RESEARCH PAPER

Comparison of Full Outline of Unresponsiveness Score and Glasgow Coma Scale for Assessment of Consciousness in Children With Acute Encephalitis Syndrome

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Received: April 27, 2022;
Initial review: May 22, 2022;
Accepted: August 23, 2022.

Objectives: To correlate the Full outline of unresponsiveness (FOUR) score and Glasgow coma scale (GCS) in the assessment of children with acute encephalitis syndrome (AES). **Method:** This observational study was conducted in the department of pediatrics of a public sector tertiary care center from January, 2019 to March, 2020. All consecutive patients of AES admitted during the study period (n=150) were recruited. Subjects were analyzed using the FOUR score and GCS on admission, and then 12-hourly till discharge/ death. Treatment-related and demographic variables were collected and analyzed. Correlation between FOUR score and GCS scores was calculated using spearman correlation coefficient. **Results:** Positive correlation was observed between the GCS score and the FOUR score (n=0.82; P<0.001). **Conclusion**: FOUR score and GCS were comparable to assess the level of consciousness in patients with AES. The possibility of using FOUR score as an alternative to GCS in children with AES needs to be considered.

Keywords: *Emergency department, Febrile encephalopathy, Pediatric intensive care unit*.

Published online: September 22, 2022; **PII:** S097475591600456

Acute encephalitis syndrome (AES) is defined as "acute onset of fever, with acute change in mental condition which includes confusion, disorientation, coma, and inability to talk or new onset of seizures (excluding simple febrile seizures) in a person of any age" [1]. It is a group of clinical symptoms and signs, proposed by the World Health Organization (WHO) for surveillance purposes, to screen patients with viral encephalitis, including Japanese encephalitis.

Glasgow coma scale (GCS) was initially developed to assess consciousness after head injury [2,3]. Now, it is also used for outcome prediction in patients with stroke, as a neurosurgical prognostic indicator, and for cerebral dysfunction measurement [2-5]. Limitations of GCS are its low efficiency in intubated patients, inability to evaluate brainstem reflexes, and its poor use in case of language disorder [6-8].

The full outline of unresponsiveness (FOUR) score was developed to overcome these limitations [9]; however, its accuracy and precision have been evaluated only in a few studies [10]. This study was performed to correlate the GCS and FOUR score for assessment of consciousness in patients admitted with AES.

METHODS

This observational study was conducted at a pediatric intensive care unit (PICU) of an academic, tertiary care center between January, 2019 to March, 2020. All patients aged five to 12 years fulfilling the WHO definition of AES, were recruited to the study after taking informed consent from their legal guardians. The study was approved by the institutional ethics committee. Children with a head injury, chronic neurological illness, known cases of epilepsy, brain tumor, or febrile seizure, and suspected metabolic disorder were excluded.

Demographic data, including age, gender, and clinical features were collected at admission to the PICU. FOUR score and GCS were evaluated by the on duty resident in each patient at the time of admission, and then 12-hourly throughout the PICU stay. The statistical analysis was performed using scores of the initial 48 hours. Patients were categorized into three groups viz., the mean GCS was classified as severe [3-8], moderate [9-12], and mild [13-15] while the mean FOUR score was divided into three groups (0-7), (8-13) and (14-16).

Statistical analysis: The collected data were coded and analyzed using IBM SPSS Statistics for Windows, version 21 (IBM Corp.). Chi-square test was used for analysis of the statistical difference between proportions. Spearman correlation coefficient was used to evaluate the correlation between the FOUR score and GCS. A P value less than 0.05 was considered statistically significant.

RESULTS

The study was conducted among 150 children. Baseline demographic characteristics are depicted in **Table I**. The mean (SD) age of children with AES was 8.82 (2.33) years and most children belonged to 8 to 10 years of age (47.3%). Fever (100%) was the most common presenting clinical feature followed by altered sensorium (75.3%).

The mean (SD) GCS score at the time of admission was 8.82 (2.33), and most children had a score between 8 and 12. After 12 hours, the GCS score improved in majority of children, and at the end of 48 hours, GCS was less than 8 in only four children. The mean GCS at admission amongst children, who were discharged and died, was not statistically different [9.5 (1.88) vs 9.7 (2.33); *P*=0.74]. However, the GCS at 48 hours was significantly lower in children who died than in children who recovered and were discharged [14.7 (0.49) vs 3.75 (0.50), *P*=0.001].

The mean (SD) FOUR score at admission was 11.03 (2.63) and was in the range of 8 to 14 in the majority of children. At the end of 48 hours, FOUR scores were low only in four children. At admission, the FOUR score was also comparable amongst patients who died and those who were discharged [11.12 (2.51) vs 10.3 (3.10) *P*=0.16]. 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] **(Table II)**. A strong positive correlation was observed between GCS score and FOUR scores (r=0.82; *P*<0.001) **(Fig. 1)**.

DISCUSSION

In this study, we observed that the FOUR score correlated well with GCS in the monitoring of consciousness among children with AES. Both FOUR scores and GCS were significantly low at 48 hours among the children who died, as compared to those who were discharged.

Fever was documented in all the children and altered sensorium was noted in 75.3% of patients. Khinchi, et al. [10] observed fever and altered sensorium in all the children with AES, seizures in 90%, and vomiting in 30% of the children. The difference in the etiology and severity of AES could be the possible reason behind these differences in both studies.

