Clinical Management of Patients with Minor Head Injuries

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Abstract:

Background: Injuries are a focus of public health practice because they pose a serious health threat, occur frequently, and are preventable. Globally, thousands of people attend their local Emergency Department daily after suffering a head injury. Early diagnosis and appropriate management improves outcomes but is sometimes more difficult to achieve than might be imagined. Of all types of injury, those to the brain are among the most likely to result in death or permanent disability. Estimates of traumatic brain injury (TBI) incidence, severity, and cost reflect the enormous losses to individuals, their families, and society. The reduction in the number and severity of injuries offers a cost-effective manner in which to improve the health status of populations.

Methods: We prospectively studied 485 consecutive patients of traumatic brain injury out of which 280 with GCS of 13, 14, and 15 were subjected to routine early CT scan of head after 4 hours of reporting to Emergency Department. Patients with penetrating head injury were excluded.

Results: 15 % of patients had abnormal CT Scans and only 4% needed surgical intervention. Though a small number of patients harbour potentially lethal intracranial lesions yet, most of these cases are salvageable if diagnosed early and proper treatment.

Conclusion: This study reveals that the current practice in the some countries of risk stratification of adult MHI based on skull radiography need to be replaced by slightly modified versions of the Canadian CT rule/NICE guidelines. This will result in a large reduction in skull radiography and will be associated with modest increases in CT and admissions rates. The authors also believe that early CT Scanning can detect intracranial lesions and will reduce unnecessary hospital admissions.

Key words: *computerized tomography, traumatic brain injury, skull fractures, intracranial hematomas,, contusions, penetrating wounds, GCS , loss of consciousness.*

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Introduction

Traumatic brain injury (TBI) is a non-degenerative, non-congenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairments of cognitive, physical, and psychosocial functions with an associated diminished or altered state of consciousness. The original definition of minor head injury was a Glasgow Coma Score (GCS) of 13–15. This has now been superseded by a more narrow definition of patients with a GCS of 15 only. A variety of clinical correlates have been identified that enable GCS 15 patients to be subcategorized into high or low risk for an abnormal head CT. Mild head injury refers to "a traumatically induced physiologic disruption of brain function, as manifested by one of the following:

- Any period of loss of consciousness,
- Any loss of memory for events immediately before or after the accident,
- Any alteration in mental state at the time of the accident,
- Focal neurologic deficits, which may or may not be transient." [1-14]

The other criteria for defining mild TBI include GCS score greater than 12, no abnormalities on CT scan, no operative lesions and length of hospital stay less than 48 hours. The criteria to define moderate TBI include length of stay of at least 48 hours, GCS score of 9-12 or higher, operative intracranial lesion and abnormal CT scan findings. Severe TBI is indicated when the GCS score is below 9 within 48 hours of the injury. [1-14]

According to the Center for Disease Control (CDC), approximately 1.5 million people sustain traumatic brain injuries throughout the United States each year. Of those, approximately 1.1 million - or 75 percent - sustain a Mild Traumatic Brain Injury (MTBI). Each year 1.4 million people attend hospitals in England and Wales after suffering a head injury, of which 150,000 are admitted to hospital. [15] The annual estimated incidence of TBI in the United States and European countries is 200 to 300 patients per 100,000 population. [16,17] TBI accounts for approximately 52000 deaths (40% of all deaths) from acute injuries in the United States. Incidence of mild TBI is about 131 cases per 100,000 people, of moderate TBI 15 and severe TBI 14. Inclusion of pre-hospital deaths increases that figure to 21 cases per 100,000 people. [1-14]

Management for patients with mild head injury varies. Patients are often admitted for observation and many undergo computed tomography. Even in patients with normal findings on computed tomography, admission remains common practice, probably because of the risk of missing severe complications and the medicolegal implications. Early diagnosis followed by rapid treatment is a potential advantage.

It is estimated that 350,000 patients require hospital treatment for mild head injury each year in the United States, representing 80% of all patients admitted to hospital for head injury.[18-19] Similarly, about 1 million recently head-injured patients go to hospitals each year in the United Kingdom, one-fiftieth of the population. [20] Head injury causes 10% of new Accident & Emergency admissions in the UK and accounts for about 25% of all emergency observation ward admissions, with 96% of patients admitted for less than 24 hours. The phenomenon of mild head injury causes a significant number of visits to emergency departments and a substantial number of hospital admissions in both the United States and Europe.

