ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

A study with focus on course and outcome of delayed neurological deterioration in mild head injury patients

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Submission: 07-05-2022 Revision: 02-09-2023 Publication: 01-10-2023

ABSTRACT

Background: Mild head injury (MHI) complicated by an intracranial hemorrhage (ICH) is a common cause of hospital admission after head trauma. The majority of patients get non-operative care, maintain neurological stability, and are successfully discharged. However, a small proportion of people experience delayed neurological deterioration (DND). The characteristics of DND following an MHI exacerbated by ICH are poorly understood. **Aims and Objectives:** The study was conducted to evaluate the temporal course and outcome of MHI patients with respect to DND. **Materials and Methods:** A prospective study was performed on all adult patients presenting over 15 consecutive months with MHI. Patients who were treated conservatively after initial head computed tomography and had a subsequent DND (Glasgow Coma Scale score decrease ≥2) were identified. Demographics, neurological status, clinical and temporal course, radiographic findings, and outcome data were collected. **Results:** Over 15 months, 150 patients with MHI were included in the study for observation; of these, 49 patients experienced DND. 31.33% of patients deteriorated within 24 h after admission. 14 patients (9.37%) died. Variables significantly associated with mortality included age >60 years delayed presentation at tertiary center, progressive intracranial bleed, or increase in cerebral edema. **Conclusion:** The incidence of DND after MHI with ICH is low and usually occurs within 24 h after admission. It results in significant morbidity and mortality if it is the result of progressive ICH. Further research is needed to identify risk factors that can allow early detection and improve outcomes in these patients.

Key words: Mild head injury; Glasgow Coma scale; Delayed neurological deterioration

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v14i10.54687

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

In India during the past three decades due to demographic, epidemiological, and economic transition, the health scenario has changed in a significant way leading to shifting of health problems from communicable to non-communicable diseases mainly injuries.

Head injury is a common problem globally with a yearly incidence of approximately 200/1,00,000 persons and mortality of 20/1,00,000/year.[1] Several of these injuries are slight, with few sequels, but some are devastating. Car and motorcycle crashes are the most common cause of traumatic brain injury (TBI), followed by injuries from firearms, falls, and sports, and the sudden rise in morbidity, disability, and mortality in the past decade has been a matter of concern.[2] Worldwide approximately 42 million people suffer from mild head injury (MHI).[3]

"MHI is an acute brain injury resulting from mechanical energy to the head from external physical force.[4] Operational criteria for clinical identification include Glasgow Coma Scale (GCS) score of 13–15 after 30 min of injury or later upon presentation for health care. These manifestations of MHI must not be due to alcohol, drugs, and medications or due to treatment for other medical conditions."[5]

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Delayed neurological deterioration (DND) is defined as a decrease of ≥2 points in the GCS score or the development of any new focal neurological deficits during the hospital stay.[6] There are various causes have been thought to be responsible for DND but most described cause is an expanding intracranial lesion.[7] Patient with MHI who progress to DND have worse outcome as compared to patient who remains stable throughout the course of injury.[8] The main aim of the study is to find temporal course of MHI with respect to neurological deterioration and to study outcomes of patients who deteriorated neurologically after presenting with MHI.

Aims and objectives

1. To study temporal course of mild head injury with respect to neurological deterioration.
2. To study outcomes of patients who deteriorated neurologically after presenting with mild head injury.

MATERIALS AND METHODS

The prospective observational study with title "A study with focus on course and outcome of DND in MHI patients" was conducted in the Department of Surgery at Shyam Shah Medical College and associated Sanjay Gandhi Memorial Hospital, Rewa (M.P.) after obtaining ethical clearance from the institutional ethics committee.

Inclusion criteria

- All patients who will be admitted and have primary diagnosis of MHI
- Patients with GCS score 13 or more with or without documented loss of consciousness
- Patients with MHI who will have an initial computed tomography (CT) head demonstrating an acute intracranial hemorrhage (ICH) and who will be managed conservatively will be included in the study.

Exclusion criteria

- Patients who are admitted for <36 h.
- Patients whose CT head demonstrated an ICH that warranted immediate or planned neurosurgical intervention.
- Pregnant Females.

Patient data collections

Demographic data recorded included age, sex, ethnicity, and mechanism of injury. Admission data recorded included GCS score, injury severity score, focal neurological deficits, and orientation. Timings of injury, arrival, deterioration, radiographic studies, discharge, and death were recorded from emergency medical services and hospital records.

