A Comparison of Four Score with the Glasgow Coma Scale score in Predicting Outcomes among Patients with Altered Mental Status Admiotted to Emergency

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How to cite this article:

Kiran Tatti, C.A Bopanna, Harold Maxim Lewis *et al.* A Comparison of Four Score with the Glasgow Coma Scale score in Predicting Outcomes among Patients with Altered Mental Status Admiotted to Emergency. Indian J Emerg Med. 2024;10(3):125-130.

Abstract

Aim: To know which is the best GCS score and FOUR score to be used in patients presenting to Emergency Medicine department with altered mental status and also predicting the outcome of patient.

Materials and Methods: This is a prospective observational comparative study. It included 100 patients of altered sensorium, whose GCS and FOUR scores were calculated at admission and followed up till discharge or death to note the outcome. Individual demographics and diagnosis were recorded, and the results were analyzed statistically.

Results: The ROC curve analysis for FOUR score in determining prognosis within 48 hours of admission indicates moderate predictive power, with an area under the curve (AUC) of 0.632. The ROC curve analysis for GCS total demonstrated a stronger predictive power with an AUC of 0.702.

Conclusion: Both GCS and FOUR score can be used with same reliability in emergency to predict outcome. Taking into account the possible inter observer variation FOUR score can be used with upper hand.

Clinical significance: In critically-ill patients with altered sensorium, explaining the prognosis to the attendants is a challenge for the physician. The commonly used GCS score has several shortcomings, especially in intubated patients. Use of the FOUR score can overcome these shortcomings and help in prognostication of these patients. In view of its good correlation with GCS score and equal efficacy in predicting outcomes in varied etiologies, it can be used as a good alternative to the GCS score.

Keywords: Altered sensorium; Full Outline of Unresponsiveness score; Glasgow Coma Scale score.

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INTRODUCTION

Glasgow Coma Scale (GCS) is a widely used method to assess the brain function and to estimate outcomes in patients with altered mental status. It was introduced by Teasdale and Jennett in 1974 to bring uniformity in the clinical assessment of consciousness.[1,2] Although the test was devised to be used in patients with brain injury, it is used extensively in other etiologies like stroke, drowning,

infections, cardiac arrest, and metabolic causes leading to altered sensorium.[3,4] The score has an excellent correlation to the outcome and good interobserver reliability.[1] However, GCS has several drawbacks. Firstly, there is no provision to grade verbal component of GCS in intubated patients. Several patients in altered sensorium will require assisted ventilation. Inability to access such condition can undermine the effectiveness of the scoring system.[4–6] Secondly, in the motor component of GCS, the withdrawal response may be mistaken as a flexor response causing an error in scoring.[4] Thirdly, brainstem reflexes are not used in the GCS, which is found to be closely related to mortality in several studies.[6,7] Given these shortcomings, Wijdicks *et al.* introduced the FOUR score in 2005.[3] The components of this new score are enlisted in Table 1 below. Apart from addressing the shortcomings discussed above, the new score also includes the assessment of the breathing pattern. The need for assisted ventilation correlates with the severity of the disease and hence with the outcome.[8] Also, the FOUR score can identify the locked-in state (pseudo-coma) and persistent vegetative state where the patient's eyes are open, but the tracking of the examiner's finger cannot be performed. There are several modifications in the motor response components in the FOUR score. Generalized myoclonus status is included and given a score of "zero." Withdrawal from pain is clubbed into decorticate response (flexion response) as it is often difficult to differentiate the two. The component "obeying commands" is replaced by a more specific response "thumps up, fist or peace sign." This has the added advantage of testing the patient's alertness. These modifications are thought to increase the effectiveness of the new score in predicting outcomes reliably. Since the introduction of the FOUR score, there have been several studies comparing it with the GCS. Most of them concluded that the FOUR score is better than the GCS score in predicting mortality and morbidity. However, the majority of these have been among patients of traumatic brain injury.[2,9,10] In the present study, the comparison is made between the two scores in patients of altered sensorium from nontraumatic causes admitted to an Emergency medicine department.

