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Original Research Article

Assessing the effectiveness of the full outline of unresponsiveness scale and the Glasgow coma scale in patients of traumatic head injury

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ABSTRACT

Background: The Glasgow coma scale (GCS) is the most commonly used scale while the full outline of unresponsiveness (FOUR) score is a new validated coma scale in the evaluation of the level of consciousness in head injury patients. The aim of the study was to compare and assess the effectiveness of the FOUR score and the GCS in patients of traumatic head injury.
Methods: This was a prospective observational study conducted in the department of surgery, Gandhi medical college, Bhopal during a 2 year period in which 100 patients of traumatic head injury were evaluated. The FOUR score and GCS score of these patients were assessed on admission and outcome followed for 2 weeks.
Results: The mean age group of 100 patients was 25-45 years with 79% male and 21% female patients. The FOUR scale was found to have a marginally higher sensitivity of 65.6% while the GCS had a sensitivity of 64.2%. The FOUR scale however had a higher specificity of 71.5% compared to 66.4% of GCS. The Youden index showed that FOUR scale (46%) has a better prediction for death than GCS (35%). FOUR had a higher accuracy of 75% than GCS with an accuracy of 65%.
Conclusions: Both FOUR score and GCS are valuable scales in assessment of traumatic head injury. The FOUR scale however is more accurate than the GCS in predicting outcome of head injury patients.

Keywords: FOUR scale, Glasgow coma scale, Traumatic head injury, Unresponsiveness

INTRODUCTION

The GCS was developed in 1974 to objectively describe neurological status and predict outcome in neuroscience patients and it is the most widely used scoring system for traumatic head injury as well as other comatose patients in the ICU. It has become the gold standard for describing the level of consciousness. Despite that it has various limitations which include the difficulty in assessing the verbal score in intubated or aphasic patients and an inconsistent inter rater reliability that are well documented in the literature.[1,2] Hence the FOUR score is a new coma scale introduced and approved recently as a replacement of the GCS. It is not dependent on verbal response and has been validated with reference to GCS in various clinical studies.[3-6] The FOUR score was developed in the Mayo clinic and evaluates 4 components: eye, motor responses, brainstem reflexes and respiration.[6]

There is still a lot of conflicting data concerning which of these two scoring systems has the best predictive value.[7-11] Some studies show the superiority of one over the other while others indicate no difference in the effectiveness of the two scales. Hence this study was done to find out the predicting power of these scoring systems for head injury patients.

METHODS

This was a prospective observational study conducted in the department of surgery, Gandhi medical college and Hamidia hospital, Bhopal, India for duration of 2 years from November 2018 to November 2020. A total of 100 patients of traumatic head injury were included that were admitted during the study period. The necessary approval was taken from the ethical committee of the institute. The sample size was calculated using an online sample size calculator. The confidence level was taken to be 75%, population size 1000 and margin of error was 10%. All traumatic head injury patients of more than 16 years of age were included in the study. Patients who were heavily sedated or on neuromuscular blockade were excluded from the study as were the patients who were comatose due to non-traumatic causes. The GCS score and the FOUR score was calculated at the time of admission. The expected risk of death was calculated using the original formulas of each scoring system. The patients were followed up for up to two weeks for outcome which included discharge or death.

Table 1: FOUR scale.

Components tested	Scores
Eye response	
Eyelids open and tracking	4
Eyelids open but not tracking	3
Eyelids closed but open to loud voice	2
Eyelids closed but open to pain	1
Eyelids remain closed to pain	0
Motor response	
Thumbs up, peace sign	4
Localizing pain	3
Flexion response to pain	2
Extension response to pain	1
No response or myoclonus status	0
Brain stem reflex	
Pupil and corneal reflex present	4
One pupil wide and fixed	3
Pupil or corneal reflex absent	2
Both absent	1
Both and cough reflex absent	0
Respiration	
Not intubated, regular breathing	4
Not intubated, cheyne stokes breathing	3
Not intubated, irregular breathing	2
Intubated, breathes above ventilator rate	1
Intubated, breathes at ventilator rate or apnea	0

The GCS was composed of three categories including eye opening, verbal response and motor response. The score was determined by the sum of the score in each of the 3 categories, with a maximum score of 15 and a minimum score of 3. The FOUR score covered eye and motor responses, brainstem reflexes and respiration patterns. Each category was given 0-4 points, 0 being the worst and 4 being the best. For both FOUR score and GCS, the lower scores denoted poor general condition.

