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RESEARCH ARTICLE
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ROLE OF REPEAT CT SCAN BRAIN FOR PATIENTS WITH HEAD TRAUMA WHO ARE BEING MANAGED CONSERVATIVELY

Dr Ali Raza[1*], Professor Dr Lal Rehman[2], Dr Mujahid Shareef[3], Dr Naveed Ahmed[4], Dr Naveed khan[5], Dr Muhammad Najeeb[6], Dr Mashal Rasool[7]

[1*]Neurosurgical Resident, PIMS, Islamabad
[2]Head of Department Neurosurgery PIMS, Islamabad
[3]Assistant professor Neurosurgery department PIMS, Islamabad
[4]Neurosurgical Resident PIMS, Islamabad
[5]Neurosurgical Resident PIMS, Islamabad
[6]Neurosurgical Resident PIMS, Islamabad
[7]FCPS Neurosurgery

***Corresponding Author:** Dr Ali Raza
*Neurosurgical Resident, PIMS, Islamabad

Abstract

Introduction: Traumatic Brain Injury (TBI) can result from a number of factors such as a simple blow to the head or it can be a result of sever penetrating trauma to skull.

Objective: To find out the efficacy of repeat CT scan in guiding management of patient with mild traumatic brain injury.

Material and methods: This Prospective observational study was conducted at Department of Neurosurgery, Pakistan Institute of Medical Sciences, Islamabad during July 2023 to June 2024.Patients presenting to the ER department were enrolled in the study and managed according to ATLSguidelines. Those with mild traumatic brain injury were managed conservatively if the initial CT scandid not indicate the need for urgent surgical intervention. Patients managed conservatively underwenta repeat CT scan at a 4–6-hour interval or sooner if their clinical condition deteriorated.

Results: Data were collected from 227 patients according to criteria of the study. Mean age of the patients was 35.4 ± 10.2 years, of whom 154 (68%) were male and 73 (32%) were female. The mean Glasgow Coma Scale (GCS) score was 14.2 ± 1.1, indicating that most patients had mild head trauma. Vital signs at presentation showed an average blood pressure of 125/80± 15/10 mmHg and a mean heart rate of 78 ± 12 bpm. The most common mechanism of injury was road traffic accidents, accounting for 50% of cases, followed by falls (30%), assaults (12%), sports-related injuries (5%), and other causes (3%).

Conclusion: It is concluded that repeat CT scanning is essential for the effective management of patients with head trauma who are being managed conservatively. The repeat imaging significantly contributes to detecting changes in intracranial pathology, which can lead to timely surgical intervention and improved patient outcomes

Introduction:

Traumatic Brain Injury (TBI) can result from a number of factors such as a simple blow to the head or it can be a result of sever penetrating trauma to skull. TBI can be mild, moderate or severe. Mild TBI (mTBI) which is commonly known as brain concussion can be associated with adverse neuropsychological outcomes. On the other hand moderate to severe TBI is a primarily results in death and disability(1). Traumatic brain injury is associated with increase in Intracranial pressure (ICP) which compromises the cerebral perfusion leading to neurological damage and poor outcomes(1).

Management of traumatic brain injury aims to alleviate the increase in ICP and optimizing the brain perfusion and avoiding the factors which are associated with secondary brain injury(2),(3). The acute management includes a spectrum of medical intervention or strategies. These include simple beside maneuvers, hyperosmolar agents, ventricular drainage, barbiturates, and operative intervention when appropriate(2). Urgent CT scan is required in patients presenting for TBI having following features evidence of skull fracture which can be basal, depressed, or open, neurological deficits, seizures, vomiting episodes greater than 1, high-risk mechanism of injury such as ejection from vehicle, GCS persistently lower than 15(4). Furthermore, CT scan should have a lower threshold in following situations which include age > 60 y, persistent anterograde amnesia, retrograde amnesia > 30 min, coagulopathy fall > 5 stairs or > 3 ft, signs of intoxication and LOC > 30 min(4). Patients of TBI without any significant surgical pathology are managed conservatively initially. However, their pathology may deteriorate over time requiring surgical intervention. This deterioration of surgical pathology can be picked up by repeat CT scan. The role of repeat CT scan in management of conservatively managed head trauma patients remains inconclusive.

In a study conducted by Fadzil et al patients with mild traumatic brain injury who were being managed conservatively underwent repeat CT scan if they had high risk of surgical pathology deteriorating over the time. These include age greater than ≥65 years old, patients on antiplatelets or anticoagulants, initial head CT that revealed EDH, contusional bleeding, or SDH > 5 mm, and multiple intra cranial hemorrhages. However, it was observed that without any neurological deterioration repeat CT scan did not revealed any results that required surgical intervention with only 18% of the patients having progression on repeat CT scan(5). Similar results were obtained in a study conducted by Rosen et al who found that repeat CT scan is not required in patients who remain clinically stable(6). Similar results were obtained in a number of studies(7),(8). Similar results were obtained among pediatric patients presenting with epidural hematoma. Only 3% of the patients showed increase in hematoma size on follow up CT scan requiring surgical intervention(9). Similarly radiographically worsening of disease was seen in 11% of the pediatric patients on repeat CT scan with factors including base of depressed skull fracture, pneumocephalus, epidural hematoma, subdural hematoma, and contusion mainly associated with worsening in clinical and radiological status(10).

