

To Study The Correlation Between Gcs Score And Four Score In Evaluating The Patients With Head Injury

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ABSTRACT

Background: GCS score by far is the most widely used score to assess the severity of Traumatic Brain Injury (TBI) in clinical research and to compare series of patients. It seems necessary for one to keep in mind the shortcomings of this score. This issue was addressed with the introduction of various scores such as Full Outline UnResponsiveness (FOUR) score. The aim of our study was to compare GCS and FOUR scores and to find out their correlation for assessment of head injury (HI) patients.

Method: In this prospective study, we enrolled 72 patients diagnosed with head injury admitted in general surgery department. All patients were assessed with a detailed history and clinical examination including GCS and FOUR score. The patients were assessed to chart out their GCS and FOUR scores at the time of admission, at 1 hour and 6 hours after admission and on a daily basis for 7 days.

Results: In present study, the head injury was most common in young age group. The maximum numbers of patients were between 21 to 30 years of age. In our study, the discriminating ability to predict mortality was fairly good with both scores. Area under the ROC curve for GCS score was 0.947 (95% CI: 0.867 to 0.986) and for FOUR score was 0.96 (95% CI: 0.885 to 0.992) with $p < 0.0001$. This showed that both GCS score and FOUR score can equally predict the mortality in head injury patients.

Conclusion: FOUR score should be taken into consideration as a potential prognostic marker since it provides more neurological information than the GCS and is a valid indicator of predicting mortality in patients with TBI.

Keywords: Full Outline UnResponsiveness (FOUR), Glasgow Coma Scale (GCS), Head Injury (HI), Traumatic Brain Injury (TBI).

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I. Introduction

The incidence of head injury is rising presently and it becomes more significant in developing countries like India, where such injuries are progressively increasing due to rapid motorization, alcohol abuse and the general indifference by the public towards safety measures. The public health burden by Head injury is huge, as most of these patients belong to the young and productive age group.¹ An adequate initial assessment and early interventions are of paramount importance in treating patients with HI, so as to decrease mortality and also to lessen the long-term disabilities. In TBI, initial level of consciousness is most important prognostic indicator. However, assessing a patient's level of consciousness is a complex affair, mostly because of difficulty in finding an appropriate terminology that is truly objective and user-independent. Thus one has to rely on clinical scores for the assessment of level of consciousness in head injury patients. Several scales have evolved over the decades to answer this need. One of the earliest systems developed is Glasgow coma scale (GCS), first described by Teasdale and Jennett in 1974.² The GCS was designed mainly to improve the communication

between physicians and nurses when describing the state of consciousness and to avoid ambiguous terminologies such as “somnia” and “unresponsiveness”. The GCS was initially developed as an unnumbered system. The assigning of numbers to the responses (using “1” for the lowest score rather than “0”) was introduced later that also expanded the motor responses, adding abnormal flexion. Although users of the GCS began creating sum scores for the 3 components (giving a total range between 3 to 15 points), this method was never the primary intention of the originators of the scale. Specific GCS sum scores such as 3, 8, and 15 have acquired immediate familiarity; so much so that use of the sum scores even led to the commonly used directive, “Glasgow 8, intubate.”³

Wijdicks and his associates published a new coma scale in 2005, the FOUR score. The assessment of the following four components, each on a scale with a maximum score of four: eye response, motor response, brainstem reflexes and respiration are involved. Three brainstem reflexes which test the functions of mesencephalon, pons, and medulla oblongata are used in different combinations. The cough reflex mostly remains absent when both corneal and pupillary reflexes are absent. Cheyne - Stokes respiration and irregular breathing can represent bi-hemispheric or lower brainstem dysfunction of respiratory control.⁴ FOUR score has four testable components (eye response, motor response, brainstem response, and respiration) in contrast with the GCS. The number of components and the maximal grade in each of the categories is four (E4, M4, B4, R4), which is easier to remember than the GCS with its varying number of scores and is reinforced by the acronym. It not only includes the determination of eye opening, but also evaluates blinking and tracking of eyes. Also, FOUR score has the ability to evaluate intubated patients.⁵

II. METHODS

The present study was conducted in the Department of Surgery, at a referral institute Of north India on 72 patients who were admitted within 24 hours of injury with a radiologically documented traumatic brain injury.

Inclusion criteria: the patients aged 14 - 80 years, who were admitted within 24 hours of injury with a radiologically documented traumatic brain injury.

