

Distal Anterior Inferior Cerebellar Artery Aneurysm Occult on Magnetic Resonance Angiography One Month Prior to Rupture

—Case Report—

Takeshi KONDOH, Eiji KURIHARA*, and Eiji KOHMURA

Department of Neurosurgery, Kobe University Graduate School of Medicine, Kobe, Hyogo;

*Section of Neurosurgery, Junshin Hospital, Kakogawa, Hyogo

Abstract

A 77-year-old man suffered subarachnoid hemorrhage due to a ruptured aneurysm of the distal anterior inferior cerebellar artery (AICA). He had a history of hearing disturbance in the left ear for more than 3 years. Computed tomography on three separate occasions had found no abnormalities. One month before the hemorrhage, he came to our outpatient service complaining of vertigo. Magnetic resonance (MR) imaging and MR angiography detected no abnormality. Conventional angiography demonstrated an aneurysm of 8 mm diameter in the distal AICA region after the hemorrhage. Filling and wash out of the aneurysm sac by contrast medium was markedly delayed, which suggested that MR imaging had failed to detect the flow void because of the slow blood flow in the dome. The aneurysm was clipped successfully. He was discharged with mild dysarthria on the 33rd postoperative day. MR angiography has limitations in detecting unruptured aneurysms and there is certainly a high risk group of false negatives, including aneurysms located in the distal region of the main trunk.

Key words: anterior inferior cerebellar artery, unruptured aneurysm, magnetic resonance angiography, false negative

Introduction

Screening for unruptured cerebral aneurysms in the general population is an important factor in determining the relative surgical risk vs. rupture rate in the natural course. Magnetic resonance (MR) angiography is one of the most common methods used for screening cerebral aneurysms, and is believed to provide reliability for detecting aneurysms. The true positive rate of detecting aneurysms by MR angiography is reported as 76–98%.^{7,12,18,20,25)} However, many of these studies were performed on a preselected population of patients who were already known to have cerebral aneurysms.^{5,19)} Episodes of subarachnoid hemorrhage or prior study by conventional angiography are indicators of the presence of an aneurysm. However, even with such strong suspicion, MR angiography does not provide a true positive rate of 100% for detecting aneurysms, indicat-

ing that the reliability for detecting aneurysms in the screening population may be lower than expected. Previously, subarachnoid hemorrhage has occurred in several cases of aneurysms undetected by MR angiography.^{16,24)} The false negative rate of MR angiography for detecting aneurysms in the screening population is unknown, and so the risk of subarachnoid hemorrhage after false negative findings remains unknown.

We report a case of unruptured aneurysm of the distal anterior inferior cerebellar artery (AICA) which was not detected by MR angiography performed one month prior to hemorrhage manifesting as vertigo. Such cases are important to estimate the cost-benefit ratio of MR angiography screening for detecting unruptured aneurysm.

Case Report

A 77-year-old man had been complaining of vertigo for 1 year before he visited our outpatient clinic on December 10, 2001. He had a history of progressive

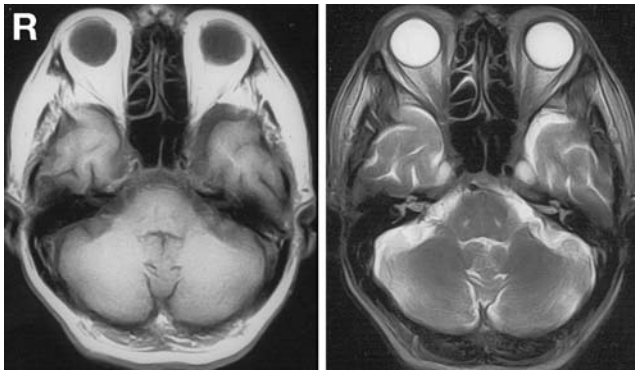


Fig. 1 T₁- (left) and T₂-weighted (right) magnetic resonance images taken one month before the onset of subarachnoid hemorrhage demonstrating no flow void in the cerebellopontine angle.

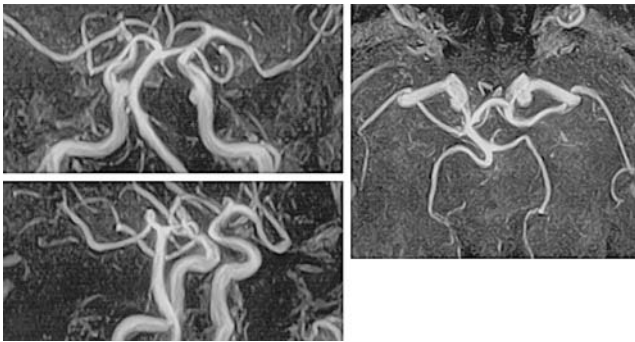


Fig. 2 Magnetic resonance angiograms, anteroposterior (left upper), lateral (left lower), and axial (right) views, demonstrating no aneurysm in the posterior circulation.

hearing disturbance in the left ear for more than 3 years. Computed tomography (CT) had been performed in other hospitals three times over the previous few years, but none had revealed pathological findings.

