

ORIGINAL RESEARCH

Comparison Of GCS (Glasgow Coma Scale) Score And Four (Full Outline Of Unresponsiveness) Score In Traumatic Head Injury Patients

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Received: 12-02-2023

Accepted: 26-03-2023

ABSTRACT

Introduction and aim - Adequate initial assessment and early intervention are of paramount importance in treating patients with Traumatic brain injury. Assessing the level of consciousness is a complex and difficult affair, mostly due to the difficulty in finding appropriate terminologies. Present study aimed to evaluate the correlation between FOUR score and GCS in evaluating the level of consciousness, initial status and determining the outcome among patients with head injuries.

Material and method- This comparative study was conducted at the Department of General Surgery, Rajindra Hospital, Patiala, including 70 patients presenting to the emergency surgery ward from March 2021 to December 2022. A structured proforma was used to enter the detailed history, mode, and mechanism of trauma, vitals, and to chart the GCS SCORE and FOUR SCORE at presentation, one hour, six hours, and 24hours after obtaining consent at the time of admission.

Observation and method Pulse rate was the most important and sensitive vital followed by oxygen saturation with a p-value of 0.002 and P-value of 0.036 respectively, in determining the outcome of TBI. Most TBIs can be managed conservatively and do not need operative intervention. As in our study, 92.9% n=65 was managed conservatively and only 7.1% n=5 patients required any sort of operative procedure related to TBI.

Conclusion Both scoring systems have good and comparable prediction values to each other, but the FOUR score performed better at presentation. FOUR score also has added benefit of assessing brainstem reflexes and respiration and does not have a dependence on verbal response.

Keywords: Traumatic, Glasgow, Trauma

Introduction

Traumatic brain injury (TBI) is the major contributor to trauma-related mortality and morbidity all over the world. In India alone, nearly 1 million people get injured, nearly 200,000 people lose their lives and another 1 million require rehabilitation every year due to traumatic brain injury.^[1] Adequate initial assessment and early intervention are of paramount importance in treating patients with TBI. Assessing the level of consciousness is a complex and difficult affair, mostly due to the difficulty in finding appropriate terminologies that are objective and user-independent. Several scales have evolved over the decades to answer this question.^[2] Glasgow Coma Scale considers three parameters: best eye response (E), best verbal response (V), and best motor response (M). The levels of response in the components of the Glasgow Coma Scale are 'scored' from 1, that is no response, up to normal values of 4 (Eye-opening response) 5 (Verbal response), and 6 (Motor response). The total score thus has values between 3 and 15, 3 being the worst and 15 being the highest. The score is the sum of the scores as well as the individual elements. For example, a score of 10 might be expressed as GCS10 = E3V4M3. The relationship between the GCS Score and outcome is the basis for a common classification of acute traumatic brain injury into Severe for GCS of 3 to 8, Moderate

for GCS of 9 to 12, and Mild for GCS of 13 to 15.^[3] GCS score is not reliable if the patient is sedated or paralyzed or under the effect of any drugs. Effects of any other associated injuries or lesions on GCS like orbital or cranial fracture, spinal cord damage, or hypoxic-ischemic encephalopathy after cold exposure, cannot be determined separately.^[4] FOUR score (Full Outline of Unresponsiveness score) considers four parameters : eye response, motor response , brainstem reflexes and respiration. The FOUR score, unlike the GCS, does not include a verbal response. The GCS, which uses a verbal score as one of the three components, was less useful in patients who were intubated. The FOUR score remains testable in neurologically critically ill patients who are intubated. Intubation is a common procedure in the field, emergency department, and ICU that invalidates one of the three components of the GCS. And thus, the FOUR score is more valuable in ICU practices.^[5] The FOUR score tests essential brainstem reflexes and provides information about stages of brainstem injury that is unavailable with the GCS. The FOUR score recognizes a locked-in syndrome and a possible vegetative state. The FOUR score includes signs suggesting uncal herniation.^[5]

The present study was conducted to evaluate the correlation between FOUR score and GCS in evaluating the level of consciousness, initial status and determining the outcome among patients with head injuries

