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Full Outline Of Unresponsiveness (Four) Score Versus Glasgow Coma Scale (Gcs) To Predict Outcome In Children Admitted To Pediatric Intensive Care Unit-A Cross-Sectional Study (Diagnostic)"

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Abstract:
Background*: Assessing altered consciousness in children is a complex and critical element of emergency treatment. There is no objective method for communicating and documenting the degree of coma other than vital signs. Clinicians widely use clinical ratings or scales to record the state of awareness. The prediction power of the FOUR score was shown to be as excellent as that of the GCS in a pooled study of prospectively examined individuals with traumatic and non-traumatic coma. As a result, the current research was conducted to test the accuracy of the Full Outline of Unresponsiveness (FOUR) Score and the Glasgow Coma Scale (GCS) in predicting outcomes in children aged 2 to 18 years admitted to the Pediatric Intensive Care Unit.*
Materials and Methods*: Eighty-four patients from the age group 2-18 were included in the study. A hospital-based cross-sectional survey (diagnostic) was conducted in the Pediatric intensive care unit of a tertiary care hospital from January 2021 to December 2022. When consciousness is impaired, the outcome is related to the etiology of the insult and rapid identification and treatment of the underlying cause. Five broad outcome categories noted were death, persistent vegetative state, severe disability (conscious but disabled), moderate disability (disabled but independent), and good recovery.*
Results*: Most subjects had a GCS score between 3 to 8 (60.71%), followed by 9 to 12 (moderate score) among 39.29%. None of the subjects had a mild score (13 to 15). The majority of the subjects had FOUR scores between 5 to 13 (moderate severity) [90.48%], followed by severe scores (0 to 4) among 4.76% of subjects, and 13 to 16 (mild) scores among 4.76% of study subjects. We observed that in discharged subjects, the mean GCS score was 8.23 ± 1.83, and the mean FOUR score was 10.38 ±1.40, which was comparatively more significant than the GCS score. Among the dead subjects, the mean GCS score was 5.2 ±1.05, and the mean FOUR score was 5 ± 1.85. All the subjects with severe FOUR scores died [n=4 (100%)], and 8 (10.52%) with moderate severity died. At the same time, 12 (23.52%) study subjects with severe GCS scores died.*
Conclusion: *The present study can conclude that the FOUR score predicts mortality better than the GCS score.*
Keyword: *Pediatric intensive care unit, motor evoked response, brainstem reflex*

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I. Introduction

The assessment of altered consciousness in children is a complex and critical element of emergency treatment. There is no objective method for communicating and documenting the degree of coma other than vital signs. Clinicians widely use clinical ratings or scales to record the state of awareness. (1) The Glasgow Coma Scale is one of the most extensively used measures for assessing patients with altered consciousness levels and predicting illness prognosis (GCS). (2)(3) GCS has three components: eye, verbal, and motor responses, with a minimum score of 1 and a maximum score of 4 in the eye component, 5 in the verbal component, and 6 in the movement component. (4) By far, the most extensively used and popular scoring system for this purpose is the Glasgow Coma Scale (GCS). It was developed to examine persons with head trauma, but it is increasingly being used to screen patients with non-traumatic coma.

According to many research, GCS serves as a guideline for primary care and illness outcome prediction (mortality and morbidity). Despite its extensive usage, GCS has limitations, such as inter-rater reliability and predictive validity fluctuation. (4)

Several drawbacks of the GCS have been discovered when using it. It has inter-observer agreement limits; it is difficult to use in nonverbal or intubated patients; it lacks brainstem reflexes; the sub-scores are not evenly represented in the total scores; and there are doubts about its predictive powers. Newer scales have not found widespread adoption.

