International Surgery Journal
Vinodh KKS et al. Int Surg J. 2024 Dec;11(12):2019-2023
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20243461

Original Research Article

Role of repeat neuroimaging in complicated mild traumatic brain injury: a single centre study

Vinodh Kumar K. S.*, L. Sankar

Department of Neurosurgery, Government Mohan Kumaramangalam Medical College Hospital, Salem, Tamil Nadu, India

Received: 22 October 2024
Revised: 07 November 2024
Accepted: 12 November 2024

***Correspondence:**
Dr. Vinodh Kumar K. S.,
E-mail: ksvk1992@gmail.com

ABSTRACT

Background: Patients with mild traumatic brain injury (TBI) and positive initial CT brain findings undergo routine repeat CT brain for follow-up usually after 48 hours as a Standard of care. Use of repeat routine neuro imaging is controversial in mild TBI. We hypothesized that in patients with mild TB I repeat neuro imaging of the brain would not alter the outcome or patient's care. Aims and objectives were to evaluate the role of repeat CT brain in patients with complicated mild TBI (c-mild TBI) who were determined non-surgical medical line of management at the time of admission.
Methods: It is a hospital based prospective observational single centre study. Clinical and demographic data including age, gender, admission and discharge GCS and timing of the first and second CT brain of the patients included in the study were recorded on pre-designed and pre-tested proforma. department of neurosurgery, government Mohan Kumaramangalam medical college hospital, Salem-01, Tamil Nadu, India.
Results: Out of 552 patients, our study found that 46 (8.33%) patients had neurological deterioration in the form of drop in GCS, change in pupillary size, increased focal deficit, seizures or raised ICP symptoms, 94 (17.02%) patients had radiological progression in the form of increase in size of hematoma or edema and out of which only 21 (3.8%) patients underwent surgical intervention following second CT and all the patients who underwent surgical intervention had clinical neurological deterioration.
Conclusions: For patients with c-mild TBI a repeat CT brain should be obtained only in patients who have neurological worsening and serial neurological examination and observation after the injury is recommended. With this approach, patients who need delayed neurosurgical intervention can be identified while unnecessary imaging procedures can be avoided.

Keywords: Repeat CT brain, Brain injury, c-mild TBI, Radiation

INTRODUCTION

Traumatic brain injuries (TBIs) have high rates of mortality in India, claiming more than 150,000 lives and injuring almost 500,000 people annually.[1] c-mild TBI, which is defined as a Glasgow coma scale (GCS) of 13-15 and positive initial CT brain for any intracranial abnormalities (hematoma, contusion, oedema, etc.) or with skull fracture.[2]

Computed tomography (CT) is the imaging modality of choice for the evaluation of acute head-injured patient.[3]

A scheduled repeat CT scan or follow up scan is still a routine at many centers for patients with TBI and there exists a lot of debate on this topic.[4] It is often routinely repeated in many trauma centers after admission because of concerns related to progression of the initial insult or the interval development of new lesions.

Some studies have shown that a routine repeat CT brain is not indicated unless there is neurological deterioration, while others suggest routine repeat imaging is necessary to identify subset of patients without neurological deterioration who require neurosurgical intervention. However, repeat CT scanning is not without complications as it further exposes patients to potentially damaging radiation and also increase cost of healthcare.

Patients with neurological deterioration defined as a decrease in GCS>2, change in pupillary size, increased focal deficit, seizures or the onset of symptoms attributable to increased intracranial pressure a repeat CT is warranted to re-evaluate the magnitude and evolution of hemorrhage.[5] GCS assessment remains the most accurate predictor of the need for intervention.

All the patients without any neurological deterioration discharged after observation for five to seven days and follow up after 15 days and one month.

The objective of our study was to evaluate the role of repeat CT brain in patients with c-mild TBI who were determined non-surgical and medical line of management at the time of admission thereby we hypothesized that a repeat head CT in patients with no neurological deterioration following MTBI even in patients with high-risk it is unlikely to change the course of management or prompt neurosurgical intervention.

METHODS

Study design

It is a hospital based prospective observational single centre study. Consecutive sampling was used for patients with c-mild TBI and a total of 552 patients were enrolled. The data collection was from November 2023 to October 2024.

Study place

The study was conducted in department of neurosurgery, government Mohan Kumaramangalam medical college and hospital, Salem.

Data analysis

Statistical data analysis was done using Microsoft excel (2019) software.

