

Application of the FOUR Score in Intracerebral Hemorrhage Risk Analysis

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Background: The Full Outline of Unresponsiveness (FOUR) Score is a validated scale describing the essentials of a coma examination, including motor response, eye opening and eye movements, brainstem reflexes, and respiratory pattern. We incorporated the FOUR Score into the existing ICH Score and evaluated its accuracy of risk assessment in spontaneous intracerebral hemorrhage (ICH). *Materials and Methods:* Consecutive patients admitted to our institution from 2009 to 2012 with spontaneous ICH were reviewed. The ICH Score was calculated using patient age, hemorrhage location, hemorrhage volume, evidence of intraventricular extension, and Glasgow Coma Scale (GCS). The FOUR Score was then incorporated into the ICH Score as a substitute for the GCS (ICH Score_{FS}). The ability of the 2 scores to predict mortality at 1 month was then compared. *Results:* In total, 274 patients met the inclusion criteria. The median age was 73 years (interquartile range 60-82) and 138 (50.4%) were male. Overall mortality at 1 month was 28.8% (n = 79). The area under the receiver operating characteristic curve was .91 for the ICH Score and .89 for the ICH Score_{FS}. For ICH Scores of 1, 2, 3, 4, and 5, 1-month mortality was 4.2%, 29.9%, 62.5%, 95.0%, and 100%. In the ICH Score_{FS} model, mortality was 10.7%, 26.5%, 64.5%, 88.9%, and 100% for scores of 1, 2, 3, 4, and 5, respectively. *Conclusions:* The ICH Score and the ICH Score_{FS} predict 1-month mortality with comparable accuracy. As the FOUR Score provides additional clinical information regarding patient status, it may be a reasonable substitute for the GCS into the ICH Score. **Key Words:** Intracerebral hemorrhage—ICH Score—prognosis—FOUR Score—Glasgow Coma Scale.

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Introduction

Intracerebral hemorrhage (ICH) is a sudden and life-changing event with an estimated overall mortality of up to 46%-48% at 1 year.^{1,2} The functional outcomes of patients with ICH remain difficult to predict overall, with independence at 1 year (defined as modified Rankin Score [mRS] of 0-2) found to be 32.8%-42.4% in a recent meta-analysis.² Estimating an accurate prognosis for patients or families can be challenging, and several outcome scores have previously been published.^{3,4} The ICH Score, devised by Hemphill, et al., incorporates multiple clinical and imaging characteristics, and is a commonly used assessment tool to assist clinicians in such situations, providing an estimated mortality risk at 30 days after hemorrhage.³ One variable included in this score, the Glasgow Coma Scale (GCS),⁵ is a widely used coma scale

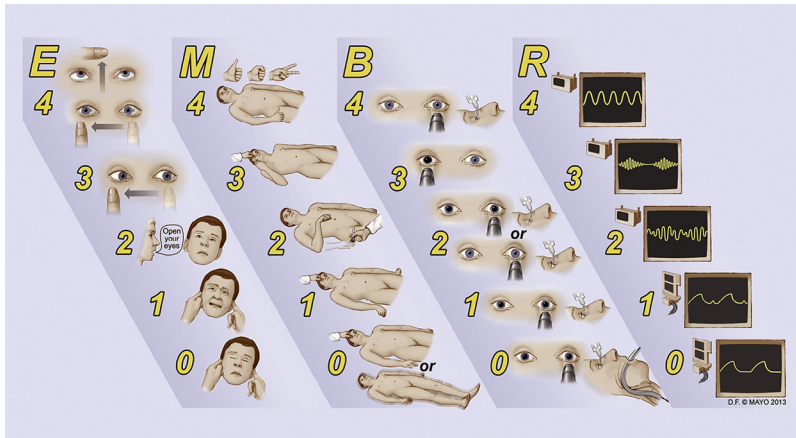


Figure 1. Full Outline of UnResponsiveness.

in many clinical situations. The factors included in this score (eye opening, motor response, and verbal output) provide a general illustration of the patient's condition and severity of illness, but do not further allow any degree of localization of the neurologic condition.

The most recent American Heart Association ICH management guidelines recommend consideration of surgical evacuation in patients with evidence of posterior fossa hemorrhages causing brainstem compression or in those with supratentorial lesions and clinical deterioration.⁶ In patients with ICH, careful and frequent neurologic examinations are required to recognize signs of clinical change requiring intervention as early as possible.

The Full Outline of Unresponsiveness (FOUR) Score was developed to assist clinicians in the clinical assessment and localization of lesions within the brain of patients with impaired consciousness⁷ (Fig 1). Unique to this score is inclusion of the routine assessment of brainstem reflexes and breathing pattern. The FOUR Score may therefore be more clinically relevant than the GCS in the neurologic assessment and early recognition of decline in patients at risk of herniation syndromes, including those with ICH. It provides a standardized assessment to evaluate patients and identify worrisome clinical changes that may prompt discussion of possible operative intervention or further goals of care in patients with spontaneous ICH and clinical deterioration.

In this study, we aimed to incorporate the FOUR Score into the ICH Score as a substitute for the GCS and assess the prediction of 30-day outcomes in patients with spontaneous ICH.

Materials and Methods

We conducted a retrospective chart review of consecutive patients with ICH admitted to Mayo Clinic Hospital—St. Marys Campus between 2009 and 2012. This study was approved by the Mayo Clinic Institutional Review Board.

Adult patients 18 years of age and older who were diagnosed with ICH were considered for inclusion in this study. Patients were excluded if the hemorrhage was secondary to trauma, venous sinus thrombus, hemorrhagic transformation of an ischemic infarction, hemorrhage due to known tumors, and hemorrhage occurring as the result of a postoperative complication. Patients with a delayed presentation from time of symptom onset to medical evaluation (>24 hours) and patients with primary intraventricular hemorrhage were also excluded. Patients with incomplete data (inability to calculate initial FOUR Score or GCS based on the medical record or those lost to follow-up) were not included in the final data analysis.

The comprehensive medical record was thoroughly reviewed, and age at presentation, hemorrhage location (supratentorial or infratentorial), intraventricular hemorrhage extension, GCS and FOUR Score at presentation, the presence of medical comorbidities and use of antithrombotics were recorded. The initial computed tomography scan was reviewed, and hemorrhage volume was calculated using the ABC/2 method.⁸ Mortality and mRS⁹ at 30 days after hemorrhage were recorded. When available, 1-year mRS was also recorded.

Using the information collected from the retrospective review, the ICH Score was calculated. The FOUR Score was then substituted for the GCS in this model, and the score (ICH Score_{FS}) was calculated.

Statistical Analysis

Descriptive summaries were reported as median and interquartile range (IQR) for continuous variables and as frequencies and percentages for categorical variables. Univariable and multivariable logistic regression models were used to assess the associations between 1-month mortality as an outcome and various predictor variables such as components of GCS, FOUR Score, ICH Score, and ICH Score_{FS}. Odds ratios (ORs) and 95% confidence intervals (CIs) were reported. The area under the receiver operating characteristic (ROC) curve was estimated as a measure

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