J Radiol Clin Imaging 2019; 2 (1): 024-032 DOI: 10.26502/jrci.2644-2809007

Research Article

Computed Tomography Findings of Traumatic Brain Injury in Patients with Head Trauma Presenting at the Tamale Teaching Hospital, Ghana

Hayford Kwakye Asare[1*], Abubakari Bawah Abdulai[2], Emmanuel Akorli[2], Samson Aweligiba[2], Patricia Akorli[2]

[1]X-Ray Unit, Tamale Regional Hospital, Tamale, Ghana

[2]Radiology Department, Tamale Teaching Hospital, Tamale, Ghana

***Corresponding Author:** Hayford Kwakye Asare, X-Ray Unit, Tamale Regional Hospital, P.O. Box TL 2649, Tamale, Ghana, Tel: +233200876050; E-mail: nkwabrodo@yahoo.com

Received: 14 February 2019; **Accepted:** 25 February 2019; **Published:** 28 February 2019

Abstract

Purpose: The purpose of this study is to report computed tomography (CT) findings of traumatic brain injury (TBI) in patients who underwent head CT at the Tamale Teaching Hospital (TTH) due to head trauma.

Material and methods: A retrospective review of 53 head trauma CT reports covering a two year period in the TTH. Variables extracted to form basis of data included patient gender and age, aetiology of injury, and findings of radiologists. Data was processed and analysed with the Statistical Package for the Social Sciences (SPSS), and results presented mainly in tables.

Results: Of the 53 head trauma patients, male composed 77.4% and female 22.6%. Patients in the age range of 21-40 years were the most affected, and least affected were those between 41-50 years. Falls, assault and road traffic accident (RTA) all together caused less traumas than trauma of unspecified aetiologies. Various TBIs were observed in twenty one (21) patients with some features being more prevalent than others. Noteworthy, the prevalence of normal brain finding was alarming, being reported in 32 patients.

Conclusion: This research concur that CT is an important imaging modality in diagnosing TBI. Our data affirms that intracranial haemorrhage, brain contusion, brain atrophy, and infarct were the most reported imaging features of TBI at the TTH. There was male and productive age population (21-40 years) preponderance of head trauma. Unspecified source was the highest cause of head traumas followed by RTA.

Keywords: Traumatic brain injury; Head trauma; Imaging finding; CT

Abbreviations: CT-Computed Tomography; TTH-Tamale Teaching Hospital; RTA-Road Traffic Accident; TBI-Traumatic Brain Injury; HI-Head Injury; GCS-Glasgow Coma Scale; MRI- Magnetic Resonance Imaging; EDH-Epidural Haemorrhage; SDH-Subdural Haemorrhage; SAH-Subarachnoid Haemorrhage; ICH-Intracerebral Haemorrhage; SVD-Small Vessel Disease

1. Introduction

In several literatures the terms "head injury (HI) and traumatic brain injury (TBI)" have being used interchangeably [1-3]. However, there are basis to disagree or vary in opinion. Anatomically the word "head" refers to a unit structure constituted by skull (i.e. bony and soft tissue of face and vault), scalp (immediate soft tissue covering of the skull) and brain (structure enclosed in the skull). Hence, HI can be defined as physical damage that may involve the skull and or scalp and or brain [2, 4], but TBI cannot entail injury of the skull and or scalp. Therefore, TBI is defined in this current paper context as damage or pathology only to the brain parenchymal/tissue caused by an external force(s), excluding injury of the skull or scalp. TBI may present with single or multiple pathoanatomic features in a patient even in a single trauma episode [5]. The main external cause of head trauma, and consequently TBI are RTA (accounting for about 60% of cases), falls (20-30%), violence (10%), and work place and sports related activities (10%) [2, 6]. Epidemiologically, TBI is considered a very serious public health and socio-economic problem, and is predicted to surpass many diseases as a major cause of death and disability by the year 2020. Estimate of 10 million people are yearly affected by TBI, resulting in increased hospital admissions worldwide [2, 6].

