

Initially Missed or Delayed Diagnosis of Subarachnoid Hemorrhage: A Nationwide Survey of Contributing Factors and Outcomes in Japan

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Background: Subarachnoid hemorrhage (SAH) remains a significant cause of mortality in Japan. The Japan Stroke Society set out to conduct a nationwide survey to identify contributing factors and outcomes of SAH misdiagnosis. *Methods:* We initially surveyed 737 training institutes and 1259 departments in Japan between April 2012 and March 2014 for the presence of misdiagnosed SAH. Clinical information was then sought from respondents with a positive misdiagnosis. Information on 579 misdiagnosed cases was collected. *Results:* Most initial misdiagnoses occurred in nonteaching hospitals (72%). Of those presenting with headache, 55% did not undergo a computed tomography (CT) scan. In addition, SAH was missed in the patients who underwent CT scans. The clinically diagnosed rerupture rate was 27%. Mortality among all cases was 11%. Institutes achieving a final diagnosis were staffed by neurologists or neurosurgeons. Multivariate logistic regression analysis indicated that age (≥ 65), consciousness level (Japan Coma Scale score at correct diagnosis), rerupture of an aneurysm, and no treatment by clipping or coiling were significantly associated with poor clinical outcome. *Conclusions:* The prognosis of misdiagnosis of SAH is severe. Neuroradiological assessment and correct diagnosis can prevent SAH misdiagnosis. When there is a possible diagnosis of SAH, consultation with a specialist is important. **Key Words:** Subarachnoid hemorrhage—misdiagnosis—nationwide survey—Japan.

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This survey was conducted as an official project of the Japan Stroke Society.

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Subarachnoid hemorrhage (SAH) affects approximately 140,000 people in Japan, resulting in about 12,000 per 100,000 deaths per year.¹ Despite recent advances in the management of aneurysm-associated SAH, the overall outcome in patients following SAH remains unsatisfactory, largely because of primary brain damage, rebleeding, and vasospasm.²⁻⁵ The rebleeding rate is highest within 6 hours of SAH onset and decreases steeply thereafter.²⁻⁵ For this reason, missed diagnosis can result in significant complications.

The rate of missed or delayed diagnosis has been reported to vary from 12% to 51%.⁶⁻¹³ The variability of misdiagnosis rates reported reflects a variety of study methods and definitions. In addition, important risk factors for misdiagnosis, such as patient acuity, physician

experience, and access to diagnostic resources, vary between different clinical settings.^{14,15} Hospital factors, such as teaching status and access to diagnostic resources, have been found to be associated with misdiagnosis in patients with acute myocardial infarction,¹⁶ yet little is known about how system factors might contribute to the risk of missed SAH, especially in the Japanese health-care system.

The Japan Stroke Society set out to conduct a nationwide survey of medical institutes regarding misdiagnosis of SAH. Specifically, we sought to determine the contribution of medical system-related factors to SAH misdiagnosis.

Methods

The survey was conducted in 2 phases as an official project of the Japan Stroke Society. The society has 737 training institutes and 1259 training departments in Japan. These institutes and departments are categorized as teaching hospitals and departments, respectively. The primary survey sought to establish the presence of misdiagnosis of SAH between April 2012 and March 2014. A secondary survey requesting deidentified clinical information was sent to those primary survey respondents with a positive misdiagnosis.

The secondary survey sought information related to the institute that missed the diagnosis and the institute that finally diagnosed SAH. This information included the institute, the number of neurologists and neurosurgeons present at the institute, the doctors involved in the first assessment and diagnosis, the method of neuroradiological assessment, and the symptoms. Rerupture cases were diagnosed by definitive diagnostician based on clinical and radiological findings. Treatment and outcome information was based on clinical chart reviews at each institute.

Statistical Analyses

Contributing factors for poor clinical outcome were analyzed by univariate and multivariate logistic regression analyses. Poor clinical outcome was defined as a modified Rankin Scale (mRS) score of 3 or higher at discharge. Variables included age (≥ 65 versus < 65), sex (male versus female), Japan Coma Scale (JCS) score at correct diagnosis (0, alert; 1, not fully alert but awake without any stimuli; 2, arousable with stimulation; 3, unarousable), headache at initial diagnosis (yes versus no), hospital where the misdiagnosis occurred (teaching versus nonteaching hospital), specialty of doctors who missed the diagnosis (neurologists or neurosurgeons versus non-neurologist and non-neurosurgeons), radiological assessment at misdiagnosis (yes versus no), rerupturing (yes versus no), treatment modalities (clipping or coiling versus other treatments), hospital where the diagnosis of SAH was made (teaching hospital versus nonteaching hospital), and specialty of doctors who diagnosed SAH (neurosurgeons versus non-neurosurgeons). Age, sex, and variables with a *P* value

less than .10 in univariate analysis were selected for multivariate analysis. All statistical analyses were performed using the R statistical software package, version 3.0.1 (The R Foundation for Statistical Computing, Vienna, Austria; <https://www.r-project.org/>), and a *P* value less than .05 was considered statistically significant. The study was approved by the institutional review board of Kyoto University Hospital.

Results

Survey Response Rate

Feedback on the primary survey was obtained from 721 departments (57.3%), and feedback on the secondary survey was obtained from 352 departments (85.1%).

Misdiagnosis of SAH

A total of 579 misdiagnosed cases were reported in this survey (Table 1). Eighty-seven percent of patients had headache as the initial symptom. The consciousness of 62% of patients was clear (JCS score 0). Initial misdiagnosis mainly occurred in nonteaching hospitals (72%). Seventy-four percent of the initial diagnoses were performed by general practitioners. Eighty-six percent of the cases were diagnosed by non-neurosurgeons or non-neurologists. Those institutes with a misdiagnosis, and without either neurosurgeons or neurologists, amounted to 55% of the cases. Fifty-five percent of patients with a headache did not undergo a computed tomography (CT) scan. In addition, SAH was missed in the patients who underwent CT scans. About misdiagnosis on CT scans, 77% of the cases were not diagnosed by neurologists or neurosurgeons. Magnetic resonance imaging was performed in 11% of the cases.

Diagnosis of SAH

Ninety-six percent of the institutes that finally diagnosed SAH have full-time neurosurgeons and 78% have full-time neurologists (Table 2). Definite diagnoses were made by neurosurgeons (77% of cases), certified neurosurgeons (69%), neurologists (12%), and certified stroke specialists (45%). Thirty-five percent and 49% of the patients were transferred to the institute with a stroke care unit and an emergency center, respectively. Initial care of the patients who had definitive diagnoses included outpatient clinics (22%), emergency care (48%), and referrals (28%).

Clinical Findings of Misdiagnosed Patients

The conscious levels at the initial diagnosis and at the definitive diagnosis are shown in Table 1. The mean JCS score at the initial and second visits were 2 and 35, respectively. Only 39% of the patients showed a JCS score of 0. Seventy-nine percent of the cases underwent

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