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STUDY OF INDICATION OF CT SCAN IN A CASE OF MILD TRAUMATIC BRAIN INJURY [GCS13-15] ON THE BASIS OF HISTORY & CLINICAL EXAMINATION

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ABSTRACT Trauma to the head may cause damage to the brain parenchyma. This intracranial damage is more probable in severe than mild forms of head trauma. Despite this knowledge, physicians could not disregard the risk of brain injury in mild forms; thus, in many cases of head trauma, computed tomography (CT) scans are performed to detect possible intracranial injuries. This excessive CT scanning could cause unnecessary radiation exposure for patients, many cases of which are children and impose a heavy burden on the society. Different studies tried to decrease unnecessary CT scans by establishing clinical rules to predict possible injuries. These rules will help clinicians to safely recognize at risk patients with clinical signs and symptoms and perform CT scans when it is really necessary. The need for these rules is more prominent in mild forms of traumatic brain injury, where patients usually come with normal level of consciousness. Aim of this study is to study the indication of CT scan in a case of mild traumatic brain injury with GCS (13-15)

KEYWORDS :

INTRODUCTION

Trauma to head may cause injury to brain parenchyma. Risk of intracranial damage is more with severe head trauma, but it should not be ignored the mild form of head trauma; so, CT head is compulsory in many cases of head trauma. Different studies tried to decrease unnecessary CT scan by establishing clinical rules to predict possible intracranial injuries. On the basis of these rules clinician can safely opt the patient who actually needed CT head. The importance of these rules is more in case of mild traumatic brain injury (MTBI) where patients usually come with normal level of consciousness.

According to the American Congress of Rehabilitation medicine (ACRM) and WHO, MTBI is described as GCS score of 13 to 15.The common clinical features of MTBI is confu sion/ disorientation, loss of consciousness for 30 minute or less post traumatic amnesia for less than 24 hours and/ or other tran sient neurological abnormalities like local signs, seizures, and intracranial lesions. other signs and symptoms like headache, dizziness ,irritability, lethargy, vomiting, blurred vision, fatigue and poor concentration have also been reported. Emergency CT scan studies showed that up to 15% of head trauma patient with GCS score of 15 could have acute lesions.

REVIEW OF LITERATURE

DEFINITION

The Centers for Disease Control as part of its Report to Congress on Mild Traumatic Brain Injury in the United States developed the following definition

- Any period of observed or self-reported transient confusion, disorientation, or impaired consciousness;
- Any period of observed or self-reported dysfunction of memory(amnesia) around the time of injury;
- Observed signs of other neurological or neurop syc hological dysfunction, such as—Seizures acutely followi ng head injury;

Among infants and very young children: irritability, lethargy, or vomiting following head injury;

Any period of observed or self-reported loss of consciousness lasting 30 minutes or less.

MECHANISM OF MILD BRAIN

Brain is soft and jelly-like in consistency, composed of millions of fine nerve fibers, and "float" in cerebral-spinal fluid within the hard, bony skull. When the head is struck suddenly, strikes a stationary object, or is shaken violently, the mechanical force of this motion is transmitted to the brain and causes brain injury. When the head has a rotational movement during trauma, the brain moves, twists, and experiences forces that cause differential movement of brain matter. This sudden movement or direct force applied to the head can set the brain tissue in motion even though the brain is well protected in the skull and very resilient. This motion squeezes, stretches and sometimes tears the neural cells. Neural cells require a precise balance and distance between cells to efficiently process and transmit messages between cells. The stretching and squeezing of brain cells from these forces can change the precise balance, which can result in problems in how the brain processes information. Any time the brain suffers a violent force or movement, the soft, floating brain is slammed against the skull's uneven and rough interior. The internal lower surface of the skull is a rough, bony structure that often damages the fragile tissues within the brain as it moves across the bone surface.

