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Outcome of Trauma Patients Admitted to Emergency Department Based on Full Outline of Unresponsiveness Score

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Abstract

Introduction: Full Outline of Unresponsiveness (FOUR) score is one of the existing scoring scales, which has been used for evaluating the level of consciousness in recent years.

Objective: The present study has been done with the aim of evaluating the ability to predict the outcome of patients with head trauma based on FOUR score on admission to emergency department (ED).

Methods: In the present prospective cross-sectional study, head trauma patients with any changes in alertness level presenting to ED were evaluated. FOUR score measurement was done on admission and 6 hours after that. The studied outcomes in the current study included discharge without sequel, discharge with neurologic sequel, brain death or death during 1 month after admission of the patients. To evaluate the correlation between FOUR score and the studied outcomes, area under the receiver operating characteristic (ROC) curve was used.

Results: In the end, 52 patients with the mean age of 32.67 ± 15.20 years were evaluated (84.6% male). Traffic accident with the frequency of 39 (75.0%) patients was the most common mechanism of trauma among the studied patients and finally, after 1 month follow up it was determined that 13 (25%) patients were discharged without sequel and 31 (59.6%) died. Area under the ROC curve for prediction of the final outcome of death using FOUR score on admission and after 6 hours were 0.889 (95% confidence interval: 0.800 - 0.977) and 0.974 (95% confidence interval: 0.938 – 1.000), respectively. Best cutoff points for FOUR score were the scores 8 and 9 on admission of the patients, and the score 5, six hours after admission.

Conclusion: Based on the findings of this study, it seems that FOUR score is applicable for prediction of probable death outcome in patients with head trauma presenting to ED.

Key words: Consciousness; Craniocerebral trauma; Emergency service, hospital; Patient outcome assessment

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INTRODUCTION

Evaluation of consciousness level is a part of the primary surveys of trauma patients in emergency department (ED). Various scoring systems have been designed for this purpose until now (1-4). A scoring model that has high accuracy, reliability and specificity is able to provide considerable data for health care systems. These possibilities include predicting the outcome of trauma, estimating mortality rate as the most important goal, evaluating the efficacy of selected treatment measures, effective pre-hospital and in-hospital triage, improving the quality of treatment measures and preventive plans, and finally, having an efficient research tool in the field of trauma (5). In addition, trauma scoring systems are able to convert the severity of injury to a number, which results in a mutual language between physicians for taking measures and planning quality control programs in the field of caring for the injured. Measuring the level of consciousness in trauma patients with the aim of predicting the outcome of patients systemically started in 1974 when Glasgow Coma Scale (GCS) was introduced by two neurosurgeons named Graham Teasdale and Bryan J. Jennett (6). Gradually, newer models were introduced, out of which Innsbruck Coma Scale, Simplified Alternative Scores, Comprehensive Level of Consciousness scale and Reaction Level Scale can be pointed out. Despite the extensive research carried out in this field, these models have always had some disadvantages and none of these systems gained the popularity of GCS in assessing the patients' consciousness level and from the viewpoint of many physicians and specialists GCS is still the best model that can present a quantitative scale of the patients' level of

consciousness (7-10).

However, due to the limitations of GCS scoring system, especially regarding intubated patients and those with speech impairment, researchers are currently searching to find another scale for these patients. A scale called Full Outline of Unresponsiveness (FOUR) Score Coma Scale (FOUR Score) is one of the models used for determining the level of consciousness in the injured. This scale was first designed by Wijdickset et al. for evaluating level of consciousness in non-trauma patients in the intensive care unit and its efficiency has been evaluated in similar study populations (11-13).

FOUR score is a 17 point (0 to 16) clinical scale that assesses the 4 areas of neurologic function including eye response, muscle response, brainstem reflexes and respiratory patterns. Recent studies have shown fair to excellent inter-rater reliability of this scoring system (11, 14, 15). Consequently, other studies have also evaluated the efficacy of FOUR scoring system out of the intensive care unit, the results of which were indicative of high diagnostic accuracy of this method in other clinical situations such as the ED (2, 11, 15-17). Recently, using this scale in trauma patients has been considered by the researchers (18, 19). The present study has been carried out with the aim of evaluating the possibility of predicting the outcome of patients with head trauma on admission to ED based on FOUR score.

Methods

Study design

The present prospective cross-sectional study was carried out during the first half of 2017 in the ED of Sina hospital, Tehran, Iran. Protocol of this study did not include any intervention with the routine treatments provided for the patients and it was approved by the research committee of Emergency Medicine Group, Tehran University of Medical Sciences. The researchers adhered to the principles introduced in the declaration of Helsinki throughout the study.