Currently radiological examination is the only reliable method to diagnose TBI. Notwithstanding a need for the radiologic imaging must be based on patient satisfaction of a specific clinical criteria. Thus, in addition to the head trauma, patients must be observed with one or more of the following clinical manifestations [loss of consciousness, confusion, altered sensation, more than 1 episode of vomiting, post-traumatic seizure, suspected open or depressed skull fracture, any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from the ear or nose, Battle's sign), Glasgow Coma Scale (GCS) <13 on initial assessment and GCS<15 at 2 hours after the injury, for children under 1 year the presence of bruise, swelling or laceration of more than 5 cm on the head, age 65 years or older, coagulopathy/patient on anticoagulant, focal neurological deficit, amnesia of events more than 30 minutes before injury] [7-8].

Historically Skull radiography was the widely used radiologic procedure in head trauma cases but presently cross sectional imaging particularly CT has become the preferred choice especially in TBI management for a good number of reasons. CT is faster in acquiring images, highly sensitive and accurate for detecting intracranial lesions requiring emergent neurosurgical decision (i.e. haemorrhages, hydrocephalus, contusion, and mass effect), and not contraindicated to metallic foreign bodies (e.g. gunshot fragment). Also been widely available and cheaper than

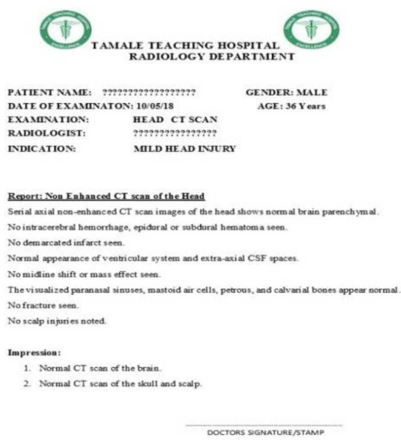
Magnetic Resonance Imaging (MRI) [3, 5]. Been the fourth largest tertiary hospital in Ghana, TTH provides varying medical services including radiological CT scan examination. This retrospective study was conducted to report CT findings of TBI as documented by radiologists in patients who underwent head CT at the TTH due to head trauma. To the best of the authors' knowledge no such research has been undertaken in the context of the radiology setting in the TTH.

2. Material and Methods

This was a retrospective review of 53 Radiologists written reports of patients who underwent head CT scanning at TTH between 2016 and 2018 with indications of head trauma. Prior to the research ethical clearance was sought and approval granted. Subsequently permission was obtained from all three Radiologists to enable access to their written CT reports (head trauma) for the years under review. Radiologists were willing to provide any further information or clarification if researchers required. Non-head trauma reports were excluded in the study. Also skull and scalp related findings were further excluded in analysis as were at variance with the operational definition of TBI for this paper (definition is in introduction section in italics). Hence inclusion was brain findings only. The content of the CT report comprised skull/scalp, and that of brain findings (see Figure 1). All head CT scan were performed with a 128 slice Toshiba Aquilion CT scanner with patients in supine positions. A slice thickness of 5 mm form the skull base to the vertex was applied to acquire images. No contrast media was administered due to the indications. Variables such as patient age and gender, aetiology of injury, and findings of the Radiologists were extracted and coded. Data was entered, processed and analysed using the Statistical Package for the Social Sciences (SPSS) version 21.0. Names of patients were not entered into data processor to purposely conceal patient identity. Images of key TBI abnormalities observed in this study could not be accessed and used as figures in this paper to support readers' appreciation of the actual CT appearances of the various pathologies reported due to crash of primary image data storage systems of the radiology department. Again, reports of one of the Radiologists were inaccessible because the personal computer on which reports were typed and stored had also crashed at the time of this study data collection.

3. Results

A total of 53 head trauma reports were reviewed, between 2016 and 2018. Table 1 shows the age and gender distribution as well as cause of patient trauma. 77.4% of the patients were males while 22.6% were females, giving a male/female ratio of 3.4:1. In 60.4% of the patients the cause of head trauma was unspecified. Of the specified aetiologies RTA (33.9%) was the most frequent cause of head trauma. Head trauma was predominant in the age bracket of 21-41 years. Unspecified age was noted in 20.8% patients. Table 2 shows TBI pathoanatomical CT imaging findings of the patients. CT findings of the brain was normal in 60.4% and abnormal in 39.6% of patients. The abnormal features comprised of acute intracranial haemorrhage as the commonest findings and the least being arachnoid cyst and hydrocephalus.



