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CLINICAL PREDICTICTORS OF CT ABNORMALITIES IN MILD HEAD INJURY

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ABSTRACT

Objectives: To evaluate the association between various clinical presentations and the presence of intracranial CT abnormalities in patients of mTBI.

Material and methods: All patients of mTBI undergoing a CT scan over a period of 1 year were included. Patients under 18 years of age and patients with serious injuries of other systems were excluded.

Result: In our study of 190 patients, ear bleed was the most significant association with CT abnormality in our study with a p-value of 0.000007. Also significant were vomiting, seizures, male gender and assault with p-values of 0.000092, 0.0219, 0.018355 and 0.01558, respectively.

Conclusion: The most common cause of mild traumatic head injury was RTA. Headache and vomiting were the commonest presentations. Significant association with positive CT was found to be with vomiting, ear bleed and seizures. Male gender and assault were also found to be significantly associated statistically.

KEYWORDS : Mild head injury, mTBI, Computed Tomography, Clinical Predictors.

INTRODUCTION:

Conventionally, the GCS has been used to classify the severity of TBI. A GCS score of 13–15 is considered as mTBI (mild traumatic brain injury).

In 2004, the World Health Organization (WHO) Collaborating Centre for Neurotrauma Task Force on Mild Traumatic Brain Injury proposed a definition with criteria similar to the ones proposed by ACRM but specifies use of the GCS score of 13–15 at time of presentation to a healthcare professional instead of restricting it to a score within 30 minutes.[1]

Centre for Disease Control (CDC) has defined mTBI as follows:[2]
Any period of observed or self-reported

- Transient confusion, disorientation, or impaired consciousness;
- Dysfunction of memory around the time of injury; and
- LOC lasting less than 30 minutes.

Ninety percent of head CT scans have negative results for clinically important brain injury.[3] Only 1% of all cases of mTBI require neurosurgical intervention. Our study aims to identify the correlation if any, between the clinical variables at presentation and the intracranial abnormalities comprehended on computed tomography. There can also be delayed and progressive brain injury in patients of mTBI. This study also aims to identify those patients with the help of interval CT done after 72 hours from the time of injury.

MATERIAL AND METHODS:

The study was conducted in Neurosurgery Unit, Department of Surgery, S.R.N. Hospital, Prayagraj from September 1st, 2017 to August 31st, 2018, on 190 patients. This was a prospective descriptive study.

All patients of mild traumatic brain injury were part of the study after applying exclusion criteria. GCS at admission was noted, along with other parameters. A non-contrast CT scan of brain at the time of admission was also done and findings recorded. An Interval CT of 50 patients was done at 72 hours or earlier if there was a fall in patient's GCS score by ≥ 2 or if there was no improvement to full GCS in 72 hours. Standard treatment guidelines were followed.

Indications for CT in our study were history of loss of consciousness or amnesia, focal neurologic deficits, headache, nausea, vomiting, blurred vision, vertigo or dizziness, tinnitus, intoxication, seizures or serious mechanism of injury.

All computed tomography studies were photographed with brain and bone windows and were reported by a radiologist. The CT scans were reported as the absence of any positive finding or the presence of either one (or a combination) of findings.

The patients were divided into 3 age groups: 18-40, 41-60 and >60 years and three GCS score groups- scores of 13, 14 and 15.

The patients were followed up to check for the need of therapeutic surgical intervention and to record the outcomes.

Inclusion criteria

- Must be traumatic brain injury.
- Patient must be aged >18 years.
- Patient's guardian must be able to understand & follow study related advices.
- Patient's guardian must be able to understand and give consent for the study.

Exclusion criteria

- History of neuropsychiatric illness
- Serious life-threatening medical illness
- Other serious life-threatening injuries present
- Inability to understand and give consent
- Participants who are unable to comply with the study

Statistical Analysis:

IBM SPSS software v25 was used. Chi Square test and Fisher Exact Test were used.

3. RESULTS:

Out of total 1224 head injury patients presenting to our emergency, 722 presented as mTBI and remaining 502 patients suffered from

moderate/severe head injury. All mTBI patients were tried for follow up, but only 190 patients with mTBI and a NCCT head done could be followed up.