The decision regarding when to use CT imaging for patients with minor head injury carries significant clinical as well as economic implications. To help physicians identify patients who are at risk of intracranial damage following minor head injury, two sets of guidelines have been proffered: the NOC (the New Orleans Criteria) and CCHR (The Canadian Computed Tomography Head Rule). The Canadian CT head rule published in 2001 was developed as a clinical tool to predict which MHI patients will have ICI on CT and consequently reduce the number of CT scans performed in North America (Box 1). While the NOC applies only to patients with a GCS score of 15, the CCHR may be used for patients with a GCS score from 13 to 15. [21]

Box 1

Clinical variables identified by the Canadian CT head rule for the selection of patients with minor head injuries (GCS 13–15) for CT

High risk (for neurosurgical interventions)

- GCS score <15 at two hours after injury
- Suspected open or depressed skull fracture
- Any sign of basal skull fracture (haemotympanum, "panda" eyes, cerebrospinal fluid otorrhoea, Battle's sign).
- Vomiting more than once
- Age ≥65 years

Medium risk (for brain injury on CT)

- Persistent retrograde amnesia of greater than 30 minutes
- Dangerous mechanism of injury (pedestrian struck by vehicle, ejection from vehicle, fall from greater than three feet or five stairs)

All rules and guidelines consider the following to be signs/risks of moderate or severe head injury and warrant urgent immediate CT:

- GCS<13
- Post-traumatic seizure
- Focal neurological deficit
- Coagulopathy (history of bleeding, clotting disorder, current warfarin treatment)

The CCHR and the NOC are clinical decision rules promulgated to identify which head injury patients should undergo CT imaging. The NOC recommends head CT for patients with minor head injury and any of the findings including headache, vomiting, age, older than 60 years, drug or alcohol intoxication, persistent anterograde amnesia, visible trauma superior to the clavicle, seizure.

Findings that should prompt CT evaluation by the standards of the CCHR include GCS score less than 15 at two hours or more after the injury, suspected open or depressed skull fracture, any sign of basal skull fracture, two or more episodes of vomiting, age, 65 years or older, more than 30 minutes of amnesia of events prior to the injury, automobile vs pedestrian crash, ejection from a motor vehicle, fall from more than three feet, or fall from five or more stairs. The CCHR does not apply to persons younger than 16 years old or those with a hypocoagulable state. The NOC and CCHR can identify patients at high risk of intracranial trauma following minor head injury. The NOC is designed to apply only to patients with a GCS score of 15, whereas the CCHR may be used for patients with a GCS score from 13 to 15. The NOC and CCHR appear equally sensitive in predicting the need for neurosurgical intervention following minor head injury. However, the CCHR is more specific, meaning that it has greater potential to reduce the number of head CT scans ordered following minor head trauma. [21]

In June 2003 the National Institute of Clinical Excellence (NICE) released the guideline "Head injury in infants, children and adults: triage, assessment, investigation and early management". The CT recommendations of this important new guideline for MHI are similar to the Canadian CT rule but with some modifications: CT can be delayed up to eight hours in those with "medium risk" criteria, and coagulopathy is a "high risk" indication for CT. Adoption of the NICE guideline in the UK for MHI would thus result in similar rates of CT, with concomitant resource implications. [22]

Methods

Authors carried out this prospective cohort study in the Emergency Departments of Sher-e-Kashmir Institute of Medical Sciences (SKIMS), Srinagar (India). SKIMS is a 700-bedded University hospital (with 100 beds for Accident & Emergency Department including 20 beds for the Disaster Management) catering to approximately seven million out of 1, 11, 82,000 population of Jammu & Kashmir State. SKIMS is the only referral centre in Kashmir for the treatment of head injury. During November 2004 to January 2005, we included consecutive adults who presented with head injury. We standardized clinical assessments before the CT scan.

Authors prospectively registered the time of trauma, arrival, computed tomography, admission, discharge, and use of investigations in the case report form for each patient. They also prospectively registered clinical course—that is, complications, change in care, and treatment.

