Original Article

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Paediatric Head Injury: Concordance between CT Findings and GCS Scores- A Retrospective Study in a Tertiary Care Hospital

Radiology Section

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ABSTRACT

Introduction: Computed Tomography (CT) remains the mainstay in the detection of traumatic brain injuries in children just as in the adult population. However, unnecessary and inadvertent use of CT in minor and less significant head injuries exposes children to harmful ionising radiation and subsequently increases the lifetime cancer risk. So, there is a need to use CT judiciously in cases of minor head injuries. The Glasgow Coma Score (GCS) can provide a comprehensive framework for proper stratification of neural impairment and head injury severity.

Aim: To assess the concordance between CT scan findings and GCS scores in paediatric patients with acute Traumatic Brain Injury (TBI).

Materials and Methods: This was a retrospective study of paediatric head injury cases who were referred to the Department of Radiodiagnosis, Mysore Medical College, Karnataka, India. from January 2021 to December 2021. The head CT of 110 patients was reviewed. Demographic details, mode of accident, CT findings, and GCS scores were collected from hospital records. Descriptive statistics were used and results were expressed in terms of frequency and percentages.

Results: Out of 110 patients (mean age: 9.17±3.02 years) reviewed, males were 78 (71%) and females were 32 (29%). Road traffic accident was found to be the most common cause, i.e., in 71 patients (64.5%). The most common CT scan finding was fracture as seen in 12 cases. Out of 110 patients, 94 had mild injury according to GCS scores, 12 had a moderate head injury and four had a severe head injury. As the GCS scores decreased, the percentage of positive findings on CT increased.

Conclusion: Percentage of positive CT findings was higher in the moderate and severe head injury category, where the role of CT scans in acute settings becomes valuable.

Keywords: Computed tomography, Minor head injury, Glasgow coma scale, Radiation risk

INTRODUCTION

There is a high incidence of head injury in the paediatric population. Statistically, road traffic accidents contributed to about 2% of deaths in India in the year 2005, out of which more than half the cases were that of head injury and more than one-fourth of the cases occurred in children under the age group of 15 years [1,2]. As a result of external physical force, neuropathological changes occur in the brain, resulting in TBI [3]. Just like in adults, TBI in children includes injuries to the scalp, skull, or brain, but the pathophysiology and the management in children differ from those of adults [4].

Rather than relying on clinical markers for detecting Intracranial Brain Injury (IBI) in children, sensitive imaging techniques like CT are needed for detecting early IBI or to rule out any significant brain injury [5]. CT is regarded as the first line of diagnosis in the early detection of traumatic intracranial haemorrhages. On imaging, the various patterns of head injury in paediatric population include: scalp swelling and haematoma, fractures of the bony calvaria, extradural and subdural haemorrhages, diffuse axonal injuries, cortical contusions, head trauma secondary to abuse or assault or those caused during birth [6].

It is not just the excessive use of CT for mild head injuries that is of concern but the exposure of children to ionising radiation that can triple their risk for leukaemia and brain tumours in later life [7]. Most of the times, the treating doctors in an emergency send the paediatric patients of trauma to CT scans based on external soft tissue injuries and medico-legal issues. However, CT scan appears normal in the majority of this population. Therefore, a study was needed to evaluate the relationship between CT head findings and GCS scores in paediatric patients with acute TBI.

MATERIALS AND METHODS

This was a retrospective study conducted in the Department of Radiodiagnosis, Mysore Medical College from January 2021 to December 2021. Ethical committee clearance was obtained from the Institutional Ethical Committee, Mysore Medical College. (ECR/134/Inst/KA/2013/RR-19).

A total of 130 patients (<15 years of age) with a history of head injury were referred to the Department for NCCT head. Out of which 20 cases were excluded due to lack of availability of clinical data, incomplete clinical data, history of previous seizure disorder, or known case of a congenital brain malformation. The head CT of 110 patients was reviewed.

Inclusion criteria: Computed Tomography (CT) scans of children below the age of 15 years, with a history of head injury, referred to the Department of Radiodiagnosis, Mysore medical college, for NCCT head, within <24 hours of head injury.

Exclusion criteria: Children with a history of prior seizure disorder, doubtful history, Central Nervous System (CNS) malformations, or any previous neurosurgery were excluded from the study.