Neurological examination on his first visit to the outpatient department revealed no neurological signs such as trigeminal nerve paresis, facial nerve paresis, nystagmus, or cerebellar signs, other than deafness in the left ear. MR imaging and MR angiography on that day demonstrated mild stenosis of the left internal carotid artery of the neck, indicating atherosclerotic change, but no other pathological findings (Figs. 1 and 2). Retrospective checking of the film after the onset of subarachnoid hemorrhage 24 days later also found no other abnormalities. The patient was given medical treatment for vertigo. MR imaging and angiography used the

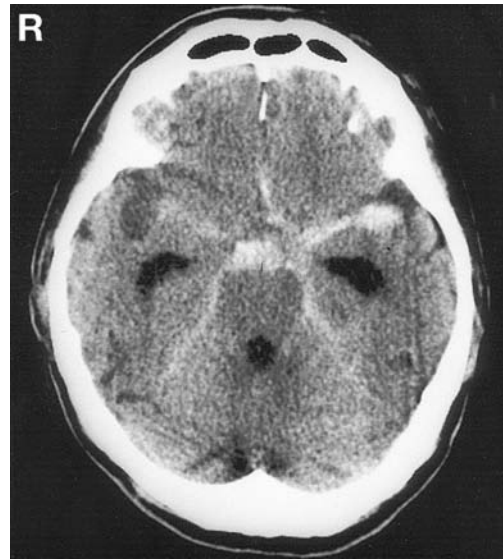


Fig. 3 Computed tomography scan on admission showing subarachnoid hemorrhage, predominantly around the basal cistern.

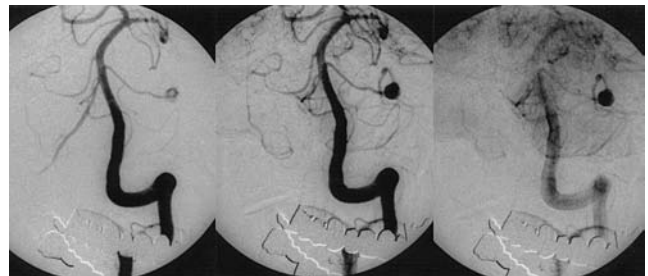


Fig. 4 Conventional angiograms, anteroposterior view, demonstrating a distal type anterior inferior cerebellar artery aneurysm. Wash out of the contrast medium was markedly delayed, suggesting that the arterial blood flow was slow in the aneurysm sac.

Shimadzu Epios 10 (Shimadzu Co., Kyoto), and the parameters for MR angiography by the three-dimensional time-of-flight (3-D TOF) method were: repetition time/echo time 37 msec/8.0 msec, matrix 256 × 256, slice thickness 1.0 mm, flip angle 18°, NEX 1, slab thickness 51 mm, field of view 20 cm, and scan time 4 min 52 sec.

Twenty-four days after the MR study, the patient suffered sudden onset of headache and vomiting. On admission, he was alert and no new cranial nerve paresis was recognized. CT revealed subarachnoid hemorrhage (Fig. 3) and cerebral angiography demonstrated an aneurysm 8 mm in diameter located on the meatal loop of the left AICA (Fig. 4). Slow filling of the aneurysm sac and delayed stasis of the

contrast agent were observed, suggesting relatively slow arterial blood flow in the aneurysm sac.

The aneurysm was treated successfully via a left suboccipital craniectomy. The aneurysm sac was located between the facial nerve and the acoustic nerve. The acoustic nerve was thin and pale, explaining the deafness in the left ear. Dissection of the aneurysm sac from the acoustic nerve was difficult due to tight adhesion. The aneurysm was trapped with aneurysm clips to avoid damaging the nerve.

The postoperative course was uneventful. Ventriculoperitoneal shunting was performed and the patient was discharged with mild dysarthria on the 33rd postoperative day.

Discussion

The incidence of distal AICA aneurysms is reported to be 0.1–0.5% of all intracranial aneurysms.^{12,17)} Unruptured distal AICA aneurysms are associated with hearing disturbance, facial nerve paresis, tinnitus, and vertigo.^{3,15,17)} In our case, we explored other etiologies such as ischemia and cerebellopontine angle tumor, but did not suspect unruptured aneurysm and thus did not perform conventional angiography or 3-D CT angiography.

