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RESEARCH ARTICLE

ASSESSMENT OF NEUROLOGICAL STATUS USING 4 SCORE AND GLASGOW COMA SCALE IN NON TRAUMATIC BRAIN INJURY PATIENTS

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ABSTRACT

Aims and Objective: To compare 4 score and Glasgow coma scale as prognostic marker for disability in patients with altered neurological status. To assess the interrater reliability of 4 score and Glasgow coma scale. **Introduction**: Assessing impaired consciousness in the medical and surgical intensive care unit (ICU) is very difficult. To asses the abnormal consciousness ,GCS. Is the major scoring system, but is not designed to capture distinct details of the neurologic examination its reliability in predicting patients outcome is unsatisfactory, especially with regard to the verbal component. It was also found that the reliability of the GCS increases with the experience of its users and that user inexperience is associated with a high rate of errors. A new coma scale, the Full Outline of Unresponsiveness (FOUR) score is based on the minimum of tests necessary to assess a patient with altered consciousnessin the emergency department. it includes much important information that is not assessed by the GCS, like measurement of brainstem reflexes; a broad spectrum of motor responses; and the presence of abnormal breath rhythms and a respiratory drive. **Methods**: In this prospective study done between January 2019 and may 2019, a total of 40 patients were included. All study patients had both these assessed independently by resident doctor and a nurse at the time of admission and on day 1 of admission. Patients were at the time of discharge to assess quality of life using MODIFIED RANKIN SCORE [MRS]. MRS 3 or less was considered as favorable outcome and scores 4-6 considered as unfavorable outcome. Ability of the maximum Delta [difference between highest and lowest score] and lowest score of GCS and four score to predict unfavorable neurological outcome were compared. **Results**: A strong agreement using Cronbachs alpha (0.94 and 0.96) was found between doctors and nurses for both GCS and FOUR score at time of admission and on day 1 respectively for all patients. Interrater reliability for FOUR score and GCS was (respectively 0.98and 0.97), Both scores were comparable in predicting neurological outcome. **Conclusion**: In this study FOUR score and GCS were comparable in their inter rater reliability and prognostic value. Both scores were comparable in assessing the disability in patients with altered neurological status but the neurologic details incorporated in the FOUR score makes it more useful in management and triage of patients.

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INTRODUCTION

Assessing impaired consciousness in the medical and surgical intensive care unit (ICU) is very difficult. The os most commonlyused tool for initial assessment of abnormal consciousness but is not designed to capture distinct details of the neurologic examination and is reliability in predicting patients outcome is not satisfactory particularly with regard to the verbal component. Studies have found additional shortcomings of the GCS and have suggested that adding measures of brainstem reflexes to the GCS could provide better assessment of neurological examination and helps in prognosis .It was also found that the reliability of the GCS increases with the experience of its users and that user inexperience is associated with a high rate of errors. A new scale, the Full Outline of Unresponsiveness (FOUR) score is based on the minimum of tests necessary to assess patient with altered consciousness, it includes much important information that is not assessed by the GCS, which includes measurement of brainstem reflexes; Eye response; a broad spectrum of motor responses; and the presence of abnormal breath rhythms and a respiratory drive. Unlike the GCS, 4 Score does not include an assessment of verbal response, which is not much useful if the patient is intubated.

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Therefore 4 scoret is more useful for assessing critically ill patients who have undergone intubation. It can detect the occurrence of brain death or locked in syndrome in a critically ill patient. The FOUR score can be used in emergency department and variety of ICU settings. It is simple and can be easily be assessed even by ain experienced user. it also pplrovides essential neurologic information that allows an accurate assessment of patients with altered consciousness when compared to GCS.

MATERIALS AND METHODS

Study design: Prospective study.

Study duration: Jan 2019 toMay2019.{5 months}

Study subjects: Patients with altered neurological status admitted in Medical Intensive Care Unit at KIMS hospital Bangalore.