MATERIALS AND METHODS

Study Design and Setting

- This was a prospective observational study, at a tertiary care teaching hospital, in the Department of Emergency Medicine, KVG Medical College and Hospital Sullia from June 2023 to July 2023.
- Study design Comparative study
- For this study a total of 100 cases were taken and compared.
- Cases included are Alcoholic intoxication, CVA including both Acute Infarct and Haemorrhagic, Drug induced sedation, Metabolic cause including all kinds, Respiratory cause, Shock of all kinds, Traumatic cause
- Comparative study was made by using the *receiver operating characteristic (ROC) curve method using Medcalc*

Inclusion Criteria

- Patients with a GCS score less than 15, or those in confusion or with a diminished or absent response to verbal or physical stimuli, were included in the study.

Exclusion Criteria

- Patients aged younger than 12 years and chronic cases like Alzheimer's, schizophrenia, and those with an altered mental status of more than a week were excluded.
- A patient who develops cardiac arrest during emergency treatment was excluded.
- Patients with known psychiatric illness were excluded from the study.

METHODOLOGY

The study population was drawn from patients who were admitted to the CCU with altered mental status, who met the inclusion and exclusion criteria. After obtaining informed consent from attendants, data were collected related to the patient's demographic characteristics, chief complaints, and duration of illness. All patients underwent full medical and neurologic clinical evaluation at the time of admission. The neurologic condition was judged by evaluating the GCS and FOUR scores, and patients were followed until death or discharge. The final diagnosis and outcome were noted in each case.

Statistical Analysis

- Data were analyzed using Medcalc software version 19.1.3 (for Windows 10). Spearman's rho coefficient was used to test the correlation

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between GCS and FOUR scores. The ROC curve was used to test the discriminating ability of the two scoring systems in predicting outcomes. The odds ratio (OR) by binary logistic regression was used to test their predictive power. The predictive scores were entered as ordinals, and OR adjusted for age, sex, and diagnosis was calculated. Internal validation was done using bootstrap technique with 1,000 replications. The goodness of fit for the logistical regression model was tested by Hosmer–Lemeshow test. Microsoft Office 2019 was used for graphical representation of data.

- The majority of the cases presented with a better prognosis, accounting for 52% of the total cases studied.

- The cases with a bad prognosis and death followed, representing 36% and 12% of cases, respectively.

- When we consider outcomes based on gender, males exhibited a slightly higher percentage in both good (53.85%) and poor outcomes (60.42%) compared to females who accounted for 46.15% of good outcomes and 39.58% of poor outcomes.

- Patients with a good outcome had a higher mean Glasgow Coma Scale (GCS) score of 8.88 with a standard deviation of 3.50, and a mean FOUR score of 11.67 with a standard deviation of 2.69.

- Conversely, individuals with poor outcomes had a lower mean GCS score of 6.50 with a standard deviation of 3.00 and a mean FOUR score of 9.06 with a higher standard deviation of 4.97, indicating greater variability in this group.

RESULTS

A Total of 100 cases were followed and comparative study done between GCS score and FOUR score.

Study included males 57 and females 43, male with good outcome 53.85% and poor outcome 60.42% and female with good outcome 46.15% and poor outcome 39.58%.

Mean GCS score with good outcome of 8.88 and poor outcome of 6.5.

Mean FOUR score with good outcome of 11.67 and poor outcome of 9.06.

Table 1: Components of the GCS and FOUR score[3]

GCS Score		Four Score	
Eye opening		**Eye response**	
4	Spontaneous	4	Eyelids open, tracking, or blinking to command
3	To speech	3	Eyelids open but not tracking
2	To pain	2	Eyelids closed, but open to loud voice
1	None	1	Eyelids closed, but open to pain
		0	Eyelids remain closed with pain
Best motor response		**Motor response**	
6	Obeying commands	4	Thumbs-up, fist, or peace sign
5	Localizing to pain	3	Localizing to pain
4	Withdrawal from pain	2	Flexion response to pain
3	Abnormal flexion response to pain	1	Extension response to pain
2	Extension response to pain	0	No response to pain or generalized myoclonus status
1	None	**Brainstem reflexes**	
		4	Pupil and corneal reflexes present
Verbal response		3	One pupil wide and fixed
5	Orientated	2	Pupil or corneal reflexes absent
4	Confused	1	Pupil and corneal reflexes absent
3	Inappropriate words	0	Absent pupil, corneal, and cough reflex
2	Incomprehensible sounds	**Respiration**	
1	None	4	Not intubated, regular breathing pattern
		3	Not intubated, Cheyne-Stokes breathing pattern
		2	Not intubated, irregular breathing
		1	Breathes above ventilator rate
		0	Breathes at ventilator rate or apnea

