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Original Article

Comparison of Glasgow Coma Scale with Full Outline of Unresponsiveness Scale for predicting mortality among patients admitted in a Medical Intensive Care Unit

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ABSTRACT:

Background: *For assessment of unconscious state in Medical Intensive Care Unit, physician mostly rely on Glasgow Coma Scale (GCS). But its verbal component has limitations in aphasic and intubated patient. More over its predilection ability to mortality is hardly challenged. The FOUR (Full outline of unresponsiveness) score, a new coma scale, evaluates 4 components: Eye, motor responses, brain stem reflexes and respiration. Aim of this study was to compare Full Outline of Unresponsiveness (FOUR) scale for prediction of mortality among patients admitted in Medical Intensive Care Unit (MICU) of a tertiary care hospital of Bangladesh with Glasgow Coma Scale (GCS).*

Objectives:*To compare prediction of mortality between Glasgow Coma Scale (GCS) and Full Outline of Unresponsiveness (FOUR) scale.*

Methods: *This is a prospective observational study was carried out in the Department of Critical Care Medicine, BIRDEM General Hospital to compare the mortality predilection in between FOUR score and GCS score. All consecutive adult unconscious patients over the age of 18 years were included in this study. Sedated patients were examined while they were not getting sedation or during routine sedation window period. Altered conscious level was examined by both GCS and FOUR scales. Data were collected using a check list containing demographic information, preexisting chronic illness, biochemical markers, imaging findings etc. Later patients were followed up and data regarding ICU stay, mortality and time of discharged from ICU were recorded. Both GCS and FOUR score were compared between survivor and non-survivor group and compared both score in between non-survivor group. Ultimately data were analyzed by using Statistical Package for Social Sciences (SPSS) software (version 20).*

Results: *Total 105 unconscious patients were enrolled within the study after fulfilling inclusion & exclusion criteria. Among them 34 patients were survivor and 71 patient were non-survivor. The mean and SD of age in this study were 64 .55 ±14.65 years. The peak age distribution was (61-70) 39%. Among them 54.3 % (n=57) were male and 45.7 % (n=48) were female. DM (82.85%) was the most common comorbidity and the predominant diagnosis was Septic shock 33% followed by Ischemic stroke 29%, Meningo encephalitis 19.04 %, and Electrolytes imbalance 17.14%, Cardiogenic shock 12.38% etc. In both GCS and FOUR score their value significantly differ in case of both survival ([7.15± 1.56]; P<.0001 and [7.74± 2.26]; P<.0001) and non-survival group ([5.38± 1.96]; P <0.0001) and ([5.35± 2.83]; P <0.0001). But comparison of FOUR score (5.35± 2.83) with GCS (5.38± 1.96) in terms of predicting mortality their value not significantly differ (P <0.93). So both GCS and FOUR score is equally effective predicting mortality among unconscious patients.*

Conclusion: *Both GCS and FOUR score significantly vary among survivor and non-survivor groups of unconscious patients but while comparing them regarding predicting mortality there is no significant differences in both score. Finally we conclude that both GCS and FOUR score equally good at predicting in hospital mortality among unconscious patients admitted in MICU.*

INTRODUCTION

Alteration of consciousness is a frequent admission finding to critical care services. Most patients require immediate and often extensive diagnostic work up. Both times to diagnosis and treatment initiation are decisive factor for brain recovery. As only about 50% of patients survive in an unselected coma population[1], coma is among the most common and striking problems in general medicine[2]. Altered conscious level can be defined as "any mental state, induced by various physiological, psychological, or pharmacological maneuvers or agents, which can be recognized subjectively by the individual himself (or by an objective observer) as representing a deviation in subjective experience or psychological functioning from certain norms for that individual during alert, waking consciousness[3]. Evaluating the level of consciousness is one of the initial, important and basic assessments of patients and it can be challenging even for experienced physicians. Various scoring systems have been defined that can be helpful in predicting patient's outcome by evaluating their level of consciousness[4]. Aninstrument that measuresdifferentdepthof coma should fulfill certain criteria. An ideal coma scale should be reliable, valid, easy to use, easy to remember and an indicator of patient outcome[5]. In comatose patients, therapeutic decisions

