

Utility of CT in Head Injury- A Prospective Study

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Abstract

Background: Head injury is defined as an impairment in brain function as a result of mechanical force. The dysfunction can be temporary or permanent, and may or may not result in underlying structural changes in the brain. Head injuries are a major public health problem worldwide. A limited amount of neurological damage occurs at the time of impact (primary injury). **Subjects and Methods:** The study was a prospective observational study took place in the Department of Radiology, over a 8 month period which involves all type of head injuries. Informed consent was obtained by the subjects who participated in the study. All head injury patients attending the emergency department were included, while those with no clear history of trauma as the primary event and neurologic deficit that could not be explained by head trauma were excluded. **Results:** A total of 1000 patients underwent CT for a head injury. Table 1 shows baseline characteristics as age, gender, referred cases, type of injury, mode of injury and clinical features where we observed 48.2% cases were in the age group between 21-40 years with 80% of male subjects. While observing for the mode of injury, we found most of the cases falls in the category of road traffic accidents (77%) with external injury (83.5%) and loss of consciousness (63.4%) as highly observed clinical features. **Conclusion:** This study showed a significant association of overall CT positivity with patients sociodemographic and clinical factors such as: male gender, elderly age group (>60 years), history of alcohol consumption, LOC >5 min, history of vomiting, history of seizures, evidence of ear bleed, evidence of nosebleed, and GCS ≤ 12 (moderate and Severe head injury). From the results of this study, we recommend the following indications for doing CT in head injury patients: (1) CT is indicated in all patients with moderate and severe head injury (GCS ≤ 12).

Keywords: Computed Tomography, Head Injury

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Introduction

Head injury is defined as an impairment in brain function as a result of mechanical force.^[1] The dysfunction can be temporary or permanent, and may or may not result in underlying structural changes in the brain. Head injuries are a major public health problem worldwide. A limited amount of neurological damage occurs at the time of impact (primary injury). Damage progresses during the ensuing minutes, hours, and days (secondary injury).^[2] Early and appropriate management of the head injury is essential for the survival of these patients.^[3-5] The choice of investigation for head injury patients is CT, as it is quick, widely available and precise in the detection of skull fractures and intracranial bleeds.^[6,7] It is superior to plain radiographs. It is more cost-effective and quick compared to MRI (Magnetic Resonance Imaging).^[8] Missed intracranial injury may lead to permanent brain damage, disability, and even death.^[9-11] Based on GCS, head injury is classified as minor (GCS 13-15), moderate

(GCS 9-12), and severe (GCS 3-8).^[12] There is a lot of controversy in the use of CT in head trauma, especially in MHI. Different guidelines are followed in different parts of the world for taking CT.^[11,13] Considerable mortality and morbidity among young and productive people of our society can be observed due to head injuries.^[14] Glasgow Coma Scale (GCS) classified head injuries as minor, moderate, and severe.^[15] Around 70%-90% of all head injuries fall in the category of minor head injuries. Computed tomography (CT) has prime importance in the investigation of head injury.^[16] The aim of our study was to estimate the rate of CT positivity and to define the criteria for doing head CT in our patient population.

Subjects and Methods

The study was a prospective observational study took place in the Department of Radiology, over a 8 month period which involves all type of head injuries. Informed consent was

obtained by the subjects who participated in the study. All head injury patients attending the emergency department were included, while those with no clear history of trauma as the primary event and neurologic deficit that could not be explained by head trauma were excluded. A complete clinical history of the patient was recorded in a prefabricated proforma. The type of trauma was further classified into road traffic accidents (RTA), falls, assaults, and others. Symptoms, including loss of consciousness (LOC), vomiting, posttraumatic seizures, and alcohol consumption, were entered. Vitals were also documented after the general examination and the severity of the head injury was classified as per GCS.