Exclusion criteria:

- GCS 15/15
- Paediatric age group (less than 14 years).
- Patients left against medical advice to some other hospital within 7 days of hospital admission.
- Patients receiving antipsychotic or anti-anxiety drugs.
- Patients with previous history of neurological disorders.

The informed consent was taken from the attendant of all patients who were enrolled in the study. All patients were assessed with a detailed history and clinical examination including GCS and FOUR score as per table 2 and 3. Conventional treatment as per advice of neurosurgeon was given to all patients after doing the initial NCCT head including general nursing care, oxygen therapy, intravenous fluids, prophylactic antibiotic (by intravenous route), anticonvulsants and cerebral decongestants. The GCS score and FOUR score were record at 1 hour and 6 hours after admission and daily for 7 days. Regular follow-up was done to continue the neurological monitoring. Daily assessment of temperature, pulse rate, blood pressure, respiratory rate, input and output, biochemical parameters were also done. Trends of the GCS score and FOUR score were calculated for each patient. Comparison was done between GCS score and FOUR score for-

1. Neurological assessment of patients
2. To find out correlation between both scores

The final recommendation of the neurosurgeon was followed, and patients were discharged with the best result in accordance with the severity of injury at the time of admission after improvement in the patient's overall status and neurological status.

All statistical analyses were performed using SPSS ver. 17.0 (SPSS Inc., USA). The level of statistical significance was set at $p < 0.05$. Data was statistically analyzed by applying Pearson correlation coefficient to check the correlation between GCS and FOUR scores.

III. RESULTS

The demographic profile of all the patients was studied and it was revealed that mean age was 36.9 years. The maximum number of patients (23) belonged to age group 21-30 years (31.94%) followed by 18 patients belonging to 31-40 years (25.00%). 65 patients (90.28%) were males and seven patients (9.72%) were females showing the male preponderance to traumatic brain injury. The mode of head injury was road side accident in maximum number of patients i.e., 52 (72.22%). The second highest numbers of patients were with mode of injury of fall from height i.e., 14 patients (19.44%). Physical assault was mode of injury in five patients

(6.94%) and only one patient (1.39%) out of 72 patients was with mode of injury of railway tract injury. In majority i.e.45 patients (62.50%) ENT/oral bleed was present. Mean value of GCS score of study subjects was 10.08 ± 3.33 with median (25th-75th percentile) of 12 (9-13) i.e. with the moderate severity of Glasgow coma scale with range of 3-14. Mean value of the FOUR score of study subjects was 11.21 ± 3.75 with median (25th-75th percentile) of 12(10-14) with range of 2-16. 15% patients have chest trauma and only four percent of the patients have blunt trauma abdomen. Patients had one or more findings on NCCT Head scan. The most common finding of NCCT head in study patients was Haemorrhagic contusions i.e.36 patients (50.00%) out of 72, followed by 28 patients (38.89%) were diagnosed with Subdural Haemorrhage.

Table 1

NCCT head findings	Number of patients	Percentage
No Abnormality Detected	2	2.78%
Haemorrhagic Contusions	36	50.00%
Subdural Haemorrhage	28	38.89%
Tension Pneumocephalus	17	23.61%
Bleed	1	1.39%
Subarachnoid Haemorrhage	27	37.50%
Extradural Haemorrhage	15	20.83%
Diffuse Axonal Injury	1	1.39%
Intraventricle Bleed	6	8.33%
Intracranial Bleed	1	1.39%

Table showing CT head findings in study patients.

The GCS and FOUR score of all head injury patients were calculated at the time of admission. Both scores were compared and a statistically significant correlation was found between these scores as shown in figure 1.

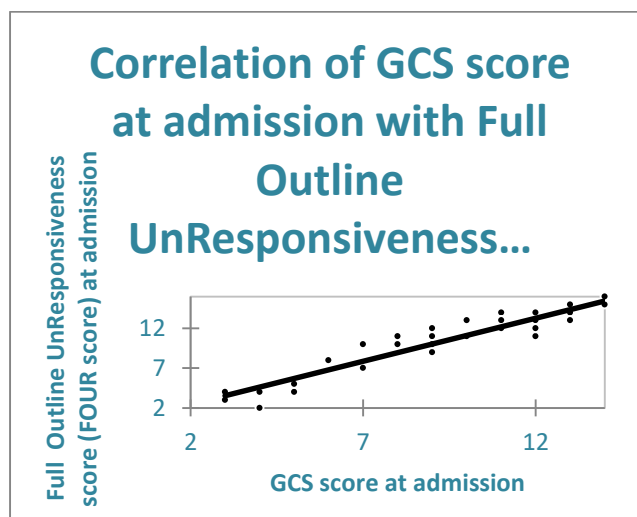


Figure 1:-Correlation of Glasgow coma scale with full outline of unresponsiveness score (FOUR score) at admission.