However, the "Full Outline of Unresponsiveness (FOUR) score," a newly validated new coma scale, has sparked international attention. The elimination of the verbal component of GCS, as well as the addition of brainstem reflexes and respiratory rhythm, are the key features of this 16-point score. The "FOUR scores" were initially evaluated in the neurological-neurosurgical ICU and showed promising results. It is beneficial in people with stroke, trauma, and non-traumatic coma during the past ten years or so. Trainees, nurses, ICU personnel, and neurologists have all utilized it. (1)(4) It has been shown to have equivalent inter-rater reliability and predictive capacity to GCS.(4)

The prediction power of the FOUR score was shown to be as excellent as that of the GCS in a pooled study of prospectively examined individuals with traumatic and non-traumatic coma. (5) Only a few studies have examined the FOUR scores in children with altered awareness. (3) (6)(7)(8) More evidence on using the FOUR score in children, particularly those in non-traumatic coma, is still needed. This research examined the prediction ability of the FOUR scores and the Glasgow Coma Scale (GCS) in children aged 5 to 12 admitted to the pediatric emergency department with impaired consciousness. (8)

II. Material And Methods

This study was conducted over two years in a tertiary care center from January 1, 2020, to December 31, 2021.

Aim and Objectives: To study the accuracy of the Full Outline of Unresponsiveness (FOUR) Score and Glasgow Coma Scale (GCS) in predicting outcomes between age group 2 years- 18 years of children admitted to the Pediatric Intensive Care Unit.

Study Design: A cross-sectional hospital-based study (diagnostic)

Study Location: Pediatric intensive care unit of tertiary care hospital at NKP Salve Institute of Medical Science & Research Centre.

Study Duration: January 2020 to December 2021

Sample size: 84 patients.

Sample size calculation: As per the article "Comparison between the ability of Glasgow Coma scale and Full Outline of Unresponsiveness Score to predict the mortality and discharge rate of PICU" (7), the mortality average in PICUs is 28.5%. Based on this, the sample size is 83.5, rounded to 84. Convenient sampling technique (all children of age group 2 years-18 years admitted to the PICU fulfilling the inclusive criteria will be included).

Inclusion criteria:
All children between the age group 2 years and 18 years were admitted to PICU.

Exclusion criteria:
1. Patients receiving sedating drugs and neuromuscular blockers, including midazolam, fentanyl, sufentanil, morphine, pancuronium bromide, atracurium, nesdonal, and propofol
2. Patients with vision, hearing, speech, or limb paralysis problems.
3. In addition, patients under the age of two years and above 18 years (because of an inability to communicate verbally ill patients less than two years and because of lack of PICU admission in patients over 18 years) were excluded.

Operational Definition

OUTCOME TREATMENT- When consciousness is impaired, the outcome is related to the etiology of the insult and rapid identification and treatment of the underlying cause. Five broad outcome categories
1. Death
2. Persistent vegetative state
3. Severe disability (conscious but disabled)
4. Moderate disability (disabled but independent)
5. Good recovery

As a result, the current research was conducted to test the accuracy of the Full Outline of Unresponsiveness (FOUR) Score and the Glasgow Coma Scale (GCS) in predicting outcomes in children aged 2 to 18 admitted to the Pediatric Intensive Care Unit.

Procedure methodology

The study was carried out over two years after obtaining permission from the Institutional Ethics Committee and written informed consent. Detailed clinical history was taken, and a general and systemic examination was done. Investigations were done wherever necessary. The data was collected using standard, pre-validated, semi-structured case record proforma. Research data was collected using the FOUR and GCS scores, which were collected using questionnaires conducted on the day of admission. Outcomes were also recorded among the study subjects. FOUR Score and GCS score were compared with outcomes

III. Result

Age distribution: Majority of the study subjects belonged to the age group of 2 to 5 years (45.24%), followed by 6 to 10 years (25%), 11 to 15 years (19.05%), and 16 to 18 years (10.71%).

Table 1: Age distribution

Age distribution	Number of subjects	Percentage
2 to 5 years	38	45.24
6 to 10 years	21	25.00
11 to 15 years	16	19.05
16 to 18 years	9	10.71
Total	84	100.00

Respiratory parameters: Spontaneous respiration was noted among 67.86% of study subjects, whereas 32.14% needed ventilatory support.