Statistical analysis

Data were recorded initially on a standardized data collection form for FOUR score and GCS and then transferred to the SPSS statistical software (IBM Corp., Released 2013, IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY, USA). The observed and expected numbers of deaths within each stratum were compared and their sensitivity, specificity and accuracy were statistically evaluated by the Youden index.

RESULTS

In this study of 100 patients 79 were male and 21 were female. The mean age group was 25-45 years. The FOUR scale was found to have a marginally higher sensitivity of 65.6% while the GCS had a sensitivity of 64.2% (Table 1). The FOUR scale however had a higher specificity of 71.5% compared to 66.4% of GCS. The positive and negative predictive value of GCS was 52% and 77% respectively while that of FOUR was 62% and 82% respectively. FOUR had a higher accuracy of 75% than GCS with an accuracy of 65%. The Youden index showed that FOUR scale (46%) has a better prediction for death than GCS (35%).

Table 2: Diagnostic values of GCS and FOUR for prediction of death.

Scale prediction power	GCS (%)	FOUR (%)
Sensitivity	64.2	65.6
Specificity	66.4	71.5
Positive predictive value	52	62
Negative predictive value	77	82
Accuracy	65	75
Youden index	46	35

DISCUSSION

Our study showed that most of the patients of traumatic head injury were of the age group of 25-25 years. This may be due to the fact that the most common mode of head injury was due to road traffic accidents. Hence most commonly effected was the younger population more involved in travelling and driving. Many studies have been done to compare the efficacy of the two scales. This study showed that the FOUR scale was slightly sensitive in prediction of outcome and assessment of head injury than the GCS. This may be due to its inclusion of brainstem reflexes and respiration instead of verbal response as brainstem reflexes play an important role in evaluation of CNS function.[3,12] These findings confirmed Ledoux study which showed that FOUR score had better prediction than previous scale for classifying and communicating impaired consciousness, in emergency setting, after cardiac arrest and in ICU.[13-17] It offerred the

advantage of being performable in intubated patients and of identifying nonverbal signs of consciousness by assessing visual pursuit and hence minimal signs of consciousness.[18] Büyükcam et al investigated whether the FOUR score was better than GCS in predicting mortality and morbidity in children with head injury.[11] In his study involving 100 children the FOUR score provided no significant advantage over the GCS in predicting mortality and morbidity. A similar study was done in 200 children by Khajeh et al which showed FOUR scale to be superior to GCS in predicting mortality.[19] Ramazani et al in 2019 also showed in 300 adult patients that both scores showed acceptable discrimination power but higher accuracy was seen with FOUR score.[20] This was similar to our study which also showed a higher accuracy of FOUR score than GCS in evaluating unconsciousness.

Said et al compared FOUR score and GCS regarding their predictive value for successful extubation at 14 days after intubation as a primary outcome measure. The secondary outcome measures were the 28 day mortality and the neurological outcome at 3 months. His study showed that both scores had similar accuracy for predicting 28 day mortality and neurological outcome at 3 months.[8] Nair et al showed that both GCS and FOUR scores showed comparable results in the assessment of patients with traumatic brain injury.[21] Most studies have found the accuracy and predicting power of both the scores comparable and FOUR score offerred a small advantage in interrater reliability which was likely insufficient to replace the GCS.[3]

This study had certain limitations. Firstly the sample size of the study was small. Secondly it was a single center study. There may also be a bias due to difference in quality of care as well as observer bias due to difference in the score by different evaluators.

CONCLUSION

Both GCS and FOUR score show comparable results in efficacy of assessing unconsciousness in traumatic head injury patients as well as predicting mortality. The FOUR score has slightly higher sensitivity and is more accurate in prediction of mortality in traumatic head injury patients. However the long tradition of use of GCS since the 40 years of its introduction and its familiarity among nurses and doctors may not permit the wide spread use of the FOUR score despite its clear advantage over the GCS. The FOUR score appears to be an easier tool to use and it provides a more comprehensive neurological assessment.

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