Deterioration data were recorded including the location of deterioration (emergency room, intensive care unit, and floors), GCS score before and after deterioration, cause of deterioration, and neurosurgical intervention. Patients with intracranial bleeds will be admitted to the trauma or neurosurgery service for observation. Patients received a neurological examination every 1–2 h by experienced doctors and nursing staff.

RESULTS

During the 15-month period of the study, 177 patients presented to the trauma center with a primary diagnosis of MHI and were found to have an ICH on initial head CT scan. Of total cases, 27 were excluded because of pregnancy, incomplete medical records, a history of brain or spinal cord disease, or planned neurosurgical operative management. Hence, the final sample size of the study was 150 patients.

The mean age of our study population was 34.03±16.107 years, maximum number of patients 52.66% were found in the category of 21–40-year category, and minimum number of patients 0.67% found in a category of above 80 years age group (Table 1). 40 patients (26.66%) had GCS score G15 with mean time duration at admission was 173.75±136.48 mins (P=0.0002). 68 (45.37%) patients had GCS score G14 with mean time duration at admission was 211.57±130.31 mins (P=0.0005) and 42 patients (28%) had GCS score G13 with mean time duration at admission was 344.35±239.09 min (P=0.0005) (Table 2).

Table 3 shows that the mean interval from injury to arrival to the emergency department was 238±181.26 min with P<0.0001. 37 patients (24.66%) had arrived within 0–100 min, 49 patients (32.66%) arrived within 101–200 min, 26 patients (17.33%) arrived in 201–300 min, 12 patients (8%) arrived in 301–400 min, 9 patients (6%) arrived in 401–500 min, 7 patients (4.66%) arrived in 501–600 min, 6 patients (4%) arrived within 601–700 min, 3 patients (2%), and 1 patient (0.66%) had arrived in 701–800 min and 801–900 min, respectively.

Table 1: Distribution of age (n=150)

S. No.	Age distribution (years)	Number of patients	Percentage	Mean
1	0–20	24	16	34.03±16.107
2	21–40	79	52.66	
3	41–60	39	26	
4	61–80	07	4.67	
5	>80	01	0.67	
Total		150	100	

Table 2: Distribution of GCS at time of admission (n=150)

S. No.	GCS score	Number of patients	Percentage	Mean	P-value
1	15	40	26.67	13.98±0.74	<0.0001
2	14	68	45.33		
3	13	42	28		
Total		150	100		

GCS: Glasgow coma scale

Table 3: Distribution of time duration between trauma and time of admission (n=150)

S. No.	Time duration (in min)	Frequency	Percentage	Mean	P-value
1	0–100	37	24.66	238.66±181.26	<0.0001
2	101–200	49	32.66		
3	201–300	26	17.33		
4	301–400	12	8		
5	401–500	09	6		
6	501–600	07	4.66		
7	601–700	06	4		
8	701–800	03	2		
9	801–900	01	0.66		
Total		150	100		

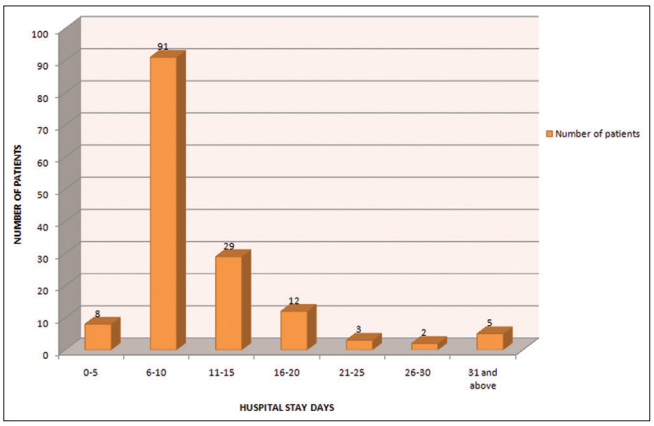

Figure 1: Distribution of hospital stay

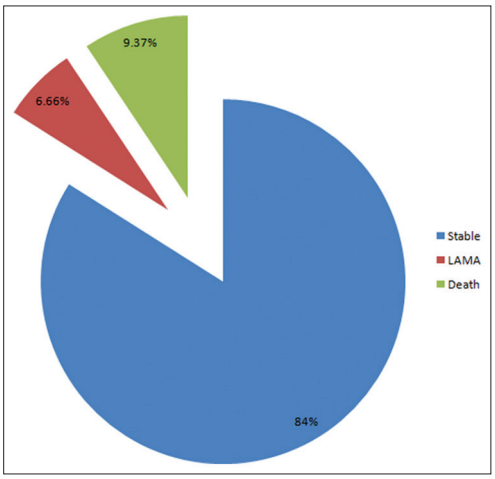

Figure 2: Condition at discharge

Among the patients admitted, maximum hospital stay was for 6–10 days observed in 95/150 (63.3%) of total patients (Figure 1). 84% of the total patients were stable at the time of discharge whereas death was final outcome in 9.37% of total cases. Remaining 6.66% of total patients underwent LAMA (Figure 2).

