

Original Research Article

Timing of presentation and correlation with computed tomography in pediatric patients with minor head trauma

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ABSTRACT

Background: The presentation of minor head trauma warrants immediate and accurate diagnosis for early clinical management among children. Computed Tomography is the gold standard tool for the diagnosis of Traumatic Brain Injury (TBI) among the children. The timing of presentation may have a significant role in predicting the incidence of TBI. This study was done to compare the CT findings among children who presented within and after 24 hours with minor head trauma.

Methods: This cross-sectional study was carried out among 992 children between 2-15 years reporting with a history of head injury. All the participants were clinically examined, and relevant history of type of injury and timing of presentation was recorded. CT scan was taken as per PECARN criteria. Data was entered and analysed using SPSS ver 15 software.

Results: Majority of the participants belonged to 6-10 years of age (45.2%) and were males (58.5%). About 81.7% of the participants presented within 24 hours. The overall prevalence of TBI among the study participants was 58.6% [55.5-61.6]. It was observed that hematoma predominantly presented after 24 hours (74.2%) and majority of the falls presented after 24 hours (92.8%). Patients who presented after 24 hours were at increased risk of presenting as TBI (67.03%) compared to those presenting within 24 hours (56.8%; $p < 0.05$).

Conclusions: This study has emphasized the need for including the timing of presentation as a key factor for facilitating early diagnosis and rapid case management of pediatric head trauma.

Keywords: Computed tomography, Glasgow coma scale, Hematoma, Pediatric emergency, Traumatic brain injury

INTRODUCTION

Injury in pediatric age group is relatively common; however, the frequency of head trauma, warranting investigations, is quite rare. The prevalence of minor head trauma is quite high, owing to frequent falls. In India, children <15 years contribute to 20-30% of all head injuries.¹ However, the mode of injury determines the mechanism of damage, and thereby influences the management of the head trauma.² The management of head trauma is greatly influenced by the role of

Computed Tomography (CT) in the diagnosis at triage level.

The need for CT for the diagnosis is as high as 34%.³ The use of CT in diagnosis has been determined as absolute and standard option in the management of head trauma. With increased availability and speed of CT use, clinicians opt for CT scans in upto 53% of the cases with minor head injury.⁴ There are few studies that document clinician conformity to established CT standards of care.⁵ The decision making on the part of clinician to order for

CT scan depends on the empirical cues in the case diagnosis. This has led to the formulation of Clinical Decision Rules (CDR) which help in ‘ruling out’ and ‘ruling in’ for the differential diagnoses and CT scan.

The major contributors for formulation of CDR were investigators from the United States who developed Pediatric Emergency Care Applied Research Network (PECARN), Canada who developed Canadian Assessment of Tomography for Childhood Head injury (CATCH) and Europe who developed Children’s Head Injury Algorithm for the prediction of Important Clinical Events (CHALICE).⁶ Several studies evaluated the validity of these guidelines, and PECARN guidelines were proven to be 96.8% sensitive and 99.95% specific.⁷

Despite an exhaustive presentation of clinical decision rules, the role of an important factor, namely the timing of presentation on the clinical progression and diagnosis was unexplained. There are limited studies which have analyzed the differences with respect to time at presentation.⁸

In a study done by Mandera et al, children with delayed pericerebral hematoma presented beyond 12 hours of injury.⁹ However, another study by Hamilton et al observed that children presenting beyond 6 hours were unlikely to have major head trauma.¹⁰

Considering the impact of CT scans on the radiation intensity and damage on the children, there is a need to devise CDR for empirical management of minor head trauma. The role of monitoring the child before taking up for CT scan needs to be substantiated with sufficient evidence. The existing evidences in support of this finding are very minimal. A thorough understanding of this will aid in improving the clinical judgement and minimizing the physical, mental and radiological impact of CT on the children with minor head trauma.

The objectives of this study is to carried out to compare the CT findings with respect to timing of presentation to the Emergency Room with minor head trauma among the pediatric population.

METHODS

Study setting and study participants

This cross-sectional study was carried out among the pediatric patients visiting the casualty of our tertiary care hospital for a period of twelve months between June 2017 and May 2018. A total of 992 patients were selected for the study by convenient sampling.

Inclusion criteria

- Age of the participant between 2-15 years
- Closed minor head trauma

Ethical approval and informed consent

Institutional ethical approval was followed prior to the commencement of the study. Each participant and their parents were explained in detail about the study.

Data collection

On arrival to the ER, airway, breathing and circulation were examined first. Each participant was examined in detail to assess the GCS and was documented. The timing of presentation was documented after eliciting detailed history from the parent. History regarding the mechanism of injury was documented.

A general physical examination and examination and clinical examination of the injury was carried out. All the participants were subjected to CT examination as per PECARN guidelines. Presence of intracranial bleeding, pneumocephalus, cerebral edema, skull fracture depressed by atleast thickness of the skull or diastasis of the skull in the CT examination were taken as positive for Traumatic Brain Injury (TBI).

Data analysis

Data was entered and analyzed using SPSS ver 15 software. Percentages were used to express the prevalence of CT findings in comparison with time of presentation. Chi square test was used to express the statistical association between the timing of presentation. A p value <0.05 was considered statistically significant.

RESULTS

This cross-sectional study was carried out among 992 patients presenting to the ER with minor head trauma. The background particulars of the study participants are given in Table 1.

Table 1: Background characteristics among the study participants.