DIAGNOSIS OF BRAIN INJURY

Due to the diffuse and subtle nature of mild brain injury, it is common for typical neuroimaging (CT scan or MRI's) to show no evidence of injury. There are newer, more sophisticated imaging technologies that show promise in more effectively capturing the damage that occurs in a mild brain injury.

Positron Emission Tomography (PET)
Single Photon Emission Computerized Tomography (SPECT)
Functional Magnetic Resonance Imaging (fMRI)
Diffuse Tensor Imaging (DTI)

GUIDELNES FOR CT SCAN

1. CANADIAN CT HEAD RULE (CCTHR)

CT scan is only required for patients with minor head injuries*

who have any 1 of the following findings:

- High risk (for neurologic intervention)
- GCS score <15 at 2 h after injury
- Suspected open or depressed skull fracture
- Any sign of basal skull fracture (eg, hemotympanum, raccoon eyes,
- cerebrospinal fluid [otorrhea or rhinorrhea, Battle sign)
- Vomiting ≥ 2 episodes
- Age ≥ 65 y
- Medium risk (for brain injury on CT)
- Amnesia before impact ≥ 30 min
- Dangerous mechanism (i.e., pedestrian struck by motor vehicle; occupant ejected from motor vehicle; fall from height ≥ 3 ft or 5 stairs).

2. NEW ORLEANS CRITERIA

CT scan is needed if a patient has 1 or more of the following criteria:

- Headache
- Vomiting (any)
- Age > 60 y
- Drug or alcohol intoxication
- Persistent anterograde amnesia (eg, deficits in short-term memory)
- Visible trauma above the clavicle
- Seizure

GLASGOW COMA SCALE

The test measures the motor response, verbal response and eye opening response with these values:

I. Motor Response	II. Verbal Response	III. Eye Opening
6 – Obeys commands fully 5 – Localizes to noxious stimuli 4 – Withdraws from noxious stimuli 3 – Abnormal flexion, i.e. decorticate posturing 2 – Extensor response, i.e. decerebrate posturing 1 – No response	5 – Alert and Oriented 4 – Confused, yet coherent, speech 3 – Inappropriate words and jumbled phrases consisting of words 2 – Incomprehensible sounds 1 – No sounds	4 – Spontaneous eye opening 3 – Eyes open to speech 2 – Eyes open to pain 1 – No eye opening

MATERIALS AND METHODS

All patients presenting with mild traumatic brain injury i.e. GCS 13-15 in casualty ED. A total of 100 were taken in study.

INCLUSION CRITERIA:

a. Patient presenting with GCS 13-15 due to traumatic brain injury.
b. Patients who give signed written consent

EXCLUSION CRITERIA :

a. Patients with GCS 13-15 with no history of trauma.
b. Patient with GCS less than 13
c. Patients with poly-trauma
d. Patients having history of trauma > 1 month

Table 1: Distribution of patients according to age

AGE	N	%
1-10	6	6
11-20	11	11
21-30	40	40
31-40	36	36
41-50	4	4
51-60	2	2
61-70	1	1
TOTAL	100	100

Table 2: Distribution of patient according to gender

Gender	N	%
Male	84	84
Female	16	16
Total	100	100

Table 3: Distribution of patients according to mode of injury

Mode of injury	N	%
Road traffic accident	90	90
Fall from height	6	6
Physical assault	4	4
Total	100	100

Table 4: Distribution according associated injury

Associated injury	N	%
Present	72	72
Absent	28	28
Total	100	100

Table 5: Distribution of patients according to symptoms

Symptoms	N	%
Headache	92	92
Nausea	84	84
Vomiting	52	52
Alcohol intoxication	15	15
Post traumatic seizure	12	12
Loss of consciousness	10	10

Table 6: CT scan finding in patients

Intracranial sequelae finding	N	%
Localized brain edema	65	65
Subarachnoid hemorrhage	28	28
Brain contusion	25	25
Diffuse brain swelling	23	23
Intracerebral hematoma	22	22
Subdural hematoma	20	20
Epidural hematoma	14	14
Pneumocephalus	10	10
Intraventricular hematoma	8	8