TAMALE TEACHING HOSPITAL
RADIOLOGY DEPARTMENT

PATIENT NAME: ?????????????????? GENDER: MALE
DATE OF EXAMINATON: 10/05/18 AGE: 36 Years
EXAMINATION: HEAD CT SCAN
RADIOLOGIST: ????????????????
INDICATION: MILD HEAD INJURY

Report: Non Enhanced CT scan of the Head

Serial axial non-enhanced CT scan images of the head shows normal brain parenchymal.
No intracerebral hemorrhage, epidural or subdural hematoma seen.
No demarcated infarct seen.
Normal appearance of ventricular system and extra-axial CSF spaces.
No midline shift or mass effect seen.
The visualized paranasal sinuses, mastoid air cells, petrous, and calvarial bones appear normal.
No fracture seen.
No scalp injuries noted.

Impression:

1. Normal CT scan of the brain.
2. Normal CT scan of the skull and scalp.

DOCTORS SIGNATURE/STAMP

Radiologist and patient identities omitted for confidentiality and anonymity.

Figure 1: A copy of radiologists head CT report.

Variable	**Frequency**	**Percentage (%)**
Age (Years)		
≤ 10	8	15.1
11-20	4	7.5
21-30	14	26.4
31-40	8	15.1
41-50	2	3.7
51-60	3	5.7
≥ 61	3	5.7
Unspecified	11	20.8
Total	**53**	**100.0**
Gender		
Male	41	77.4
Female	12	22.6
Total	**53**	**100.0**
Cause of Trauma		
RTA	18	33.9
Falls	1	1.9
Assault	2	3.8
Unspecified	32	60.4
Total	**53**	**100.0**

Table 1: Distribution of head trauma patients by age, gender and cause.

Findings	Frequency	Percentage (%)
Main (n=53)		
Abnormal	21	39.6
Normal	32	60.4
TBI Specific (n= 21) ***Intracranial Haemorrhage***		
EDH	2	5.7
ADH	4	11.4
SAH	1	2.9
ICH	4	11.4
Effacement		
Effaced ventricle	1	29
Effaced sulci	1	2.9
Infarct		
Caudate nucleus infarct	1	2.9
Cerebral infarct	3	8.6
Contusion		
Cerebral	3	8.6
Haemorrhagic	4	8.6
Mass effect		
Ventricular shift	1	2.9
Falx cerebri shift	2	5.7
Others		
Brain atrophy	4	8.6
Arachnoid cyst	1	2.9
Hydrocephalus	1	2.9
Small vessel disease	2	5.7

*Multiple findings observed in 7 of the reports.

Table 2: Mediums of accident and age group specific distribution (n=444).

4. Discussion

TBI is a worrying public health problem worldwide [6]. CT imaging is critical both in the diagnosis and management of TBI, particularly important is its role for triaging in the acute setups in determination of which patients require urgent neurosurgical attention [5]. This study was aimed at reporting CT findings of TBI in patients undergoing head CT examinations at the TTH due to histories of head traumas. Largely, head trauma occurred in patients of active age, and in males than females. Unspecified source of trauma was first to RTA being predominantly responsible for head traumas and TBI. Generally, males and youthful/productive age persons engages in considerable risky-related activities such as use of motor vehicle, predisposing them to increasing injuries [9]. These observations have been made similarly by other researchers [10-11]. In this study, CT outcome was normal in 60.4% of patients and in 39.6% various abnormalities of TBI were noted including EDH (5.7%), SDH (11.4%), SAH (2.9%), ICH (11.4%), contusions (20%), brain atrophy (11.4%), and infarct (11.4%). These abnormalities can progress to cause further neurological deteriorations and secondary injuries in absence or delayed treatment. Primarily non timely ruptured vascular repair and evacuation of haemorrhage may complicate collection progression in and around the brain, which initiate inflammatory processes including brain irritations leading to brain swelling (cerebral oedema), which in tend cause effacement (loss) of structures such as the sulci and ventricles. The presence of oedema and or large collection advertently increases intracranial pressure to cause pushing effects of surrounding tissue (mass effect), of which the mass effect can directly compress vascular structures resulting in ischaemia and infarction [12-13]. Increased intracranial pressure is also believed to induce cerebral contusion especially at the impact site [14]. The findings of mass effects and effacements might have been likely caused by haemorrhage since no patient in our study presented CT outcome of brain oedema.

