Primary Pontine Hemorrhage in the Acute Stage: Clinical Features and a Proposed New Simple Scoring System

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Background: It is important to evaluate the likelihood of fatality in patients with acute primary pontine hemorrhage (PPH) in emergency departments. We aimed to evaluate the clinical symptoms and computed tomography findings of PPH to develop a simple grading scale for predicting the mortality of PPH. *Methods:* Records of 101 consecutive patients admitted to our hospital with acute PPH between June 1, 2006, and January 31, 2014, were retrospectively reviewed. Independent predictors of 30-day mortality were identified by univariate and multivariate logistic regression analyses. A simple and easy clinical score (PPH score) was developed from independent factors to predict mortality in acute PPH. The PPH score was compared with the established intracerebral hemorrhage (ICH) score, which served as the reference scoring system. *Results:* Overall mortality rate 30 days after onset was 58.4% (59 of 101). Factors independently associated with 30-day mortality were Glasgow Coma Scale (GCS) score of 6 or less ($P = .0051$), absence of pupillary light reflex ($P = .0003$), and blood glucose of 180 mg/dL or greater ($P = .0312$). The PPH score was the sum of independent factors, which were assigned 1 point each. The area under the receiver operating characteristic curve for predicting 30-day mortality was .90 (95% confidence interval [CI], .84-.95) for PPH score and .86 (95% CI, .78-.93) for ICH score. *Conclusions:* GCS score of 6 or less, absence of pupillary light reflex, and plasma glucose of 10 mmol/L or greater are independent mortality predictors of PPH. The PPH score is a simple and reliable clinical grading scale for predicting 30-day mortality. **Key Words:** Primary pontine hemorrhage—outcome—prognosis—mortality.

Primary pontine hemorrhage (PPH) is known to have one of the worst prognoses among the anatomically defined subtypes of intracerebral hemorrhage (ICH). The prognostic implications of various clinical and computed tomography (CT) parameters have been characterized in patients with PPH,[1-8] but appropriate treatment options for severe PPH, which are determined by these distinct parameters have not yet been developed. Thus, it is extremely important that physicians in the emergency department evaluate the prognostic state of acute stage PPH to judge the necessity of limited neurointensive care.

Several grading scales for the evaluation of ICH have been designed to date,[9-14] but there are no specific grading scales for PPH. Moreover, the ICH score has proven to be reliable in predicting 30-day mortality throughout various affected regions of the brain.[9,12] The ICH score is based on analysis of 152 ICH patients,

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but only 15 patients with pontine hemorrhage were included in the development of this score.[9]

In this study, we analyzed the clinical features of PPH from 101 consecutive cases in our hospital. Based on our findings, we propose a new and simple grading system for predicting mortality from PPH based on acute stage characteristics.

Materials and Methods

We retrospectively studied a total of 101 consecutive patients with acute PPH who had been referred to our hospital between June 2006 and January 2014. All cases of arteriovenous malformation, cryptic angioma, and other intratumor hemorrhage were excluded. They represented 11.5% of the 881 patients with ICH seen at our clinic during this period. Their mean age was 63.3 years (range, 37-91 years), and 67 patients (67.3% of the total) were men. Among the 101 patients, there were 64 patients with the history of hypertension and 21 patients without the history of hypertension, and 16 patients were unidentified. As for the history of diabetes, there were 23 patients with diabetic history and 59 patients without diabetic history, and 19 patients were unidentified. All patients were admitted to our stroke unit within 24 hours of symptom onset and diagnosed by CT within 30 minutes of admission. Endotracheal intubation and artificial respirator management were not positively performed, except for the case when the emergency steps and the family at the time of a visit to the hospital wish. It was performed for 26 patients, and 20 patients died within 30 days among them. None of the patients in the study underwent surgical evacuation of hematoma or continuous ventricular drainage to treat ventricular dilatation.

A follow-up examination was conducted 30 days after onset. Outcomes were assessed according to the modified Rankin Scale (mRS). Patients were divided into 2 simple groups: a survival group (mRS, 0-5) and a death group (mRS, 6). Then, we statistically evaluated the difference between the 2 groups, using parameters made up of clinical manifestations and CT findings. We assessed age, sex, the initial level of consciousness (based on the Glasgow Coma Scale [GCS]), the absence of pupillary light reflex, systolic blood pressure, heart rate, white blood cell counts, blood glucose level, extension of hematoma, intraventricular hematoma, ventricular dilatation, maximum size of hematoma, and volume of hematoma. We assessed the maximum diameter of hematoma on the horizontal section of CT and the vertical extension of the hematoma with respect to the midbrain and/or thalamus or subthalamus. The total volume of the hemorrhage was estimated using the formula for an ellipsoid, that is, $4/3\ \pi$ abc, where a, b, and c represent the respective radii in 3 dimensions.[15]

A new outcome risk stratification scale, that we now name the PPH score, was developed through analysis of the variables associated with 30-day mortality in all PPH patients whom we studied. Cut points of the variables were chosen to produce a simple and intuitive model and to incorporate values similar to those used in prior reports.[9,10] The PPH score was compared with the established ICH score,[9] which we used as the reference scoring system.

We analyzed the variables by univariate comparisons; the chi-square test or the Fisher exact test for categorical variables and Mann–Whitney *U* test for continuous variables. Parameters proven to be significant on univariate comparison were analyzed again with multivariate logistic regression analysis to identify those variables that independently associated with 30-day mortality. To evaluate the prediction accuracy, we used the receiver operator characteristic curves of the ICH score and the PPH score of 30-day mortality, in addition to the corresponding area under the curve. All *P* values were 2 sided and *P* values of .05 or less were considered statistically significant. All statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria). More precisely, it is a modified version of R commander designed to add statistical functions frequently used in biostatistics.[16]

Results

Analysis of Clinical and CT Findings

Total mortality rate at 30 days after onset was 58.4% (59 of 101). One patient died from renal failure on day 23, one patient died from pneumonia on day 23, and the other 56 patients died from primary brain damage within 14 days. The clinical features and CT findings in all 101 patients were analyzed. Their mean age was 63 ± 14 years (range, 37-91 years), 67 patients (66.3%) were men. Mean GCS score on admission was 7 ± 4 (range, 3-15). Pupillary light reflex was absent in 49 patients (48.5%). Mean systolic blood pressure on hospital arrival was 203 ± 45 mm Hg (range, 55-364 mm Hg) and mean heart rate was 98 ± 24 bpm (range, 52-180 bpm). Highest body temperature during the first 3 hours after admission was obtained in 93 patients, with a mean of 38.6 ± .3°C (range, 35.1-41.7°C). White blood cell count was obtained in 100 patients, with a mean of $10.1 \pm 3.5 \times 10^9$/L (range, $3.7\text{-}19.7 \times 10^9$/L). Blood glucose level was obtained in 99 patients with a mean of 181.7 ± 82.8 mg/dL (range, 93.6-567 mg/dL). Mean maximum diameter of hematoma was 29 ± 9 mm (range, 5-46 mm). Fifty-eight patients (57.4%) had intraventricular hemorrhage and 15 (14.9%) had ventricular dilatation. Hematoma was within the pons in 38 patients (37.6%). Extension of the hematoma into midbrain was found in 39 patients (38.6%), and 24 patients (23.8%) had extension of the hematoma into thalamus.