The patients were classified into three groups based on GCS as:

- Group 1: GCS 13–15 (MHI)
- Group 2: GCS 9–12 (moderate head injury)
- Group 3: GCS ≤ 8 (severe head injury)

After initial resuscitation and stabilization, CT was performed and the findings were noted down as skull fractures, contusions, diffuse axonal injury, extradural hematoma, subdural hematoma, subarachnoid hemorrhage, intracerebral hematoma, and pneumocephalus. All statistical analysis was carried out using SPSS software, version 19.0 at 5% level of significance and the level of risk for CT positivity was estimated using Odds Ratio along with its 95% confidence interval. The comparison between patients sociodemographic characteristics and clinical characteristics was carried out using the Chi-square test.

Results

A total of 1000 patients underwent CT for a head injury. Table 1 shows baseline characteristics as age, gender, referred cases, type of injury, mode of injury and clinical features where we observed 48.2% cases were in the age group between 21-40 years with 80% of male subjects. While observing for the mode of injury, we found most of the cases fall in the category of road traffic accidents (77%) with external injury (83.5%) and loss of consciousness (63.4%) as highly observed clinical features. Table 2 shows CT positivity for study population with positivity for minor, moderate and severe head injury. 51.2% study population shows CT positivity and 80.4% were in the category of moderate type of head injury showing CT positivity. Table 3 and 4 shows the association of CT positivity with clinical features and baseline characteristics of the study population which we found statistically significant.

Discussion

1000 patients, who satisfied inclusion criteria, during the index year, were included in this study. Out of these, 80% were male.

Table 1: Baseline Characteristics

Baseline characteristics	Number (%)
Age (Years)	
<12	6.1
13-20	9.0
21-40	48.2
41-60	25.0
>60	8.1
Gender	
Male	80.0
Female	18.1
Referred cases	
Yes	85.4
No	12.2
Mode of Injury	
RTA	77
Assault	9.5
Fall	9.7
Other	1.0
Clinical features	
LOC	63.4
Vomiting	25.0
Seizures	5.0
External injury	83.5
Ear bleeding	10.0
Nose bleeding	9.2
Type of Injury	
Mild	74.5
Moderate	10.9
Severe	13.5

Table 2: CT Positivity for Overall Study Population and Separately For Minor, Moderate, and Severe Head Injury

CT positive	
Yes	51.2
No	48.5
Type of head injury	
Mild	37.5
Moderate	80.4
Severe	95.2

The most common mechanism was RTA (77%), followed by assault (9.5%), fall (9.7%), and other modes of injury (1%). These findings are consistent with the findings of India.^[17]

Table 3: The Association of CT Positivity in Relation to Clinical Characteristics

Variables	CT positive		P-value
	Yes (%)	No (%)	
*LOC>5 Min.	81	19	0.000
*LOC<5 Min.	25	75	
History of vomiting	75	25	
No history of vomiting	40	60	0.000
History of seizure	51	49	
No history of seizure	47	53	0.000
External injury	53	47	
No external injury	51	49	0.635
Ear bleeding	81	19	
No ear bleeding	46	54	0.000
Nose bleeding	71	29	
No nose bleeding	59	41	0.000
Mild head injury	37	63	
Moderate head injury	82	18	0.000
Severe head injury	96	4	

*LOC (Loss of Consciousness)

The most common clinical presentation was external injury over scalp and face (83.5%), followed by a history of LOC, history of vomiting, history of ear-bleed, history of a nosebleed, and history of seizures. MHI was the most common. This is consistent with the findings of Gururaj, who reported minor head is more common, followed by severe (16%) and moderate head injury (14%).^[17]

Overall rate of CT positivity in our study was 51%, which is more compared to study conducted by Chen et al. in Taiwan, who reported mean CT positivity as 29.1%.^[18] Dunning et al., who did a meta-analysis of 16 different studies, reported a wide range of CT positivity 1.3%–36%.^[19] Schynoll et al.

