STUDY OF OUTCOME OF SEVERE HEAD INJURY USING GLASGOW COMA SCALE-PUPIL (GCS-P) SCORE- A HOSPITAL BASED CROSS-SECTIONAL STUDY

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ABSTRACT

INTRODUCTION

Traumatic brain injuries are typically characterized as disruptions in brain function or evidence of brain pathology resulting from external forces. Given the significant mortality associated with traumatic brain injury ,this study aimed to evaluate the applicability of the Glasgow Coma Scale-Pupil score in outcome of severe head injury patients.

MATERIAL AND METHODS

A prospective observational study was conducted at Neurosurgery Department at UCMS, Bhairahawa, Nepal from October, 2021 to March, 2023 (18 months). All the patients presenting in the emergency department with severe traumatic brain injury i.e., Glasgow Coma Scale score 3 to 8 were enrolled in the study after obtaining written consent from parents.

RESULTS

Out of 92 patients , 79 were males and 13 were females. The average age was 37.88 ± 16.06 years with most of the patients being from the age groups 31-40 years (25%). The results showed that about 83.8% mortality was found in both pupils non-reactive followed by 66.7% mortality in groups with one pupil unreactive and 61.8% mortality in both reactive pupils.The results showed an overall mortality of 71.7%. Among 28.3% of surviving patients, 57.69% patients had unfavorable outcomes and 42.31% patients had favorable outcomes. The receiver operating characteristic curve showed that the Glasgow Coma Scale-Pupil score is better than the Glasgow Coma Scale in predicting unfavorable outcomes of patients with an area under the curve of 0.807 to 0.689.

CONCLUSION

The decline in the Glasgow Coma Scale-pupil score was associated with increased mortality and the additional two points in the Glasgow Coma Scale-pupil score gives more idea about the prognosis. Glasgow Coma Scale- pupil score is comparable to Glasgow Coma Scale for predicting mortality but better for predicting unfavorable outcomes in severe head injury patients.

KEYWORDS

Glasgow coma scale, Glasgow coma scale-pupil score, Glasgow outcome score, Pupil reactivity score, Severe head injury

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INTRODUCTION

Traumatic brain injuries (TBI) are typically characterized as disruptions in brain function or evidence of brain pathology resulting from external forces.[1] TBI stands as a significant cause of both mortality and morbidity, impacting not only industrialized nations but also developing countries including Nepal. In developing nations, TBI contributes significantly to socioeconomic costs. Despite its substantial impact, traumatic injuries often receive inadequate attention and have been labeled as "the neglected disease of modern society".[2]

Given the significant mortality associated with traumatic brain injury (TBI) and the substantial costs involved in both inpatient and long-term treatments, accurate outcome prediction has become a major concern. Therefore, the development of scoring systems is of utmost importance in establishing precise diagnoses, prognosticating patient outcomes, and making informed management decisions. These scoring systems play a vital role in guiding healthcare professionals in effectively assessing and managing TBI patients.

The Glasgow Coma Scale (GCS) is widely used to assess the level of consciousness in both acute medical and head injury patients. It provides clinicians with an objective measure to quantify the extent of consciousness impairment, predict outcomes, and guide treatment decisions.

In addition to the GCS, several methods have been described to enhance its spectrum or add supplementary information. These include the addition of memory (GCS-Memory),[3] Glasgow-Liege Score,[4] Innsbruck Coma Scale,[5] FOUR score[6] and the Glasgow Coma Scale Pupils Reactivity Score (GCS-P).

The combination of pupil reactivity and the GCS score has proven to be highly clinically relevant for predicting the survival of patients with TBI. To simplify the utilization of prognostic information in TBI, Brennan et al[7] in 2018 introduced an arithmetic combination called the GCS-P score, which incorporates both the GCS score and pupillary response. The GCS-P score demonstrated its ability to provide valuable prognostic information regarding patient outcomes when compared to more complex methods.