In this study incidence of mTBI was 58.98% (n=722) and that of moderate/severe injury was 41.01% (n=502).

The age of patients ranged from 18 to 92 years. The mean age was 35.8 with a standard deviation of 17. Majority of patients were of age group 18-40 (n=130; 68.4%), followed by age group 41-60 (n=36; 19.0%). Age>60yrs was least common (n=24; 12.6%).

Males suffered from mTBI more commonly (n=130; 68.4%) as compared to females (n=60; 31.6%) with M:F ratio being 2.16:1.

RTA was the most common mode of injury contributing 66.4%, (n=126) of patients with mild TBI, followed by assault (n=36; 18.9%) and fall from height (n=28; 14.7%).

Most patients of head injury due to assault (77.8%) had an intracranial CT abnormality, followed by head injury due to fall from height (57.1%) and RTA (55.6%).

Majority of patients with mTBI presented to emergency department within 24 hours of injury (n=170; 89.5%), while 10.5% (n=20) of patients presented after 24 hours of injury.

30.5% (n=58) of patients required less than 24 hours of hospitalization and 69.5% (n=132) of patients for more than 24 hrs.

Majority of patients had a GCS score of 15 (n=136; 71.6%). 10.5% (n=20) had a GCS score of 14 and 17.9% (n=34) had a score of 13.

Table 1: Distribution of CT scan findings

CT scan findings	Frequency	Percentage (out of total)
Normal	76	40.0
Contusion	54	28.4
Extradural haemorrhage	36	18.9
Subdural haemorrhage	14	7.4
Fracture skull	10	5.3
Subarachnoid haemorrhage	8	4.2
Intracerebral haemorrhage	4	2.1

The CT scan of 76 patients had no significant finding and their CT scan was normal (n=76; 40% of total).

Contusion was present in 28.4% (n=54) of the patients. Extradural haemorrhage was present in 18.9% (n=36) followed by subdural haemorrhage, fracture skull, subarachnoid haemorrhage and intracerebral haemorrhage respectively in 7.4% (n=14), 5.3% (n=10), 4.2% (n=8) and 2.1% (n=4). The various abnormalities were occasionally in combination with each other.

Table 2: Various presenting symptoms with the frequency of CT abnormalities

Symptom	Total patients presenting	Percentage of patients presenting	CT positive patients	Percentage (out of symptom positive patients)
Headache	156	82.1%	94	60.3%
Vomiting	98	51.6%	72	73.5%
LOC	54	28.4%	34	62.9%
Ear Bleed	34	17.9%	32	94.1%
Irritability	24	12.6%	18	75.0%
Amnesia for event	16	8.4%	12	75.0%
Seizures	8	4.2%	8	100.0%
Vertigo	6	3.1%	6	100.0%
Nose Bleed	2	1.1%	0	0.0%

The most common symptom encountered was Headache in 82.1% (n=156) patients, but CT scan abnormality was present in 60.3% of them (n=94). It was followed by vomiting in 51.6% (n=98) patients with abnormal CT in 73.5% of them (n=68).

This was followed by loss of consciousness, ear bleed, irritability, amnesia for event, seizures, vertigo and nose bleed presenting in 54 (28.4%), 34 (17.9%), 24 (12.6%), 16 (8.4%), 8 (4.2%), 6 (3.1%) and 2 (1.1%) patients each, respectively. The percentage of CT positive patients in these were 62.9% (n=34), 94.1% (n=32), 75% (n=18), 75% (n=12), 100% (n=8), 100% (n=6) and 0% (n=0), in the same order.

Table 3: Significance of association between presentations and various abnormalities

Symptoms	P-value	Association
Headache	0.8772	Not Significant
Vomiting	0.000092	Significant
Loss of Consciousness	0.7336	Not Significant
Ear Bleed	0.000007	Significant
Irritability	0.1085	Not Significant
Seizure	0.0219	Significant
Vertigo	0.0831	Not Significant
Nose Bleed	0.1673	Not Significant
Amnesia for event	0.1961	Not Significant
History		
Male Gender	0.018355	Significant
RTA	0.07932	Not Significant
Assault	0.0156	Significant
Fall	0.7382	Not Significant

Ear bleed (i.e. the signs of skull base fracture) was the most significant association with a p-value of 0.000007. It was followed by vomiting, with a p-value of 0.000092. Presence of seizures was also found to be a significant predictor with a p-value of 0.0219. Male gender and assault as a mode too were significantly associated (p=0.018355 and p=0.01558, respectively) with CT abnormality.