More often TBI patient may sustain multiple brain injuries, either over time or at instant of the trauma. For instance almost 50% of contusions have tendencies of enlarging over time, and of a potential occupying site for large intracranial haemorrhage formations [15-16]. Relatedly, SAH is commonly associated with other types of intracranial haemorrhage and hydrocephalus outcomes [17], haemorrhagic contusion with ICH and mass effect [16], SVD with (brain atrophy, ICH, enlarged perivascular spaces and hydrocephalus) [18], and brain atrophy with ICH [19]. The multiple injury observation is in congruence with similar evidence in our study where seven patients were noted presenting more than one TBI lesions, stated in the footnote of Table 2.

To large extent the primary lesions of TBI represent spectrum of injuries rather than discrete or independent entities. The observed pathologies in our study may cost patients in many ways, including risk of death, disability and prolonged hospitalisation. The mere hospitalisation can have adverse effects on patients, i.e. psychological boredom, barrier of limitable access to families, physical stress, risk of nosocomial infection, unintended financial expenditure and risk of work absenteeism which could even lead to job loss. Invariably these burdens can have consequential impact of worsening patient initial presenting condition. In this regard the paramount expectation of patient is recovery, which also is dependent on effective treatment based on accurate diagnosis. On one hand clinicians must need efficient clinical guideline to guide imaging decision i.e. head trauma CT guideline. Head trauma guideline is a clinical tool that should assist accident and emergency staff to predict which head trauma patients can highly have TBI and consequently would need CT scans performed. Thus, not all head trauma victims necessarily require CT scans. The CT guideline may help minimise the number of CT scans in trauma patient population, consequently controlling liberal access and over utilisation, and indirectly reduce unnecessary patient irradiation and resource wastages (i.e. cross sectional imaging services are accessed by out-of-pocket payment in our study site) [5, 7]. Although our study noted important positive TBI abnormality findings, on the other hand the prevalence of negative or normal outcome was high, which highlights the need to develop and implement head trauma CT clinical guideline for the accident and allied emergency departments in TTH. The prevalence of normal findings in an earlier published work [11] is lower than observed in our study.

We noted that our total patient sample population (53) for the two year period of our study was fewer than samples of similar studies [3-4, 11] in other setups that covered lesser time period range. It may be argued that probably head trauma cases are generally prevalent in those settings than in our locality of study. Furthermore, it is conceivable that the scope of inclusion and exclusion criteria might differ accounting for such different proportions. On one hand Radiologists of our study setting indicated that in many occasion especially in very injured patients referring Doctors follow up in persons to obtain verbal interpretations or comments, of which beyond Radiologists do not document any written report. Moreover, one of the Radiologists' reports were unavailable because the personal computer the reports had been typed and stored had damaged few days prior to this study. These suggest that TBI may be underreported in head trauma patients at the TTH, basing data on only recorded or written Radiologists' reports. As in reports of two large IMPACT studies [20-21], outcome following TBI was noted to have association with patient demographic characteristics and cause of injury. Better outcome corroborated in patients with RTA, assault, sports and recreational activities, low age, other race than black and partly on higher education. Clearly basic background information of patient is valuable in the management of TBI. Despite this, a high number of patients in our study presented their examination request forms without specified cause of injury (60.4%) and ages (20.8%), hence not known for recording in patients' images and reports.

5. Conclusion

The finding of this study reveals a relative high prevalence of normal brain CT outcomes in head trauma patients attending the TTH. The study also shows that TBI features were grossly intracranial bleedings, contusions, brain atrophy and infarcts. Unknown aetiology and RTA were generally the cause of all head trauma and TBIs. Most commonly head trauma incidence was higher in males than females, and in the most productive age persons than other age categories. Generalisation of our data may be affected by two major issues. Firstly, reports analysed did not include patients whose findings were not documented in written by Radiologists and reports lost to storage crash. Secondly, the study is a single centre report. Notwithstanding our study can serve as a pilot model for replication in other settings in Ghana to gather reliable national data about prevalence of TBI in Ghana which is useful for planning interventions, policies and public health education. In any way this study has revealed the prevalence data and burden of TBI in Northern Ghana.

Going forward the authors offer the following recommendations for future direction.

- ✓ Motor traffic safety measure should be strictly enforced.
- ✓ High normal brain CT findings suggest a need for introduction of head trauma CT referrer guideline at the TTH.
- ✓ For the purposes of teaching, research projects, medico-legal reference and general good record keeping, Radiologists should document written reports for all patients examinations even if verbal reports have

already been communicated to patient referrers. Also, Radiologists should be encouraged to type and store all reports in radiology office use computers instead of Radiologists personal use computers.