While the initial results of GCS-P are promising, further validation studies across diverse patient populations are necessary to establish its broader applicability and reliability. Our study aimed to evaluate the applicability of the GCS-P score in severe head injury patients presenting to UCMS-TH.

MATERIAL AND METHODS

The current study was a hospital based prospective observational longitudinal study conducted for Severe head injury patients in UCMS Hospital, Bhairahawa, approved by Institutional Review Committee UCMS-TH. (UCMS/IRC/202/19) prior to the study. All patients who agreed to participate in study gave a written consent. All patients with severe head injury i.e., GCS 3 to 8 were included in study. Patients with significant other system injuries which could affect the GCS, patient not willing to participate in the study, patients with preexisting pupillary abnormalities were excluded. All the data collected from patients presenting in the emergency department with severe traumatic brain injury i.e., GCS score 3 to 8 , pupil reactivity, and GCS-P scores were calculated and filled in preformed proforma. A detailed history of the incident including mode of injury and time of arrival after the incident was noted according to the patient's relative or with the help of local police.

After the primary management, a non-contrast CT scan of the head was done in all cases. X-rays of the cervical spine, chest, and pelvis and an e-FAST scan were done in all cases. The patients meeting the inclusion criteria were included in the study. The patients meeting the criteria for operative management were immediately shifted to the operation theatre and a craniotomy was performed with the evacuation of the hematoma. If the patients had edematous or swollen brains after the hematoma evacuation, craniectomy with a lax duroplasty using the temporalis fascia was done. The patients were then shifted to ICU and hourly monitoring was done. The patients were transferred to the ward and discharged when the discharging criteria were met. Complications during the hospital stay were managed accordingly.

Patients not meeting the criteria for the operation were managed conservatively in an ICU setting. Prophylactic anti-seizure medications were given to all the patients.
During discharge, GCS score and GOS were noted. The length of hospital stay was noted. All the patients were followed up for three months and GOS at three months was noted. GOS of 1,2 and 3 were categorized as unfavorable outcome whereas GOS of 4 and 5 were categorized as favorable outcome.

Data were entered and analyzed into SPSS Vs.20. Descriptive as well as inferential statistics were used to analyze the data. In descriptive statistics, frequency, percentage, mean, and standard deviation were used to analyze the data. In inferential statistics, the Chi-Square test was used to find the association between outcome and independent variables. Independent Sample t-test was used to find the mean difference in different parameters. ROC curve was used to predict the mortality and unfavorable outcome using GCS and GCS P scores. *P*-value less than 0.05 was considered as statistically significant.

RESULTS

The results showed that more than fourth-fifth of the patients were male (85.9%).

Average ages of the patients were 37.88 ± 16.06 years. The results showed that majority of the patients were from the age groups 31-40 years (25%) and least patients were from age group 51-60 years (7.6%). Majority of the mode of the injury was RTA (73.9%) followed by fall from height (18.5%) and physical assault (7.6%).

Most common CT scan findings was mixed (40.2%) followed by contusion (19.6%), SDH (18.5%), EDH (8.7%), SAH (5.4%), normal (4.3%) and ICH (3.3%). Both types of management, conservative and surgical were done in equal proportion.

Overall, mortality was 71.7% in severe head injury patients . Among 28.3% survived patients, 57.69% cases had unfavorable outcome and 42.31% cases had favorable outcome.

Table 1. Outcome of patients according to pupil reactivity score

Outcome	Pupil Reactivity Score		
	0	1	2
Mortality	21 (61.8)	14 (66.7)	31 (83.8)
Survived	13 (38.2)	7 (33.3)	6 (16.2)
Total	34	21	37

The results showed that about 83.8% mortality was found in both pupil non-reactive followed by one pupil unreactive (66.7%) and both reactive pupil (61.8%) (Table 1).