Sample Technique: All the patients who meet inclusion and exclusion criteria will be recruited in the study till the sample size is achieved.

Inclusion criteria: Patients of age more than 18 years with altered neurological status presented to emergency department in kims hospital Banglore.

Exclusion criteria: Traumatic brain injury patients.

Method of collection of data: Patient after enrolling into the study, Basic information will be collected using preformed Performa . Neurological status will be assessed by 4 score and GCS scoring at the time of arrival to emergency department {ED} and subsequently on day1.Modified Rankin Score(MRS) is used to to assess the disability at the time of discharge. MRS of <3 was considered favourable outcome and 4- 6 was considered unfavourable outcome. Method statistical analysis: Cronbachs alpha and kappa scoring

DISCUSSION

This is the first study of the FOUR score outside the Neurosciences Intensive Care Unit using non-neurology staff as raters. The advantages of the FOUR score have been outlined previously [2,3}.

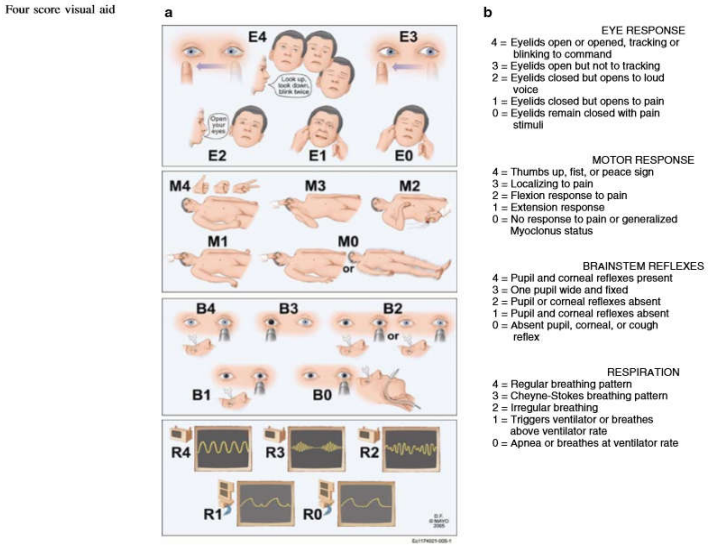


Table 1: Glasgow coma scale.

Component tested	Score
Eye response	
Eyes open spontaneously	4
Eye opening to verbal command	3
Eye opening to pain	2
No eye opening	1
Motor response	
Obeys command	6
Localises pain	5
Withdraws from pain	4
Flexion response to pain	3
Extension response to pain	2
No motor response	1
Verbal response	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
No verbal response	1

Table 1. Total of 40 patients were included in the study out of which 29 showed favourable outcome and 11 showed unfavourable outcome based on Modified Rankin Score

Modified Rankin Score		
	Frequency	Percent
Favourable	29	75.7
Unfavourable	11	24.3
Total	40	100.0

Age

	N	Mean	SD	Min.	Max.	't' value	P value
Favourable	29	53.8	16.107	23	85	1.408	0.243
Unfavourable	11	60.9	13.851	35	75		
Total	40	55.5	15.708	23	85		

	Age							Total
	<30 yrs	30--39 yrs	40-49 yrs	50-59 yrs	60-69 yrs	70-79 yrs	80-89 yrs	
Favourable	3	2	7	7	4	5	1	29
	10.7%	7.1%	25.0%	21.4%	14.3%	17.9%	3.6%	100.0%
Unfavourable	0	1	1	2	3	4	0	11
	.0%	11.1%	11.1%	11.1%	22.2%	44.4%	.0%	100.0%
Total	3	3	8	7	6	9	1	40
	8.1%	8.1%	21.6%	18.9%	16.2%	24.3%	2.7%	100.0%

Table 2. A very good agreement between GCS Scoring done by nurses and doctors at the time of admission as well as on day 1 .