Procedure

Non contrast CT scans of head were done using "Siemens Somatom 128 slice dual CT scanner" with low dose protocol. CT images of the patients were retrieved from Picture Archiving and Communication System (PACS) and were examined by two experienced radiologists to look for signs of any acute traumatic intracranial pathology like the presence of pneumocephalus, intracranial bleeds, extra and subdural haemorrhages,midline shift and fractures etc. Demographic details, mode of accident, CT scan findings and GCS scores [7] were collected from hospital records.

STATISTICAL ANALYSIS

Descriptive statistics were used and results were expressed in terms of frequency, mean±SD and percentages.

RESULTS

The age group ranged from one month to 15 years, with mean age group 9.17±3.02 years [Table/Fig-1]. Out of 110 patients reviewed, males were 78 (71%) and females were 32 (29%).

Age group (years)	Number of patients	Percentage (%)
0-5	9	8.2
6-10	68	61.8
11-15	33	30
Total	110	100

[Table/Fig-1]: Distribution of patients with respect to age.

Road traffic accident was found to be the most common cause of trauma in 71 (64.5%) patients [Table/Fig-2]. The most common CT scan finding was fractures as seen in 12 (60%) cases [Table/Fig-3].

Mode of injury	Number of Patients	Percentage (%)
Road traffic accident	71	64.5
Fall from height	37	34.5
Assault, violence, others	2	2
Total	110	100

[Table/Fig-2]: Mode of injury-road traffic accidents were the leading cause followed by fall from height.

CT finding	Number of cases	Percentage
Fractures	12	60%
Contusions	8	40%
Extradural haemorrhage	5	25%
Subdural haemorrhage	2	10%
Subarachnoid haemorrhage	2	10%
Midline shift	3	15%

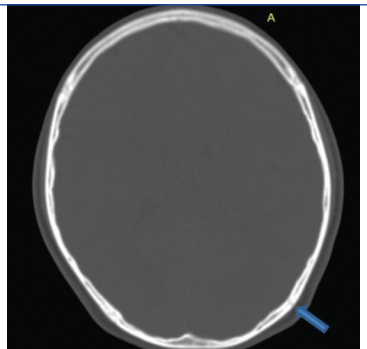
[Table/Fig-3]: Positive Computed Tomography (CT) findings.

Out of 110 patients, 94 had mild injury according to GCS scores, 12 had moderate head injury and four had severe head injury [Table/Fig-4].

Amongst the patients with mild head injury, eight cases had positive CT findings, eight out of 12 cases with moderate head injury had positive findings on CT, and all cases of severe head injury had positive CT findings [Table/Fig-4].

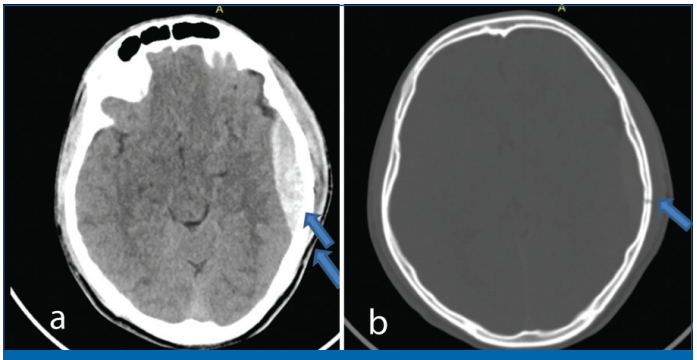
GCS scores	No. of patients	No. of patients with positive CT findings	Percentage
Mild	94	8	8.5
Moderate	12	8	66
Severe	4	4	100

[Table/Fig-4]: Distribution of patients according to their GCS scores.