Table 2. Association between mortality and pupil reactivity

Outcome	Pupil reactivity		*p* value
	Bilateral reactive pupils	Unilateral or bilateral unreactive pupils	
Mortality	21 (31.8)	45 (68.2)	0.0054

There was significant association between outcome and pupil reactivity (p=0.0054). The results showed that about 68.2% mortality was found in patients with unilateral or bilateral unreactive pupil (Table 2).

The mean difference in ages between mortality and survived outcome of patients was calculated by using Independent Sample t test.

The results showed that the mean age of the patients was found to be statistically significant between different outcome (p=0.011). The results showed that patients of mortality cases were found of high age than survived case.

Similarly, there was significant mean difference in length of hospital stay between different outcome of patients (p<0.001). The results showed that the average length of hospital stay for survived patients was found larger than mortality cases.

Table 3. Association between GCS and outcome of patients

GCS	Outcome		Total	*p* value
	Mortality	Survived		
3.00	14 (93.3)	1 (6.7)	15	
4.00	1 (100)	0 (0)	1	
5.00	5 (100)	0 (0)	5	0.01
6.00	18 (81.8)	4 (18.2)	22	
7.00	14 (63.6)	8 (36.4)	22	
8.00	14 (51.9)	13 (48.1)	27	

The results showed that there was significant association between GCS score and outcome of patients (p=0.01). The results showed that patients having low GCS score had higher cases of mortality (Table 3).

Table 4. Association between GCS-P and outcome of patients

GCS-P	Outcome		Total	*p* value
	Mortality	Survived		
1.00	12 (92.3)	1 (7.7)	13	
2.00	29 (100)	0 (0)	2	
3.00	4 (100)	0 (0)	4	
4.00	8 (88.9)	1 (11.1)	9	0.017
5.00	11 (68.8)	5 (31.3)	16	
6.00	15 (78.9)	4 (21.1)	19	
7.00	4 (40)	6 (60)	10	
8.00	10 (52.6)	9 (47.4)	19	

The association between outcome and GCS-P score was found to be statistically significant (p=0.017). The results showed that patients with GCS-P score from 1 to 4 had higher chance of mortality and patients with GCS-P 5 to 8 had less chance of mortality (Table 4).

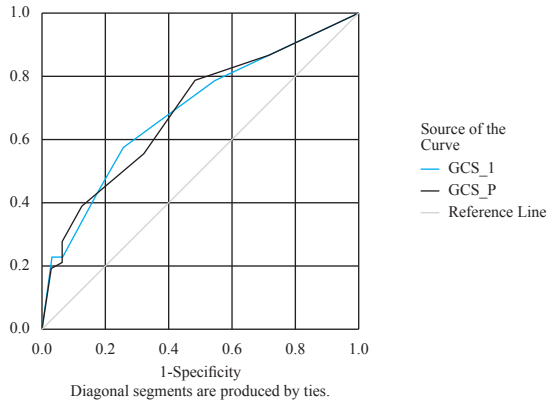

Figure 1. ROC Curve for predicting unfavorable outcome

Interpretation: The ROC curve showed that GCS-P is better than in predicting unfavorable outcome of patients with AUC=0.807 (Figure 1).

DISCUSSION

In our study, 85.9% of patients were males and 14.1% of patients were females. These findings were similar to previous studies with male and female ratio of 81:19 and 77:23 in two large head-injury databases: CRASH (Corticosteroid Randomization After Significant Head Injury) and IMPACT (International Mission for Prognosis and Clinical Trials in TBI) respectively.[7]

In our study, the average age of the patient was 37.88 ± 16.06 years. The results showed that majority of the patients were from the age groups 31-40 years (25%) and least patients were from age group 51-60 years (7.6%). These findings were similar to previous studies with mean age of 37.1 (17.0) and 33.9 (16.3) in CRASH and IMPACT database respectively.[7]

The mean time of presentation since injury in our study was 6.09 hours and the mean hospital stay was 9.83 days. The results showed that majority of the mode of the injury was RTA (73.9%) followed by fall from height (18.5%) and physical assault (7.6%).Most of the patients (40.2%) in our study had mixed CT scan findings with more than one type of injury. The frequency of isolated brain injury was contusion (19.6%) SDH (18.5%), EDH (8.7%), SAH (5.4%), Normal (4.3%) and ICH (3.3%).