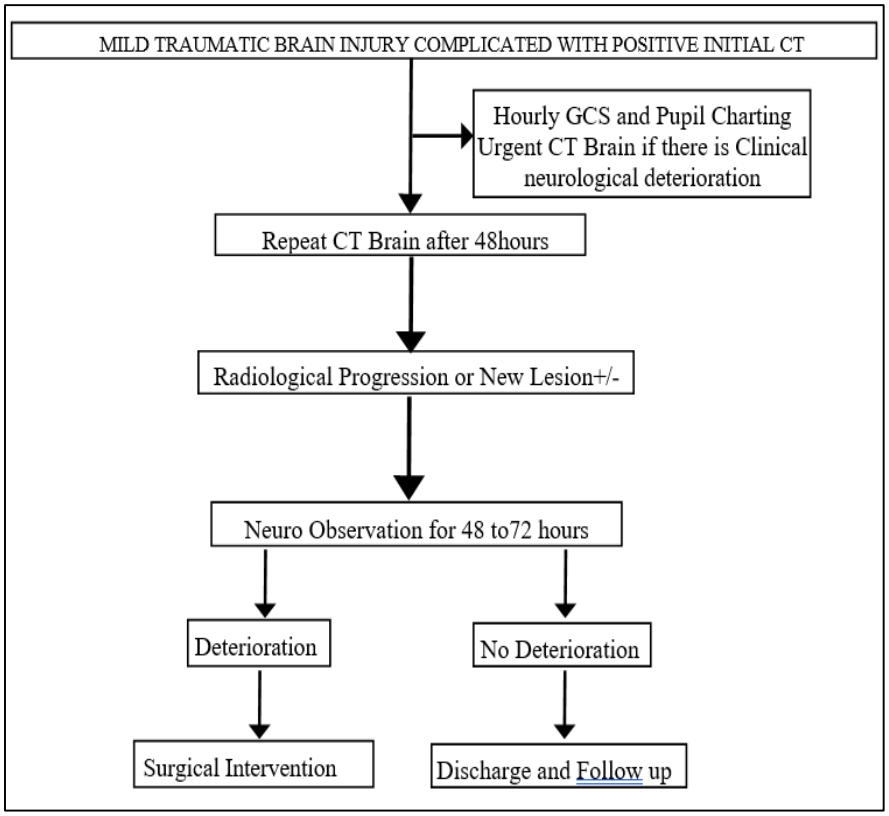

Figure 1: Study flow diagram.

Ethics approval and consent to appropriate

The study protocol was approved by the institutional ethics committee and all patients provided written informed consent before enrolment.

Inclusion criteria

All the patients admitted with mild TBI (GCS-13-15) with positive findings on initial CT scan of the brain between November 2023 to October 2024 were enrolled

in this study. Positive CT brain findings includes any abnormality like bone fracture, epidural hematoma (EDH), subdural hematoma (SDH), subarachnoid hemorrhage (SAH), Intra cerebral hemorrhage (ICH), Intra ventricular hemorrhage (IVH), contusion, edema, and pneumocephalus. Presented within 24hours of initial injury, isolated blunt traumatic brain injury, all patients who had a follow-up CT Brain during their hospitalization admitted in GMKMCH, Salem were included in the study.

Exclusion criteria

Exclusion criteria were as follows; patients who needed immediate surgery after the first CT scan, poly trauma patients with unstable hemodynamic status or severe underlying medical disorders, patients with incomplete data such as patients who absconded from hospital stay.

All the patients admitted in the department of neurosurgery, government Mohan Kumaramangalam medical college hospital, Salem with mild TBI (GCS-13-15) with positive findings on initial CT brain who were determined non-surgical and medical line of management at the time of admission were kept under intense Neuro observation with parameters like hourly GCS and pupil charting. If there was any clinical deterioration urgent CT brain was taken while all other patients without clinical deterioration underwent scheduled repeat CT brain after 48 hours of admission. Radiological progression or development of new lesions if any was noted during the second CT scan and the patients were continued under intense neuro observation for 48 to 72 hours. Patients with clinical deterioration underwent surgical intervention and if there were no clinical deterioration patients were discharged after observation for five to seven days and follow up after 15 days and one month.

RESULTS

During the one year study period 552 patients with c-mild TBI met the inclusion criteria.

Table 1: Age distribution.

