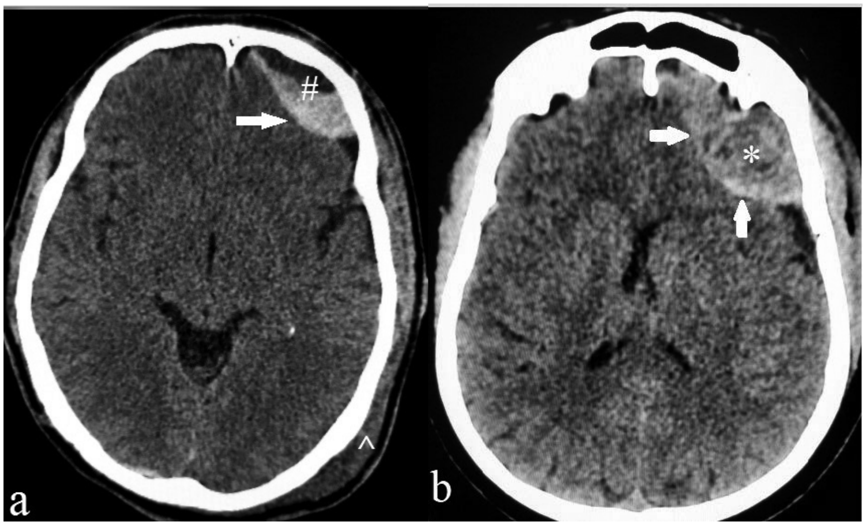

Figure 3: (a) Axial CT image of 30 years old female after RTA demonstrates left frontal region EDH with fluid-fluid level (#) "hematocrit effect". The hypodense supernatant represents serum and denser sediment corresponds to settled blood cells with left frontal bone fracture (not shown). Subgaleal hemorrhage in left parietal region (^). (b) Axial CT image of 32 years old male after RTA demonstrates heterogenous EDH in left frontal region with mottling appearance (swirl sign "*"). "Swirl sign" is due to mixing of hyperacute (low attenuation) with acute (high attenuation) blood with left frontal bone fracture (not shown)

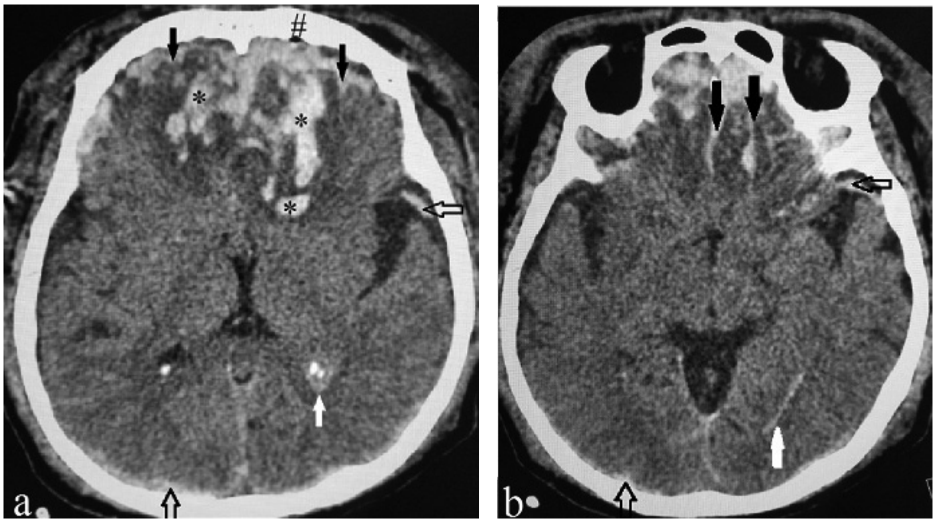

Figure 4: Different types of intracranial hemorrhages in non-contrast axial CT images of 44 years old male after RTA (a) at the level of atrium of lateral ventricle and (b) at the level of occipital horns, demonstrate subarachnoid hemorrhages (black arrows) and contusion/intracerebral hematoma (*) in bi frontal lobes, SDH (transparent arrows) in left temporal and right occipital region, pneumocephalous (#) in left frontal region, intraventricular hemorrhage (white arrows) in atrium and occipital horn of left side. The surrounding low attenuation around intracerebral hematoma is due to vasogenic edema. Frontal horns of both sides are effaced due to edema/ mass effects