GCS nurses and GCS doctors

Reliability Statistics

Visit	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Admission	0.977	0.977	2
Day 1	0.974	0.974	2

Agreement between GCS nurses and GCS doctors

Intraclass Correlation Coefficient						
Visit		Intraclass Correlation	95% Confidence Interval		F Test with True Value 0	
			Lower Bound	Upper Bound	Value	P value
Admission		0.955	0.915	0.977	43.931	*<0.001*
Day 1		0.949	0.902	0.973	37.870	*<0.001*

Table 3. A very good agreement between FOUR Scoring done by nurses and doctors at the time of admission as well as on day 1

FS nurses and FS doctor

Reliability Statistics

Visit	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Admission	0.996	0.996	2
Day 1	0.988	0.988	2

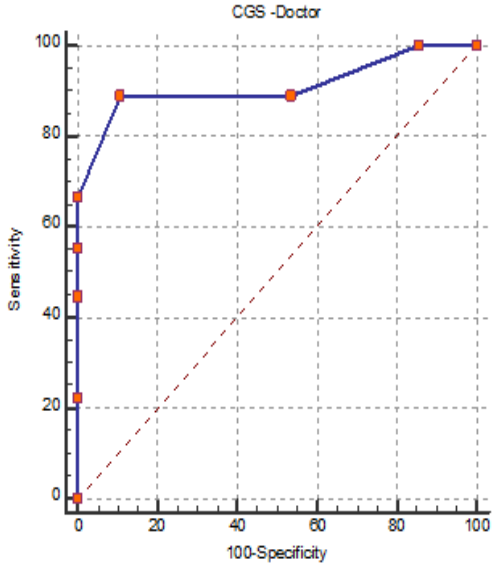
Agreement between FS nurses and FS doctor

Intraclass Correlation Coefficient						
Visit		Intraclass Correlation	95% Confidence Interval		F Test with True Value 0	
			Lower Bound	Upper Bound	Value	Sig
Admission		0.991	0.983	0.995	227.405	*<0.001*
Day 1		0.977	0.956	0.988	86.574	*<0.001*

Cronbach's alpha between GCS and FS for all patients

Reliability Statistics			
Visit	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Admission	0.945	0.959	2
Day 1	0.960	0.965	2

Intraclass Correlation Coefficient					
Visit		Intraclass Correlation	95% Confidence Interval		F Test with True Value 0
			Lower Bound	Upper Bound	Value	Sig
Admission		0.895	0.806	0.944	18.032	<0.001
Day 1		0.923	0.857	0.960	25.142	<0.001



Variable	CGSR CGS -Doctor
Classification variable	MRSRE
Sample size	40
Positive group : MRSRE = 1	9
Negative group : MRSRE = 0	28
Disease prevalence (%)	Unknown

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.911
Standard Error[a]	0.0747
95% Confidence interval[b]	0.764 to 1.000
z statistic	5.501
Significance level P (Area=0.5)	<0.0001

[a] Hanley & McNeil, 1982
[b] AUC ± 1.96 SE

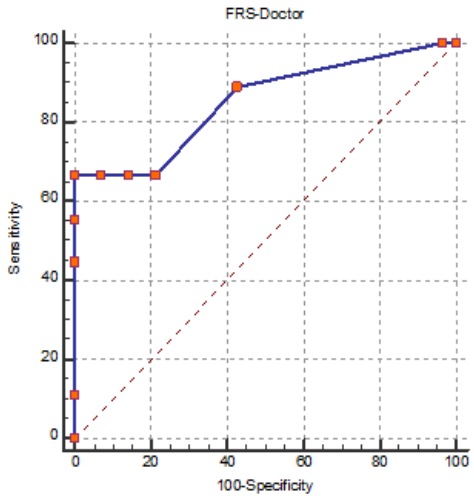
Youden index

Youden index J	0.7817
Associated criterion	≤9
Sensitivity	88.89
Specificity	89.29

Criterion values and coordinates of the ROC curve [Hide]