MATERIALS AND METHODS

This was a prospective and comparative study conducted at the Department of General Surgery, Rajindra Hospital, Patiala, including 70 patients presenting to the emergency surgery ward from March 2021 to December 2022. A structured proforma was used to enter the detailed history, mode, and mechanism of trauma, vitals, and to chart the GCS SCORE and FOUR SCORE at presentation, one hour, six hours, and 24 hours after obtaining consent at the time of admission. Patients were managed according to ATLS protocol. Patients were followed up for 30 days post-admission. Present study Included age 5 years or above, All presenting to ESW with a head injury, Patients/guardians who have consented to participate in the study. Patients who had not given consent to participate, malignancy and fatal preexisting condition, Cervical spinal cord injury, Musculoskeletal paralysis, deafness and blindness, history of eye surgery resulting in a change in pupil size and shape were excluded from the study.

STATISTICAL ANALYSIS

Data was described in terms of range; mean \pm standard deviation (\pm SD), median, frequencies (number of cases), and relative frequencies (percentages) as appropriate. To determine whether the data were normally distributed, a Kolmogorov-Smirnov test was used. A comparison of quantitative variables between the study groups was done using the Mann-Whitney *U* test for non-parametric data. For comparing categorical data, the Chi-square (χ^2) test was performed and an exact test was used when the expected frequency is less than 5. The receiver operator characteristics (ROC) curve was done, and the criterion value was estimated depending on the specificity and sensitivity. The area under the curve (AUC) was measured. A probability value (*p-value*) less than 0.05 was considered statistically significant.

OBSERVATIONS

The present study was conducted in the Department of Surgery, Rajindra Hospital, Patiala, amongst 70 cases of traumatic head injury, during March 2021 to December 2022. The following results were observed.

	Alive		Death		Z	p-value
	Mean	SD	Mean	SD		
E AT PRESENTATION	3.34	1.01	1.25	1.39	-3.791	0.001
M AT PRESENTATION	3.63	0.68	1.75	1.16	-4.627	0.001
B AT PRESENTATION	3.98	0.13	3.00	1.20	-5.023	0.001
R AT PRESENTATION	3.92	0.42	2.75	1.58	-4.061	0.001
FOUR SCORE AT PRESENTATION	14.87	1.53	8.75	3.99	-4.325	0.001
E 1HR	3.27	1.06	0.63	1.19	-4.380	0.001
M 1HR	3.56	0.72	1.38	1.19	-4.632	0.001
B 1HR	3.95	0.22	2.88	1.55	-4.080	0.001
R 1HR	3.92	0.42	2.63	1.51	-4.847	0.001
FOUR SCORE 1HR	14.71	1.68	7.50	4.50	-4.484	0.001
E 6HR	3.34	0.99	0.50	0.93	-4.685	0.001
M 6HR	3.58	0.69	0.75	1.04	-5.029	0.001
B 6HR	3.97	0.18	2.25	1.91	-4.563	0.001
R 6HR	3.90	0.43	1.88	1.89	-4.682	0.001
FOUR SCORE 6HR	14.79	1.67	5.38	5.24	-4.689	0.001
24HR E	3.34	0.99	0.50	0.93	-4.685	0.001
24HR M	3.58	0.69	0.75	1.04	-5.029	0.001
24HR B	3.97	0.18	2.13	2.03	-4.563	0.001
24HR R	3.90	0.43	1.88	1.89	-4.682	0.001
FOUR SCORE 24HR	14.79	1.67	5.25	5.37	-4.690	0.001

