Is Age a Risk Factor for Poor Outcome of Surgical Treatment of Unruptured Intracranial Aneurysms?

Hidetoshi Matsukawa[1], Hiroyasu Kamiyama[1], Toshiyuki Tsuboi[1], Kosumo Noda[1], Nakao Ota[1], Shiro Miyata[1], Osamu Takahashi[2], Sadahisa Tokuda[1], Rokuya Tanikawa[1]

■ OBJECTIVE: **Advanced age is known to be a significant risk factor for the rupture of intracranial aneurysms. The impact of age on outcomes of surgically treated patients with unruptured intracranial aneurysms (UIAs) is less clear.**

■ METHODS: **A total of 663 consecutive patients with 823 surgically treated UIAs were evaluated. UIAs, which need bypass surgery including low-flow or high-flow bypass, were defined as complex aneurysms. Aneurysm size was categorized as small (<15 mm), large (15–24 mm), and giant (≥25 mm). In patients without symptoms, a poor outcome is defined as a modified Rankin Scale (mRS) score of 2–6. In those with mRS score higher than 1 as a result of UIA-related symptoms or other comorbidities, a poor outcome is defined as an increase of 1 or more on the mRS. Outcomes were evaluated at the 6-month and 12-month follow-up examinations.**

■ RESULTS: **The mean age was 62 ± 12 years and 650 UIAs (78%) were observed in women. Previously treated aneurysm ($P = 0.009$), posterior circulation aneurysm ($P < 0.0001$), complex aneurysm ($P < 0.0001$), a larger size ($P = 0.011$), and perforator territory infarction ($P < 0.0001$) were related to poor outcome at 6 months, and posterior circulation aneurysm ($P < 0.0001$), complex aneurysm ($P < 0.0001$), a larger size ($P = 0.035$), and perforator territory infarction ($P = 0.013$) were related to poor outcome at 12 months. Age was not associated with poor outcome in patients with UIAs who undertook direct surgery.**

■ CONCLUSIONS: **Although risks and benefits of aneurysm treatment in older patients should be carefully considered, surgical treatment of UIAs in the elderly should be considered positively.**

INTRODUCTION

Physicians perform neuroimaging more frequently during health checkups and to evaluate minor symptoms, and the incidence of unruptured intracranial aneurysms (UIAs) has shown a steady increase as a result of advances in these modalities, such as computed tomography angiography and magnetic resonance (MR) angiography, with sensitivities of 76%–98% and specificities of 85%–100%.[1]

As of 2008, Japan had the highest proportion in the world of individuals older than 65 years, at 22.1%, with 10.4% of the total population aged more than 75 years, making Japan the first country to have 10% of the population in this very elderly range.[2] Given the aging population of Japan and the increased incidence of UIAs with age, it is important to elucidate the role of age in management of UIAs. However, established guidelines do not exist for ideal management of UIAs in elderly patients. Several studies have shown that older patients with aneurysmal subarachnoid hemorrhage fare worse than their younger counterparts, regardless of treatment strategy.[3-5] However, the impact of age on outcomes of patients with UIAs is less clear.

The aim of this study was to investigate the impact of age on the outcome of surgical management of UIAs.

METHODS

The study is reported based on criteria from the STROBE (Strengthening the Reporting of Observational Study in Epidemiology) statement.[6] The study protocol was approved by the

Key words
- Age factors
- Patient outcome assessment
- Saccular aneurysm

Abbreviations and Acronyms
MR: Magnetic resonance
mRS: Modified Rankin Scale
SCA: Superior cerebellar artery
STA: Superficial temporal artery
UIA: Unruptured intracranial aneurysm

From the [1]Department of Neurosurgery, Stroke Center, Teishinkai Hospital, Sapporo; and [2]Center for Clinical Epidemiology, Internal Medicine, St. Luke's International Hospital, Chuo-ku, Tokyo, Japan

To whom correspondence should be addressed: Hidetoshi Matsukawa, M.D., Ph.D. [E-mail: nowornever1982@gmail.com]

Citation: World Neurosurg. (2016) 94:222-228.
http://dx.doi.org/10.1016/j.wneu.2016.06.118

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

institutional ethics committee. We recommend treating symptomatic UIAs and asymptomatic UIAs greater than 7 mm; however, we do not refuse to treat smaller aneurysms (3–7 mm) if patients express a strong desire to have them treated after recognition of the natural history of UIA and the morbidity/mortality of surgical clipping. Surgical indications are shown in Table 1. Patients who wished to undergo endovascular treatment were referred to another hospital where they were treated endovascularly. Those who wished to be followed up medically were observed in the outpatient department. Regardless of patient age, we do not perform direct surgery in patients who have cardiovascular disease and are intolerant to general anesthesia or who have uncontrollable diabetes mellitus. We retrospectively reviewed 664 consecutive patients with 824 UIAs and treated with direct surgery at the Department of Neurosurgery at Teishinkai Hospital between April 2012 and June 2015. Among 664 patients, 1 patient was suspected of having mycotic aneurysm. After exclusion of this patient (because of the different cause from noninfectious UIAs), 663 patients with 823 UIAs participated in this study.