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and prognosis often depend upon the degree of encephalic disturbance. An evaluation of the state of consciousness, both precise and reliable, is therefore of vital importance [6]. The Glasgow Coma scale was originated in a Neurosurgical Intensive Care Unit, but found its way elsewhere, and became a standard scale used in the field by first responders, emergency physicians, and neuroscience specialists. The reliability of GCS in predicting patient outcomes is unsatisfactory, especially with regard to the verbal component. As a result researchers published a new scoring system, the Full Outline of Unresponsiveness (FOUR) score, a newer scale, developed to provide a more comprehensive assessment [7, 8]. The new scale provides greater neurological outcome [9]. The assessment of comatose patients includes the key findings of a neurologic examination, which can be entered into a practical scale such as the Glasgow Coma Scale (GCS), the standard coma scale for assessing the level of consciousness in patients with significant brain injury. The GCS assesses the motor, verbal, and eye responses of comatose patients and was constructed mainly to improve communication between physicians and nurses when describing different states of impaired consciousness and to avoid ambiguous designations. Despite broad acceptance for its simplicity and practical usefulness, the GCS has been criticized for being skewed toward the scale's motor response component and for the fact that the verbal component is unusable in intubated patients. Over the years, alternative scales have been developed but have rarely emerged in publications outside the institution or country where they originated [5]. However, a new and simple scale that is more comprehensive than the GCS has recently been validated, the Full Outline of Unresponsiveness (FOUR) Score, which has 4 testable components (eye responses, motor responses, brainstem reflexes, and respiration) with 5 possible scores for each component. The FOUR Score requires very little training, provides greater neurologic detail than the GCS, is simple to use, and recognizes possible brain death, allowing for possible organ donation. It forces the physician to do a more thorough coma examination, and provides information that may be of great use in prospective clinical trials [5].There is several studies available regarding predictive ability of FOUR score over GCS. In this study FOUR score was compared with GCS in predicting of mortality among unconscious patients admitted in Medical Intensive Care Unit (MICU) of a tertiary care hospital of Bangladesh.

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Materials and Methods:

This observational study was carried out in the Department of Critical Care Medicine; BIRDEM General Hospital aiming at compare GCS and FOUR score in terms of predicting mortality. All consecutive adult patients over the age of 18 years were selected for the purpose of the study after applying the inclusion and exclusion criteria.

Inclusion criteria: All patients admitted to ICU with the features of altered conscious level with Age ≥18years.

Exclusion criteria: Patient getting sedation, muscle relaxant at examination with Age <18year.

As most of the intubated patients in ICU on routine sedation we examined the patient while not getting sedation or during routine sedation window period after admission or within 24 hours of development of altered conscious level. Data were collected using a check list containing demographic information, preexisting chronic illness, biochemical markers, imaging findings etc. Later patients were followed up and data of hospital stay and mortality and time of ICU discharge were taken. Those who were discharged or transferred to ward/cabin were classified as survivors and those who were died, categorized as non survivors. Patient's resuscitation and management were done according to the standard ICU protocol of BIRDEM General Hospital Study patients were bearing the cost of the relevant investigations as tests were routinely done in the departments as part of management. Ultimately data analyzed by using Statistical Package for Social Sciences (SPSS) software (version 20).

Statistical analysis: Collected data was processed and analyzed by using Statistical Package for Social Sciences (SPSS) software version 20. For the purpose of this study, GCS score, FOUR score, biomarkers, and imaging studies were analyzed in all patients enrolled in the study. Descriptive statistics were used to summarize patient characteristics. Here categorical data were presented as frequency and percentage; numerical data were presented as Mean and Standard Deviation and two sample t-test for quantitative variables. P-value less than 0.05 were considered statistically significant.

Results:

In this study period (1st April 2017 to 30th September 2017), total 672 patients were admitted into the ICU. From them sample size was selected. All patients were resuscitated and treated in Intensive Care Unit as per standard ICU protocol. All patients were evaluated by both GCS and FOUR score simultaneously within 24 hours of admission or development of altered conscious level. By the process of selection 105 patients were included in my study.