Criterion	Sensitivity	Specificity	+LR	-LR
<2	0.00	100.00		1.00
≤6	66.67	100.00		0.33
≤9	88.89	89.29	8.30	0.12
≤10	88.89	46.43	1.66	0.24
≤11	100.00	14.29	1.17	0.00
≤12	100.00	0.00	1.00	

Table. AUC for GCS doctors and nurses was 0.911and the specificity and sensitivity was 89.29% and 88.29% respectively



Variable	FSR FRS-Doctor
Classification variable	MRSRE
Sample size	40
Positive group : MRSRE = 1	9
Negative group : MRSRE = 0	28
Disease prevalence (%)	unknown

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.851
Standard Error[a]	0.0850
95% Confidence interval[b]	0.685 to 1.000
z statistic	4.131
Significance level P (Area=0.5)	<0.0001

[a] Hanley & McNeil, 1982
[b] AUC ± 1.96 SE

Youden index

Youden index J	0.6667
Associated criterion	≤7
Sensitivity	66.67
Specificity	100.00

Criterion values and coordinates of the ROC curve [Hide]

Criterion	Sensitivity	Specificity	+LR	-LR
<2	0.00	100.00		1.00
≤9	66.67	100.00		0.33
≤12	66.67	78.57	3.11	0.42
≤13	88.89	57.14	2.07	0.19
≤14	100.00	3.57	1.04	0.00
≤15	100.00	0.00	1.00	

Table 6. AUC for FOUR score doctors and nurses was 0.851 and the specificity and sensitivity was 100% and 66.67% respectively

This new coma scale includes important clinical neurological findings in patients with impaired consciousness and this study shows that can be assessed by emergency physicians, and nurses in the ED with excellent agreement. Our raters with no specific neurological training were able to identify key neurologic signs in patients with impaired consciousness. Furthermore, this study confirmed prior studies that the FOUR score is a robust predictor of in-hospital mortality, functional outcome at hospital discharge, and overall survival in patients seen for neurologic complaints. The GCS has remained the ‘‘gold standard’’ for assessment of impaired consciousness in all patient populations. Studies in the ED have not only involved validation of the scale, but also attempts at modifications (e.g., simplified motor scale) eliminating the eye and verbal response .The FOUR score was developed to fill in a need for an easy to use rapid assessment of all essential neurologic signs in patients with impaired consciousness. It ignores disorientation or confusion used in the verbal scale, but provides a good assessment of eye movements, brainstem reflexes, and respiratory drive in ventilated patients.

The FOUR score has the potential to recognize a locked-insyndrome, uncalherniation, brain death, and less severe neurologic injury. A more comprehensive assessment of a patient with an impaired consciousness could assist in initial decision making, assess the need for additional consultation (neurosurgeon) and more effectively triage patient to the most appropriate Intensive Care Unit, neuroradiology suite, or operating theater.

Limitations

One of the limitations was that the target enrollment cohort was not reached, and approximately half of the studied patient population included alert patients. This increases the chance of interobserver agreement because no neurologic abnormality will have to be identified. A study of a larger group of stuporous or comatose patients would be desirable. However prospective scale validation studies are very difficult to perform in the ED environment with a diverse population of patients and varying work schedules of potential raters. Such a study is easier to perform in a neurological Intensive Care Unit with patients with acute neurologic disease. This was a single center study, so the generalizability to other EDs has not been yet proved.

Conclusion

The FOUR score can be used in a variety of ICU settings. It is easily taught, is simple to administer, and provides essential neurologic information that allows an accurate assessment of patients with altered consciousness. The FOUR score can predict which patients will have a poor outcome and can detect the occurrence of brain death in a critically ill patient. In addition, the FOUR score can diagnose a locked-in syndrome mimicking coma and can test the vigilance of the patient by using simple hand signals. In contrast, the GCS cannot assess these conditions because it uses only eye opening and motor response to pain as measures of impaired consciousness in intubated patients. The FOUR score has the potential to become an important measure in prospective clinical studies.

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