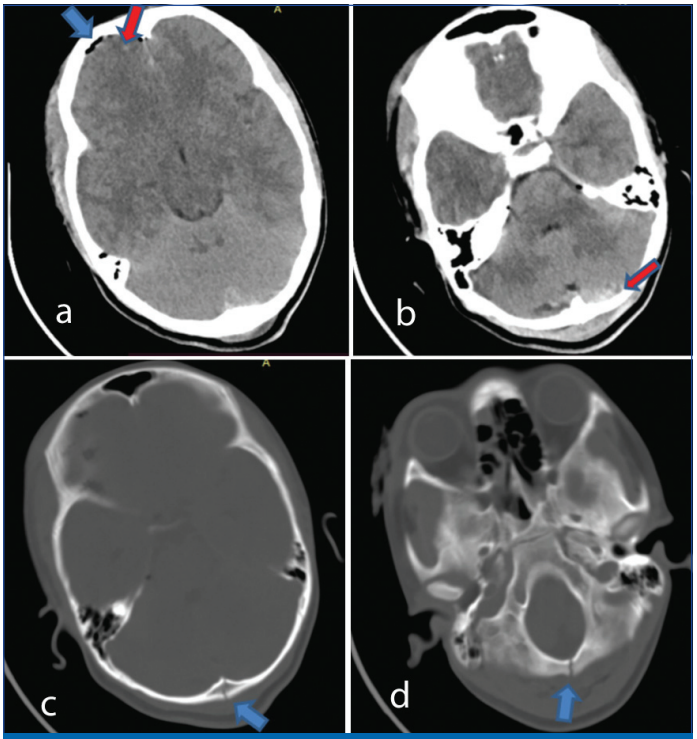


[Table/Fig-5]: Multidetector Computed Tomography (MDCT) brain axial section bone window of a 12-year-old boy with history of Road Traffic Accident (RTA) shows linear undisplaced fracture of left parietal bone. There were no intra-parenchymal or extra-axial lesions. GCS: Glasgow coma scale 14/15: mild traumatic brain injury.

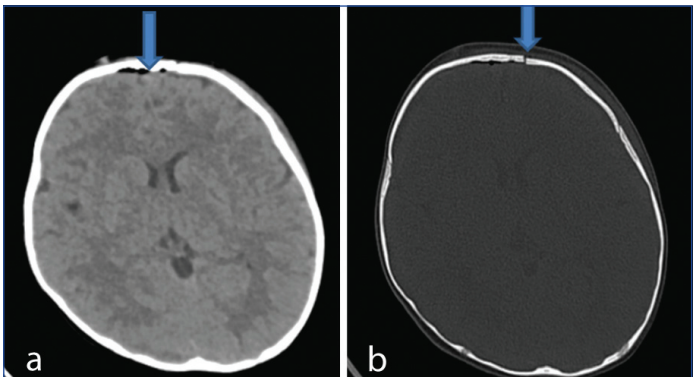
The NCCT findings and GCS scores of the patients with mild, moderate and severe brain injuries have been shown in [Table/Fig-5-9].



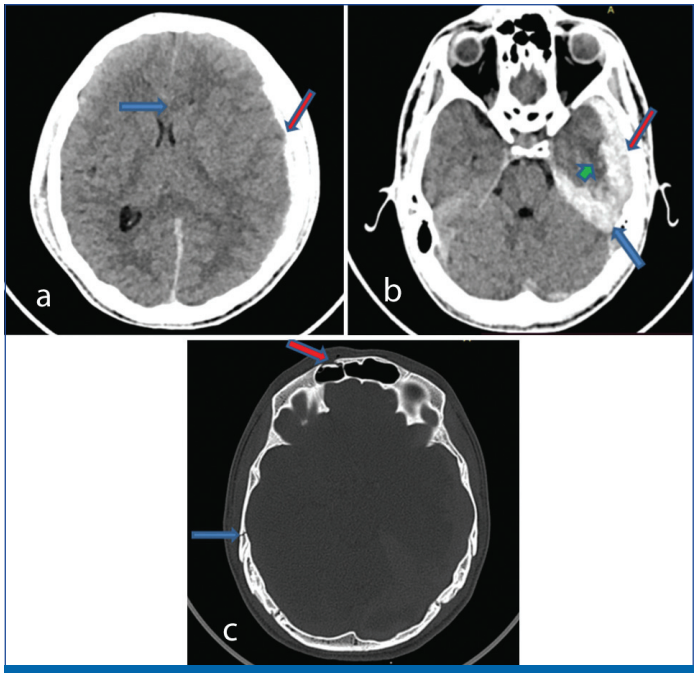
[Table/Fig-6]: A 15-year-old boy with history of RTA, axial Non-contrast Computed Tomography (NCCT) brain images: a) soft tissue window showing extra dural haemorrhage along left temporal lobe convexity with associated soft-tissue swelling with haematoma in the scalp region; b) bone window showing: linear undisplaced fracture of left parietal bone extending into left temporal bone. GCS: 9/15- moderate TBI.



[Table/Fig-7]: NCCT brain axial sections of a 14-year-old boy with a history of fall from height. a) Soft tissue window showing contusions in the right frontal lobe (red arrow) and pneumocephalus (blue arrow); b) Soft tissue window at the level of cerebellum showing contusions in the left cerebellar hemisphere (red arrow); c&d) Bone window showing linear undisplaced fracture of the occipital bone in the midline extending up to margins of the foramen magnum (blue arrows). GCS: 9/15: moderate TBI.