Table I: Distribution of patients by their Age

Age (years) (n=105)	Total number (n)	Percentage
≤ 40	6	5.7
41-50	10	9.7
51 – 60	16	15.8
61 – 70	41	39.04
71-80	22	20.95
≥ 81	10	9.5
Total	105	100.72

Mean = 64.55 ; range = 20- 92 years

Table II: Distribution of patients by Gender

Among the study participants male patients were predominant

Gender (n=105)	Total number	Percentage
Male	57	54.3
Female	48	45.7
Total	105	100

Table III: Baseline characteristics of the patients

Baseline hemodynamic status and total count of WBC, Hb%, platelet count, serum creatinine and value are illustrated in Table III.

Variables	Mean ± SD	Range (Min-max)
Systolic BP (mmHg)	111.24 ± 21.15	70 – 200
Diastolic BP (mmHg)	62.86 ± 14.05	40 – 100
MAP	79.01 ± 15.8	50 – 130
Hb% (gm/dl)	10.16 ± 2.11	5.30 – 15.90
TC	14981 ±7549	2520 – 54120
Platelet	191611±108948	11000-620000
S. Creatinine (mg/dl)	2.90 ± 2.21	0.5 - 8.9

Septic shock was the commonest diagnosis (33.33%) among study subjects. Followed by Ischemic stroke 29 %, Meningo encephalitis 19.04 %, Electrolyte imbalance 17.14 %, Cardiogenic shock 12.38 %, others 17 %.

Table IV: Diagnoses of the patients (multiple responses)

Diagnosis (n=105)	Total number	Percentage
Septic shock	35	33.33
Ischemic stroke	31	29
Meningo encephalitis	20	19.04
Electrolyte imbalance	18	17.14
Cardiogenic shock	13	12.38
Survivor of cardiac arrest	9	8.57
Hemorrhagic stroke	2	1.9
Brain tumor	2	1.9
Diabetic ketoacidosis	2	1.9
Hypoglycemia	2	1.9
Brain trauma	1	0.9

Below table showed that most of the patients had multiple co morbidities as the study was performed in a specialized hospital with predominant diabetic patients. DM, HTN and Renal disease were on the top of the list.

Table V: Associated co-morbidities of the patients

Co-morbidity	Total number	Percentage
DM+HTN+RENAL DISEASES	41	39
DM+HTN	25	23
DM	12	11
DM+HTN+RENAL DISEASE+CAD	10	9
HTN+COPD+RENAL DISEASE+CAD	7	6
DM+Br Asthma+ CAD	5	4
DM+COPD+HTN	5	4
Total	105	100.0

Lowest total score was found 3, Highest total score was found 11, Eye minimum score 1, maximum 4, Motor minimum score 1, maximum 5, Verbal minimum score 1, maximum 5.

Table VI: GCS values with its individual components

Total and component	Minimum	Maximum	Mean	SD Deviation
TOTAL GCS SCORE	3	11	5.95	2.016
EYE	1	4	1.77	0.880
MOTOR	1	5	2.90	1.252
VERBAL	1	4	1.26	0.621

Lowest **FOUR** score was found 1, Highest score was found 13, Eye minimum score 0, maximum 4, Motor minimum score 0, maximum 3, Brain reflex minimum score 0, maximum 4, Respiration minimum score 0, maximum 4. In my study, among survivor group (n=34) Mean ± SD of GCS was 7.15 ±1.56 and FOUR score was 7.74 ±2.26; among non-survivor group (n=71) Mean ± SD of GCS was 5.38 ±1.97 and FOUR score was 5.35 ±2.83 (table VIII).

Two sample t-test was done to measure the level of significance. It was statistically significant. Total 71 patients were non-survived. Mean ± SD of GCS score among this group was 5.38 ±1.967. Mean ± SD of FOUR score among this group was 5.35 ±2.83. Two sample t-test was done to measure the level of significance. It was statistically not significant *P*-value <0.93 (table IX). Total 34 patients were survived. Mean ± SD of GCS score among this group was 7.15 ±1.56 (table X). Mean ± SD of FOUR score among this group was 7.74 ±2.26. Two sample t-test was done to measure the level of significance. It was statistically not significant *P*-value <0.21