Table 2: Respiratory parameters

Respiratory parameters	Number of subjects	Percentage
Spontaneous respiration	57	67.86
Ventilatory support	27	32.14
Total	84	100.00

Diagnosis: Intracranial hemorrhage was noted among 29.76% of study subjects, Intracranial infection was noted among 25.00 % of study subjects, Hydrocephaly was noted among 14.29 % of study subjects, Seizure was noted among 17.86 % of study subjects, Aneurysm was noted among 2.38% of study subjects, Brain tumor was noted among 3.57 % of study subjects, and Other causes were observed among 7.14 % of study subjects.

Table 4: Diagnosis

Diagnosis	Number of subjects	Percentage
Intracranial hemorrhage	25	29.76
Intracranial infection	21	25.00
Hydrocephaly	12	14.29
Seizure	15	17.86
Aneurysm	2	2.38
Brain tumor	3	3.57
Other causes	6	7.14
Total	84	100.00

Outcomes: 85.71% of study subjects were cured and discharged, whereas we observed mortality among 14.29% of study subjects.

Table 5: Outcomes

Outcomes	Number of subjects	Percentage
Discharged	72	85.71
Mortality	12	14.29
Total	84	100.00

Comparison of mean GCS and FOUR scores with outcomes: In discharged subjects, the mean GCS score was 8.23 ± 1.83, and the mean FOUR score was 10.38 ±1.40, which was comparatively more significant than the GCS score. Among the dead subjects, the mean GCS score was 5.2 ±1.05, and the mean FOUR score was 5 ± 1.85. All the subjects with severe FOUR scores died [n=4 (100%)], and 8 (10.52%) with moderate severity died. At the same time, 12 (23.52%) study subjects with severe GCS scores died.

Table 10: Comparison of mean GCS and FOUR scores with outcomes

SCORES	Discharged	Mortality
GCS score	8.23 ± 1.83	5.2 ±1.05
FOUR score	10.38 ±1.40	5 ± 1.85

Interpretation	Mortality	
	GCS scale	FOUR score scale
Severe	12 (23.52%)	4 (100%)
Moderate	0	8 (10.52%)
Mild	0	0

IV. Discussion

Establishing a Pediatric intensive care unit aims to achieve the best results and outcomes for critically ill children. One way to accomplish this goal is to predict the mortality risk of patients admitted to the Pediatric intensive care unit to provide the best care possible. To assess the efficacy of the care provided, models that predict mortality risk in pediatric intensive care units must be developed. For this purpose, patient neurological examination tools or coma examination scales are accepted as effective scales for disease outcome examination. A coma scale must be usable in various settings and by healthcare providers with varying experience levels to be an effective tool. In this regard, the FOUR score is intended to compensate for GCS shortcomings by revealing more neurological details in unconscious patients and predicting the final result more accurately and efficiently. Hence, the current study was conducted at a tertiary healthcare center to assess the accuracy of the Full Outline of Unresponsiveness (FOUR) Score and Glasgow Coma Scale (GCS) in predicting outcomes in children admitted to the Pediatric Intensive Care Unit between the ages of 2 and 18.

Demographic information: Majority of the study subjects belonged to the age group of 2 to 5 years (45.24%), followed by 6 to 10 years (25%), 11 to 15 years (19.05%), and 16 to 18 years (10.71%). Tamer Fakhry et al. (9) discovered that the mean and standard deviation of patients' ages was 7.65.1 years (77% male) in their study. In their research, Kundan Mittal et al. discovered that most patients were younger than five years old, ranging from 1-14 years. The study population's average age was 6.64 4.13 years. (10)

Respiratory parameters: In the present study, we observed that Spontaneous respiration was noted among 67.86% of study subjects, whereas 32.14% needed ventilatory support. Ali Khajeh et al.(7) observed that of the 200 patients, 76% (n=152) had spontaneous respiration, and 24% (n=48) were ventilated with a mechanical ventilator.