The similar correlation of GCS and FOUR score was found after 6th hour of admission and day 1 of admission as shown in figure 2 and 3.

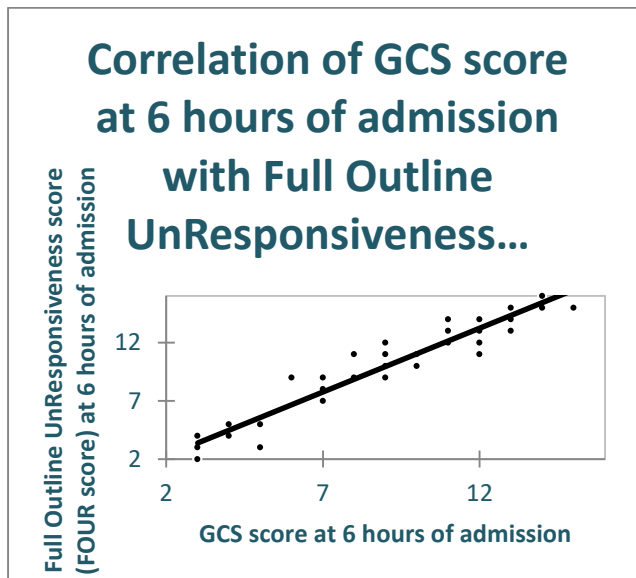


Figure 2:-Correlation of GCS score at 6 hours of admission with Full Outline UnResponsiveness score (FOUR score) at 6 hours of admission.

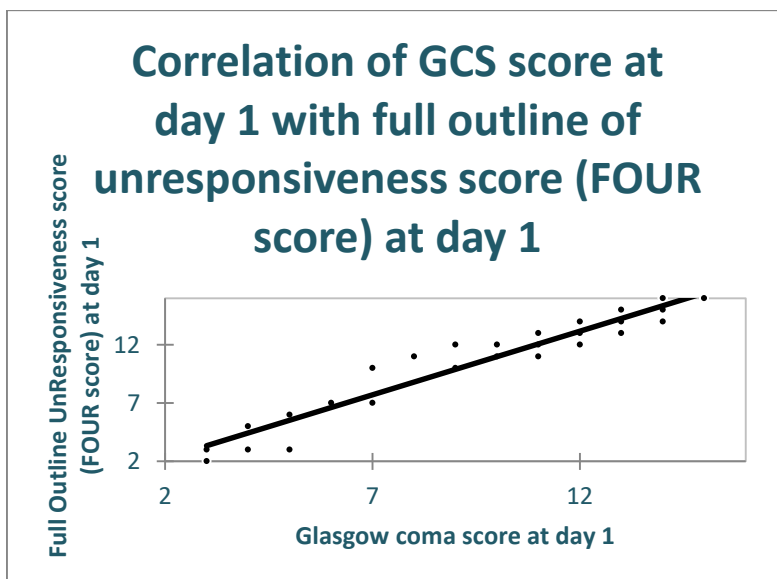


Figure 3:-Correlation of GCS score at day 1 with Full Outline UnResponsiveness score (FOUR score) at day 1.

The GCS and FOUR scores were calculated for all the patients included in our study on daily basis till 7th day of admission/ discharge/death and similar comparison was made which also showed significant correlation between the two scores. The receiver operating curve(ROC) was prepared on the basis of GCS calculated at the time of admission and prediction of mortality was made depending on this curve. A similar curve also prepared on the basis of calculations of FOUR score at admission and prediction of mortality was calculated. The area under curve (AUC) was similar in both ROCs and showed same specificity as well as sensitivity for prediction of mortality at admission as shown in figure 4 and 5.