Table VII: FOUR score and its component values of all patients

Total and component	Minimum	Maximum	Mean	SD Deviation
TOTAL FOUR SCORE	1	13	6.12	2.878
EYE	0	4	0.85	0.969
MOTOR	0	3	1.63	0.912
BRAIN REFLEX	0	4	2.33	1.174
RESPIRATION	0	4	1.34	0.928

Table VIII: Comparison of GCS & FOUR score between survivor and non-survivor groups

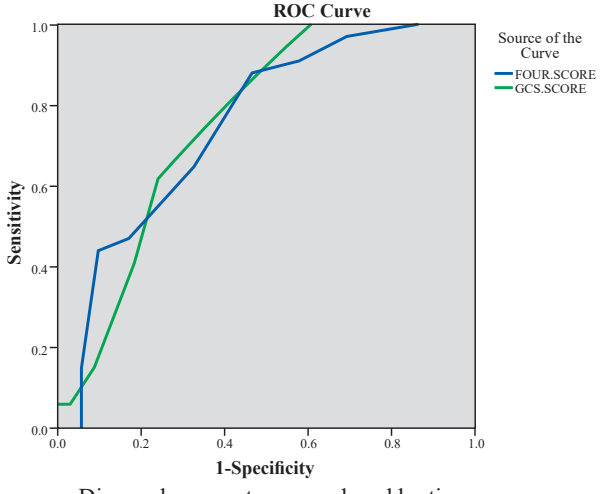
	Group		*P*-value
	Survivors (n=34) Mean ± SD	Non-survivors (n=71) Mean ± SD	
GCS	7.15 ±1.56	5.38 ±1.97	<0.0001
FOUR score	7.74 ±2.26	5.35 ±2.83	<0.0001

Table IX: Comparison between GCS and FOUR score in non-survivor group of altered conscious patients

Score	Mortality	(Mean ± SD)	*P*-value
GCS	5.38 ±1.967		<0.93
FOUR	5.35 ±2.83		

Table X: Comparison between GCS and FOUR score in survivor group of altered conscious patients.

Score	Mortality	(Mean ± SD)	*P*-value
GCS	7.15 ±1.56		<0.21
FOUR	7.74 ±2.26		



Diagonal segments are produced by ties.

Figure: Both ROC curve of FOUR score and GCS score

ROC curve of FOUR score and GCS score both in prediction of outcome of unconscious patients. : ROC curve of GCS showing that [AUC = 0.757], (it is statistically significant), Cut-off value 5.5 with sensitivity = 85%, Specificity= 55%. ROC curve of FOUR score showing that [AUC = 0.754], (it is statistically significant), Cut-off value 5.5 with sensitivity = 88%, Specificity

Discussion:

Altered conscious level is a common examination finding in this study is a reflection of diseases severity and prognosis. In this study DM (82.85%) was most common co morbidity and the predominant diagnosis was Septic shock 33%, followed by Ischemic stroke 29%, Meningo encephalitis 19.04 %, and Electrolytes imbalance 17.14%, Cardiogenic shock 12.38%, Survivor of cardiac arrest 8.87%, Hemorrhagic stroke 1.9%, Diabetic ketoacidosis 1.9%, Hypoglycemic coma 1.9% and traumatic brain injury .9%, (1case only). DM is common co morbidity because in my study place it is well known for diabetic care and understandably infection and micro and macro vascular complications are very common in this group of population. Septic shock is a predominant diagnosis (33%). Mean ± SD of MAP of total study population was (79.01 ± 15.8) mm Hg, which ranges (50-130) mm Hg. Among them in case of survival patients MAP was (84.79 ± 12.33) mm Hg which ranges (53 – 113) mm Hg and incase of non-survival patient it was (76.24 ± 16.59) mm Hg which ranges (50 – 133) mm Hg.