None of the previous studies have assessed the predictive value of the FOUR score in AES. We found that both GCS and FOUR scores at admission were poor predictors of outcome; however, the change in GCS and FOUR scores at subsequent time intervals were the better determinants of outcome. In our study, both GCS and FOUR scores showed a similar performance, and both tools were good at predicting the outcome in children with AES.

Table I Baseline Characteristics of Children With Acute Encephalitis Syndrome Enrolled in the Study (*N*=150)

Characteristics	*n (%)*
Age (y)	8.82 (2.33)
Male gender	79 (52.7)
Clinical features at presentation	
Fever	150 (100)
Altered sensorium	113 (75.3)
Seizures	54 (36.0)
Glasgow Coma Scale[a]	8.82 (2.33)
Full Outline of Unresponsiveness Score[a]	11.03 (2.63)
Discharged	126 (84)

Values in no.(%) or [a]mean (SD).

Table II Glasgow Coma Scale Scores and Full Outline of Unresponsiveness (FOUR) Scores and Outcome in Children with Acute Encephalitis Syndrome (*N*=150)

Characteristics	*Discharged alive*	*Death during hospital stay*
Glasgow coma scale scores		
At admission, *n*= 150	9.5 (1.88)	9.7 (2.33)
12 h after admission,[a] *n*=149	11.2 (2.39)	7.8 (2.07)
24 h after admission,[a] *n*=135	12.6 (2.85)	5.5 (2.28)
48 h after admission,[a] *n*= 126	14.7 (0.49)	3.7 (0.50)
Full outline of unresponsiveness scores		
At admission, *n*=150	11.2 (2.51)	10.3 (3.10)
12 h after admission,[a] *n*=149	12.1 (3.38)	6.3 (3.31)
24 h after admission,[a] *n*= 135	13.8 (3.65)	4.6 (2.94)
48 h after admission,[a] *n*= 126	16.0 (0)	2.5 (0.57)

Values in mean (SD). [a]P<0.001.

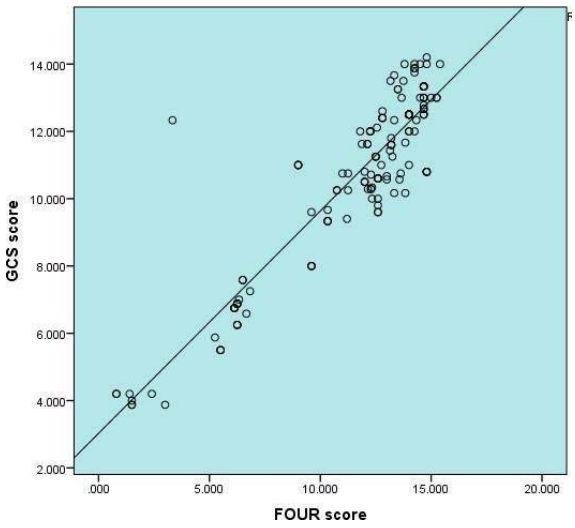

Fig. 1 Scatterplot showing correlation of full outline of unresponsiveness score with Glasgow coma scales score (r^2=0.827).

WHAT THIS STUDY ADDS?

- Full outline of unresponsiveness (FOUR) scores correlated well with Glasgow coma scale scores in children with acute encephalitis syndrome.

However, GCS has certain disadvantages, such as the verbal component cannot be assessed in intubated patients, and it does not reflect the severity of coma. FOUR score provides information about brainstem function and respiratory drive by which severity of coma can be assessed. It is also useful in intubated patients, comatose patients, and the pediatric population as the verbal response is not a component of the FOUR score.

In our study, a strong positive correlation was observed between GCS and FOUR scores. Many previous studies also documented a similar predictive value of the GCS and FOUR scores [11-15]. McNett, et al. [13] concluded that the predictive ability of the FOUR score was comparable to GCS while assessing the functional status and cognitive outcome amongst children admitted with a traumatic injury. Stead, et al. [14] concluded that inter-rater reliability was excellent for the FOUR score in predicting the functional outcome and overall survival among children. The authors documented that the performance of the FOUR score was comparable to that of GCS; however, the FOUR score provided more neurological details that helped in the triaging and the management of these patients.

The limitations of the present study include a small sample size and limited generalizability of these results as we included only AES patients; thus, the results of this study cannot be extended to all patients admitted to PICU. We also did not calculate the inter-rater reliability of the residents for the FOUR score.

FOUR scale and GCS scores have a good correlation for the assessment of children with AES. These results, if confirmed in different settings, suggest that FOUR score may be used as an alternative to GCS while assessing the level of consciousness; especially, in children with AES.

Ethics clearance: Institution ethics committee, GMC, Bhopal; No. 35673-75 MC/IEC/2018, dated November 5, 2018.
Contributors: NM: Acquisition and interpretation of data and literature review, BM: Acquisition and interpretation, data analysis, and literature review; UP: Concept, interpretation of data and data analysis, literature review, and drafting the article; SR: Interpretation of data and data analysis, literature review and drafting the article; AA: Editing the article, literature review, and revising the article critically for important intellectual content. All the authors approved the final manuscript.
Funding: None; *Competing interests*: None stated.

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