Study population

In this study, all the head trauma patients with any level of altered mental status who presented to ED and were categorized in the moderate to severe traumatic brain injury (TBI) group based on the existing definitions were studied. Patients with loss of consciousness due to non-traumatic reasons (hypoglycemia, receiving sedatives, drug poisoning), unstable hemodynamics (systolic blood pressure less than 90 mmHg), and those who died in ED in less than 6 hours were excluded from the study. Convenience sampling was used and no age or sex limitation was imposed.

Data gathering

For this purpose, data were gathered via a checklist consisting of demographic data, trauma mechanism, patient outcome, and finally, subunits of FOUR score. In this study, data gathering was done by emergency medicine specialists. FOUR score was evaluated on admission to ED and 6 hours later. The outcomes evaluated in this study included discharge without sequel, discharge with neurologic sequel, brain death or death during 1 month after admission of the patients.

Statistical analysis

Data were analyzed via SPSS software version 23.0 (Armonk, New York, US). Quantitative data were calculated as mean and standard deviation and qualitative ones were calculated as percentage. To analyze the relationship between FOUR score and studied outcomes, area under the receiver operating characteristic (ROC) curve was used. Best cutoff points were determined using Youden's J index. Sensitivity, specificity, positive and negative predictive values, and positive and negative test probabilities of the best cutoff points for determining/predicting death outcome both on admission and 6 hours after that were calculated via Amare software version 1.0 (Safa app, Iran).

Results

In the end, 52 patients with the mean age of 32.67 ± 15.20 years were evaluated, 44 (84.6%) of which were male. Baseline characteristics of the studied patients are summarized in table 1. In this regard, 27 (51.9%) cases were in the moderate TBI group;

Table 1: Baseline characteristics of the studied patients

Variable	Number (%)
Sex	
Male	44 (84.6)
Female	8 (15.4)
Trauma Mechanism	
Traffic accident	39 (75.0)
Fall from height	8 (15.4)
Assault	3 (5.8)
Unknown	2 (3.8)
Head Trauma	
Moderate	27 (51.9)
Severe	25 (48.1)
Underwent craniotomy	
Yes	12 (23.1)
No	40 (76.9)
Outcome	
Discharge without sequel	13 (25.0)
Discharge with sequel	8 (15.4)
Death	31 (59.6)

Table 2: The score of each category in FOUR scale in the studied patients on admission to emergency department and after 6 hours

Variable	Score (mean ± standard deviation)	
	On admission	After 6 hours
Eye response	1.48 ± 1.32	1.48 ± 1.67
Motor response	2.83 ± 1.00	2.60 ± 1.24
Brainstem reflexes	3.31 ± 1.20	2.79 ± 1.47
Respiration	3.29 ± 1.21	2.46 ± 1.66
FOUR score	**10.90 ± 3.90**	**9.33 ± 5.44**

traffic accident with frequency of 39 (75%) patients was the most common mechanism of trauma among the studied patients; finally, after 1 month follow up it was determined that 13 (25%) patients were discharged without sequel and 31 (59.6%) died.

The score of each category in FOUR scale and the final score based on this scale in the studied patients on admission to ED and 6 hours later are presented in table 2.

The ROC curve of FOUR score for determining the prognosis is shown in figure 1. Area under the ROC curve for prediction of the final outcome of death using FOUR score on admission and after 6 hours were 0.889 (95% confidence interval: 0.800 - 0.977) and 0.974 (95% confidence interval: 0.938 – 1.000), respectively (figure 1). Best cutoff points for FOUR score on admission of the patients were the scores 8 and 9 (Youden's J index of 0.487, sensitivity: 61.54%, specificity: 87.18%, positive predictive value: 61.54%, negative predictive value: 87.18%, positive test probability: 4.8 and negative test probability: 0.44). Best cutoff point for FOUR score 6 hours after admission of the patients was the score 5 (Youden's J index of 0.821, sensitivity: 84.62%, specificity: 97.44%, positive predictive value: 91.67%, negative predictive value: 95.00%, positive test probability: 33 and negative test probability: 0.16). Figure 2 shows the ROC curve of predicting craniotomy performance outcome by FOUR score, which indicates that this scale has not been a good determinant for this decision.

Discussion

Based on the results of this study, outcome of the patients with loss of consciousness following head trauma is predictable based on FOUR score on admission and 6 hours after that.

Strong and weak points

FOUR score evaluated the details of brainstem reflexes including pupil and cornea reflexes, cough reflex and respiratory pattern of the patient including regular and irregular breathing, Cheyne–Stoke and apnea in head trauma patients in addition to motor and eye scales/indices. Repeated evaluation of these items during estimation of consciousness level can be of help in more rapid detection of their alteration. Speech scale/index, which is considered an important part of GCS and in cases that the patient did not have proper verbal communication, such as cases of intubation, relative drop in consciousness due to hypovolemic shock, severe head and face traumas or psychological disturbances after trauma, it could not provide a correct estimation of consciousness level. FOUR score does not have the limitations of speech evaluation that GCS has; however, in patients with drug poisoning and environmental accidents simultaneous to trauma, respiratory patterns and pupil size are not reliable due to alterations in level of consciousness. In addition, pupil size changes in eye diseases and history of eye surgery as well as the natural reduction in cough reflex in elderly patients lead to incorrect estimation of overall consciousness level score using this method despite the absence of significant trauma to the brain. Very restless patients in need of sedation also develop a different pupil response and respiratory pattern, which make future evaluations of consciousness level difficult.