Many researchers validated FOUR score as a Coma score and they found the diagnoses of the patients selected for the study were ischemic or hemorrhagic stroke (29 patients; 24%), traumatic head injury (25 patients; 21%), craniotomy for brain tumor (13 patients; 11%), aneurysmal subarachnoid hemorrhage (12 patients; 10%), post anoxic-ischemic encephalopathy (10 patients; 8%), spinal surgery (including trauma; 8 patients; 7%), seizures and status epilepticus (7 patients; 6%), other encephalopathies (4 patients; 3%), central nervous system infection (4 patients; 3%), acute neuromuscular disease (3 patients; 2%), and miscellaneous acute neurological conditions (5 patients; 4%)[7]. Others found that the distributions of the patients' diagnoses were brain tumour (56.6%), intracranial hemorrhage (21.1%), intracranial aneurysm (15.1%), intracranial infection (2.3%), hydrocephalus (2.0%), pneumocephalus (1.3%) and skull defect (1.7%)[10]. Many researchers validated FOUR score coma scale in a Medical Intensive Care and they found 66 patients, diagnoses included cerebral hemorrhage (n=12), anoxic ischemic brain injury (n=11), ischemic stroke (n=10), subarachnoid hemorrhage (n=7), craniotomy (n=7), metabolic encephalopathy (n=6), seizures (n=5), meningitis or encephalitis (n=5), and traumatic brain injury (n=3)[11]. A total of 51 patients were enrolled[8]. The diagnosis of TBI included intracranial bleeding contusions (n=27), subarachnoid hemorrhage (n=27), subdural hematoma (n=24), concussion (n=5), and epidural hematoma (n=2). In this study among all unconscious patients (Mean ± SD) of GCS was (5.95 ±2) ranges from (3-11). In case of survivor group (n-34) (Mean ± SD) of GCS was (7.15 ±1.56.In case of non-survivor (n=71)

group it was (Mean ± SD) of GCS was (5.38 ±1.96). Two sample t-test was done to measure the level of significance among both survivor and non-survivor group and found p <0.0001. In case of FOUR score (Mean ± SD) was (6.12 ±2.87) ranges from (1-13). In case of survivor group (n-34) (Mean ± SD) of FOUR score was (7.74 ±2.26).In case of non-survival (n=71) group it was (Mean ± SD) of FOUR score was (5.35 ±2.83). Two sample t-test was done to measure the level of significance among both survivor and non-survivor group and found p <0.0001. Khanal et al. (2016) found in their study that Mean GCS score among survivors was 9.56 ± 3.63 and among the non-survivors was 5.24 ± 2.20 ($P < 0.001$). Mean FOUR score among survivors was 9.13 ± 3.61 and among non-survivors was 4.97 ± 2.76 ($P < 0.001$).Both GCS and FOUR scores were lower among non-survivors than among survivors, and they were statistically significant[12]. Others found that Means of scores in dead and alive patients for GCS were 4.62 ± 2.094 and 6.58 ± 2.281, and for FOUR they were 4.7 ± 3.471 and 8.42 ± 2.925, respectively. t-test showed a significant difference between means of the alive and dead subjects in both scales (< 0.0001)[13].

In this study survivor (n=34) group among all unconscious patients (Mean ± SD) of FOUR score was (7.74 ±2.26) In case of GCS (Mean ± SD) was (7.15 ±1.56). Two sample t-test was done to measure the level of significance among both group and found p <0.21. In case of non-survivor (n=71) group among all unconscious patients (Mean ± SD) of FOUR score was (5.35 ±2.83) In case of GCS (Mean ± SD) was (5.38 ±1967). Two sample t-test was done to measure the level of significance among both group and found p <0.93. Others found that in terms of predictive power for in-hospital mortality, the area under the receiver operating characteristic (ROC) curve was 0.93 for FOUR score and 0.89 for GCS. In terms of predictive power of poor neurologic outcome at 3–6 months, the area under the ROC curve was 0.85 for FOUR score and 0.83 for GCS as evidenced by GOS 1–3, and 0.80 for FOUR score and 0.78 for GCS as evidenced by mRS 3–6. The odds ratio (OR) for in-hospital mortality was 0.64 (0.46–0.88) from FOUR score and 0.63 (0.45–0.89) from GCS, for poor neurologic outcome was 0.67 (0.53–0.85) from FOUR score and 0.65 (0.51–0.83) from GCS for GOS, and was 0.71 (0.57–0.87) from FOUR score and 0.71 (0.57–0.87) from GCS for mRS[8].

