

Fatal Intracranial Aneurysms and Dissections Causing Subarachnoid Hemorrhage: An Epidemiological and Pathological Analysis of 607 Legal Autopsy Cases

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Background: There are no detailed reports, in terms of epidemiology and pathology, on intracranial aneurysms and on dissections that were found in unexpected fatal subarachnoid hemorrhage (SAH) cases. In this report we analyzed, based on large-sized medicolegal autopsy cases, the detailed epidemiology and pathological aspects of both lesions. *Methods:* We analyzed 607 autopsy cases of unexpected fatal SAHs including 496 aneurysms and 111 dissections. *Results:* The following results were obtained: (1) Patients who died of dissections were younger than those who died of aneurysms; (2) symptom prevalence rates of aneurysms were 31.9%, appearing to be lower than those in previous studies; (3) a significantly higher prevalence of clinical symptoms was found in patients with dissections (60.5%) than patients with aneurysms; (4) hypertensive cardiomegaly was indicated in more than 80%, while no obvious difference in incidence in hypertensive cardiomegaly was noted between aneurysms and dissections; (5) aneurysms were found to occur much more frequently in the anterior communicating artery (31.9%) and vertebral arteries (7.5%), while dissections were found much more commonly in vertebral arteries (93.7%); and (6) the size of aneurysms was much smaller in general than that previously regarded as a risk factor of rupturing. *Conclusions:* These data might help in the prompt intervention in SAH and also in the prevention of lethal SAH in clinical settings. **Key Words:** Subarachnoid hemorrhage—intracranial aneurysm—intracranial arterial dissection—unexpected sudden deaths—medicolegal autopsy.

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Introduction

Unexpected sudden deaths caused by subarachnoid hemorrhage (SAH) are commonly experienced among forensic pathologists and medical examiners. Indeed, in 2314 administrative autopsies conducted in 2015 at the Tokyo Medical Examiner's Office, 171 cases (7.4%) were diagnosed as SAH.

The risk of rupture of intracranial aneurysms is said to be dependent on the patient's race, age, sex, the position in cranial arteries, the size, and the presence of antecedent clinical symptoms.¹⁻⁸ These previous studies, however, were based on patients with obvious symptoms and thus were submitted medical care. Hence, we

thought it might be interesting to analyze cases of unexpected sudden death because those data may reflect the real aspect in the epidemiology and pathology of those diseases, eliminating medically biased features of these diseases. There are a few previous reports dealing with this line of study based on autopsy cases.⁹ Sugai and Kono, and Akimoto performed pathological studies of intracranial aneurysms,^{10,11} and Murai et al performed pathological studies of vertebral arterial dissections.¹² However, they are again based on a small number of cases, and thus, statistical analyses were imperfect.

Therefore, we performed a statistical analysis of large-sized medicolegal autopsy cases involving ruptured intracranial aneurysms and dissections in terms of their pathological and epidemiological features.

Materials and Methods

Selection of Cases

There were 1078 cases of SAH that were confirmed by medicolegal autopsies performed at the Tokyo Medical Examiner's Office during April 1999 and March 2015. Among those, we excluded cases caused by trauma and also those who died of causes other than intracranial aneurysm or dissection, such as arteriovenous malformation and/or Moyamoya disease. Thus, 607 cases composed of 496 aneurysms and 111 dissections were finally submitted for this study.

This study was approved by our institutional ethics committee.

Epidemiological Analysis

The patients' age, sex, premonitory symptoms, and past histories were retrospectively reviewed as epidemiological characteristics. The presence of premonitory symptoms was submitted only when complaints or signs were witnessed within 24 hours before the death. The past histories were based on the clinical records and submitted to this study only when they were available. Antecedent symptoms or previous histories, when adequate information was not described in medical records, were excluded from the data.

Autopsy Findings

The size and location of aneurysms and/or dissections as well as the patients' body length and cardiac weight were cited from the autopsy records. The ratio of heart weight (gram) to body length (centimeter) (HW/BL ratio) greater than 2.00 was regarded as cardiomegaly following Sato's criteria.¹³

Lesions found in the anterior communicating artery bifurcations of anterior cerebral arteries were classified in this report as "lesions of the anterior communicating

artery," and those in posterior cerebral arteries–basilar artery were classified as "lesions of the basilar artery."

The sizes of the lesions were divided into 5 categories according to previous studies^{2,3}: 0.4 cm or smaller, 0.5–0.6 cm, 0.7–0.9 cm, 1.0–2.4 cm, and 2.5 cm or bigger. Such cases where no aneurysms or dissections were detected and/or the size of the lesions was uncertain were excluded from this study.

Statistical Analysis

All statistical analyses were performed with Microsoft Excel 2016 (Microsoft Corporation, Redmond, WA) and the statistics add-in software BellCurve Ekuseru-Toukei (Social Survey Research Information Co., Ltd., Tokyo, Japan).

The chi-squared test was used to evaluate the independence of qualitative variables. With regard to sex differences, for the correction of the ratio, expected values were calculated from data from all autopsies performed at the Tokyo Medical Examiner's Office from April 1999 to March 2015. Differences in quantitative variables between the 2 groups were evaluated using Mann-Whitney's *U*-test, differences among multiple groups were determined using the Kruskal-Wallis test, and multiple comparisons were performed using the Steel-Dwass test. A *P* value of less than 0.05 was considered statistically significant.

Correlations were evaluated using Spearman's rank-correlation coefficient.

Results

Overview of Cases

We included 607 cases (496 cases of intracranial aneurysm and 111 cases of intracranial arterial dissection) in this study (Table 1). They constituted of 371 males and 236 females. Male predominance was statistically confirmed both in the aneurysm and dissection groups: the male-to-female ratios were 1.3 in the aneurysm and 5.5 in the dissection groups, respectively. The median age of overall cases was 54.0 (ranging from 20 to 93) and was significantly higher in females (60.0) than in males (50.0) ($P < 0.05$). Meanwhile, the median age of the aneurysm group (56.0) was significantly higher than that of the dissection group (46.0).

The antecedent clinical symptoms were reviewed in 401 patients. Among those, 151 (37.7%) were found to have suffered from clinical symptoms (Table 1). They included headache ($n = 90$; 22.4%), vomiting ($n = 18$; 4.5%), dizziness ($n = 12$; 3.0%), cold-like symptoms ($n = 10$; 2.5%), and neck pain ($n = 8$; 2.0%). Symptom prevalence was significantly higher in the dissection group (60.5%) than in the aneurysm group (31.9%). The incidence of headache was especially high ($n = 34$; 42.0%) in the dissection group.

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