A total of 280 patients with GCS of 13, 14, and 15 were subjected to routine early CT scan (Spiral) of head after 4 hours of reporting to Emergency Department. Scans were reported and interpreted according to local clinical practice. If the scan was interpreted as normal, the patient was discharged home.

Patients with penetrating head injury were excluded. No patient with a focal neurodeficit was included in the study. Patients with normal CT Scans were discharged from Accident & Emergency Department while patients who had abnormal CT Scans were admitted in the hospital for further management under Neurosurgery department. None of the discharged patients was readmitted during the study for initial head injury. The main outcome measures include need for neurological intervention and clinically important brain injury on CT.

Results

A total of 1085 head injury patients have been admitted during 2004 that comprise about 3.05 % of 35505 total admissions. The study included 280 (57.7%) of TBI patients, out of which 180 had GCS of 15, 72 had GCS of 14 and 48 had GCS of 13. 44 (15%) had abnormal CT scans. Patients with GCS of 15 had 11% abnormal CT scans in contrast to 29 per cent in patients with GCS of 13 (Table 1).

Majority of patients were victims of motor vehicle accidents comprising 56 percent followed by falls 28 percent, assault 36 percent, flying objects like cricket ball etc 11 percent abnormal CT scans were correlated with mode of injury which showed that the highest number of abnormal scans (38 percent) followed by patients hit by flying objects, assault and motor vehicle accidents (Table 2). This may be directly related to the impact of force hitting the head. A total of 72 scans were abnormal. Most common was single contusion. Around 4 percent patients needed surgical intervention (4 patients with depressed fracture, 3 cases with extradural hematoma and, 1 case with contusion) (Fig 1).

Forty-four patients admitted after positive CT scan finding accounted for 197 bed days. If all patients with brain trauma (including 236 with normal CT findings) had to be admitted for observation it would require additional 415 bed days. It saved 236 bed days for the hospital leading to availability of beds for new emergency admissions.

Discussion

Minor injuries include patients having loss of consciousness or post-traumatic amnesia with a GCS of more than 13. In the United States, incidence of mild TBI is about 131 cases per 100,000 people. Incidence of moderate TBI is about 15 cases per 100,000 people. Incidence of severe TBI is about 14 cases per 100,000 people. More than 80 percent of TBI admissions are mild and the average length of hospital stay was 2-3 days. [18]

Table (1). Percentage of patients with abnormal CT scan in relation to GCS

GCS	Number of patients	Number of abnormal CT scans
15	160	17 (11%)
14	72	13 (18%)
13	48	14 (29%)

Table (2). Category-wise percentage of patients with CT findings and need for surgical intervention.

Mode of injury	No. of patients	No. of positive scans	Patients requiring surgical intervention
MVA	158 (56%)	17 (38%)	2 (11%)
Fall	78 (28%)	13 (29%)	1 (8%)
Assault	36 (13%)	8 (18%)	3 (37%)
Flying objects	8 (3%)	5 (11%)	2 (40%)

MVA= Motor vehicle Accidents

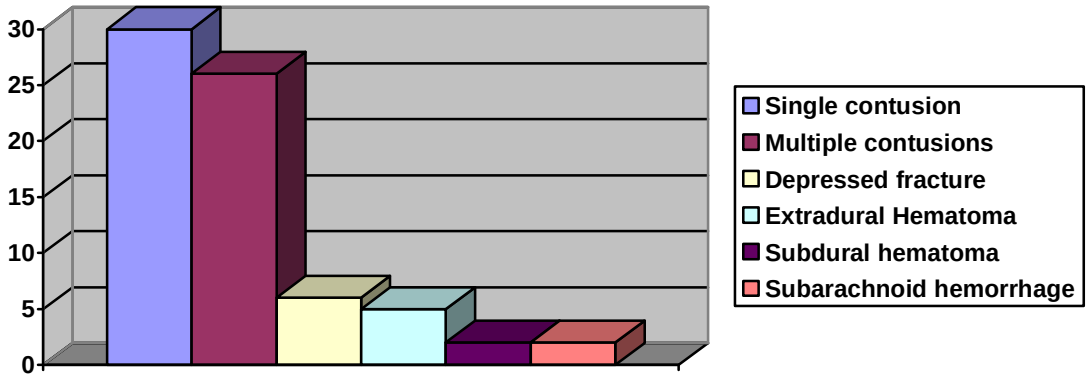

Fig. (1). CT scan findings

[Single contusion: 30; Multiple contusions: 26; Depressed fracture: 6; Extradural Hematoma: 5; Subdural hematoma: 2; Subarachnoid hemorrhage: 2]

Mild head injury refers to a patient with head trauma who has a GCS of 13-15. [20,23] Any other clinical, radiological or surgical finding has been an additional risk. Kraus et al have reported that 80% of head injury admissions in hospitals are of mild brain injuries. [24-26] Although these patients comprise the majority of head injury admissions, the consensus on the treatment policy of these patients is still lacking.