Characteristics	Frequency (n=992)	%
Age (in years)		
1-5	326	32.9
6-10	448	45.2
11-15	218	21.9
Gender		
Male	580	58.5
Female	412	41.5
GCS		
<15	168	16.9
>15	824	83.1
Time of presentation		
Within 24 hours	810	81.7
After 24 hours	182	18.3

Majority of the participants belonged to 6-10 years of age (45.2%) and were males (58.5%). About 81.7% of the participants presented within 24 hours.

Table 2: Type and mechanism of trauma among the study participants.

Characteristics	Frequency (n=992)	(%)
Hematoma		
Present	605	61.0
Absent	387	39.0
Severe injury		
Present	446	44.9
Absent	546	55.1
Fall		
Present	883	89
Absent	109	11
Motor Vehicle Accidents		
Present	29	2.9
Absent	963	97.1
Other mechanism of injuries		
Present	80	8.1
Absent	912	91.9

Particulars related to the types and mechanisms of trauma are given in Table 2. Hematoma was present in 61% of the participants, while severe head injury was present in 44.9%. Majority of the trauma was due to fall (89%).

Table 3: Prevalence of traumatic brain injury detected by CT scan among the study participants.

Parameter	Frequency(n=992)	(%)	95%CI
TBI presented within 24 hours	460	49.4	46.2-52.5
TBI presented after 21 hours	122	12.3	10.3-14.3
Overall prevalence TBI	582	58.6	55.5-61.6

The prevalence of Traumatic Brain Injury (TBI) among the study participants is given in Table 3. The overall prevalence of TBI among the study participants was 58.6% [55.5-61.6]. The prevalence of TBI was higher among the participants who presented within 24 hours (49.4%) and among those who presented after 24 hours was 12.3%.

The comparison of various parameters with respect to the time of presentation is given in Table 4. It was observed that hematoma predominantly presented after 24 hours (74.2%) and majority of the falls presented after 24 hours (92.8%). Between the two groups, GCS<15 more frequently presented within 24 hours (17.5%) compared to those presenting after 24 hours (14.3%). The association between TBI and timing of presentation is given in Table 5. There was a significant difference in the timing of presentation and diagnosis of TBI in CT scan.

Table 4: Presentation of various parameters based on the timing of presentation.

Factors	Within 24hrs (N=810) n (%)	After 24hrs (N=182) n (%)
Gender		
Male	485 (59.9)	95 (52.2)
Female	325 (40.1)	87 (47.8)
GCS<15	142 (17.5)	26 (14.3)
Hematoma	470 (58.02)	135 (74.2)
Severe mechanism of injury	412 (50.9)	34 (18.7)
Mechanism- fall	714 (88.1)	169 (92.8)
Mechanism-MVA	28 (3.4)	1 (0.5)
Mechanism- other	68 (8.4)	12 (6.6)

It was observed that patients who presented after 24 hours were at increased risk of presenting as TBI (67.03%) compared to those presenting within 24 hours (56.8%).

Table 5: Association between TBI and timing of presentation.

Timing of presentation	N	TBI		Chi sq	p value
		Present	Absent		
Within 24 hours	810	460 (56.8)	350 (43.2)	6.4	<0.05*
After 21 hours	182	122 (67.03)	60 (32.9)		

*statistically significant

The observed difference was found to be statistically significant (p<0.05).

DISCUSSION

Traumatic Brain Injury (TBI) results in a significant damage to the brain function if not detected and addressed at an early stage. It is clinically diagnosed when the Glasgow Coma Scale (GCS) score is below 15. Severe TBI can have lifelong impact resulting in disability, if not death.¹¹ Though there is an adequate scope for early diagnosis through computed tomography, there is a growing need to develop Clinical diagnostic guidelines, which gives an empirical diagnosis, in order to minimize the overdose of radiation in children.

The prevalence of TBI in present study was 58.6%. The prevalence was high among those who presented beyond 24 hours (67.03%) compared to those who presented within 24 hours (56.8%; p<0.05). In a study done by Gelernter R et al, the prevalence of TBI was 63% after 24 hours and 42% within 24 hours, which was similar to our findings.⁸ In another study done by Bosen CB et al, participants presented with lower GCS beyond 24 hours, warranting surgical intervention compared to those who presented within 24 hours, and the association was found to be statistically significant.¹²

Acute TBI results in raised intracranial pressure, brain swelling, hypoxia, infection, metabolic changes including hypothermia, electrolyte imbalance and respiratory difficulties.¹³ The impact of pediatric TBI on the neuro myelination of the brain is of key importance. Myelination of the corpus callosum begins in the infant stages and progressed to maturation by 8 years of age. Therefore, injuries in the pediatric ages are likely to affect the development of the immature callosal fibres resulting in motor disability of varying severity.¹⁴

The timing of presentation acts as a proxy measure for CT examination in the diagnosis of TBI. Studies have shown that CT examinations are unnecessary in pediatric patients presenting with minor head trauma, when the GCS is >15 and the patient has presented well within 24 hours. When such patients are subjected to repeated CT examination, there is an iatrogenic risk of inducing repeated low dose radiation, which may result in cancers in adult life.¹⁵

CONCLUSION

Present study has elucidated the need for early detection of TBI in acute trauma. Nevertheless, the timing of presentation facilitates the diagnosis of TBI in resource limited settings and in situations where repeated CT examinations place increased burden on the health care costs. This study has emphasized the need for including the timing of presentation as a key factor in the Clinical Decision Rules proposed by several critical care bodies for facilitating early diagnosis and rapid case management of pediatric head trauma.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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