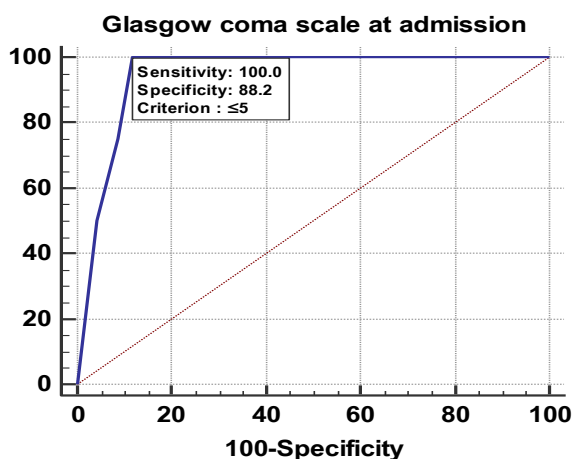


Figure 4:- Receiver operating characteristic curve of GCS score at admission for predicting mortality.

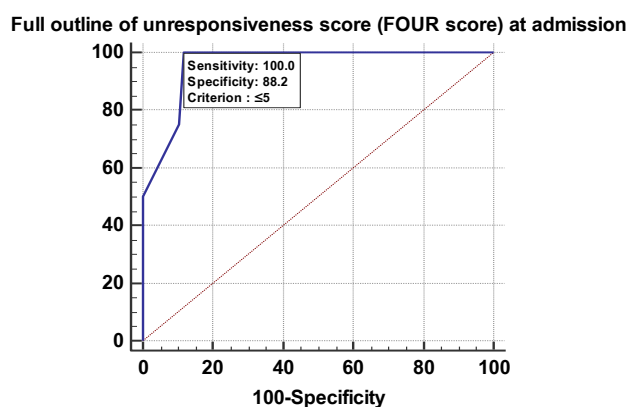


Figure 5:- Receiver operating characteristic curve of Full Outline UnResponsiveness score (FOUR score) at admission for predicting mortality.

IV. DISCUSSION

Traumatic brain injury (TBI) forms a major cause of trauma related mortality and morbidity all over the world. Traumatic brain injury (TBI) constitutes a major health problem globally, and is one of the leading cause of death and disability.¹ GCS score by far is the most widely used score to assess the severity of TBI in clinical practice. But it is necessary to keep in mind the shortcomings of this score and this issue was addressed with the introduction of some other scoring systems such as Full Outline UnResponsiveness score. The details of calculations of GCS and FOUR scores have been described in table 2 and 3.

In our prospective study, all the patients were in age group from 18 to 73 years with the mean age of 36.9 years. The maximum numbers of patients (32%) were between 21 to 30 years of age followed by age group 31-40 years (25%). The male to female ratio in our study was 9.28:1. According to our study, the head injury was more common in males than females. The study conducted by **Md. Gorji et al.** reported 80 patients in age group of 16-60 years with mean age of 33.8 years.⁶

In present study, the mode of head injury was road side accident (RSA) in maximum number of patients 72.22%. The majority of road side accidents were in the patients riding on two wheelers. The second highest number of patients were (19.44%) with mode of injury of fall from height. Physical assault was mode of injury in five patients (6.94%) and only one patient was with railway tract injury. The study conducted by **Alireza Baratloo et al.** demonstrated that RSA was the most common mode of injury with 70.8% patients followed by 18% patients with fall from height and 11.2% patients were with assault.⁷

In our study, the majority of patients i.e. 50% were diagnosed with haemorrhagic contusions on NCCT head, 38.9% patients with subdural haemorrhage, 37.5% patients with subarachnoid hemorrhage, 23.6% patients with tension pneumocephalus, 20.8% patients with extradural haemorrhage, 8.3% with intraventricle haemorrhage and 2.8% with intracranial bleed as per table 1. **Farid Sadaka et al.** also reported that

haemorrhagic contusion and subarachnoid haemorrhage were most common findings in 27% patients each, and extradural haemorrhage was the least common encountered finding in only 2% patients.⁸

In present study, 62.5% patients had multiple facial bone fractures, 15.2% patients had chest trauma and 4.17% patients had blunt trauma abdomen. The patients with multiple facial bone fracture and other significant injuries to chest had significant association with lower GCS and FOUR scores.