In a busy trauma centre these patients occupy the majority of beds and utilize the hospital resources. 17-18% of these patients have abnormal CT Scans [27,28] and only 5-6% need surgical intervention. Though a small number of patients harbour potentially lethal intracranial lesions yet most of these cases are salvageable with early diagnosis ad proper treatment early.

Some authors recommend routine admission and observation without early CT Scanning. [27] This will result in significant number of unnecessary admissions. Some authors recommend early CT Scanning and relative admissions. [27,28,30] The authors believe that early CT Scanning can detect potentially lethal intracranial lesions and will reduce unnecessary hospital admissions.

Recommendations for management of these patients vary from routine admission and observation without CT scan to mandatory CT scanning and admission, to CT scanning without admission. The timing of the initial CT scan is important. It has been shown that 14 to 20 percent of patients admitted with a diffuse brain injury may develop a mass lesion within 12 to 24

hours after injury. Thus the danger is particularly evident when patients with mild head injuries undergo CT very early. [30,31]

Difficulties encountered in the management of these patients include large number of such patients presenting as brain injuries and a high number of abnormal intracranial lesions which can be missed if routine CT scan is not done. Moreover, inappropriate admission of all patients with head injury will need additional bed days thus taxing the limited resources.

There is wide variation in the indications for obtaining a CT scan. One approach recommends scanning the vast majority of mildly TBI patients, with the only indication being loss of consciousness (LoC) or a period of post-traumatic amnesia. [32-35] The other approach is to scan a patient only in the presence of clinical deterioration [27,28,36] and a focal neurological deficit. Some have suggested a combination of clinicoradiographic parameters, such as CT for all patients with a GCS score of 13 or 14 or a skull fracture. In patients with a GCS score of 15, the decision is left to the discretion of the treating neurosurgeon. [39] Some authors recommend CT on the presence of a skull fracture, persistent headache or vomiting, or clinical deterioration. [30,31] Purely clinical indications for CT are mild TBI with PTA or LOC; focal neurological deficit; vomiting; headache; a serious injury mechanism [37-39] or Master's criteria. [39]

Current use of cranial computed tomography (CT) for minor head injury is increasing rapidly, highly variable, and inefficient. The Canadian CT Head Rule (CCHR) and New Orleans Criteria (NOC) are previously developed clinical decision rules to guide CT use for patients with minor head injury and with Glasgow Coma Scale (GCS) scores of 13 to 15 for the CCHR and a score of 15 for the NOC. However, uncertainty about the clinical performance of these rules exists. For patients with minor head injury and GCS score of 15, the CCHR and the NOC have equivalent high sensitivities for need for neurosurgical intervention and clinically important brain injury, but the CCHR has higher specificity for important clinical outcomes than does the NOC, and its use may result in reduced imaging rates. [40]

The adapted NOC decision rule appears valid for use in all patients with minor head injury who are 16 years or older and have a GCS score of 13 to 15, irrespective of loss of consciousness, However, further research is needed to identify patients with neurocranial injury who do not require neurosurgical intervention but may benefit from emergency CT scanning and to determine the optimal trade-off between sensitivity and specificity for a decision rule for CT scanning in patients with minor head injury based on cost and effectiveness outcomes.

Further research is required to provide standard guidelines to clinicians for the management of mild head injury patients.

The SKIMS hospital adopted the policy of routine CT scanning of mild brain injury patients and selective admission of patients with abnormal CT scans. The authors observed that around 15 percent patients had abnormal CT scans. Similar results (17-18%) have been reported elsewhere. [34,42, 43] Some authors have recommended routine admission and close observation without routine early CT scan. [44] They suggest routine admission and observation without CT scanning on the basis that it resulted in more efficient use of CT scanning. The authors believe that it results in large number of unnecessary admissions that leads to overutilisation of scarce resources that could otherwise be directed to genuine admissions.

