Differences Between Vascular Structural Abnormality and Hypertensive Intracerebral Hemorrhage

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Background: How the clinical characteristics and prognosis of various types of vascular structural abnormality–related intracerebral hemorrhage (ICH) differ from those of hypertensive ICH is poorly understood. This lack of understanding poses a problem for differential diagnosis and prognosis. *Methods:* Patients diagnosed with ICH between January 2012 and February 2014 at 50 tertiary and secondary hospitals in China were enrolled into this prospective cohort study. Patients were classified as having vascular structural abnormality–related ICH or hypertensive ICH, and data on the demographics and clinical characteristics of each group were compared. Multivariate logistic regression was used to explore associations while controlling for other risk factors for good outcome and mortality. *Results:* Data for 281 patients showed that vascular structural abnormality–related ICH usually occurred in lobar areas and affected patients who were younger and had higher Glasgow Coma Scale (GCS) scores than those with hypertensive ICH. Mortality and good outcome at 3 months after ICH were significantly better among patients with vascular structural abnormality–related ICH (3.4% and 77.2%) than among patients with hypertensive ICH (15.2% and 49.9%, both $P < .001$). Multivariate logistic regression identified the following independent predictors of mortality: lower GCS score, old age, presence of intraventricular hemorrhage, larger hematoma volume, and surgery treatment. The regression also identified several independent predictors of good outcome at 3 months: ICH etiology due to vascular structural abnormality, higher GCS score, younger age, and smaller hematoma volume. *Conclusions:* Patients with vascular structural abnormality–related ICH are more likely to experience better clinical outcomes than those with hypertensive ICH. GCS score, age, hematoma volume, and ICH etiology are independent predictors of ICH outcome. **Key Words:** Vascular structural abnormality—hypertension—intracerebral hemorrhage—mortality—functional outcome.

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Intracerebral hemorrhage (ICH) occurs more often in association with hypertension than with intracranial vascular structural abnormality.[1] Nevertheless, vascular structural abnormality–related ICH poses significant clinical challenges. Patients usually contain heterogeneous structural lesions, which can cause serious neurologic symptoms or death.[2] Accurate epidemiology of vascular structural abnormality–related ICH remains difficult; its etiology is unknown and cases are often diagnosed simply as "spontaneous" ICH. Improving the epidemiology of this type of ICH is important because patients may have different prognoses than those with hypertensive ICH. For example, mortality is lower for patients with

vascular structural abnormality–related ICH during the first year after ICH.[3]

As a first step toward improving epidemiology of vascular structural abnormality–related ICH, some studies have compared the demographic and clinical characteristics of patients with this type of ICH to those of patients with hypertensive ICH. Those studies suggest that patients tend to be younger than patients with hypertensive ICH and that they have lower blood pressure before ICH and at hospital admission, as well as higher scores on the Glasgow Coma Scale (GCS) at admission.[3–5] However, those studies were relatively small and retrospective, and they examined only a few subtypes of vascular structural abnormality–related ICH. This lack of understanding about the clinical profile of patients with this type of ICH hampers treatment optimization.

Advances in radiology methods promise to allow better sensitivity and accuracy for detecting vascular structural abnormality–related ICH.[3] However, this technological progress requires a parallel improvement in our understanding of the clinicopathology and prognosis of patients with this type of ICH. For example, comparing the locations of lesions in patients with either type of ICH may help clarify their presumably different etiologies.

Therefore, we undertook a large, multicenter, prospective study to explore the clinical characteristics and clinical outcomes of each subtype of vascular structural abnormality–related ICH and to compare them with those of hypertensive ICH. We also compared the locations of lesions in the 2 types of ICH.

Subjects and Methods

Patients and Evaluation

This work was carried out as part of the "Study on Etiology and Minimally Invasive Neurosurgery for Hemorrhagic Stroke," a National Key Technology R&D Program of the 12th Five-Year Plan. The study is an ongoing, prospective, hospital-based clinical investigation taking place throughout mainland China. This study protocol was approved by the Scientific Research Department of West China Hospital, and it was designed in accordance with local ethics criteria for human research. Informed consent was obtained from subjects or their guardians.

Patients in the study were consecutively admitted between January 2012 and February 2014 to 50 tertiary and secondary hospitals across mainland China with a diagnosis of ICH. Patients were eligible for enrollment if they were at least 18 years old; if they were admitted to hospital within 1 week of the onset of neurologic deficit; and if they were diagnosed with ICH according to World Health Organization criteria for stroke,[6] including rapid analysis with computed tomography (CT) or magnetic resonance imaging to distinguish hemorrhagic stroke from ischemic stroke. We excluded patients who refused to participate in the study and patients who had experienced traumatic or recurrent ICH.

All patients were screened according to a strict protocol consisting of a complete medical history, full neurologic examination, standard blood tests, CT and/or MRI, and intracranial vascular imaging by CT angiography, magnetic resonance angiography, or digital subtraction angiography.

Data Collection

Data on clinicopathology, functional outcomes, and mortality were calculated for 2 groups of patients in our cohort: those with vascular structural abnormality–related ICH and those with hypertensive ICH. Vascular structural abnormality–related ICH was defined according to the International Classification of Diseases (10th Revision) as ICH that was intraventricular or subarachnoid and that was associated with brain vascular structural abnormality diagnosed by radiology or pathology.

The following baseline information was collected from all patients on admission: age, gender, GCS score, hypertension, diabetes mellitus, current smoking, current drinking, and current anticoagulant and antiplatelet therapy. Two neurologists blinded to clinical data independently determined the presence, locations, and volumes of hematomas on brain images. Hematoma volume was measured on the initial head CT scan using the ABC/2 method, in which A is the largest diameter on the largest hemorrhage slice, B is the diameter perpendicular to A, and C is the approximate number of axial slices with hemorrhage multiplied by the slice thickness.[7]

Functional outcome and mortality were assessed at 3 months after ICH through telephone interviews conducted by experienced stroke neurologists blinded to patients' clinical data. Good clinical outcome was defined as a modified Rankin Scale (mRS) score of 0-2. Stroke mortality at 3 months was confirmed by contacting family members.

Statistical Analysis

All statistical analyses were performed using SPSS version 16 (International Business Machines Corporation, Armonk, USA). Continuous variables were described as mean ± standard deviation if the data were normally distributed, or as median values with 25th and 75th percentiles if the data were not normally distributed. Numerical outcomes were estimated using odds ratios with 95% confidence intervals. Continuous outcomes were compared between the 2 types of ICH using Student *t* test and the Mann–Whitney *U* test; categorical outcomes, using χ^2 or Fisher exact tests. Logistic regression was performed to identify factors that independently predicted