

# Analysis of the Surgical Outcome of Unruptured Intracranial Saccular Aneurysms in Octogenarians (80–89 Years)

## Abstract

**Background:** The prevalence of unruptured intracranial aneurysms is increasing in elderly population in Japan. Octogenarians (80–89 years) are more prone to complications due to increased age, comorbidities, increased risk of vasospasm, and treatment risks. **Aim:** The aim is to study the surgical outcome of unruptured intracranial saccular aneurysms in elderly patients aged between 80 and 89 years. **Patients and Methods:** A retrospective study was conducted involving all the cases of unruptured intracranial saccular aneurysms operated surgically in elderly patients aged between 80 and 89 years. All the cases operated between January 2017 and October 2019 were included in the study. The preoperative neurological status was assessed using the Glasgow Coma Scale (GCS). The comorbidities and risk factors involved were assessed. Postoperative neurological status was assessed by (1) postoperative GCS score and by the (2) presence or absence of the motor weakness of limbs. **Results:** Thirty-three aneurysms were operated in 27 patients. Two patients were operated two times at separate occasions for different aneurysms during the study period and hence making a total of 29 surgeries. The age range was 80–88 years, with a mean of 82.4 years  $\pm$  2.64 standard deviation (SD). There were 7 (24.1%) males and 22 (75.86%) females. All the patients had a preoperative GCS score of 15/15 without focal neurological deficit. The mean size (mm) of the aneurysms was 6.57  $\pm$  4.04 SD. There were 31 (93.94%) aneurysms in the anterior circulation and 2 (6.06%) aneurysms in the posterior circulation. The comorbidities and risk factors were analyzed and found to be not influencing the outcome of the patients. Clipping was done in 32 aneurysms. One case of posterior inferior cerebellar artery (PICA) aneurysm underwent occipital artery to PICA bypass surgery. The postoperative complications include chronic subdural hematoma (CSDH) in 7 (24.13%) patients, extradural hematoma in 1 (3.4%), meningitis in 1 (3.4%), and lower cranial nerve palsy in 1 (3.4%) patient. All the patients were discharged with GCS score 15/15 without motor weakness of the limbs. The mean duration of stay was 16.62 days  $\pm$  9.98 SD. **Conclusion:** Surgery for unruptured saccular aneurysms in octogenarians has got a good result in the tertiary care facility. Advanced age alone should not be considered for preferring coiling over clipping. Octogenarians are more prone to developing postoperative CSDH.

**Keywords:** Aneurysm, clipping, octogenarian, unruptured intracranial aneurysms

## Introduction

The number of elderly patients with unruptured cerebral aneurysms (UCAs) is increasing with time in aging populations. The choice of the proper treatment method remains inconclusive. Kwinta *et al.* did a study to evaluate the possible complications and treatment outcome among 139 elderly patients of >65 years with UCAs. The mean age was 69.01 years  $\pm$  3.60 standard deviation (SD). The most common aneurysm location was the middle cerebral artery (MCA). The mean dome size was 8.36  $\pm$  4.24 mm. Seventy-two patients (55.97%) underwent aneurysm

clipping and 39 (27.04%) coiling. Eighteen patients (11.90%) required stent-assisted coiling and 4 (5.00%) had a single stent placement. A total of 133 patients (95.71%) had good treatment outcomes (modified Rankin Scale score 0–3, surgical 0.32  $\pm$  1.03 vs. endovascular group 0.40  $\pm$  1.12,  $P$  = 0.65). The occlusion rate of aneurysms was evaluated based on digital subtraction angiogram (endovascular group) or computed tomography (CT) angiogram (microsurgical group) results. Complete or near-complete occlusion in the endovascular group was achieved in 83% directly after treatment and in 89%

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at 6–12 months after procedure. The microsurgical group presented 100% occlusion at follow-up. A total of 95.71% of patients presented a good outcome in early observation and 94.96% in late follow-up. In clipping group, one patient died 3 months after MCA aneurysm clipping and another patient presented with motor aphasia after left MCA aneurysm clipping. These complications occurred as a consequence of cerebral infarction. Despite the high prevalence of comorbidities in the age group >65 years, the vast majority of patients in this series treated invasively for UCAs presented with good treatment outcomes. Among elderly patients, modern microsurgical as well as endovascular management of brain aneurysms in a high-volume center seems to be a safe and effective method of treatment.<sup>[1]</sup>