MR angiography did not detect the aneurysm in our case, probably because of the slow blood flow in the aneurysm sac. TOF MR angiography detects complex and pulsatile blood flow, but the signal tends to be less distinct from the surrounding tissues as the flow rate diminishes.^{4,6,10)} The progressive saturation of slow-moving protons is responsible for the decrease in signal intensity.²²⁾ TOF MR angiography has failed to demonstrate such aneurysms in several cases.^{14,23)} The true positive rate of detection of aneurysms on TOF MR angiography is 76–98%.^{7,12,18,20,25)} The size of aneurysms and the strength of the field are the important factors.^{13,21)} The 3-D phase contrast technique is superior to the TOF method,⁹⁾ with variable velocity sensitivity and low sensitivity to saturation effects, but some reports question this superiority.^{1,26)} T₂-weighted MR imaging by either method is supposed to demonstrate a flow void in the aneurysm sac if the appropriate plane is obtained. However, slow flow within the lumen may appear as a high signal intensity on T₂-weighted imaging, which is difficult to differentiate from a thrombus²⁾ as in the present patient. We did not perform 3-D CT angiography prior to the hemorrhage. The patient had symptoms of hearing disturbance on the left. 3-D CT angiography could have demonstrated the aneurysm sac if the posterior fossa region had been examined.

Similar cases of distal AICA aneurysm have been reported previously, in which MR angiography could not disclose a ruptured aneurysm of 3 mm diameter.¹⁵⁾ Conventional angiography has demonstrated the disappearance of a ruptured distal AICA aneurysm 8 days after the onset of hemorrhage, which presumably reflected the slow blood flow of the parent artery.⁸⁾ Slow blood flow leading to non-visualization of an aneurysm is often proposed for giant aneurysms. However, aneurysms of the distal type are another candidate. The presence of distal aneurysms also receives less attention in analysis of MR imaging. Therefore, distal unruptured aneurysms remain undetected by MR angiography.

Besides the technical difficulty of detecting aneurysms with slow blood flow, previous MR angiographical findings of false negative aneurysms were characterized by the limitations in detecting small aneurysms,²⁴⁾ overlapping of the images with parent arteries,^{11,16)} and the late formation of a de novo aneurysm. Therefore, MR angiography screening has certain limitations. Evaluation of the cost-benefit ratio of the treatment of unruptured aneurysms should include these false negative cases which may later manifest as hemorrhage.

References

- 1) Araki Y, Kohmura E, Tsukaguchi I: A pitfall in detection of intracranial unruptured aneurysms on three-dimensional phase-contrast MR angiography. *AJNR Am J Neuroradiol* 15: 1618–1623, 1994
- 2) Atlas SW, Grossman RI, Goldberg HI, Hackney DB, Bilaniuk LT, Zimmerman RA: Partially thrombosed giant intracranial aneurysms: correlation of MR and pathologic findings. *Radiology* 162: 111–114, 1987
- 3) Banczerowski P, Sipos L, Vajda J: Aneurysm of the internal auditory artery: our experience and review of the literature. *Acta Neurochir (Wien)* 138: 1157–1162, 1996
- 4) Brugieres P, Blustajn J, Le Guerin C, Meder JF, Thomas P, Gaston A: Magnetic resonance angiography of giant intracranial aneurysms. *Neuroradiology* 40: 96–102, 1998
- 5) Chung TS, Joo JY, Lee SK, Chien D, Laub G: Evaluation of cerebral aneurysms with high-resolution MR angiography using a section-interpolation technique: correlation with digital subtraction angiography. *AJNR Am J Neuroradiol* 20: 229–235, 1999
- 6) De Jesus O, Rifkinson N: Magnetic resonance angiography of giant aneurysms. Pitfalls and surgical implications. *P R Health Sci J* 16: 131–135, 1997
- 7) Grandin CB, Mathurin P, Duprez T, Stroobandt G, Hammer F, Goffette P, Cosnard G: Diagnosis of intracranial aneurysms: accuracy of MR angiography at 0.5 T. *AJNR Am J Neuroradiol* 19: 245–252, 1998
- 8) Honda Y, Tanaka R, Kameyama S: Ruptured distal