The most prevalent diagnosis associated with a good outcome was metabolic cause, accounting for 65.38% of the good outcome cases.

Row Lable	Frequency	Percentage
Better Prognosis	52	52.00%
Bad Prognosis	36	36.00%
Death	12	12.00%
Grand Total	100	100.00%

In contrast, the Cerebrovascular Accident (CVA) was the major contributing factor to poor outcomes, constituting 33.33% of such cases.

Traumatic causes also showed a substantial presence in the poor outcome category, with a 22.92% occurrence.

It's worth noting that alcoholic intoxication exclusively resulted in good outcomes, and drug-induced sedation was solely associated with poor outcomes in this study.

The ROC curve analysis for FOUR score in determining prognosis within 48 hours of admission indicates moderate predictive power, with an area under the curve (AUC) of 0.632.

|	Good Outcome		Poor Outcome		Total	
Sex	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Female	24	46.15%	19	39.58%	43	43.00%
Male	28	53.85%	29	60.42%	57	57.00%
Grand Total	52	100.00%	48	100.00%	100	100.00%

This model exhibited a high specificity of 98.08%, suggesting it is proficient at identifying true good outcomes, but had a lower sensitivity of 39.58%, indicating limited ability to correctly identify poor outcomes. The optimal cutoff value, as per the Youden index of 0.3766, was ≤7. Criterion values and coordinates of the ROC curve [Show].

Prognosis	Mean GCS	SD GCS	Mean Four Score	SD Four Score
Good Outcome	8.88	3.50	11.67	2.69
Poor Outcome	6.50	3.00	9.06	4.97
Grand Total	7.74	3.47	10.42	4.15

|	Good Outcome		Poor Outcome		Total	
Diagnosis	N	%	N	%	N	%
Alcoholic Intoxication	2	3.85%		0.00%	2	2.00%
CVA	9	17.31%	16	33.33%	25	25.00%
Drud Induced Sedation		0.00%	1	2.08%	1	1.00%
Metabolic Cause	34	65.38%	12	25.00%	46	46.00%
Respiratory Failure	3	5.77%	2	4.17%	5	5.00%
Shock	1	1.92%	6	12.50%	7	7.00%
Traumtic Cause	3	5.77%	11	22.92%	14	14.00%
Grand Total	52	100.00%	48	100.00%	100	100.00%
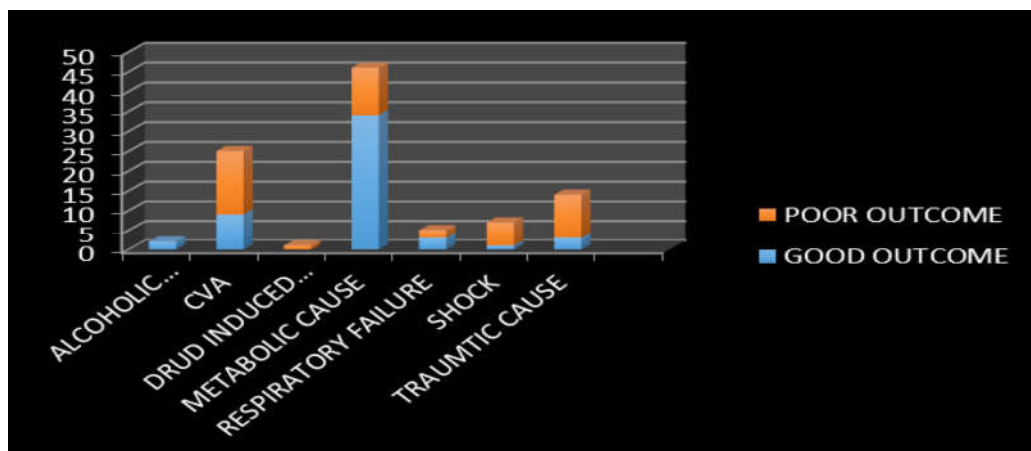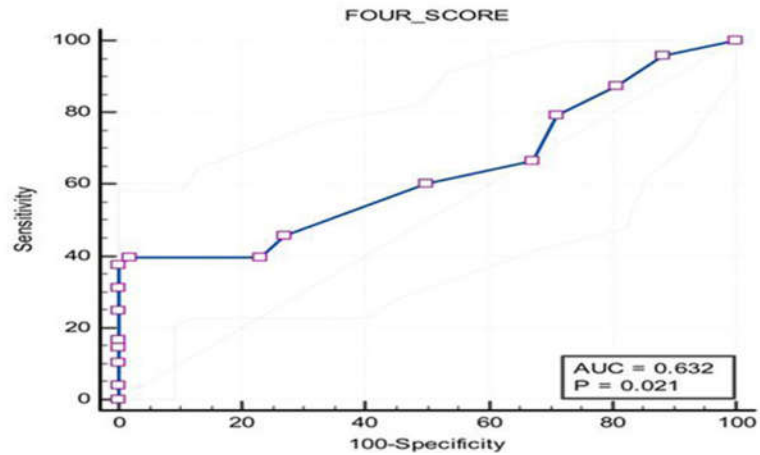
Variable	FOUR_SCORE
Classification variable	PROGNOSIS_WITHIN_48_HOURS_OF_ADMISSION