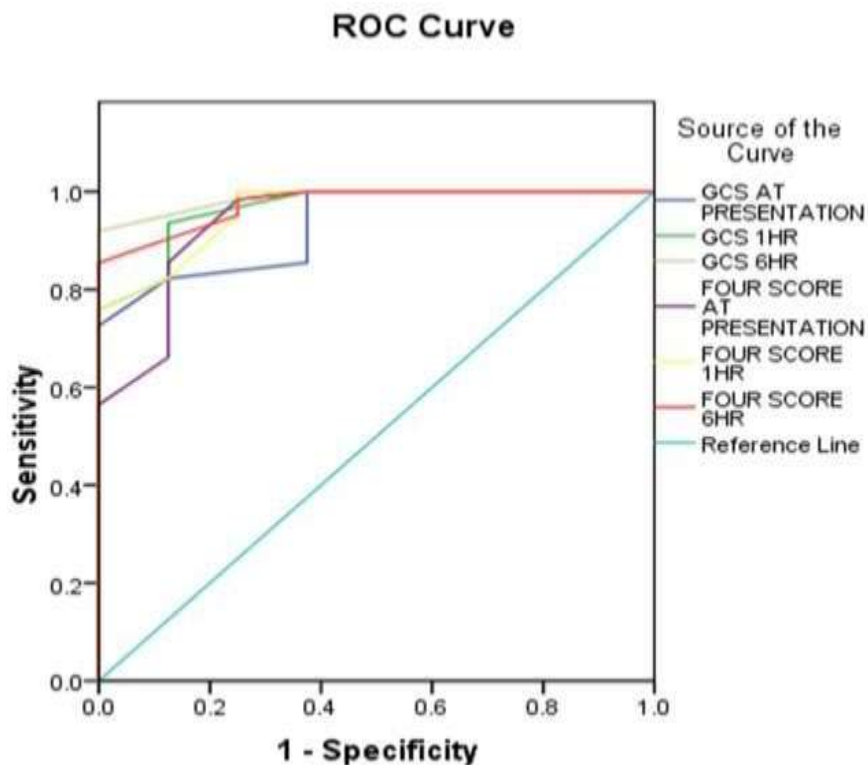
Table no. 1: Significance of each component of FOUR score in predicting outcome at presentation, 1 hour, 6 hours, and 24 hours.

As per table no.1, All the components of the FOUR score (E, M, B, and R) are equally statistically significant (p value= 0.001)

	Alive		Death		Z	p-value
	Mean	SD	Mean	SD		
E AT PRESENTATION	3.61	0.71	1.88	1.13	-4.057	0.001
V AT PRESENTATION	4.47	0.87	2.25	1.28	-4.331	0.001
M AT PRESENTATION	5.61	0.78	3.50	1.31	-4.745	0.001
GCS AT PRESENTATION	13.55	2.01	7.63	3.25	-4.205	0.001
E 1HR	3.58	0.71	1.63	0.92	-4.603	0.001
V 1HR	4.40	0.91	1.88	1.13	-4.495	0.001
M 1HR	5.56	0.84	3.13	1.46	-4.780	0.001
GCS 1HR	13.40	2.13	6.63	2.88	-4.539	0.001
E 6HR	3.60	0.69	1.50	0.76	-4.826	0.001
V 6HR	4.38	0.94	1.75	0.89	-4.651	0.001
M 6HR	5.55	0.88	2.25	1.39	-5.139	0.001
GCS 6HR	13.39	2.23	5.50	2.51	-4.754	0.001
E 24HR	3.66	0.60	1.38	0.74	-5.104	0.001
V 24HR	4.45	1.08	1.50	0.76	-4.807	0.001
M 24HR	5.65	0.75	1.75	1.04	-5.503	0.001
GCS 24HR	13.74	1.99	4.63	2.39	-4.990	0.001

Table no.2: Significance of each component of GCS score in predicting outcome at presentation, 1 hour, 6 hours, and 24 hours.

As per table no. 2, All the components of the GCS (E, V, and M) are equally statistically significant (p-value = 0.001).



Graph 1 :ROC curve for GCS and Four score

Area Under the Curve					
Test Result Variable(s)	Area	Std. Error	p-value	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
GCS AT PRESENTATION	0.931	0.038	0.001	0.851	1.000
GCS 1 HR	0.966	0.027	0.001	0.000	1.000
GCS 6 HR	0.988	0.011	0.001	0.000	1.000
GCS 24 HR	0.995	0.006	0.001	0.000	1.000

Table 3 – Areas under the Curves for the GCS SCORE.

Area Under the Curve					
Test Result Variable(s)	Area	Std. Error	p-value	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
FOUR SCORE AT THE PRESENTATION	0.941	0.047	0.001	0.000	1.000
FOUR SCORE 1HR	0.960	0.029	0.001	0.000	1.000
FOUR SCORE 6HR	0.975	0.019	0.001	0.000	1.000
FOUR SCORE 24HR	0.975	0.019	0.001	0.000	1.000

Table 4 – Areas under the Curves for the FOUR SCORE.

