



Case Report

# Rupture immediately after growth of unruptured intracranial aneurysms during follow-up

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## ABSTRACT

**Background:** The annual rupture rate of small unruptured intracranial aneurysms (UIAs) <5 mm is generally low; further, small UIAs are often treated conservatively. While the growth of aneurysms during follow-up is associated with a high risk of rupture, the urgency for surgical treatment of asymptomatic enlarged UIAs remains controversial. We experienced two patients in whom UIAs ruptured shortly after asymptomatic growth during follow-up.

**Case Description:** A 1-mm right middle cerebral artery aneurysm was incidentally found in a 63-year-old woman. Preventive surgery was planned because the aneurysm grew rapidly; however, the aneurysm ruptured preoperatively. A 68-year-old woman had a small (4 mm) aneurysm at the left internal carotid-posterior communicating artery. The aneurysm grew rapidly after many years. Several hours after magnetic resonance imaging was performed, she presented to the hospital with loss of consciousness, and a diagnosis of subarachnoid hemorrhage due to the ruptured aneurysm was made.

**Conclusion:** UIAs that rapidly increase during follow-up may be regarded as impending ruptured aneurysms.

**Keywords:** Impending ruptured aneurysm, Magnetic resonance imaging, Subarachnoid hemorrhage, Unruptured intracranial aneurysm

## INTRODUCTION

Research on unruptured intracranial aneurysms (UIAs) has progressed and its natural history has recently been better defined according to multiple prospective studies. Due to the increasing use of magnetic resonance imaging (MRI) for various symptoms, asymptomatic small UIAs are being detected more frequently. The annual rupture rate of small UIAs <5 mm is generally low and small UIAs are often treated conservatively. Aneurysm growth during follow-up is reportedly associated with a high rupture risk.<sup>[1,3,7]</sup> Few reports have also analyzed the period from aneurysm growth to rupture. The urgency of surgical treatment when UIAs grow remains controversial. We experienced two patients with asymptomatic impending rupture in whom UIAs ruptured within a short period after growth during follow-up.

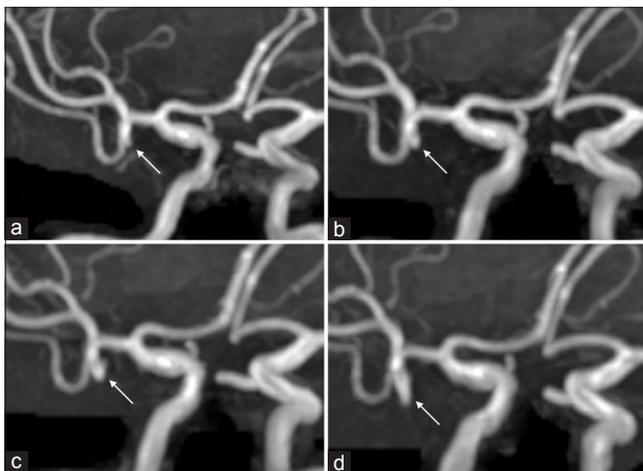
## CASE DESCRIPTIONS

### Case 1

A 1-mm right middle cerebral artery aneurysm was incidentally revealed in a 63-year-old woman on MRI [Figure 1]. Three years later, another MRI revealed enlargement of the aneurysm to 2 mm. Subsequent MRIs performed approximately once a year revealed no significant changes in the aneurysm size. However, after 3 years, the aneurysm had gradually increased in size to 3.3 mm. MRI performed 1 year later revealed that the aneurysm had increased to 7.3 mm; hence, preventive surgery was planned. However, the aneurysm ruptured 1 week after the MRI and remained at 7 mm on examination at the time of rupture.

### Case 2

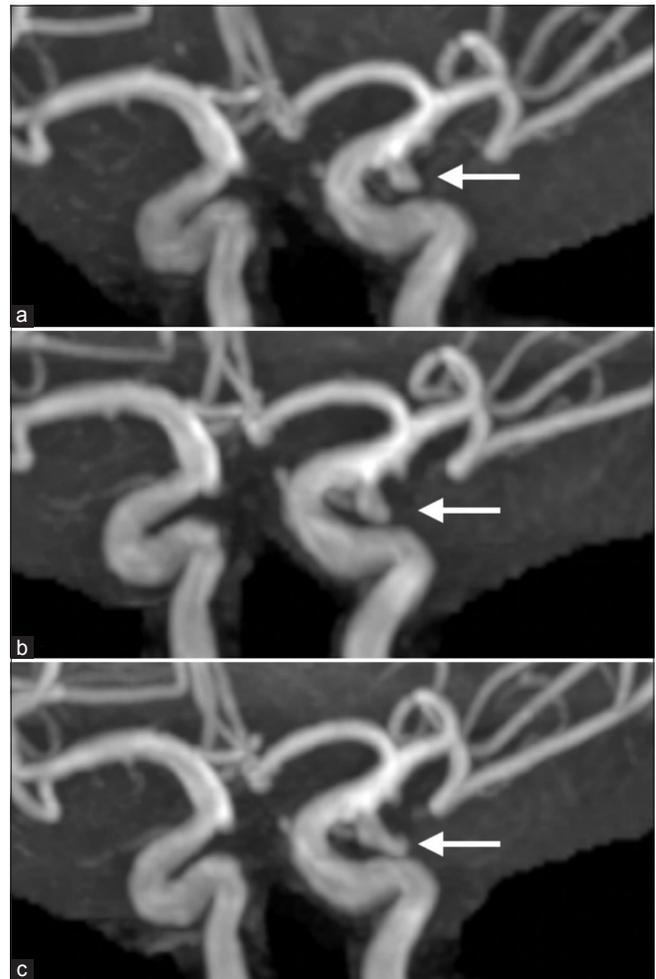
A 68-year-old woman >had no significant medical history; however, MRI performed during a routine health check-up incidentally revealed a small aneurysm (4 mm) at the left internal carotid-posterior communicating artery. Subsequent MRIs performed every 6 or 12 months revealed no significant changes in the aneurysm size [Figure 2]. The aneurysm had grown to 5 mm on MRI 3 years after the detection, although it was not noticed at that time. The aneurysm had increased to 7.5 mm on MRI performed 1 year later, but she went home without being examined on that day. Few hours later, she presented to the hospital with loss of consciousness. Subarachnoid hemorrhage due to the ruptured aneurysm was diagnosed. Computed tomography angiography (CTA) performed after admission revealed the same findings as the previous MRI.



