Grading Scale for Prediction of Outcome in Primary Intracerebral Hemorrhages

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Background and Purpose—This study aimed to independently derive an intracerebral hemorrhage grading scale (ICH-GS) for prediction of 3 outcome measures.

Methods—We evaluated 378 patients with primary ICH at hospital arrival and during the next 30 days. Independent predictors were identified by multivariate models of in-hospital and 30-day mortality. Points were allotted to each predictor based on its prognostic performance. ICH-GS was also evaluated to predict good 30-day functional status and ICH-GS was compared with the ICH score as the reference scoring system.

Results—Independent predictors were age, Glasgow Coma Scale, ICH location, ICH volume, and intraventricular extension, all components of the ICH score. Nevertheless, different cutoffs and scoring improved substantially the prognostic power of the predictors. Compared with the ICH score, ICH-GS explained more variance in the 3 outcome measures, had higher sensitivity in predicting in-hospital and 30-day mortality, and performed equally well in predicting good functional outcome at 30 days follow up.

Conclusions—The derived ICH-GS is a simple yet robust scale in predicting in-hospital and 30-day mortality, as well as good 30-day functional status, with equivalent performance. (Stroke. 2007;38:1641-1644.)

Key Words: intracerebral hemorrhage • mortality • outcome • prognosis • risk factors

Accurate prediction of outcome after primary intracerebral hemorrhage (ICH) is necessary to distinguish those patients who need special care or who would benefit from particular therapeutic strategies. Several scales for prediction of ICH mortality have been designed to date1–6 with different characteristics regarding applicability, scale components, scoring and performance. Of them, the ICH score has proven scoring and performance. Of them, the ICH score has proven

Scale Derivation

Bivariate analyses were performed to identify risk factors associated with in-hospital and 30-day mortality by χ² statistics. Age, Glasgow Coma Scale (GCS) at hospital presentation, and ICH volume were dichotomized to transform them into nominal variables using the median value or its nearest multiple-of-5 integer. Multivariate analyses were constructed to find independent predictors of in-hospital and 30-day mortality. Input variables were those significantly associated with mortality in bivariate analyses; but demographic characteristics, risk factors, blood pressure measures, and in-hospital neurological and nonneurological complications were included in multivariate analyses as potential confounders. Adjusted ORs and 95% CIs are provided. The fitness of the models was evaluated by using the Hosmer-Lemeshow goodness-of-fit test, which was considered as reliable if P>0.2. After identifying independent predictors of in-hospital and 30-day mortality, cutoffs or value intervals were selected for continuous variables to determine
Results

We analyzed 187 (49.5%) men and 191 (50.5%) women with a mean age of 64.2 years (range, 15 to 99 years) (supplemental Table I, available online at http://stroke.ahajournals.org). Mean duration of the hospital stay was 10 days (range, 0 to 82 days). The main risk factor for ICH was hypertension (n=258 [68%]).

In bivariate analysis, factors associated with mortality were age 65 or more years, GCS at hospital admission less than 8, ICH volume more than 70 mL, irruption into the ventricular system, and infratentorial location of the hematoma. These variables were also independent predictors in multivariate logistic regressions (Table 1). After risk modeling, ICH-GS was generated by assigning points to the independent predictors with a minimum scoring of 5 points and a maximum of 13 coinciding with the categories of ICH-GS with those of the ICH score but with different cutoffs and points assignment (Table 2). ICH-GS explained more variance than did the ICH score in-hospital mortality (r²=0.442 versus 0.343; respectively), 30-day mortality (r²=0.438 versus 0.342; respectively), and good functional outcome at 30 days follow up (r²=0.332 versus 0.267; respectively). ICH-GS had significantly higher sensitivity than the ICH score in predicting both in-hospital (78.2% versus 63.8%, respectively; P<0.05) and 30-day mortality (78.5% versus 64.4%, respectively; P<0.05) (supplemental Table II, available online at http://...
stroke.ahajournals.org). Moreover, ICH-GS had higher accuracy than the ICH score in predicting mortality and good functional outcome (Figure).

**Discussion**

In a prospective design and with the largest sample size to date,1–6 we derived a system for prediction of 3 outcome measures in patients presenting with ICH. Independent predictors were those consistently reported in previous studies, which includes the original report of the ICH score.1–9 However, in this report, every component of the scale was obtained by multivariate analysis and not at a discretional level. Our study confirms previous results on the importance of the clinical and radiological components of ICH-GS in predicting mortality2,3,5 and adds new information in that different selection of cutoff values and point assignments based on the prognosticator’s properties can further refine previous models. In ICH-GS, points assigned to clot volume are in function of the hemorrhage location, because the infratentorial and supratentorial spaces differ in compliance. Also, age is divided into 3 intervals coinciding with the most important stages of adulthood. In ICH-GS, it is possible to find patients with every scoring from 5 to 13 points. It seems convenient to assign a minimum of 5 points to the lowest probability of dying, because having zero points in ICH score does not necessarily mean the absence of death;5,6 hence, we assigned one point to the lowest category of every scale item and 2 or 3 points, respectively, to the highest. With future effective treatments, the prognosis for every point of ICH-GS will certainly change.

Indeed, the use of a prognostic scale goes beyond numbers and estimations. It could sensitize to the staff entrusted with the care of patients regarding a particular prognosis, facilitating a bedside humanitarian approach. With future studies applying this scale, futile actions could be clarified, avoiding useless actions in cases in which the overwhelming evidence points to a fatal outcome, but in those in which there is evidence of a favorable prognosis, unnecessary stress and the consequences motivated by this factor could be diminished. However, because all current ICH scales are not perfect prediction models, other variables such as biochemical markers, genomics, or advanced brain imaging technology should be included in future refinement of the existing scales.

In summary, ICH-GS is a robust method able to predict different outcome measures with equivalent performance. It retains simplicity and reliability and represents a refinement.
of previous prognostic models. We are confident about the performance of ICH-GS in clinical practice; however, it should receive systematic evaluation and, of course, the test of time.

Disclosures
None.

References
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