Age group (in years)	N	Percentage (%)	P value
<18	53	10.14	<0.001
19-30	133	25.45	
31-50	225	43.05	
50-70	132	25.27	
71 and above	9	1.72	

The majority of patients (43.05%) are in the 31-50 years age group, suggesting this is the most affected group for the condition or injury being studied. Patients below 18 years and those above 71 years represent the smallest percentages (10.14% and 1.72%, respectively), indicating that younger and older age groups are less affected. The p<0.001 indicates the age distribution is statistically significant.

Table 2: Gender distribution.

Gender	N	Percentage (%)	P value
Male	466	84.42	<0.001
Female	86	15.58	

The gender distribution shows a significant male predominance, with 84.42% of the patients being male. This may suggest that males are at a much higher risk for the condition or injury under study, which could be due to behavioral, environmental, or occupational factors. The p<0.001 signifies the difference in gender distribution is highly statistically significant.

Table 3: Mode of injury.

Mode of injury	N	Percentage (%)	P value
Road traffic accidents	429	77.72	<0.001
Assault	45	8.15	
Self fall/ others	78	14.13	

Road traffic accidents are the most common mode of injury, accounting for 77.72% of cases. This suggests that RTAs are a major public health issue in this population. Self-fall or other causes account for 14.13%, while assault-related injuries make up only 8.15% and the p<0.001 indicates a statistically significant difference in the distribution of modes of injury.

Table 4: GCS score at admission.

GCS score	N	Percentage (%)	P value
13	65	11.77	<0.001
14	127	23.01	
15	360	65.22	

The majority of patients (65.22%) had a GCS score of 15, indicating that most patients were conscious and alert at the time of admission. About 23.01% had a GCS score of 14 and 11.77% had a score of 13, representing progressively lower levels of consciousness or neurologic impairment. The p<0.001 confirms that the distribution of GCS scores is statistically significant.

Table 5: Findings of CT brain.

Finding	N	Percentage (%)	P value
Contusion	181	32.79	<0.001
Sub dural hematoma	148	26.81	
Extra dural hematoma	102	18.48	
Sub arachnoid hemorrhage	205	37.14	
Intra ventricular hemorrhage	8	1.45	
Pneumocephalus	44	7.97	

The most common brain findings were sub arachnoid hemorrhage (37.14%) and contusion (32.79%), indicating these are the prevalent types of brain injury in this cohort. Sub dural hematomas were observed in 26.81% of patients, while extra dural hematomas were present in 18.48%. Less common findings include pneumocephalus (7.97%) and intra ventricular hemorrhage (1.45%), the p<0.001suggests a statistically significant difference in the distribution of brain findings.

Table 6: Outcome variables.

Outcome variables	N	Percentage (%)	P value
Clinico-neurological deterioration	46	8.33	<0.001
Radiological progression	94	17.02	
Neuro surgical intervention	21	3.80	

Clinico-neurological deterioration occurred in 8.33% of patients, and radiological progression was observed in 17.02% of cases. Neuro surgical interventions were required in 3.80% of patients, indicating a smaller proportion needed surgery and the p<0.001 indicates that the differences in outcomes are statistically significant.

DISCUSSION

The purpose of the routine repeat head CT after TBI is to follow the state of the initial event and also identify patients who require neurosurgical intervention.[6] At our and many other institutions, the usual practice has been for patients with a mild TBI and any intra cranial blood on a head CT scan to be admitted to an ICU and undergo repeat head CT 12-24 hours after admission. This management plan is an increasing burden on the health care system and creates substantial difficulty in appropriately allocating ICU beds and imaging resources.

Several studies have shown that 1-4% of complicated mild TBI patients had either clinical or radiographic deterioration requiring delayed surgical intervention after the second CT scan. An existing argument against our finding might be that both clinical and imaging surveillance should be used to increase patient safety, while missing a single patient has a high individual, social and economic burden. However, based on our results, significant imaging deterioration needing surgical intervention is always accompanied by clinico-neurological deterioration. Previous reports found that progressive hemorrhage occurred in approximately 15-28% of patients with acute mild TBI. Most developed early (within one day after the injury) during the clinical course.

Trevisi et al showed in a recent study that patients in clinically stable condition with a mild traumatic brain injury and a post-traumatic intracranial lesion at initial CT scan has been shown to minimally benefit from repeated CT scans.[7] However, from a pragmatic point of view, it is often not realistic to suggest avoidance of at least a second CT scan for this subset of patients.