According to the Glasgow Outcome scale (GOS) score, 118 patients (84.90%) had shown favorable condition, 3 patients (2.15%) showed with poor condition with moderate disability, and 4 patients (2.88%) had poor GOS score with severe disability. Fourteen patients (10.07%) died with neurological deterioration and 11 patients were lost to follow-up. Neurological deterioration within 24 h of admission was most common in 47/150 (31.33%) of the total admission. Mean GOS score in 7 days was 4±0.844 and after 6-month follow-up, the mean GOS score was 4.89±0.50, with the significant P<0.0001 (Tables 4 and 5).

DISCUSSION

This study was done mainly to focus on DND occurring in patients presenting with MHI. The phenomenon of DND was first described in patients who would "talk and deteriorate." This patient population could articulate recognizable words after a head injury but subsequently deteriorated. With the introduction and promulgation of the GCS, the terms DND and acute neurological deterioration became more popular. The GCS score has been shown to have excellent prognostic value in assessing patients with TBI, and GCS scores of ≥13 indicate a mild primary brain injury from which patients typically recover fully. Neurological deterioration is rarely encountered but nevertheless carries serious implications for patient prognosis and recovery.

In the present study, most of the patients with MHI were fallen under 21–40 years age group 52.66% and the mean

age was 34.03±16.107 years. Almost similar results were found in a study done by Choudhry et al.,[6] in which the mean age distribution was 49±20 years.

According to this study, gender-wise distribution of patients with MHI was 20% females and 80% males, where n=150. This gender distribution is comparable to the gender distribution in study done by Choudhry et al.,[6] which also had 80% males and 20% females, respectively.

In our study, the GCS score was found to be score 15 in 26.67% patients, score 14 in 45.33% patients, and score 13 in 28% patients, respectively. On comparing with other studies, we found some comparable results in study done by Choudhry et al.[6]

Understanding the temporal course of this population is paramount to ensuring timely intervention and establishing a time period for heightened vigilance. In our study, we found that the mean of time duration between trauma and time of admission was 238.66±181.26 min with significant P (<0.0001). The main reason for delayed arrival was that patients are coming from very remote areas with minimal health-care facility and transport services. In rural areas due to lack of awareness and lack of ambulance facilities, patients are unable to reach higher centers on time. On comparing with other studies, we did not find any type of similar results as previous studies which were done in developed countries with better health and transport facilities.

According to our study, 28% patients with GCS score 13 had shown delayed in arrival to hospital in 344.35±239.09 min with significant P-value and most of the patients 45.37% arrived to hospital within 211.57±130.31 min, these patients are fallen under the category of GCS score 14. Thus, it seems that we need a more appropriate categorization of head injury patients scoring 13–15. Even patients with a GCS of 15 are at different risk of deterioration depending on whether they have a normal or an abnormal mental status. Our study shows that gathering patients with a GCS of 13–15 into a single group may be misleading because they have a significantly different incidence of skull fracture, signs of brain damage, DND, need for hospital admission, abnormal CT findings, surgical lesions, and mortality rate. These findings would lead us to recommend, along with other authors, to consider MHI only in those occurring in patients with a GCS of 15, especially if they show normal radiography or CT findings.

In our study, 31.33% of patients deteriorated within the first 24 h of admission and 1.33% of patients deteriorated after 24 h and within 36 h. In a study done by Choudhry et al.,[6] 211 patients who talked and deteriorated, 87% deteriorated within the first 24 h. Although the natural history of TBI is not entirely understood, studies have shown that contusions and ICH typically progress only within a 24-h time period from injury. Homnick et al.,[9] reviewed the temporal course of ICH progression in 304 MHI patients; 97% of patients had cessation of ICH progression within 24 h and 99% within 48 h (Table 6).

In a study done by Choudhry et al.,[6] the mean duration of hospital stay for all patients was 11±8.2 days while on comparing with our study, we found similar result on hospital stay 10.82±7.126 days. Most of the patients 60.67% got discharged within 6–10 days, respectively. The cause of the neurological deterioration was determined based on the patient's hospital course and radiographic studies before and after deterioration. According to GCS score, we found that GCS score G15 criteria the mean hospital stay period was 9.65±0.923 days. In GCS score, G14 mean hospital stay periods was 10.220±6.882 days and in G13 mean hospital stay period was 12.928±7.419 days, respectively.