## Patients and Methods

A retrospective study was conducted involving all the cases of unruptured intracranial saccular aneurysms operated surgically in elderly patients aged between 80 and 89 years. All the patients operated in Fujita Health University Bantane Hospital, Nagoya, Aichi, Japan, between January 2017 and October 2019 were selected. The preoperative neurological status was assessed using the Glasgow Coma Scale (GCS). The preoperative diagnosis of the aneurysm was done using cerebral CT angiogram. The size of the aneurysm was defined by the maximum diameter of the aneurysm. The risk factors and comorbidities of the patients were noted. Patients underwent surgical clipping or bypass surgery of aneurysms. Postoperative neurological status was assessed by postoperative GCS score and by the presence or absence of the motor weakness of limbs.

## Parameters analyzed

Age, sex, preoperative GCS score, history of hypertension, diabetes mellitus, smoking, history of alcoholism, previous history of treatment for aneurysm, family history of subarachnoid hemorrhage (SAH) or aneurysm in first-degree relatives, intake of antiplatelet/anticoagulant medication, history of other comorbid diseases, number of aneurysms, aneurysm location, aneurysm size, use of motor evoked potential (MEP), postoperative GCS score, presence or absence of postoperative motor weakness of limbs, postoperative complications occurring during the hospital stay, and duration of stay.

## Statistical analysis

Data were collected in the Microsoft Excel sheet. Statistical analysis was done using Epi Info software (Centers for Disease Control and Prevention, Atlanta, Georgia, United States).

## Results

Thirty-three unruptured intracranial saccular aneurysms were operated in 27 patients. Two patients were operated

two times at separate occasions for different aneurysms during the study period and hence making a total of 29 surgeries. The age range was 80–88 years, with a mean of 82.4 years  $\pm$  2.64 SD, and there were 7 (24.1%) males and 22 (75.86%) females. All the patients had a preoperative GCS score of 15/15 without any focal neurological deficit. The mean size (mm) of the aneurysms was 6.57  $\pm$  4.04 SD, and the locations of the aneurysms are given in Table 1. There were 31 (93.94%) aneurysms in the anterior circulation and 2 (6.06%) aneurysms in the posterior circulation. The comorbidities and risk factors are given in Table 2. Age, sex, risk factors, and comorbid diseases did not influence the outcome of unruptured saccular aneurysm surgery in octogenarians.

MEP was used in 14 cases. Clipping was done in 32 aneurysms. One case of posterior inferior cerebellar artery (PICA) aneurysm underwent occipital artery to PICA bypass surgery. In postoperative period, seven patients developed chronic subdural hematoma (CSDH), all of which were irrigated. One case of ophthalmic

**Table 1: The locations of the unruptured intracranial aneurysms in octogenarians**

Location of aneurysm	Number of aneurysms (%)
IC-PC	10 (30.30)
MCA	10 (30.30)
IC top aneurysm	2 (6.06)
Acom artery aneurysm	2 (6.06)
IC ophthalmic artery aneurysm	2 (6.06)
IC anterior choroidal aneurysm	2 (6.06)
Distal ACA	2 (6.06)
PICA	2 (6.06)
A1 ACA	1 (3.03)

IC – Internal carotid; PC – Posterior communicating; MCA – Middle cerebral artery; Acom – Anterior communicating; ACA – Anterior cerebral artery; PICA – Posterior inferior cerebellar artery

**Table 2: Comorbidities and risk factors in octogenarians with unruptured intracranial aneurysms**

Comorbidities and risk factors	Number of patients (%)
Hypertension	10 (34.48)
Cerebral ischemia	6 (20.69)
Diabetes	1 (3.44)
Atherosclerosis	2 (6.89)
Hyperlipidemia	2 (6.89)
Angina	1 (3.44)
Systemic cancer	2 (6.89)
Degenerative spine diseases	8 (27.58)
Antiplatelet/anticoagulant medication	8 (27.58)
Previous treatment for aneurysm	3 (10.34)
Family history of SAH/aneurysm	2 (6.89)
Smoking	1 (3.44)
Alcohol	1 (3.44)