The receiver operating characteristic (ROC) curves demonstrate the sensitivity vs. specificity of each component of the GCS, and THE FOUR SCORE at presentation, 1 hr, 6 hr, and 24 hr in the

assessment of traumatic head injury patients and their outcome. Statistical analysis revealed all AUCs to be statistically significant. Hence, all components of both scoring systems are helpful in the assessment of traumatic head injury patients and their outcomes. However, as per table no. 23 and 24, the P-value (0.001) of GCS test variables suggests that all components were significant. ROC AUC of the M component of GCS is 0.929 at presentation, 0.967 at 6 hr, and 0.994 at 24 hr suggesting the better performance of M then E and V Whereas, in comparison, the ROC AUC (0.925) of the motor component (P value=.0001) of the FOUR score is better than the other components at presentation. Similarly, at 1 hr and 6 hr, both E (AUC at 1 hr=0.932, AUC at 6 hr=0.958 and AUC at 24 hr=0.958) and M (AUC at 1hr =0.941, AUC at 6 hr=0.979 and AUC at 24 hr=0.979) performed better (P value =0.0001).

Discussion

The present study was conducted in the Department of Surgery, Rajindra Hospital, Patiala, amongst 70 cases of traumatic head injury, admitted to the emergency surgery ward to compare the GCS and the FOUR score in the assessment of traumatic head injury patients and their outcome. In our study, Pearson correlation showed a correlation coefficient of 0.877 between GCS and FOUR score, with a P value of .001, which is statistically very significant. This indicates a positive (When one variable changes, the other variable changes in the same direction) and good (significant relationship between two variables) correlation between the two scores and was comparable to previous studies. In a study by Javvaji et al,^[6] the correlation between GCS and FOUR scores in predicting mortality showed an excellent correlation with a coefficient of 0.88 ($p < 0.001$), Saika et al^[7] showed a correlation coefficient of 0.758 between GCS and FOUR score with a p-value of < 0.001 . This indicates a good to very good correlation between the two scores. Kishor et al^[8] reported the coefficient as 0.91 and Iyer et al^[5] reported it as 0.98. In our study, the mean GCS and FOUR score were 12.9 ± 2.9 and 14.2 ± 2.7 respectively. Whereas in non-survivors, the mean GCS score was 6.58 and the mean FOUR score was 7.21 and in survivors, the mean GCS score was 13.45 and the mean FOUR score 14.79. In both the score mean was lower for non-survivors than survivors. In comparison, Saika et al^[7] showed that the mean GCS and FOUR scores for the entire patient cohort were 9.5 (SD 2.4) and 11 (SD 3), respectively. The mean FOUR scores were 12 and 4.9 in survivors and non-survivors, respectively. The mean GCS scores were 10 and 4.7 in survivors and non-survivors respectively. In our study P value (0.001) of GCS, test variables suggest that all components were significant. ROC AUC of the M component of GCS is 0.929 at presentation, 0.967 at 6 hr, and 0.994 at 24 hr, suggesting the better performance of M than E and V. Whereas, in comparison, ROC AUC (0.925) of motor component (P value=.0001) of FOUR score is better than other components at presentation. Similarly, at 1 hr, 6 hr, and 24hr both E (AUC at 1hr =0.932, AUC at 6 hr=0.958, AUC at 24 hr=0.958) and M (AUC at 1hr =0.941, AUC at 6 hr=0.979, AUC at 24 hr=0.979) performed better (P value =0.0001). As per Reith et al ^[9] the variation in prognostic performance between components may be a result of floor and ceiling effects of the components as observed in the GCS, with each component contributing differentially across the spectrum of consciousness. Our study was comparable to the study by Foo et al^[10] which showed that individual components of FOUR score which were supposed to address the shortcomings of GCS, namely brainstem and respiratory pattern, showed significantly poorer performance than the eye and motor components of the FOUR score.

Conclusion

The present study involved a comparison between GCS and FOUR score in TBI patients for the prediction of outcome. The study proves that there is a good correlation between GCS and FOUR score. Both scoring systems have good and comparable prediction values to each other, but the FOUR score performed better at presentation. FOUR score also has added benefit of assessing brainstem reflexes and respiration and does not have a dependence on verbal response.

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