Interval CT

A total of 50 interval CTs were done in the study. 34 (68%) of patients were found to have a previously undiagnosed abnormality. Rest (n=16; 32%) were found to have either no improvement or resolution of the initial abnormality. Total 12 out of these 50 patients were operated, out of which 8 were operated mainly on the basis on an interval CT finding.

Outcome Measures

Follow up of patients showed a favourable outcome for patients with mTBI. While most patients were normal (67.4%) with no signs and symptoms, only small percentages of patients were found suffering from minor grades of symptoms like headache (18.4%) and dizziness (9%) at the end of 3 months.

Intervention and Outcome

16.8% (n=32) of the patients underwent a neurosurgical procedure on emergency basis. All the patients undergoing an intervention survived. Out of the total 190 patients, 189 (99.5%) were alive and 1 (0.5%) patient expired. The expired patient was 96 years old, was managed conservatively and discharged, but was found to have expired due to natural cause on follow up.

DISCUSSION:

In the study, incidence of mTBI was 58.98% (n=722) and that of moderate/severe injury was 41.01% (n=502). Bruns et. al. (2003)[4] showed that the incidence of mTBI out of all cases of TBI ranged from 58-80% depending on the region, which correlates positively with our findings. AK Singh et. al. (2018)[5] conducted a study on traumatic brain injury cases in a dedicated South India trauma centre and estimated the percentage of mTBI as 51.42%.

In this study, majority of the patients were in the age group 18-40 years (68.4%), followed by 19% in 41-60 years of age and >60 years with 12.6%.

The study done by Bruns Jr. & Hauser (2003)[4] concluded 16-25 years as the peak age for mTBI. AK Singh et. al. (2018)[5] found maximum patients in the age group 31-40 years (25.32%), followed by 22.58% in the 21-30 years group. Thurman et. al. (2001)[6] found that there was bimodal distribution of mTBI, with peaks at 15–24 years and >65 years. This difference might have occurred as our study was not multicentric.

We found males (n=130; 68.4%) to be more prone to head injury as compared to females (n=60; 31.6%). The M:F ratio was 2.16:1. Arfat et. al. (2017)[7] concluded it to be 2.4:1. Corrigan et. al. (2010)[8] also

found the ratio to be approximately 2:1. The findings of these studies and ours are in concordance.

We found RTAs (road traffic accidents) to be the major cause of head injuries, contributing to 66.4% (n=126) of the cases. The next most common mode was assault (18.9%; n=36), followed by fall from height (14.7%; n=28). Gururaj et. al. (2002)[9] found traffic related injuries accounted for 45%–60% of brain injury, second leading cause was falls, varying between 20%–30%, with violence accounting for a further 10%–20%. AK Singh et. al. (2018)[5] also found RTAs to be the most common (54.12%) mechanism of injury responsible for TBIs, followed by fall from height (21.31%) . The variations in results could be due to a difference in the source population and a smaller sample size.

Majority of patients in this study had no significant finding and their CT scan was normal (n=76 ;40%). Contusion was the next most common finding (n=54; 28.4%). Extradural haemorrhage was present in 18.9% (n=36), subdural haemorrhage was present in 7.4% (n=14), while fracture skull, subarachnoid haemorrhage and intracerebral haemorrhage were present respectively in 5.3% (n=10), 4.2% (n=8) and 2.1% (n=4). Munivenkatappa et al (2013)[10] showed similar radioimaging findings in patients of mTBI. In their study normal CT scan finding was in 50.9% of patients, skull fracture in 23.1% of patients, contusion in 19.4% of patients, subarachnoid haemorrhage and extradural haemorrhage in 9.3% each and subdural haematoma in 6.5% of the patients. Arfat et. al. (2017)[7] reported that 23 (37.7%) of 61 patients in his study reported skull fractures. Six had extradural hematoma (9.83%), 9 had Subdural hematoma (14.75%), 8 had Subarachnoid haemorrhage (13.11%), 4 had Intra cerebral hematoma (6.55%), 17 had brain contusions (27.86%) and 6 had diffuse cerebral oedema (9.83%).