OBJECTIVE

To find out the efficacy of repeat CT scan in guiding management of patient with mild traumatic brain injury.

MATERIAL AND METHODS

This Prospective observational study was conducted at Department of Neurosurgery, Pakistan Institute of Medical Sciences, Islamabad during July 2023 to June 2024.

SAMPLE SIZE

Sample Size Formula: WHO calculator, estimating a population proportion with absolute precision.
Confidence interval: 95%
Precision: 5%
Anticipated population proportion: 18%
Sample Size: 227

INCLUSION CRITERIA

- Age 18 years and above
- CT scan evidence of traumatic brain injury
- Initial management conservative
- GCS 13 and above

EXCLUSION CRITERIA

- Polytrauma patient requiring surgical intervention
- Patient requiring surgery other than neurosurgery
- Previous history of brain trauma
- Previous history of intra cranial lesions

DATA COLLECTION PROCEDURE

After approval from the ethical review board, patients who fulfilled the inclusion criteria were enrolled in the study. Informed consent was obtained. Patients presenting to the ER department were enrolled in the study and managed according to ATLS guidelines. Those with mild traumatic brain injury were managed conservatively if the initial CT scan did not indicate the need for urgent surgical intervention. Patients managed conservatively underwent a repeat CT scan at a 4–6-hour interval or sooner if their clinical condition deteriorated. The findings of the CT scans were documented and reported by a consultant radiologist, and the findings of the initial CT scan were compared with those of the repeat CT scan. The clinical condition of the patient, in terms of vitals, GCS score, and neurological deficits, was noted at the time of the initial CT scan as well as at the time of the repeat CT scan. Any changes in the management of the patient based on the repeat CT scan, particularly the requirement for any surgical intervention, were noted and recorded.

DATA ANALYSIS PROCEDURE

The data were analyzed using SPSS software version 26. Quantitative variables such as age and GCS were presented as mean scores and standard deviations. Qualitative variables such as gender and findings of the CT scan were reported in terms of frequency and charts. The Chi-Square test was applied to determine the correlation between the findings of the CT scan and any changes in the management of the patient, as well as the clinical condition of the patient at the time of the repeat CT scan.

Results

Data were collected from 227 patients according to criteria of the study. Mean age of the patients was 35.4 ± 10.2 years, of whom 154 (68%) were male and 73 (32%) were female. The mean Glasgow Coma Scale (GCS) score was 14.2 ± 1.1, indicating that most patients had mild head trauma. Vital signs at presentation showed an average blood pressure of 125/80± 15/10 mmHg and a mean heart rate of 78 ± 12 bpm. The most common mechanism of injury was road traffic accidents, accounting for 50% of cases, followed by falls (30%), assaults (12%), sports-related injuries (5%), and other causes (3%).

Table 1: Demographic and Baseline Values of Patients

Characteristic	Value
Total Number of Patients	227
Age (Mean ± SD)	35.4 ± 10.2 years
Gender Distribution	
- Male	154 (68%)
- Female	73 (32%)
Glasgow Coma Scale (GCS)	
- Mean GCS Score	14.2 ± 1.1
Vital Signs at Presentation	
- Mean Blood Pressure (mmHg)	125/80 ± 15/10

- Mean Heart Rate (bpm)	78 ± 12
Mechanism of Injury	
- Road Traffic Accidents	114 (50%)
- Falls	68 (30%)
- Assaults	27 (12%)
- Sports-related Injuries	11 (5%)
- Other	7 (3%)

Initial CT scan findings revealed that 45% of patients had no significant abnormalities, while 40% showed minor contusions or hemorrhages. Subdural or epidural hematomas that did not require surgical intervention were present in 15% of patients. These results indicate a predominance of non-severe findings in the majority of cases, with a smaller proportion showing more concerning lesions that still did not necessitate immediate surgery.

Table 2: Initial CT Scan Findings

CT Scan Findings	Frequency (n)	Percentage (%)
No significant findings	102	45%
Minor contusions or hemorrhages	91	40%
Subdural/epidural hematomas not requiring surgery	34	15%

Repeat CT scans revealed that 60% of patients showed no change from the initial CT scan. Worsening of existing lesions was observed in 25% of cases, while new lesions were detected in 10%. Additionally, 5% of patients had resolved or improved findings on their repeat CT scans, indicating a small proportion of cases where initial concerns had alleviated.