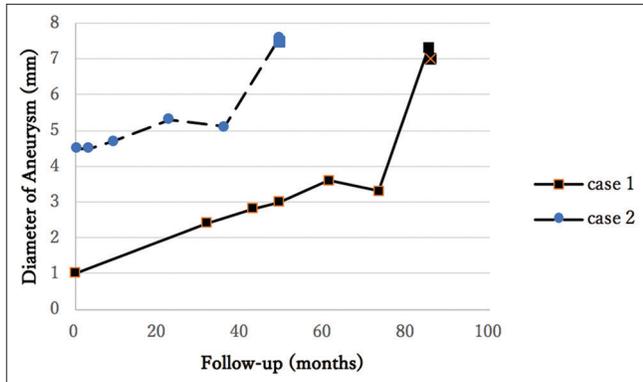
**Figure 1:** (a) Magnetic resonance angiography (MRA) shows a 1-mm right middle cerebral artery aneurysm in case 1 (arrow). (b) MRA shows growth of the aneurysm to 2 mm. (c) MRA shows growth of the aneurysm to 3.3 mm. (d) MRA shows rapid growth of the aneurysm just before rupture.

## DISCUSSION

The present study highlights two important clinical issues. First, UIAs that show rapid growth during follow-up may rupture within a short period. During observation, UIAs must be compared against the initial image as well as the previous image. When UIAs sized  $\leq 5$  mm are detected incidentally, follow-up may be appropriate due to the low rupture rate (for example, 0.54%/year in the SUAVE study and 0.36%/year in the UCAS Japan report).<sup>[5,6]</sup> Some studies have claimed that the risk of ruptured UIAs became high if they grew in size during follow-up.<sup>[1,3,7]</sup> Inoue *et al.*<sup>[1]</sup> reported that the annual rupture rate of UIAs was 18.5% when the diameter of the aneurysm increased by 1.5 times or a bleb appeared during follow-up. Villablanca *et al.*<sup>[7]</sup> reported that the rupture rate in the group with UIA growth during follow-up was 12 times that of the group without growth. Although



**Figure 2:** (a) Magnetic resonance angiography (MRA) shows small left internal carotid-posterior communicating artery aneurysm in case 2 (4 mm; arrow). (b) MRA shows growth of the aneurysm to 5 mm. (c) MRA shows rapid growth of the aneurysm just before rupture.



**Figure 3:** Diameter of the aneurysm in case 1 is represented by a solid line and that in case 2 is represented by a dotted line.

many physicians recognize that rapidly growing UIAs must be treated, only few studies have been performed to actually consider the urgency of treating rapidly growing UIAs using scientific or statistical methods. A previous study reported that 27 of 324 UIAs grew and ruptured during follow-up that the average growth rate of the 27 UIAs was 0.92 mm/year and that the average size of the 27 UIAs that ruptured was 6.1 mm.<sup>[2]</sup>

In both cases 1 and 2, the growth rate of UIAs just before rupture was 2.24 and 3.97 mm/year, respectively; this rate was much more rapid growth than that reported by Juvela.<sup>[2]</sup> It is important to assess not only whether the diameter of the aneurysm has increased but also by how many times the original diameter has increased. Inoue *et al.*<sup>[1]</sup> defined aneurysm growth as an increase of the maximum aneurysm diameter by 1.5 times on MRI. In our cases, the maximum aneurysm diameter growth rates were >2 mm/year and >1.5 times/year, respectively [Figure 3]. These two cases emphasize that rapid aneurysm growth is an important and powerful risk factor for aneurysm rupture.

Second, during observation, the UIAs must be compared with the initial and previous images. When UIAs are followed closely, it seems that MRI is often performed approximately once a year and slow growth may be missed when compared with only the previous image. When the growth of UIAs was  $\leq 1$  mm on MRI, the judgment was difficult. However, comparison with several prior MRI images could have shown a clear growth. For such patients, it is recommended that a request for direct comparison with the results of the initial diagnostic exam be included in the instructions provided to the radiologist for the follow-up magnetic resonance angiography/CTA. The previous studies have reported that UIAs have the highest rate of rupture immediately after aneurysm formation and that the rate gradually decreases subsequently.<sup>[4,8]</sup> However, if UIA growth was observed during follow-up, the rupture rate was reported to be increased.

Therefore, whether the UIA was growing gradually or there was no change an important factor.

## CONCLUSION

UIAs that show rapid growth during follow-up can rupture within a short period. During observation, UIAs must be compared against the initial and previous images. UIAs that show rapid growth during follow-up could be regarded as impending ruptured aneurysms even if they are asymptomatic. Hence, the urgency of treatment for such aneurysms should be carefully determined. Further reports should be accumulated to examine the rate of growth of the ruptured aneurysm during follow-up.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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