SAH – Subarachnoid hemorrhage

artery aneurysm developed extradural hematoma (EDH) in postoperative day 1 and underwent EDH evacuation. One case of MCA aneurysm developed meningitis which was managed conservatively. One case of PICA aneurysm developed lower cranial nerve palsy following occipital artery-PICA bypass, which was recovered in postoperative period. All the patients were discharged with GCS 15/15 without motor weakness of the limbs. Although detailed Mini-Mental State Examination (MMSE) was not done, a patient's gross cognitive function remained the same as that of the preoperative status. The mean duration of stay was 16.62 days  $\pm$  9.98 SD.

## Discussion

Sorenson *et al.*, in their study on UCAs, found that patients over 80 years had a significantly higher incidence of hypertension and a significantly lower incidence of smoking history and familial aneurysm history. UCAs >7 mm carry a nonnegligible risk of rupture of 3.2% per patient-year in patients over the age of 80 years.<sup>[2]</sup>

Ikawa *et al.* did a study to clarify the risk factors of treatment for UCAs in elderly patients by comparing the morbidity at discharge between surgical clipping and endovascular coiling in nonelderly (<65 years) and elderly ( $\geq$ 65 years) patients based on a national database in Japan. Risk factors for morbidity at discharge were basilar artery aneurysm compared with internal carotid artery (ICA), diabetes mellitus, antiplatelet drug, and anticoagulation drug; however, the highest hospital volume compared with lowest was an inverse risk factor in both age groups. Anterior communicating artery (Acom) aneurysm and MCA aneurysm compared with ICA were significantly inverse risks in the elderly group.<sup>[3]</sup>

Juvela *et al.* investigated the long-term natural history of UCAs and risk factors predictive of subsequent rupture. A total of 142 patients with 181 UCAs diagnosed between 1956 and 1978, when these were not treated, were followed up until death or SAH or until 2011–2012. They concluded that cigarette smoking, Acom aneurysm, patient's age inversely, and aneurysm diameter  $\geq$ 7 mm independently predicted the subsequent aneurysm rupture.<sup>[4]</sup>

The comparative effectiveness of clipping and coiling for UCAs remains an issue of debate and has not been studied in clinical trials. Bekelis *et al.* performed a cohort study for elderly patients who had treatment for UCAs between 2007 and 2012. During the study period, 8705 patients underwent treatment for UCAs. Of these patients, 29.7% had surgical clipping and 70.3% had endovascular coiling. Instrumental variable analysis demonstrated no difference between coiling and clipping in 1-year postoperative mortality or 90-day readmission rate. Clipping was associated with a higher rate of discharge to a rehabilitation facility and a longer length of stay.<sup>[5]</sup>

Mori *et al.* compared the complications and outcomes after keyhole clipping between nonfrail elderly

patients ( $\geq$ 70 years) and nonelderly patients. Keyhole clipping (either supraorbital or pterional) was performed to treat 260 cases of relatively small ( $\leq$ 10 mm) anterior circulation UCAs. There were 62 cases in the nonfrail elderly group (mean age: 72.9  $\pm$  2.6 years SD) and 198 cases in the nonelderly group (mean age: 59.5  $\pm$  7.6 years). The incidence of CSDH was not significantly higher in the elderly group than in the nonelderly group (8.1% vs. 4.5%,  $P = 0.332$ ); rates of other complications including stroke and epilepsy were not significantly different. Lacunar infarction occurred in 3.2% of the elderly group and 3.0% of the nonelderly group. No patient in the elderly group required retreatment or demonstrated the recurrence of clipped aneurysms. The MMSE score at 3 months significantly improved in the nonelderly group but did not change in the elderly group. The Beck Depression Inventory and Hamilton Rating Scale for Depression at 3 months were significantly improved in both the groups. No patient died in either group. The morbidity at 3 months and 1 year in the elderly group (1.6% and 4.8%, respectively) was not significantly different from that in the nonelderly group (2.0% and 1.5%, respectively). They concluded that keyhole clipping for nonfrail elderly patients ( $\geq$ 70 years) with relatively small anterior circulation UCAs did not significantly increase the complication, mortality, or morbidity rate; hospitalization period; or aneurysm recurrence compared with nonelderly patients, and it was associated with improvement in anxiety and depression.<sup>[6]</sup>