Table 7: Correlation between physical examination and CT scan

Physical examination	**CT scan**		**P value**
	Positive	**Negative**	
Positive	12	32	P<0.05*
Negative	6	50	

P<0.05-statistically significant

Sensitivity %	Specificity %	PPV %	NPV %	Prevalence %
66.7	60.9	27.2	89.2	18

Table 8:Corelation between absent physical findings and CT scan

Physical examination	CTscan		Relative risk	Z statistic	P value
	Positive	Negative			
Negative	6	50	2.545	2.042	P<0.05

DISCUSSION

A hospital based prospective study was done with 100 patients to assess requirement of CT scan in mild traumatic brain injury with GCS (13-15).

Tavender EJ et al [6], Stiell IG et al [30], Jagoda AS et al [32] and Hay del MJ et al 15 in their study on Indications for computed tomography in patients with minor head injury suggested that

some 10%–35% of CTs obtained in the ED for MTBI were not recommended according to the guidelines. Successful implementation of existing guidelines could decrease CT use in MTBI by up to 35%, leading to a significant reduction in radiation-induced cancers and health care costs. To prevent overuse of CT and to differentiate MTBI from clinically

important brain injury, multiple evidence-based guidelines exist to direct appropriate use of CT—four high-quality guidelines that are frequently used in practice include the Canadian CT Head Rule (CCHR), American College of Emergency Physicians (ACEP) Clinical Policy, New Orleans Criteria (NOC), and National Institute for Health and Clinical Excellence (NICE) guidelines

CT SCAN FINDINGS IN PATIENTS

As discussed in table 6 and graph 6, intracranial sequelae seen on CT scan are Localized brain edema is observed in 65 (65%) cases whereas subarachnoid hemorrhage was seen in 28 (28%) cases. The other sequelae observed were: brain contusion in 25 cases, diffuse brain swelling in 23 cases, intracerebral hematoma in 22 cases, subdural hematoma in 20 cases, epidural hematoma, pneumocephalus and intra ventricular hematoma in 14,10 and 8 cases respectively. Kreitzer N et al 110 in a retrospective cohort study including patients presenting to the ED with blunt mild TBI with Glasgow Coma Scale (GCS) scores of 14 or 15 and stable vital signs of the total of 153 (47%) patients had subarachnoid hemorrhage, 132 (41%) patients had subdural hemorrhage, 11 (3%) patients had epidural hemorrhage, 78 (24%) patients had cerebral contusions, and 59 (18%) patients had intraparenchymal hemorrhage.

CORRELATION BETWEEN PHYSICAL EXAMINATION AND CT SCAN

As discussed in table 7 and , in the present study, 12 patients with positive physical examinations showed positive CT scans and 32 patients had negative CT scans. 6 patients with negative PEs had positive CT scans and 50 patients had negative CT scans. A Chi-square test was applied to analyse the association between these 2 variables. The results showed a significant association between physical examinations and CT scans ($p<0.05$). The prevalence of positive CT scans was 18%. Sensitivity was 66.7% and specificity was 60.9%. In a similar study done by Sifri ZC et al 126 showed that nearly one in 10 patients thought to have minor head injuries had positive findings on head CT.

CORRELATION BETWEEN ABSENT PHYSICAL FINDINGS AND CT SCAN

As discussed in table 8 , 6 patients with negative physical examinations had positive CT scans and 50 patients had negative CT scans. Relative risk ratio showed there is no significant association between absent physical findings and CT scans ($p<0.05$).

Kreitzer N et al 110 in a retrospective cohort study the findings of clinical deterioration were rare even with radiographic progression of ICH. However, there were no delayed adverse clinical outcomes detected that were not associated with radiographic progression. While preliminary, these findings suggest that optimal risk stratification may include radiographic phenotyping of the initial CT findings and a concurrent period of observation for clinical deterioration. These findings also suggest that repeat CT imaging in the absence of clinical deterioration for the mild TBI patient with GCS > 13 and traumatic ICH on initial CT may be unne ces sary.