In our study, we found that 16% patients had extradural hemorrhage, 12.67% patients had subdural hemorrhage, 8.66% patients shown with ICH, most of the 52 patients found to be in sub-arachnoid hemorrhage, and 4% and 24% lying under criteria of depressed fracture and contusion. Similar results were found in a study done by Boto et al.,[10]

Table 4: Neurological deterioration (n=150)

S. No.	Neurological deterioration	Yes	%	No	%
1	Deterioration within 24 h of admission	47	31.33	103	68.66
2	Deterioration after 24 h of admission	02	1.33	101	98.66

Table 5: Outcome according to GOS score (n=150)

S. No.	GOS score	N	Percentage	Mean in 7 days	Mean after 6 month follow up	P-value
1	5 (Favorable)	118	84.90	4±0.844	4.89±0.50	<0.0001
2	4 (Poor with moderate disability)	03	2.15			
3	2–3 (Poor with severe disability)	04	2.88			
4	1 (Death)	14	10.07			
Total		139	100			

GOS: Glasgow Outcome scale

Table 6: Temporal course of neurological deterioration in various studies

Study	Deterioration within 24 h (%)	Deterioration after 24 h (%)
Choudhry et al. (n=211)	87	10
Homnick et al. (n=304)	97	2
Present study (n=150)	31.33	1.33

Table 7: Distribution of CT findings of patients (n=150)

S. No.	CT findings	Number of patients	Percentage
1	Extradural hemorrhage	24	16
2	Subdural hemorrhage	19	12.67
3	Intracranial hemorrhage	13	8.66
4	Subarachnoid hemorrhage	52	34.66
5	Depressed fracture	06	4
6	Contusion	36	24
Total		150	100

CT: Computed tomography

and Choudhry et al.[6] (Table 7).

The overall mortality rate in our series of patients undergoing DND was 10.07%. Compared with survivors, patients who died declined faster after admission and experienced greater declines in GCS score. All deaths occurred specifically in the PIH group. This mortality rate is alarmingly high compared with what has been reported for patients overall with MHI and specifically for MHI+ICH patients. In a study done by Choudhry et al.,[6] we found almost similar results in all aspects, respectively.

The GOS was used to assess functional outcome as an extent of the patient's neurological functioning and need for assistance. In our study, a total of 150 patients (84.90% patients) had GOS score 5 with favorable condition at discharge. Under category of GOS score 4, 3, and 2, minimum number of patients was found with some medical complications. On comparing with a study done by Choudhry et al.,[6] we found almost similar results at a time of discharge.

In this study, we have demonstrated that DND of patients with MHI results in higher mortality and worse functional outcomes than in those who remain clinically stable. To improve outcomes in these patients, criteria must be established in which proper identification of patients at risk can be made. A few novel techniques have been used to predict DND, including measurement of serum S100-β measurement at admission and the use of transcranial Doppler to predict neurological deterioration in patients with MHI or moderate head injury. Additional measures to help identify of these patients can include the subclassification of MHI patients into low- and high-risk categories based on age (>60 years), coagulopathy, and radiographic evidence of ICH. Further prospective studies are needed to incorporate the use of these tools and variables into early identification and initiation of treatment of this subset of patients before the onset of deterioration.

Limitations of the study

The only limitation of this study was that it excludes the patients who has underwent neurosurgical intervention.

CONCLUSION

The study shows that patients with mild head injury have variable course and duration of hospital stay as it depends on various factors. And Delayed neurological deterioration after mild head injury is usually seen within 24 hours from time of trauma and rarely seen after 24 hours. Study shows significant association of older age, progressive intracranial bleed and delay in hospital arrival with delayed neurological deterioration and hence poor outcomes. Study also shows that patients with MHI + ICH results in higher mortality and worse functional outcomes. Hence to improve outcomes some criteria must be established for proper identification of at risk patients who may suffer from DND.

ACKNOWLEDGMENT

The authors would like to thank the department of surgery and emergency department with all the nursing and technical staff for their cooperation and coordination throughout the period of study.

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Authors Contribution:
SD- Concept and design of the study, prepared first draft of manuscript; **AS-** Interpreted the results; reviewed the literature and manuscript preparation; **KD-** Concept, coordination, preparation of manuscript, and revision of the manuscript; **PCS-** Preparation of manuscript, statistical analysis, and interpretation and revision of the manuscript, **RT-** Review manuscript; **VY-** Revision of manuscript; **SJ-** Revision of manuscript.

Work attributed to:
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Source of Support: Nil, **Conflicts of Interest:** None declared.