Diagnosis: In the present study, we assessed the diagnosis of the study subjects. We observed that Intracranial hemorrhage was noted among 29.76% study subjects, Intracranial infection was noted among 25.00 % study subjects, Hydrocephaly was noted among 14.29 % study subjects, Seizure was noted among 17.86 % study subjects, Aneurysm was noted among 2.38% study subjects, Brain tumor was noted among 3.57 % study subjects, Other causes were observed among 7.14 % study subjects. Kundan Mittal et al. (10), in their study, observed that Among 150 enrolled patients, meningoencephalitis was found to be the most common disease in 91 (60.66%) patients, followed by hepatic encephalopathy in 26 (17.33%) and tubercular meningitis in 17 (11.33%) patients.

Outcomes: 85.71% of study subjects were cured and discharged, whereas we observed mortality among 14.29% of study subjects. Ali Khajeh et al.(7) observed that of the 200 patients who participated in this study, 143 (71.5%) were discharged after recovery, and 57 (28.5%) patients died in the ICU.

Glasgow coma scale: Most subjects had GCS scores between 3 to 8 (60.71%), followed by 9 to 12 (moderate score) among 39.29%. None of the subjects had mild scores (13 to 15)

FOUR Scale: Although the GCS has been widely used in hospital settings, the FOUR score was developed because of failures in examining intubated patients' verbal responses and brainstem reflexes. Because of these benefits, the FOUR scores can reveal patients' actual state of consciousness, making it more accurate in predicting patients' future states. We discovered that the majority of the subjects [90.48%] had a FOUR score between 5 and 13 (moderate severity), with 4.76% having a severe score (0 to 4) and 4.76% having a 13 to 16 (mild) score. These findings agree with those of Cohen, Wijdicks, et al., and Iyer et al. (5)(11)(12)(13)(14)(15).

In a study conducted in Turkey by Büyükcam et al. (3), no significant difference was found between these tools for predicting the mortality of children admitted to the ICU. This difference is most likely because the participants in the research by Büyükcam et al. (3) were only children with a medical diagnosis of stroke. In contrast, the current study included children with a variety of medical neurology and neurosurgery diagnoses. Comparison of mean GCS and FOUR scores with outcomes: In the present study, we assessed the comparison between mean GCS and FOUR scores and the outcomes among the study subjects. We observed that in discharged subjects, the mean GCS score was 8.23 ± 1.83, and the mean FOUR score was 10.38 ±1.40, which was comparatively more significant than the GCS score. Among the deceased subjects, the mean GCS score was 5.2 ±1.05, and the mean FOUR score was 5 ± 1.85. All the subjects with severe FOUR scores died [n=4 (100%)], and 8 (10.52%) with moderate severity died. At the same time, 12 (23.52%) study subjects with severe GCS scores died.

Pandwar U et al. (16) in their study observed that the mean (SD) FOUR score was significantly lower at 48 hours in children who died than in children who recovered and were discharged [16.0 (0) vs. 2.5 (0.57); P=0.001].

V. Conclusion

The present study concluded that The male-to-female ratio in the current study was 1.89:1. Intracranial hemorrhage was the most typical presentation, followed by Intracranial infection, Hydrocephaly, and Seizure. We observed mortality among 14.29% of study subjects. In FOUR scale parameters, mean values of all four parameters (eye response, motor response, brainstem reflexes, respiration) were significantly lesser in subjects who died in the present study than those who were discharged. When GCS scale parameters were assessed among death and discharged subjects among the study subjects, We observed that mean scores of eye-opening response, best motor response, and overall GCS score in the GCS scale were significantly lesser in the subjects who died than those who were discharged. In discharged subjects, the mean GCS score was 8.23 ± 1.83, and the mean FOUR score was 10.38 ±1.40, which was comparatively more significant than the GCS score. Among the dead subjects, the mean GCS score was 5.2 ±1.05, and the mean FOUR score was 5 ± 1.85. All the subjects with severe FOUR scores died [n=4 (100%)], and 8 (10.52%) with moderate severity died. At the same time, 12 (23.52%) study subjects with severe GCS scores died. Hence, from the present study, we can conclude that the FOUR score predicts mortality better than the GCS score.

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