The overall mortality observed in our study was 5.56% which was almost similar with the study conducted by Farid Sadaka et al. with mortality of 7.8%.⁸

Table 2: GLASGOW COMA SCALE:

Clinical parameter	Points
Eyes	
Open Spontaneously	4
To verbal command	3
To pain	2
No response	1
Best motor response	
To verbal commands Obeys	6
To painful stimulus Localizes pain	5
Flexion withdrawal.	4
Flexion abnormal (decorticate rigidity).	3
Extension (decerebrate rigidity).	2
No response.	1
Best verbal response	
Oriented	5
Confused	4
Inappropriate speech	3
Incomprehensible speech	2
No response	1
Total	(3-15 points)

Mean GCS score at admission was 10.08±3.33 and FOUR score at admission was 11. 21±3. These results were comparable with results from study conducted by **Alireza Baratloo et al.** in which mean GCS score at admission was 9.7±3.6 and mean FOUR score at admission was 10.9±4.2.⁷ In our study, a statistically significant correlation was seen between GCS and FOUR score with p value of <0.0001 during the hospital stay. The Pearson correlation coefficient noted at admission, at 6th hour, at day1, at day2, at day3, at day4, at day5, at day6 and at day7 were 0.961, 0.964, 0.973, 0.975, 0.977, 0.981, 0.980, 0.959 and 0.961 respectively. The trends of both GCS and FOUR score in present study were towards the maximum values, indicated that as GCS improved, FOUR score also improved. The prediction of prognosis during hospital stay with FOUR score was comparable with GCS score. But as FOUR score involved four components with equal values made the assessment of neurological status easier and better. These findings of our study were consistent with results of study by **Nair et al.** which reported that GCS and FOUR scores were comparable in the assessment of patients with Traumatic Brain Injury and both score showed statistically significant correlation with Pearson coefficient of 0.94 at admission, 0.96 at 1 hour and 0.98 at 6th hour in their study.⁹ **Vivek N. Iyer et al.** also compared GCS and FOUR scores in their study and reported a significant correlation between both scores with Spearman coefficient of 0.98.¹⁰

Table 3: Full Outline UnResponsiveness (FOUR) Score:

Findings	Score
Eye response	
Eyelids open or opened, tracking, or blinking to command.	4
Eyelids open but not tracking	3
Eyelids closed but open to loud voice	2
Eyelids closed but open to pain	1
Motor response	
Makes sign (thumbs-up, fist, or peace sign)	4
Localizing to pain	3
Flexion response to pain	2
Extension response to pain	1
No response to pain or generalized myoclonus status	0
Brainstem reflexes	
Pupil and corneal reflexes present	4

One pupil wide and fixed	3
Pupil or corneal reflexes absent	2
Pupil and corneal reflexes absent	1
Absent pupil, corneal, and cough reflex	0
Respiration	
Not intubated, regular breathing pattern	4
Not intubated, cheyne-stokes breathing pattern	3
Not intubated, irregular breathing	2
Breathes above ventilator rate	1
Breathes at ventilator rate or apnea	0

In the present study, area under ROC curve for FOUR score ranging 0.885 to 0.992 was 0.96 and for GCS Score ranging 0.867 to 0.986 was 0.947 with 100% of sensitivity each. This shows that the predicting value of FOUR score for mortality of traumatic brain injury patients is better as compared to GCS score. Similarly, in the study conducted by Cenker Eken et al. also revealed that area under the curve for FOUR score was 0.751 which was significantly higher than AUC for GCS score being 0.72.¹¹ **Md. Gorji et al.** also reported that FOUR score is more precise than GCS score with AUC of 0.90.⁶

Different scoring systems are frequently utilized in the present day for the management of head injury patients. These scoring should be straightforward, trustworthy and able to predict relevant therapeutic decisions and results. The broad use of such a tool would improve the ability to correctly forecast survivability, which would have an effect on how these patients are treated and managed, as well as how their relatives are treated. The Glasgow Coma Scale (GCS), a standard part of a neurological examination for seriously ill TBI patients, has been criticized for failing to appropriately reflect speech status in intubated patients or take into account brain stem reflexes. Both the FOUR score and the GCS performed well, but the FOUR score is better for patient management and triage because it includes neurologic detail like brain stem reflexes & respiration pattern. So the primarily results of present study shows that FOUR score is equally or more effective as compared to GCS score for management of head injury patients. One of the limitations of our study was that sample may not have covered enough severely injured patients with operative management as in general surgery department of our institute the head injury patients with only conservative management were admitted.

V. CONCLUSION:

The assessment of the patients with GCS has been the common method for evaluation of head injury patients to make a decision regarding their management and also to predict their outcome. In our study also, the GCS has also stood the test of time and has done well in guiding regarding management of head injury patients and prediction of their prognosis. But the assessment of patients with FOUR score has also achieved the same purpose with high accuracy. Also, the FOUR score has advantage over GCS to calculate all of its components in intubated patients and the capacity for the examiner to discover lesions and identify a locked-in status.

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