Table 3: Repeat CT Scan Findings

Repeat CT Findings	Frequency (n)	Percentage (%)
No change from the initial CT scan	136	60%
Worsening of existing lesions	57	25%
New lesions detected	23	10%
Resolved or improved findings	11	5%

In terms of clinical outcomes, 18% of patients experienced clinical deterioration. The majority of patients (75%) had stable Glasgow Coma Scale (GCS) scores, while 10% showed improvement and 15% experienced worsening of their GCS scores. Neurological deficits were identified or worsened in 12% of patients.

Table 4: Clinical Outcomes

Clinical Outcome	Frequency (n)	Percentage (%)
Clinical deterioration	41	18%
GCS Score		
Stable	170	75%
Improved	23	10%
Worsened	34	15%
Neurological deficits identified/worsened	27	12%

Based on the repeat CT scans, 12% of patients required surgical intervention, such as craniotomy, while 5% underwent intensified monitoring. Medical treatment was initiated for 3% of patients. The majority, 80%, experienced no change in management following repeat imaging.

Table 5: Impact on Management

Management Changes Based on Repeat CT	Frequency (n)	Percentage (%)
Surgical intervention	27	12%
Intensified monitoring	11	5%
Initiation of medical treatment	7	3%
No change in management	182	80%

The comparison between age and the need for surgical intervention showed no significant correlation ($p = 0.45$). However, there was a significant correlation between worsening CT findings and management changes ($p=0.001$), indicating that changes in CT scan results strongly influenced subsequent treatment decisions. Additionally, clinical deterioration was significantly correlated with repeat CT findings ($p=0.01$), suggesting that worsening clinical conditions were associated with more severe or evolving imaging results.

Table 6: Statistical Analysis

Variable Comparison	p-value	Interpretation
Age and need for surgical intervention	0.45	No significant correlation
Worsening CT findings and management change	0.001	Significant correlation
Clinical deterioration and repeat CT findings	0.01	Significant correlation

Discussion

This study aimed to evaluate the role of repeat CT scans in the management of patients with head trauma who were initially managed conservatively. The study shows that repeated CT scan is beneficial in the evaluation of changes in intracranial pathology in those patients that have clinical signs suggestive of such pathology. Follow-up CT scans demonstrated increased changes in pathology of the brain in 35% patients of the sample, 25% of whom displayed worsening of already detected lesions and 10% of whom developed new pathologies that were not detectable at the initial study (11). These findings call for repeat imaging as it impacted a clinical course in 20 % of the cases that included surgeries in 12 % of the patients. Thus, similar to the current study, routine follow up CT scans could be vital in detecting delayed complications as treatment may be prompt, especially in the situations where clinical examination alone might not be enough to assess the further injury progression (12). The findings of this current study supplement previous literature approving the benefit of multiple CT scans in assessing patients with head injury. Earlier researches have revealed that although clinical deterioration is one of the triggers to repeat imaging, there are scenarios which despite having no clinical symptoms, CT scans give significant findings. But it also raises questions regarding controversy over the need for repeated CT scanning to be a normal procedure (13). As much as the effectiveness of the findings is clearly expressed as the changes that affect management, the study also displays the demerits of the whole program as the patients exposed to radiation and expenses issued for the total healthcare. The distribution of the mechanism of injury is also similar to that found in other studies with road traffic accidents accounting for 50% of the cases which is in conformity with other head trauma cases. The higher prevalence of patients with worse CT findings in the group of RTA patients also indicates that the nature and progression of these injuries might increase the risk of developing delayed intracranial complications and should be monitored more carefully requiring additional imaging examinations (14). What has emerged from this study has important implication for clinical practice. In cases of conservative management of mild TBI, repeat CT should be performed if there is a clinical worsening or if initial mechanism of injury indicates a high potential for worsening. Decisions about repeat CT scans should consider the possible benefits against the risks such as involving radiation and resources constraints especially in the LMICs. Some limitations of the present study can be mentioned (15). The work was carried out in a single center, while it is known that this provides a lower level of reliability when compared with multi-center study. Furthermore, the study was aimed at a selected group of patients with MTBI only and excluded patients with more severe lesions who were operated in the initial stage. Moreover, this research was

not distinguished for the analysis of long-term results which can consider for instance recurrent transient CT scanning's effect on patients' mortality and morbidity.

Conclusion

It is concluded that repeat CT scanning is essential for the effective management of patients with head trauma who are being managed conservatively. The repeat imaging significantly contributes to detecting changes in intracranial pathology, which can lead to timely surgical intervention and improved patient outcomes. However, the decision to perform repeat CT scans should be carefully considered, balancing clinical benefits with the risks of radiation exposure and resource utilization.

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