Patients with admission GCS score of 13, 14, or 15 have, minor or mild head injuries. A patient with mild head injury complicated by an intracranial lesion has more severe sequelae and disability compared with a patient with an uncomplicated injury. In patients with a GCS score of 15 but with LOC or PTA, diffuse headache, or vomiting, a CT scan of the head must be obtained as soon as possible. In patients with admission GCS score of 14 or 15 but with skull fractures or neurological deficit CT scan must be obtained immediately. The risk of missing delayed hematomas is overwhelmed by the benefits of early hematomas detection. A CT scan should be obtained preferably with 4 hours of injury. Klauber et al [43] have reported a high mortality among very low risk patients in at least one hospital due to inadequate staffing which is a serious concern. One must question the reluctance to employ routinely early CT scanning in all cases of mild brain injury because the policy of routine hospital admission for all patients of mild head injury results in more hospital charges. [45,46] Routine admission does not guarantee neurological observation, and the cost difference of CT

scanning and X-ray films as screening devices are relatively less than cost of prolonged hospitalization, lost wages, medical complication and expenses resulting from malpractice litigation.

The use of immediate computed tomography during triage for patients with mild head injury, rather than admission, is feasible and clinically similar in outcome compared with observation in hospital. Costs for acute care of patients with mild head injuries are considerable. Model calculations indicate that use of computed tomography during triage for admission would be less expensive than admission for observation. Computed tomography is more cost effective for acute care of patients with mild head injury, being about a third less expensive than admission for observation. [47]

There is a strong need for improved methods of initial assessment and care that are both safe and effective in managing head injured patients which subsequently lead to a reduction in the number of unnecessary admissions and a more focussed system of head injury care.

When clinical suspicion is high, it is up to the individual physician to determine if a clinical decision instrument is applicable to the individual patient and particular setting.

Observation in hospital is often standard practice, and the addition of computed tomography has recently become more common. Even in patients with normal findings on computed tomography, admission remains common practice [48-50], probably because of the risk of missing severe complications and the medicolegal implications. Consistent use of computed tomography during triage for admission might relieve the strain on health services.

Some model studies indicate that use of computed tomography reduces costs. Detection of minor intracerebral injuries that would otherwise go undetected may increase the number of surgical procedures. [51]

Early diagnosis followed by rapid treatment is another potential advantage. [52-54] In various clinical settings and circumstances, the computed tomography strategy is not inferior to observation as regards patients' outcomes, with similar rates of complications, mortality, and worst disabilities in the groups.

Use of computed tomography during triage in patients with mild head injury is feasible, and clinical outcomes are similar to those in patients admitted for observation. No patient with normal findings on immediate computed tomography required intervention, despite almost half of all patients being scanned within four hours after trauma. [55]

Although both the CCHR and NOC approach 100% sensitivity for their respective outcome measures, it is up to the individual clinician to determine if a decision instrument is applicable to the individual patient and particular setting.

Conclusion

Early diagnosis and appropriate management improves outcomes. CT scanning is the examination of choice in mild TBI patients in the acute phase. This study supports other similar studies suggesting the need for replacing of risk stratification of adult MHI based on skull radiography by slightly modified versions of the Canadian CT rule/NICE guidelines. This will result in a large reduction in skull radiography and will be associated with modest increases in CT and admissions rates.

The authors also believe that early CT Scanning can detect potentially lethal intracranial lesions and will reduce unnecessary hospital admissions. The lives will be saved by early diagnosis and proper management. In addition, it saves bed days for the hospital leading to availability of beds for new emergency admissions. It could lead to decrease in the number of admissions annually thus reserving hospital beds for patients with greater needs.

Patients with mild head injury can be managed more cost effectively with a computed tomography strategy instead of admission for observation at the acute stage. The computed tomography strategy costs €196 less per patient.

Costs for acute care of patients with mild head injuries are considerable. Model calculations indicate that use of computed tomography during triage for admission would be less expensive than admission for observation. Computed tomography is more cost effective for acute care of patients with mild head injury, being about a third less expensive than admission for observation

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