We collected the following data: age, sex, previous treatment of aneurysms, aneurysm location and side, whether UIAs were complex, aneurysm size, findings of postoperative diffusion-weighted imaging, postoperative neurologic complications, and clinical outcome. UIAs, which need bypass surgery including low-flow or high-flow bypass, were defined as complex aneurysms. Aneurysm size was categorized as small (<15 mm), large (15–24 mm) and giant (≥25 mm). All patients underwent MR imaging after surgery to diagnose perforator infarction. The surgical technique of extracranial to intracranial high-flow bypass was described previously.[7,8]

Table 1. Surgical Indications for Unruptured Intracranial Aneurysms

Patient characteristics
Younger age
Female sex
Current or former smoker
Hypertension
Family history of subarachnoid hemorrhage
Severe psychological disturbances secondary to harboring unruptured aneurysms
Desire to be treated surgically, not endovascularly
Previous history of subarachnoid hemorrhage by an other aneurysm
Aneurysm characteristics
Symptomatic aneurysm
Enlarging aneurysm
Daughter sac
Size >7 mm
Multiplicity

The clinical outcome was examined at 6-month and 12-month follow-up examination or at the last hospital visit by the modified Rankin Scale (mRS),[9] either by telephone interviews (conducted by H.M independently of the primary surgeon) with the patient or family members or during a physical examination for patients who were able to visit our hospital. In patients without symptoms, a poor outcome is defined as an mRS score of 2–6. In patients with an mRS score greater than 1 as a result of UIA-related symptoms or other comorbidities, a poor outcome is defined as an increase of 1 or more on the mRS.

Statistical Analysis

Statistical analysis was performed using SPSS for Mac (version 21.0 [IBM Corp., Armonk, New York, USA]). Variables are expressed as mean ± standard deviation, median (interquartile range, 25th–75th percentile), or number of patients (%), as appropriate. A Fisher exact test was performed for nominal variables. A Pearson χ^2 test was used to assess associations between categorical variables, complemented by adjusted residual analysis. The normality of the data was evaluated using the Shapiro-Wilk test. Normally distributed continuous variables were compared using a Student t test and nonnormally distributed variables using the Mann-Whitney U test.

Variables were compared between patients with and without poor outcome at 6 and 12 months by univariate analysis. A multivariate logistic regression analysis was performed using variables that were significantly associated with the poor outcome by univariate analysis and were clinically significant for the outcome. Clinical and radiologic characteristics were compared among each age group and among each aneurysm location. Differences were considered significant at $P < 0.05$ for a 95% confidence interval.

RESULTS

All data were collected. The mean age was 62 ± 12 years and 650 UIAs (78%) were observed in women. One hundred and twenty patients had multiple UIAs. Preoperative mRS score greater than 1 was observed in 75 UIAs (9.1%). Among 75 UIAs, decrease of mRS because of other comorbidities was seen in 44 UIAs (5.3%) and 31 (3.8%) were symptomatic UIAs. Complex aneurysms were observed in 105 UIAs (13%). Among these 105 complex UIAs, low-flow bypasses were performed in 47 (5.7%) and combinations of low-flow and high-flow bypasses were performed in 58 (7.0%). Age was not significantly different between patients with good and poor outcomes (Table 2). Clinical and radiologic characteristics of 823 UIAs are shown in Table 2. Male sex, previously treated aneurysm, posterior circulation aneurysm, complex aneurysm, larger size (giant or large), and perforator territory infarction on postoperative diffusion-weighted MR imaging were significantly related to poor outcome at both 6 and 12 months. In multivariate analysis, previously treated aneurysm, posterior circulation aneurysm, complex aneurysm, larger size (giant or large), and perforator territory infarction on postoperative diffusion-weighted MR imaging were significantly related to poor outcome at 6 months, and posterior circulation aneurysm, complex aneurysm, larger size (giant or large), and perforator territory infarction were significantly related to poor outcome at 12 months (Table 3).