Table 4: Ratio of CT Positivity For Different Study Variables

Variables	CT positive		P-value
	Yes	No	
Male	40	60	0.01
Female	28	72	
Age (years)			
<12	33	67	0.474
13-20	41	59	
21-40	37	63	
41-60	40	60	
>60	42	58	
History of alcohol	37	63	0.872
No history of alcohol	36	64	
LOC>5 Min	66	34	0.000
LOC<5 Min	18	82	
History of vomiting	63	37	0.000
No history of vomiting	30	70	
History of seizure	90	10	0.000
No history of seizure	36	64	
Ear bleeding	66	34	0.000
No ear bleeding	36	64	
Nose bleeding	63	37	0.000
No nose bleeding	36	64	
External injury	38	62	0.843
No external injury	38	62	

reported CT positivity of 33% in his study.^[20] CT positivity was found to be high in the elderly age group (>60 years) compared to adults and young age groups with $P < 0.05$. This is consistent with findings of Schynoll et al.,^[20] who reported a high prevalence of intracranial injury among elderly age group (>60 years) and suggested a low threshold for obtaining CT on an elderly head injury patient. A strong association was found between CT positivity and a history of alcohol consumption at the time of injury with $P < 0.05$. CT positivity was found to be 9 times higher in patients who had a history

of alcohol consumption at the time of injury, compared to those who did not give a history of alcohol consumption during injury. This finding is consistent with Schynoll et al,^[20] who reported CT positivity to be 5 times more in patients with alcohol intoxication at the time of injury compared to those who were not under the influence of alcohol at the time of injury. A strong association was found between CT positivity and severity of head injury based on GCS score with $P < 0.05$. CT positivity is higher in severe head injury (GCS ≤ 8) with odds ratio [OR] = 54.702 (95% CI: 25.88–116.943) and in moderate head injury (GCS 9–12) with OR = 7.668 (95% CI: 3.336–17.624), compared to MHI (GCS 13–15) as the reference group. This is consistent with findings of Schynoll et al,^[20] who reported a strong association of abnormal CT findings with patients with GCS < 15 . Strong association was found between CT positivity and LOC of more than 5 min following head injury. CT positivity was found to be 12 times higher in patients LOC more than 5 min, compared to those with LOC < 5 min (OR = 12.250, 95% CI: 90160–16.382). This finding is consistent with Schynoll et al.,^[20] who reported CT positivity is more in patients with LOC > 4 min, compared to those with LOC < 4 min. We found a strong association of overall CT positivity and variables such as the history of vomiting, history of seizures, history of ear bleed, and history nosebleed. CT positivity was 3 times in patients with a history of vomiting following head injury compared to those with no history of vomiting. CT positivity was more in patients with a history of seizures following head injury compared to those without a history of seizures positivity is more in patients with a history of ear-bleed following head injury compared to those with no history of ear-bleed. CT positivity is more in patients nose bleed compared to those without nose bleed.

These patients have a small but important risk of serious intracranial injury that requires early identification and neuro-surgical treatment. Management involves a potential trade-off between under-investigation, which risks missing the opportunity to provide effective early treatment for an intracranial injury, and over-investigation, which risks unnecessary radiation exposures and associated health hazards. This problem can be minimized by considering patients clinical variables. In this study, 38% of MHI patients had positive findings on CT. The incidence of positive CT scans in patients with MHI (GCS 13–15) ranges from 4% to 83%.^[21–25]

Conclusion

This study showed a significant association of overall CT positivity with patients sociodemographic and clinical factors such as: male gender, elderly age group (> 60 years), history of alcohol consumption, LOC > 5 min, history of vomiting, history of seizures, evidence of ear bleed, evidence of nosebleed, and GCS ≤ 12 (moderate and Severe head injury). From the results of this study, we recommend the following

indications for doing CT in head injury patients: (1) CT is indicated in all patients with moderate and severe head injury (GCS ≤ 12). (2) Low threshold for taking CT is advisable in elderly patients and alcohol-intoxicated patients, irrespective of GCS. (3) In MHI (GCS 13–15), CT is indicated if any one of the following risk factors is present. Namely, LOC > 5 min, history of vomiting, history of seizures, history of ear bleed, and history of nose bleed.

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