Miller EC et al 127 and Reinus WR et al 128 observed that while reducing the number of CTs performed for mild TBI patients by 10% could result in more than $10 million in savings each year, a repeat CT scan showing lack of radiographic progression might avoid an otherwise expensive admission, especially recognizing that many hospitals currently admit these patients to an intensive care unit for intensive neurologic monitoring Patients often have unrealistic expectations of benefits and harms, providers are poor judges of patient preferences and values, and these factors contribute to overuse of resources that informed patients may not value .Perhaps this is due to the fact that traditional guidelines and decision rules are geared toward physician decision making without considering patients' preferences or the need to educate patients that more care is not always better.

SUMMARY

A hospital based prospective study was done with 100 patients to assess requirement of CT scan in mild traumatic brain injury with GCS (13-15). The following observations were noted:

1. Majority of the patients (40%) were in the age group of 21-30 years followed by 36% in the age group of 31-40 years, 11% in the age group of 11-20 years, 6% in the age group of 1-10 years, 4% patients in the age group of 41-50 years, 2% in the age group of 51-60 years and 1% in the age group of 61-70 years.
2. Majority of the patients were male (84%) whereas female patients constituted 16% of the study group.
3. Road traffic accident (RTA) was responsible for 90% of cases, while fall from height and physical assault accounted for 6% and 4% of cases respectively.
4. Associated injuries were found in 72 (72%) cases whereas 28 (28%) cases had no associated injuries.
5. Headache was the most common symptoms among cases (92%) followed by nausea (84%), vomiting (52%), alcohol intoxication (15%), post traumatic seizure (12%) and loss of consciousness (10%).
6. Intracranial sequelae seen on CT scan are characterized in Table 5.Localized brain edema is observed in 65 (65%) cases whereas subarachnoid hemorrhage was seen in 28 (28%) cases. The other sequelae observed were: brain contusion in 25 cases, diffuse brain swelling in 23 cases, intracerebral hematoma in 22 cases, subdural hematoma in 20 cases, epidural hematoma, pneumocephalus and intra ventricular hematoma in 14, 10 and 8 cases respectively.
7. In the present study, 12 patients with positive physical examinations showed positive CT scans and 32 patients had negative CT scans. 6 patients with negative PEs had positive CT scans and 50 patients had negative CT scans. A Chi-square test was applied to analyse the association between these 2 variables. The results showed a significant association between physical examinations and CT scans ($p<0.05$). The prevalence of positive CT scans was 18%. Sensitivity was 66.7% and specificity was 60.9%.
8. 6 patients with negative physical examinations had positive CT scans and 50 patients had negative CT scans. Relative risk ratio showed there is no significant association between absent physical findings and CT scans ($p<0.05$).

CONCLUSION

The study showed that most head injury victims, brought to a hospital, were due to road traffic accidents and males are more prone to get Head injury. So it warrants the urgency to establish good pre-hospital care and provision of efficient and prompt trauma services at Road side to prevent mortality from RTA. RTA remains the most common cause for Head injury and demands good neurosurgical care for such patients. Hospitals should establish "TraumaTeams"to initiate rapid assessment and resuscitation of trauma victims in general, and head injury, in particular. Primary Health Care Centers need to be equipped with life support measures and proper

transportation facility for referral of suitable head injury cases to the nearest specialised centers. Finally, the follow up of fatal head injury cases should be extended up to the autopsy table, by establishing proper co-ordination with the doctor conducting the autopsy. Discharge after a head CT and brief period of observation in the ED allowed early discharge of a cohort of mild TBI patients with traumatic ICH without delayed adverse outcomes. Whether this justifies the cost and radiation exposure involved with this pattern of practice requires further study.