Majority of patients in our study presented with headache alone or in association with other symptoms (n=156, 82.1%) making it the most common presenting symptom. Vomiting was the second most common presenting symptom and was present in 51.6% (n=98) of the patients. Other presentations were loss of consciousness, ear bleed, irritability, amnesia for event, seizures, vertigo and nose bleed presenting in 28.4% (n=54), 17.9% (n=34), 12.6% (n=24), 8.4% (n=16), 4.2% (n=8), 3.1% (n=6) and 1.1% (n=2) of the patients, respectively.

Arfat M. et. al. (2017)[7] showed that transient loss of consciousness as most common presenting symptom (66.6%), next most common being headache and vomiting. AK Singh et. al. (2018)[5] also reported the loss of consciousness as the most common clinical presentation, followed by vomiting, ENT bleed, and posttraumatic seizures. The differences could possibly be because of our study being focused on mild head injury cases specifically.

On statistical analysis, we found ear bleed (p=0.000007), vomiting (p=0.000092) and seizures (0.0219) to be significantly associated ($p<0.05$) with an intracranial CT abnormality. Other than these three symptoms, male gender and assault as the mode of injury were also significantly associated with p values of 0.018355 and 0.01558, respectively. Contrary to popular opinion that LOC and amnesia for event were significant associations with an intracranial abnormality, our study found them both to be poor predictors of the same (p=0.7336 and 0.1961, respectively) . Jeret et. al. (1993)[11] in their study, found that older age, white race, signs of basilar skull fracture and being either a pedestrian hit by a motor vehicle or a victim of an assault were statistically correlated with an abnormal intracranial abnormality. The differences could be attributed to a different sample size and source population in their study.

We also found that 16.8% (n=32) of the patients underwent an emergency neurosurgical procedure. We concluded that GCS cannot always be used as a criterion for ordering a CT scan because in our study 12 patients were operated even though their GCS was 15 at presentation. Using GCS as the sole criterion for ordering a CT scan we would have missed 33.6% of CT positive patients.

Although some factors were statistically correlated with CT abnormalities in our study, a normal clinical and mental status examination at the time of presentation was unable to exclude the possibility of an abnormal CT scan. We also found previously undetected CT findings in 68% of patients in which an interval CT was ordered because of lack of improvement or deterioration of the GCS score, thus emphasizing the need of a continuous monitoring in a mild head injury patient.

The outcome of intervention in the form of neurosurgery was very positive when undertaken. All the 16.8% (n=32) who underwent surgery survived.

The only patient in our study who expired was 96 years old, was managed conservatively and discharged, but found to have expired due to natural causes on follow up.

The overall outcome in cases of mild head injury cases was good. All surviving patients had a GOS of 5 at discharge. The problems reduced with the passage of time due to medical care provided to the patients. More percentage of patients were found to be normal with less problems after 1 month and 3 months as compared to 15 days. Almost all were able to resume their usual activities and reported their symptoms to be relieved.

Further multicentric studies with much larger sample size are required to develop a reliable prediction model.

CONCLUSION:

The following conclusions were drawn in our study:

- The most common cause of mild traumatic head injury was RTA, which is more common among young males. Headache and vomiting were the commonest presentation.
- CT finding in majority of patients with mild Traumatic Brain Injury was normal as a single finding. But almost 60% of patients selected for a CT scan in our study had one or other CT abnormality.
- Significant association between presenting symptom and positive CT was found to be with vomiting, ear bleed and seizures. Male gender and assault as a mode of injury were also found to be significantly associated statistically.
- Rate of intervention was less marked with only 16.8% patients needing major surgical intervention.
- Most of post-traumatic symptoms resolved by 3rd month of follow up.

DECLARATIONS

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