FOUR score has been used in numerous studies and in various situations including intensive care unit, ED, neurosurgery, and in different populations such as adults and children with head trauma, degenerative brain diseases, cerebral palsy, and has been compared to GCS more than any other scale (11, 13, 18-21). Jamal et al. carried out a study in 2017 on the 5-15 years age group with loss of consciousness and expressed that FOUR score is as efficient as GCS for predicting mortality and decrease in hospital function and after 3 months. Additionally, considering the wide population of the study, they concluded that serial change in both scales probably gives a more effective evaluation regarding their prediction ability (20). Eken et al. assessed 3 outcomes, namely in-hospital mortality during 3 months and prediction of undesirable outcome with Modified Rankin scale in head trauma patients in ED and concluded that FOUR score is not superior to GCS in evaluation of outcome, but motor and pupil evaluations of FOUR

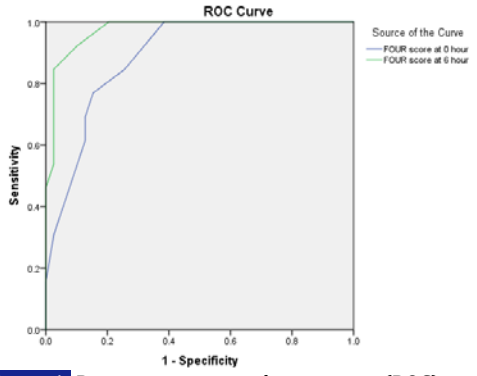

Figure 1: Receiver operating characteristic (ROC) curve of predicting death outcome by FOUR score.

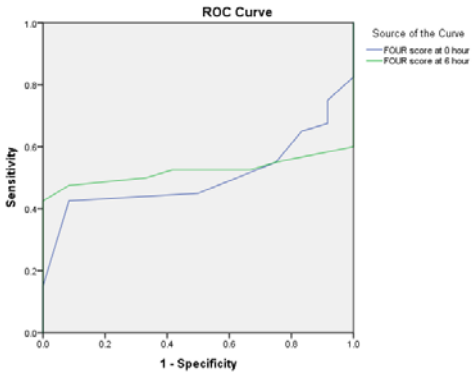

Figure2: Receiver operating characteristic (ROC) curve of predicting craniotomy performance outcome by FOUR score.

course reported a higher specificity for FOUR score 6 and 12 hours after trauma (19). This scale was also evaluated by neurosurgery intensive care unit nurses in comparison to GCS in patients with cranial surgery and head trauma and it was concluded that FOUR score is also a sensitive scale and can replace other methods and has acceptable inter-rater agreement (23, 24). Khanal et al. in 2016 compared these scales during 24 hours of hospitalization in neurosurgery intensive care unit and concluded that mortality of patients with a FOUR score less than 6.5 is higher and probably gives a better prediction in this regard compared to GCS. In addition, in comparison of sensitivity, specificity and positive and negative predictive values they concluded that FOUR score is more accurate (21). McNett et al. expressed that FOUR score has a high value for predicting mortality during 24 hours after trauma (ROC curve=0.913). Moreover, it has sufficient predictive value during 72 hours (ROC curve=0.837) (25). In the present score can be applied as a complementary scale for evaluating level of consciousness (18). Nair et al. also assessed these 2 scales in head trauma patients in neurosurgery department and obtained similar results (22). Baratloo et al. assessed FOUR score and GCS in multiple trauma patients in ED on admission and after 6 and 12 hours and concluded that these scales have relatively similar sensitivity and specificity in the mentioned times and of study, using FOUR score, a high predictive value during 6 hours after trauma and fair predictive value on admission have been found (ROC curve of 0.974 and 0.889, respectively). Considering these findings, it seems that FOUR score can be used as a replacement or adjunct for GCS in ED and is especially helpful in case of patients without the ability to respond verbally and the additional findings it provides regarding neural examination are effective in evaluating their changes.

Limitations

Patients with simultaneous poisoning were excluded from the study population due to probability of bias. Previous eye pathologies make estimation of pupil response to light difficult in FOUR score. Additionally, very restless patients in need of sedation should better be excluded from studies.

Conclusions

Based on the findings of this study, it seems that FOUR score is applicable for prediction of probable death outcome in patients with head trauma presenting to ED.

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Authors' contribution

All authors contribute in drafting/revising the manuscript, study concept or design, analysis or interpretation of data.

Conflict of interest

The authors declare that there are no conflicts of interest.

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