Sifri et al showed a 100% negative predictive value of normal neurologic examination in mild TBI with intracranial bleed on initial head CT and concluded that a repeat head CT in the setting of a normal neurologic examination results in no change in management or neurosurgical intervention.[8]

Fattah et al looked at the use of RHCT in patients with intracranial hemorrhage and GCS score 13-15 in a prospective study of 145 patients with TBI.[9] They found that selective use of RHCT decreased hospital length of stay in these patients, but they did not use injury pattern on initial CT scan to allocate patients to routine or selective repeat scans.

Rosen et al in every patient with anatomic TBI and suggests that clinically stable patients with small injury can simply be followed clinically.[10]

Given that signs of neurological worsening can predict the need for neurological intervention, we recommend that repeat CT brain only to be conducted in this subgroup of c-mild TBI patients. The rate of clinical neurological worsening requiring surgical intervention in our study was 3.8% and applying this recommendation would have reduced the rate of CT scanning by more than 95%.

Limitations

This study requires intense neuro observation with qualified staff for Stringent neurological monitoring without which the study recommendations remain uncertain. The outcome of our study was limited to either surgical intervention or discharge due to time constraints. Multicentre and longer study duration is required for the study of other outcomes like functional outcomes.

CONCLUSION

Routine repeat CT brain in c-mild TBI patients even with commonly considered risk factors such as anticoagulation, EDH and SDH is very low yield to predict need for delayed surgical intervention. Instead, serial neurological examination and observation after the injury is recommended. A second CT scan should be obtained only in patients who have neurological worsening. With this approach, patients who need delayed neurosurgical intervention can be identified while unnecessary imaging procedures can be avoided.

ACKNOWLEDGEMENTS

The authors would like to thank the staff and the nurses from the neurosurgery department at GMKMCH Salem, for their support.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Veerappan VR, Nagendra B, Thalluri P, Manda VS, Rao RN, Pattisapu JV. Reducing the Neurotrauma Burden in India-A National Mobilization. World Neurosurg. 2022;165:106-13.
2. Williams DH, Levin HS, Eisenberg HM. Mild head injury classification. Neurosurgery. 1990;27:422-8.
3. Lolli V, Pezzullo M, Delpierre I, Sadeghi N. MDCT imaging of traumatic brain injury. Br J Radiol. 2016;89(1061):20150849.
4. Saurabh BG, Lakshmi P, Girish M. Role of scheduled repeat CT scan in traumatic brain injuries: A prospective observational study. 2024;15:317.
5. Fadzil F, Mei AKC, Mohd Khairy A, Kumar R, Mohd Azli AN. Value of Repeat CT Brain in Mild Traumatic Brain Injury Patients with High Risk of Intracerebral Hemorrhage Progression. Int J Environ Res Public Health. 2022;19(21):14311.
6. Stippler M, Liu J, Motiei-Langroudi R, Voronovich Z, Yonas H, Davis RB. Complicated Mild Traumatic Brain Injury and the Need for Imaging Surveillance. World Neurosurg. 2017;105:265-9.
7. Trevisi G, Alba S, Elisabetta P, Chiara DW, Carmelo A, Annunziato M. What Is the Best Timing of Repeated CT Scan in Mild Head Trauma with an Initially Positive CT Scan? World Neurosurg. 2018;118:e316-22.
8. Sifri ZC, Nyak N, Homnick AT, Mohr AA, Yonclas P, Livingston DH. Utility of Repeat Head Computed Tomography in Patients with an Abnormal Neurologic Examination After Minimal Head Injury. J Trauma Inj Infect Crit Care. 2011;71:1605-10.
9. Fattah AKR, Eastman AL, Aldy KN, Wolf SE, Minei JP, Scott WW, et al. A prospective evaluation of the use of routine repeat cranial CT scans in patients with intracranial hemorrhage and GCS score of 13 to 15. J Trauma Acute Care Surg. 2012;73(3):685-8.
10. Rosen CB, Luy DD, Deane MR, Thomas MS, Deborah MS. Routine repeat head CT may not be necessary for patients with mild TBI Trauma Surg Acute Care Open. 2018;3(1):e000129.

Cite this article as: Vinodh KKS, Sankar L. Role of repeat neuroimaging in complicated mild traumatic brain injury: a single centre study. Int Surg J 2024;11:2019-23.