- ✓ The radiology department should back up or archive patient examination data including images and reports at all times in secondary storage materials so that data can still be retrieved or accessed in the event of primary device crash as currently is the case at the time of our research, denying access to reports, and images for use as figures in this paper.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Kristin M, Johnson DO. The hazard of stopping a brain in motion: Evaluation and classification of traumatic brain injury. AMA J Ethics 10 (2008): 516-520.
2. Hydera AA, Wunderlich CA, Puvanachandraa P, et al. The impact of traumatic brain injuries: A global perspective. Neuro Rehabilitation 22 (2007): 341-353.
3. Khadka B, Deka PK, Karki A. Role of CT (Computed Tomography) in head injury. JMMIHS 2 (2016): 45-52.
4. Mebrahtu-Ghebrehiwet M, Quan LH, Andebirhan T. The profile of CT scan findings in acute head trauma in Orotta Hospital, Asmara, Eritrea. J Eritrean Med Assoc 4 (2009): 5-8.
5. Mutch CA, Talbott JF, Gean A. Imaging evaluation of acute traumatic brain injury. Neurosurg Clin N Am 27 (2016): 409-439.
6. Puvanachandra P, Hyder AA. The burden of traumatic brain injury in Asia: a call for research. Pak J Neurol Sci 4 (2009): 27-32.
7. Coxa M, Beckerb TD, Motsumic M. Head injury burden in a major referral hospital emergency centre in Botswana. Afr J Emerg Med 8 (2018): 100-105.
8. National Clinical Guidance Centre. Head Injury: Triage, assessment, investigation and early management of head injury in children, young people and adults. NICE: London (2014).
9. Rastogi D, Meena S, Sharma V, et al. Epidemiology of patients admitted to a major trauma centre in Northern India. Chin J Traumatol 17 (2014):103-107.
10. Onwuchekwa RC, Echem RC. An epidemiologic study of traumatic head injuries in emergency department of a tertiary health institution. J Med Trop 20 (2018): 24-29.
11. Ogbeide E, Isara AE. Computed tomographic findings in elderly patients with head trauma in a Southern Nigerian tertiary hospital. IJMHDEV 19 (2014): 32-49.
12. Acute CT Brain. Radiology masterclass.
13. Lee B, Newberg A. Neuroimaging in traumatic brain imaging. NeuroRx 2 (2015): 372-383.
14. Alvis-Miranda H, Alcala-Cerra G, Moscote-Salazar LR. Traumatic cerebral contusion: pathobiology and critical aspects. Rom Neurosurg 2 (2013): 125-137.

15. Lolli V, Pezzullo M, Delpierre I, et al. Emergency Radiology special feature: Review article MDCT imaging of traumatic brain injury. Br J Radiol 89 (2016): 0849.
16. Heit JJ, Iv M, Wintermark M. Imaging of intracranial haemorrhage. J Stroke 19 (2017): 11-27.
17. Kim JJ, Gean AD. Imaging for the diagnosis and management of traumatic brain injury. NeuroRx 8 (2011): 39-53.
18. Blair GW, Hernandez MV, Thrippleton MJ, et al. Advanced neuroimaging of cerebral small vessel disease. Curr Treat Options Cardio Med 19 (2017): 56.
19. Dunham CM, Cook AJ, Paparodis AM, et al. Practical one-dimensional measurement of age-related brain atrophy are validated by 3-dimensional values and clinical outcomes: a retrospective study. BMC Med Imaging 16 (2016): 32.
20. Butcher I, McHugh GS, Lu J, et al. Prognostic value of cause of injury in traumatic brain injury: results from the IMPACT study. J Neurotrauma 24 (2007): 281-286.
21. Mushkudiani NA, Engel DC, Steyerberg EW, et al. Prognostic value of demographic characteristics in traumatic brain injury: results from the IMPACT study. J Neurotrauma 24 (2007): 259-269.

Citation: Hayford Kwakye Asare, Abubakari Bawah Abdulai, Emmanuel Akorli, Samson Aweligiba, Patricia Akorli. Computed Tomography Findings of Traumatic Brain Injury in Patients with Head Trauma Presenting at the Tamale Teaching Hospital, Ghana. Journal of Radiology and Clinical Imaging 2 (2019): 024-032.