In this study ROC curve of GCS in prediction of outcome of unconscious patients [AUC = 0.757], cut-off value 5.5 with sensitivity = 85%, specificity= 55%. And ROC curve of FOUR score in prediction of outcome of unconscious patient [AUC = 0.754], cut-off value 5.5 with sensitivity = 88%, specificity= 54%. Many researchers found in their study that good correlation between GCS and FOUR score, with Spearman's rho correlation coefficient of 0.91 (P < 0.001)[12]

Some researchers found that (Spearman's rho = 0.92)[7]and (Spearman's rho = 0.81).In this study it was found that Spearman's rho 0.868; P-<0 .001, which was also statistically significant.

Limitations:

Like any other scientific study the present study is not without limitations. The following limitations deserve mention:

1. As the sample size was small, the findings derived from study cannot be generalized to reference population and the data should be interpreted with utmost caution.
2. Study was conducted in a tertiary care hospital where most of the patient population were diabetic, CKD and having preexisting multiple co-morbidities.
3. To evaluate Coma scale and its efficacy we should also studied upon traumatic head injury patient and those patient required Neurosurgical intervention
4. The study patients were followed up only during the time period ICU admission not in total hospital length of stay.

Conclusions:

In this study it was found that both GCS and FOUR score significantly varies among survivor and non-survivor groups of unconscious patients but while comparing them regarding predicting mortality there is no significant differences in both score. Finally we conclude that both GCS and FOUR score equally good at predicting in hospital mortality among unconscious patients admitted in MICU.

References:

1. Parrillo JE, Dellinger RP. Critical care medicine: principles of diagnosis and management in the adult. Philadelphia: Elsevier. 2014.
2. Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson J, Loscalzo J. Harrison's Principles of Internal Medicine. 18thedition. New York, NY: McGraw-Hill.2012.
3. Kevric j, Jelinec GA, Knott J, Weiland TJ. Validation of full outline of unresponsiveness (FOUR) scale for conscious state in the emergency department: compare against Glasgow coma scale. Emerg Med J. 2011; 28:486-90.
4. Baratloo A, Shokravi M, Safari S, Aziz Ak. Predictive value of glasgow coma score and full outline of unresponsiveness score on the outcome of multiple trauma patients. Arch Iran Med. 2016; 19(3):215-20.
5. Wijdicks EFM. Clinical scales for comatose patients: The Glasgow coma scale in historical context and the new FOUR score. Reviews in Neurological diseases. 2006; 3(3):109-17.
6. Born JD, Hans P, Albert A, et al. Interobserver Agreement in Assessment of Motor Response and Brain Stem Reflexes. 1987; 20:513-17.
7. Wijdicks EFM, Baler WR, Maramattom BV, Manno EM, Mc CellandRL. Validation of new Coma scale: The Four score. Ann.Neurol. 2005; 58:585-93.
8. Sadaka F, Patel D, Lakshman R.The Four score predicts outcome in patients after traumatic brain injury. NeuroCritcare. 2011;16: 95-101.
9. Idrovo L, Fuentes B, Medina j, GabaIdon L, Ruiz-Ares G, Abenja MJ, et al. Validation of Four score (Spanish version) in acute stroke: An inter observer variability study. EurNeurol. 2010; 63:364-69.

10. Akavipat, P, Sookplung, P, Kaewsingha, P, Maunsaiyat, P. Prediction of discharge outcome with the full outline of unresponsiveness (FOUR) score in neurosurgical patients. Acta Medica Okayama. 2011; 65(3):205-210.

11. Iyer VN, Mandrekar JN, Danielson RD, Zuvkof AY, Elmer JL, Wijdicks EFM. Validity of Four Coma scale in the medical intensive care unit. Mayo Clin Proc. 2009; 84(8):694-701.

12. Khanal K, Bhandari SS, Shrestha N, Acharya SP, Marhatta MN. Comparison of outcome prediction by the Glasgow coma scale and the Full Outline of Unresponsiveness score in the neurological and neurosurgical patients in the Intensive Care Unit. Indian J Crit Care Med. 2016; 20:473-6.

13. Rostam J, Mansour R.A Comparison of the Glasgow Coma Scale Score with Full Outline of Unresponsiveness Scale to Predict Patients' traumatic Brain Injury Outcomes in Intensive Care Units. Critical Care Research and Practice. 2014.