- anterior inferior cerebellar artery aneurysm. Case report. *Neurol Med Chir (Tokyo)* 34: 763-767, 1994
- 9) Huston J 3rd, Rufenacht DA, Ehman RL, Wiebers DO: Intracranial aneurysms and vascular malformations: comparison of time-of-flight and phase-contrast MR angiography. *Radiology* 181: 721-730, 1991
 - 10) Ikawa F, Sumida M, Uozumi T, Kuwabara S, Kiya K, Kurisu K, Arita K, Satoh H: Comparison of three-dimensional phase-contrast magnetic resonance angiography with three-dimensional time-of-flight magnetic resonance angiography in cerebral aneurysms. *Surg Neurol* 42: 287-292, 1994
 - 11) Johnson MR, Good CD, Penny WD, Barnes PR, Scadding JW: Lesson of the week: Playing the odds in clinical decision making: lessons from berry aneurysms undetected by magnetic resonance angiography. *BMJ* 322: 1347-1349, 2001
 - 12) Kamano S, Kirino T, Mizuno S: Intrameatal aneurysm. *Neurochirurgia (Stuttg)* 29: 28-30, 1986
 - 13) Korogi Y, Takahashi M, Mabuchi N, Watabe T, Shiokawa Y, Shiga H, O'Uchi T, Nakagawa T, Miki H, Horikawa Y, Fujiwara S, Furuse M: MR angiography of intracranial aneurysms: a comparison of 0.5 T and 1.5 T. *Comput Med Imaging Graph* 21: 111-116, 1997
 - 14) Kuzma BB, Goodman JM: Non-visualization of known cerebral aneurysm on MRA. *Surg Neurol* 51: 110-112, 1999
 - 15) Mizushima H, Kobayashi N, Yoshiharu S, Kazuo H, Dohi K, Sasaki K, Matsumoto K: Aneurysm of the distal anterior inferior cerebellar artery at the medial branch: a case report and review of the literature. *Surg Neurol* 52: 137-142, 1999
 - 16) Nakajima F, Shibahara N, Arai M, Ueda H, Katsuoka Y: Ruptured cerebral aneurysm not detected by magnetic resonance angiography in juvenile autosomal dominant polycystic kidney. *Int J Urol* 7: 153-156, 2000
 - 17) Oana K, Murakami T, Beppu T, Yamaura A, Kanaya H: Aneurysm of the distal anterior inferior cerebellar artery unrelated to the cerebellopontine angle: case report. *Neurosurgery* 28: 899-903, 1991
 - 18) Olsen WL, Brant-Zawadzki M, Hodes J, Norman D, Newton TH: Giant intracranial aneurysms: MR imaging. *Radiology* 163: 431-435, 1987
 - 19) Raaymakers TW, Buys PC, Verbeeten B Jr, Ramos LM, Witkamp TD, Hulsmans FJ, Mali WP, Algra A, Bonsel GJ, Bossuyt PM, Vonk CM, Buskens E, Limburg M, van Gijn J, Gorissen A, Greebe P, Albrecht KW, Tulleken CA, Rinkel GJ: MR angiography as a screening tool for intracranial aneurysms: feasibility, test characteristics, and interobserver agreement. *AJR Am J Roentgenol* 173: 1469-1475, 1999
 - 20) Ronkainen A, Puranen MI, Hernesniemi JA, Vanninen RL, Partanen PL, Saari JT, Vainio PA, Ryyanen M: Intracranial aneurysms: MR angiographic screening in 400 asymptomatic individuals with increased familial risk. *Radiology* 195: 35-40, 1995
 - 21) Schmieder K, Falk A, Hardenack M, Heuser L, Harders A: Clinical utility of magnetic resonance angiography in the evaluation of aneurysms from a neurosurgical point of view. *Zentralbl Neurochir* 60: 61-67, 1999
 - 22) Tsuruda J, Saloner D, Norman D: Artifacts associated with MR neuroangiography. *AJNR Am J Neuroradiol* 13: 1411-1422, 1992
 - 23) Turtz A, Allen D, Koenigsberg R, Goldman HW: Non-visualization of a large cerebral aneurysm despite high-resolution magnetic resonance angiography. Case report. *J Neurosurg* 82: 294-295, 1995
 - 24) Vanninen RL, Hernesniemi JA, Puranen MI, Ronkainen A: Magnetic resonance angiographic screening for asymptomatic intracranial aneurysms: the problem of false negatives: technical case report. *Neurosurgery* 38: 838-840, 1996
 - 25) Wardlaw JM, White PM: The detection and management of unruptured intracranial aneurysms. *Brain* 123: 205-221, 2000
 - 26) Wilcock DJ, Jaspan T, Worthington BS: Problems and pitfalls of 3-D TOF magnetic resonance angiography of the intracranial circulation. *Clin Radiol* 50: 526-532, 1995

Address reprint requests to: T. Kondoh, M.D., Department of Neurosurgery, Kobe University Graduate School of Medicine, 7-5-1 Kusunoki-cho, Chuo-ku, Kobe, Hyogo 650-0017, Japan.
e-mail: tkondo@med.kobe-u.ac.jp