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.632
Standard Error [a]	0.0573
95% Confidence interval [b]	0.529 to 0.726
z statistic	2.301
Significance level P (Area=0.5)	0.0214
Youden index J	0.3766
Associated criterion	≤7
Sensitivity	39.58
Specificity	98.08
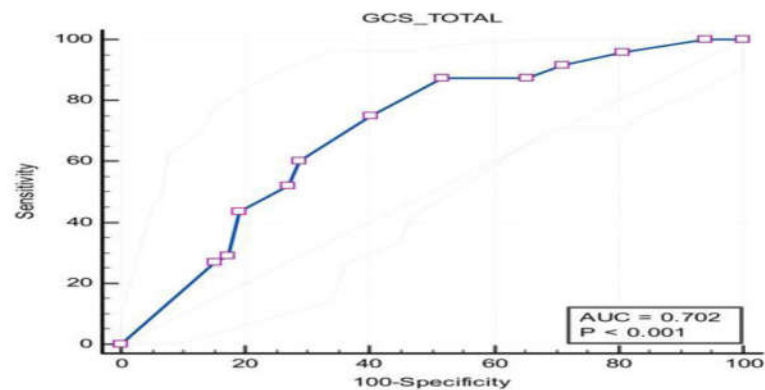
Variable	GCS_TOTAL
Classification variable	PROGNOSIS_WITHIN_48_HOURS_OF_ADMISSION

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.702
Standard Error [a]	0.0525
95% Confidence interval [b]	0.602 to 0.789
z statistic	3.849
Significance level P (Area=0.5)	0.0001
Youden index J	0.3558
Associated criterion	≤9
Sensitivity	87.50
Specificity	48.08

DISCUSSION

The ROC curve analysis for GCS total demonstrated a stronger predictive power with an AUC of 0.702.

This analysis revealed a considerably high sensitivity of 87.50%, denoting its effectiveness in correctly identifying poor outcomes, albeit with a specificity of 48.08%, indicating a lower accuracy in identifying true good outcomes.

The analysis identified an optimal cut off value of ≤9, guided by a Youden index of 0.3558.

CONCLUSION

Both GCS and FOUR score can be used with same reliability in emergency to predict outcome.

Taking into account the possible inter observer variation FOUR score can be used with upper hand.

Easy calculation of GCS with 3 components can take a upper hand over FOUR score in untrained personnel.

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