[Table/Fig-8]: One-month-old female child with h/o fall from height. Axial NCCT images: a) brain window: Pneumocephalus along frontal lobe convexity (blue arrow); b) bone window: linear minimally displaced fracture of frontal bone on the left side (blue arrow), with soft tissue swelling in the frontal scalp region.



[Table/Fig-9]: A 15-year-old boy with history of RTA, NCCT axial brain sections: a) Acute subdural haemorrhage along left fronto-parietal lobe convexity (red arrow) with midline shift to right (blue arrow); and b) showing acute subdural haemorrhage extending along left temporal lobe convexity (red arrow) and along left tentorial leaflet (blue arrow). also seen are contusions in left temporal lobe (green arrow); c) brain window showing linear undisplaced fracture of the right temporal bone (blue arrow) and fracture of the frontal sinus (red arrow) GCS: 6/15: Severe TBI.

DISCUSSION

The TBI in children is often associated with important morbidity and mortality and is one of the most common indications for hospitalisation among children. Timely detection and interventions are fundamental for favourable neurological outcomes in this population.

A study conducted by Satapathy MC et al., showed males outnumbered females with a male: female ratio 2.19:1, with reference to head injury among paediatric patients [8], a finding consistent with this study. Sharma M et al., found that the most common paediatric age group predisposed to trauma was 6-12 years [9]. In a study conducted by Bhargava P et al., fall from height (56.5%) followed by road traffic accident (21%) was the most common mode of injury in paediatric population [10]. The study conducted by Satapathy MC et al., showed falls as the most common cause in children less than five year, road traffic accident in 5-15 years of age as the most common mode of injury [8]. However, in this study, the common mode of injury was found to be road traffic accidents followed by fall from height.

Amongst the 94 patients evaluated with mild head injury scores on GCS, eight had positive CT findings (8.5%), eight out of 12 cases (66%) with moderate head injury had positive findings on CT, and all cases of severe head injury had positive CT findings (100%). A study conducted by Gómez PA et al., showed that abnormal CT findings were significantly higher in patients with a GCS of 13 than in those scoring 14 or 15 [11]. A study conducted by Mohanty SK et al., showed that in patients who maintained GCS scores of atleast 13, CT scan did not have any prognostic or therapeutic implications [12].

The most common CT finding in this study was fractures (60%). Similar findings were also seen in the study conducted by Tabrizi S et al., which showed fractures to be the most common CT finding followed by subarachnoid haemorrhage and intracranial haemorrhage [13]. The study conducted by Madaan P et al., showed fractures to be the most common finding followed by contusions and extradural haemorrhage [14]. Study conducted by Ng SM et al., contusion 35% was most common CT finding followed by depressed skull fracture 26% and EDH 14% [15]. According to Fundarò C et al., EDH was found in 20% and depressed skull fracture and SDH in 14% of cases [16].

In this study, majority of children with mild GCS scores had negative findings on CT. A population-based cohort study on paediatric emergency care named Paediatric Emergency Care Research Network (PECARN), which is the largest study on the subject provides objectively defined clinically important signs to help identify significant brain injuries. Accordingly, in the setting of acute head trauma (<24 hours), a child ≥2 years with a GCS of 15 and a normal mental status, with no signs of basilar skull fractures, no loss of consciousness, no vomiting, no severe injury mechanism, or severe headaches would be considered to have a very low risk of clinically important TBI (estimated risk of clinically important TBI of <0.05%) CT evaluation for acute head trauma can be avoided for children who meet these criteria [17].

Limitation(s)

Non haemorrhagic contusions, the diffuse axonal injury which are devasting injuries cannot always be picked up on CT. Therefore, children with less Glasgow coma scale and normal CT should be further evaluated with MRI. Due to the retrospective nature of the study, it was done on basis of limited descriptive variables. The smaller sample size was another limitation of this study.

CONCLUSION(S)

In this study, it was established that the percentage of positive CT findings were higher in moderate and severe head injury category, where role of CT scans in acute setting becomes valuable. However, in contrast, the mild head injury patients had a lesser percentage of positive CT findings and hence CT can be avoided in acute settings in cases of non severe head injuries with no loss of consciousness, or neurological deficits. This significantly brings down the unnecessary exposure of children to the harmful effects of ionising radiation.

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