Silva *et al.* did a study to analyze the outcomes of UCAs in elderly patients ( $\geq$ 65 years of age) after coiling or clipping. These patients had a significantly higher prevalence of various comorbidities and incidence of complications. Elderly patients who received clipping experienced a 10.3% incidence rate of perioperative stroke, whereas their coiling counterparts experienced this complication at a rate of 3.5%. Elderly patients treated with clipping had greater odds of perioperative acute renal failure, whereas their coiling counterparts had greater odds of perioperative deep venous thrombosis and pulmonary embolism.<sup>[7]</sup>

An increasing number of UCAs have been discovered in elderly patients in recent years, but the optimal treatment strategy for these patients remains controversial. Yang *et al.* did a retrospective review in elderly patients ( $\geq$ 70 years old) who harbored UCAs and treated by conservative observation, microsurgical clipping, or endovascular coiling between January 2009 and December 2014. A total of 141 consecutive elderly patients with 166 UCAs were enrolled in the study. Seventy-nine aneurysms were treated with coiling, and 14 aneurysms were treated with clipping. The remaining 73 aneurysms were placed under conservative observation. There was no significant difference of the modified Rankin Scale in patients with UCAs treated by different methods. Multivariate analysis showed that age and aneurysm size are independent risk factors for

unfavorable outcome of UCAs in the elderly. Patient age and aneurysm size were also significantly associated with unfavorable outcome of UCAs managed with observation initially. Their results indicated that endovascular coil embolization and clipping were both safe and effective treatment methods for UCAs in the elderly. Aggressive treatment for UCAs in elderly patients with risk factors of aneurysm rupture should be considered positively.<sup>[8]</sup>

Brinjikji *et al.* applied the United States National Inpatient Sample data from 2001 to 2008 to determine and compare outcomes of coiling and clipping of UCAs in the elderly. They found that 140 (0.5%) patients aged 80 years or older underwent clipping of UCAs. 33.5% (47/140) of clipped patients were discharged to long-term facilities. The mortality rate was 21.4% (30/140), and the mean length of stay was 12.7 (SD, 23.0) days.<sup>[9]</sup>

Ansari *et al.* did a retrospective analysis of all patients with UCAs operated between September 2014 and December 2016. A total of 247 patients underwent craniotomies for clipping of aneurysms. CSDH developed in 22 (8.9%) patients in the postoperative period.<sup>[10]</sup> In an author's cases also, CSDH is the most common complication. It is mainly due to the atrophy of the brain.

Hoh *et al.* obtained the Nationwide Inpatient Sample from the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality. Hospitalizations for clipping or coiling of ruptured and UCA from 2002 to 2006 were identified. There were 4513 patients who underwent clipping of UCAs. Their mean age was 53.3 years  $\pm$  11.6 SD, and the length of hospital stay was 1–182 days (9.0 days  $\pm$  10.4 SD). For unruptured aneurysm patients, after adjusting for patient-specific and hospital-specific factors, clipping compared to coiling was associated with significantly longer length of stay ( $P < 0.0001$ ).<sup>[11]</sup> In our study, the mean age was 82.4 years  $\pm$  2.64 SD, and the mean duration of stay was 16.62 days  $\pm$  9.98 SD. The length of stay in octogenarians of an author's study is more than the general population.

In an author's study, all the patients were recovered with a GCS score of 15/15 without weakness of limbs. The main reason for the good clinical outcome is that these cases are nonfrail octogenarians and are operated in a high-volume tertiary care neurovascular center in Japan. The small number of cases and lack of long-term follow-up are the limitations of the study. The authors recommend that the advanced age alone should not be considered for preferring coiling against clipping in octogenarians, who are otherwise fit to undergo surgery.

## Conclusion

Although octogenarians are at risk for open surgery for intracranial aneurysm, unruptured saccular aneurysms have

got a good result in the tertiary care neurovascular center in Japan. Hence, advanced age alone should not be considered for preferring coiling against clipping. Octogenarians are more prone to developing postoperative CSDH due to atrophy of the brain.

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## Conflicts of interest

There are no conflicts of interest.

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