In our study, 48.9% of patients underwent surgery and 51.1% of patients were managed conservatively. Overall mortality of severe head injury patients in our study was 71.7% at three months. Out of 28.3% of patients who survived, 57.69% patients had unfavorable outcomes at three months and 42.31% patients had favorable outcomes at three months. There is a high rate of mortality in our study which might be due to the delayed presentation of the patients and delayed referral from another center.

In our study, patients with bilateral unreactive pupils had 83.8% mortality, patients with unilateral pupil had 66.7% mortality and those with bilateral reactive pupil had 61.8% mortality. There was significant association between outcome and pupil reactivity (p=0.0054). The results showed that about 68.2% mortality was found in patients with either one or both unreactive pupils.

In a study conducted by from pooled data from CRASH and IMPACT database in 2018 loss of pupil reactivity was associated with an increase in mortality rate from 16.3% when both pupils reacted, to 38.3% when only 1 reacted, and to 58.7% when neither pupil reacted which is similar to the pattern seen in our study.[7]

The mean difference in ages between mortality and survived outcome of patients was calculated by using Independent Sample t test. The results showed that the mean age of the patients was found to be statistically significant between different outcome (p=0.011). The results showed that patients of mortality cases were found of higher age than survived case.

In another study conducted in 5600 severe head injury patients in 2003, poor patient outcome increased with age (the mortality rate increased from 21% at an age less than 35 years to 72% at an age more than 65 years).[8] Similar pattern is seen in our study.

In our study, the association between outcome and GCS score was found to be statistically significant (p=0.01). The results showed that patients with low GCS score had higher mortality. In the pooled data the mortality rate of patients was 51% at GCS score 3 and 54% at GCS score 4; after that the mortality rate declined progressively to 3% at GCS score 15.

The association between outcome and GCS-P score was also found to be statistically significant (p=0.017). The mortality rate of patients with GCS-P score 1 to 8 were 92.3, 100, 100, 88.9, 68.8, 78.9, 40 and 52.6% respectively. There was increase in mortality with decreasing GCS-P score. In a study done in 2023 in 1551 patients with severe head injury to compare the ability of the Glasgow Coma Scale (GCS) score, the GCS Pupils (GCS-P) score, and the Pupil Reactivity Score (PRS) to predict mortality. The GCS-P score was significantly better at predicting mortality, with an AUC of 0.77 (95% CI, 0.74-0.79), vs 0.69 (95% CI, 0.67-0.72) for the GCS, and 0.75 (95% CI, 0.72-0.77) for the PRS. As the GCS-P score decreased, mortality increased.[9]

In our study, ROC curve showing the predictor of mortality from GCS and GCS-P was plotted which showed that GCS-P is comparable to GCS in predicting mortality case of patients with AUC=0.689. In other several articles, GCS-P is either better than or comparable to GCS in predicting the mortality in traumatic brain injury patients. However, the ROC curve showing the predictor of unfavorable outcome including mortality from GCS and GCS-P showed GCS-P is better than GCS in predicting unfavorable outcome with AUC=0.807.[10-12]

CONCLUSION

In this study ,we conclude that the decline in the Glasgow Coma Scale-pupil score was associated with increased mortality and the additional two points in the Glasgow Coma Scale-pupil score gives more idea about the prognosis. Glasgow Coma Scale- pupil score is comparable to Glasgow Coma Scale for predicting mortality but better for predicting unfavorable outcomes in severe head injury patients. The comparison of association between outcome and GCS score with outcome and GCS-Pscore found to be p=0.01 to p=0.017. The association between outcome and GCS-P score was found to be statistically significant (p=0.017).

CONFLICT OF INTEREST

None

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