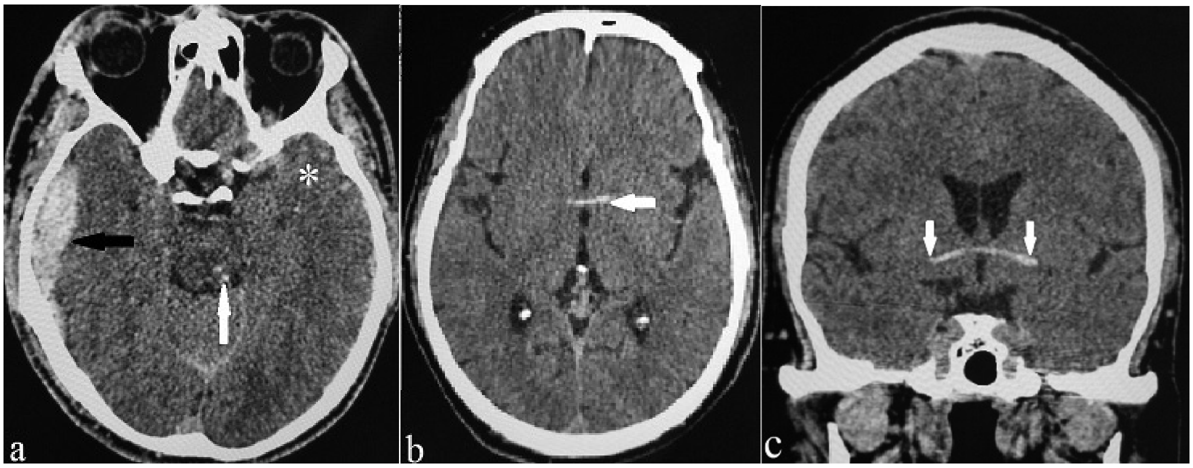

Figure 5: Diffuse axonal injury. (a) Non-contrast axial CT image of a 22 years old male after RTA demonstrates two petechial hemorrhages (white arrow) in posterolateral aspect of mid-brain with right temporal region EDH (black arrow), left temporal lobe contusion (*) and right temporal bone fracture (not shown). (b, c) Axial and coronal reformatted images of 33-year-old male after fall injury demonstrate hemorrhage (arrow) along anterior commissure fibers. No fracture was identified

DISCUSSION

Head injury is a major cause of morbidity and mortality worldwide.[7] Approximately 65% of traumatic patients have head injuries.[8] CT is gold standard technique in assessment of head injury which provides an objective assessment of structural damage to brain.[9] Intracranial hemorrhage with mass effect and mid line shift are diagnostic criteria for intracranial injury.[10] Intracranial hemorrhage is a serious consequence of head injury.[9]

In this study head injury was common in male population than the female. Almost 63% of patients were male. This finding was similar to studies done by others[11-15]. The high number of cases in male was probably due involvement in risky works and high risk behavior. The male to female ratio in this studies done by above mentioned authors[11-15]. The mean age of patients in this study was 35.5 years. The peak incidence of head injury was in adulthood which was similar to findings from previous studies.[11-15] The next common group to have head injury was children followed by elderly and infants. The low incidence of head injury in the latter two groups was probably due to less high risk and outdoor activity.

RTA is found to be the most common cause of head injury ranging from 43.1-69%.[13,15] Whereas, previous studies done in Kathmandu, Nepal by McClennan, Khadka and Stenholm showed fall injury to be the leading cause of head injury followed by RTA[11,12,14]. In our study, we found RTA to be the leading cause of head injury accounting for 58% followed by fall injury accounting for 29.6% cases. Increased RTA in current scenario is likely due to increased access of general population to transportation, increased number of vehicles plying on the road and the poor quality of road.[16]

The most common injury in our study was scalp injury (48.6%). As scalp is the most superficial covering of the head it is most vulnerable to direct impact. The different types of skull lesions were laceration, cephalohematoma and subgaleal hemorrhage.

Fractures of the cranial bones including the skull base were seen in 27.6% cases. Frontal bone was the most common site of fracture (34.3%%) followed by temporal bone (23.8%). EDH, hemorrhagic parenchymal contusion, SDH, and SAH were found to be associated with fracture in 67%, 64%, 51.7%, and 47.6 % respectively. Our study showed slightly decreased but highest association of EDH with skull fracture which was contrast to the finding by Samudrala for association of EDH with skull fracture in more than 90% of the cases.[17]

In this study, SDH was commonest intracranial hemorrhage which was not associated with fracture in nearly half of the cases (48.3%) unlike EDH which occurred in 67% of skull fracture. It suggested the possibility of occurrences of SDH even with minor head trauma and merely the absence of cranial bone fracture did not preclude severe intracranial hemorrhage. SDH was most common in infant and elderly. This might be due to smaller brain volume compared to the cranial vault, allowing space for the shearing force and tearing thin walled bridging cortical veins that cross the subdural space to enter a dural venous sinus.

The frontal region was the most common site of EDH matching the incidence of fracture in the frontal bone. Hemorrhagic parenchymal contusion was most common in the temporal lobe (44%) followed by frontal lobe (24%). This may be due to proximity of the these lobes to bony ridges and prominences at the base of the skull and hence vulnerable to coup-counter coup phenomenon.

The incidence of pneumocephalous varied in the literature from 1.5 to 16.8%. The incidence of pneumocephalous in our study was 16.4% similar to the previous data.[18]

CONCLUSION

RTA is the most common mode of head injury involving young adults, so appropriate preventive measures through public health approach and road safety should be undertaken to reduce mortality and morbidity. CT scan is a frontline imaging modality in assessment of symptomatic head injury patients for early detection of intracranial lesion requiring conservative management from those requiring prompt surgical intervention. This study provides epidemiological data, mechanism of injury and various abnormal CT findings in THI. The increased rate of THI. And early detection of intracranial abnormalities by CT scan justifies its use in head trauma.

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