



Fenestrated Anterior Communicating Artery Complex Mimicking an Unruptured Aneurysm: Diagnostic Pitfall

Atsushi Tsukada¹ Kiyoyuki Yanaka¹ Hayato Takeda¹ Kuniyuki Onuma¹ Maya Takada¹
Kazuhiro Nakamura¹ Eiichi Ishikawa²

¹ Department of Neurosurgery, Tsukuba Memorial Hospital, Kaname, Tsukuba, Ibaraki, Japan

² Department of Neurosurgery, Faculty of Medicine, University of Tsukuba, Tennodai 1-1-1, Tsukuba, Ibaraki, Japan

Address for correspondence Eiichi Ishikawa, MD, PhD, Department of Neurosurgery, Faculty of Medicine, University of Tsukuba, 2-1-1 Amakubo, Tsukuba, Ibaraki, 305-8576, Japan (e-mail: e-ishikawa@md.tsukuba.ac.jp).

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Abstract

Anatomical variations often occur in the anterior communicating artery (ACoM) complex, and a careful preoperative evaluation is required before repair of this lesion. We report a case of a fenestrated ACoM complex mimicking an unruptured cerebral aneurysm. A 49-year-old woman was referred to our hospital under suspicion of unruptured aneurysms of the ACoM and the left middle cerebral artery on magnetic resonance angiography (MRA). Additional three-dimensional computed tomographic angiography (CTA) showed the lesion arising from the ACoM complex with a maximum diameter of 4.2 mm. Intraoperative findings showed that the putative aneurysm was actually a fenestrated ACoM complex as the blood vessels that formed the ACoM complex were dilated and meandering. After the operation, MRA and CTA three-dimensional images were reviewed again but we could still not diagnose the lesion as a fenestrated ACoM complex rather than an aneurysm. However, in the MRA source image, a secant line in the lesion was the only finding suggestive of a fenestration. The ACoM complex is often associated with various vascular malformations, and it is essential to consider this association in the preoperative evaluation. The interpretation of source images may be helpful for accurate diagnosis and surgical planning.

Keywords

- ▶ anterior communicating artery
- ▶ aneurysm
- ▶ computed tomographic angiography
- ▶ digital subtraction angiography
- ▶ fenestration
- ▶ magnetic resonance angiography

Introduction

With recent advances in non-invasive diagnostic imaging methods, such as magnetic resonance (MR) imaging and computed tomography (CT), the detection rate of unruptured cerebral aneurysms is increasing. Imaging techniques for visualizing intracranial vasculature include MR angiog-

raphy (MRA), CT angiography (CTA), and digital subtraction angiography (DSA). DSA is a gold standard but invasive and noninvasive MRA and/or CTA are often used instead of DSA to delineate and monitor the aneurysm.^{1,2}

According to a recent survey of cerebrovascular treatment specialists, for aneurysms in locations other than the MCA, 68% of unruptured aneurysms and 73% of ruptured

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aneurysms underwent microsurgery without preoperative DSA.³ Therefore, when planning treatment for aneurysms without DSA, it is necessary to be familiar with the diagnostic pitfalls of MRI and CTA.

The AComA complex is a challenging part of the preoperative vascular evaluation as vascular malformations, including fenestration, are often encountered during AComA aneurysm surgery.⁴ Here, we report a case of a fenestrated AComA complex that was inaccurately diagnosed by CTA and several MRAs before surgery.

Case Description

A 49-year-old woman was referred to our hospital under suspicion of unruptured cerebral aneurysms of the AComA and the left middle cerebral artery. MRI was performed using a 1.5T MRI scanner (Philips, Philips Achieva, Amsterdam, Netherlands) for a checkup 5 years ago at our hospital that showed no abnormalities. The imaging conditions were repetition time (TR); 24 ms, echo time (TE); 6.91 ms, flip angle (FA); 17, and the thickness was 1.7 mm (→Fig. 1A).

Although the possibility of de novo aneurysms could not be ruled out, the patient was conservatively followed up with a 3.0Tesla MRI every 6 months (Philips, Philips Ingenia Cx, Amsterdam, Netherlands or Philips, Amsterdam, the Netherlands). The imaging conditions were TR; 24 ms, TE; 6.91 ms, FA; 17, and the thickness; 1.3 mm) (→Fig. 1B,C).

MRI at the age of 51 years showed a gradual growth in the AComA aneurysm (→Fig. 1B,C), while an additional three-dimensional CTA (3D-CTA) showed an aneurysm arising from the right A1-A2 junction with a maximum diameter of 4.2 mm (→Fig. 2). The 3D-CTA was performed with iopamidol 370 on a multi-detector CT scanner (Philips, IQon spectral CT, Amsterdam, the Netherlands) with 64 detector

rows. The protocol consisted of 64 × 0.625 mm collimation, 1 mm slice, 0.703 pitch, and 120 kV tube voltage). The size of the aneurysm was still small, less than 5 mm, but demonstrated gradual growth.

Considering the risk of rupture, a right pterional craniotomy was performed to obliterate the AComA aneurysm. No aneurysm was observed in the expected area, and the lesion, which was preoperatively diagnosed as an aneurysm, was actually a fenestrated AComA complex as the blood vessels forming the AComA complex were dilated and meandering. A small aneurysm-like bulge with strong arteriosclerosis was found in the ipsilateral right A2-fenestrated AComA junction (→Fig. 3) and coated with a piece of muscle and fibrin glue. The postoperative course was uneventful and the patient was discharged 8 days after surgery. Such unruptured/untreated left middle cerebral artery aneurysms are followed up regularly with MRI.

Discussion

Intracranial arterial fenestration is an anatomic variant more often manifesting at the AComA complex and basilar artery junction.⁵ AComA forms part of the circle of Willis and is developed by the fusion of the medial vascular network between the left and right anterior cerebral arteries, which is itself derived from the cranial division of the primitive internal carotid artery,⁶ and several variations have been reported.⁷ In both endovascular treatment and microsurgical clipping, preoperative evaluation, including the spatial relationship with the blood vessels around the aneurysm (in addition to the size and the shape of the aneurysm itself), is imperative.⁷⁻¹⁰ However, such complex vasculature renders accurate diagnosis difficult.

Due to recent advances in imaging technology, the diagnostic accuracy of noninvasive MRI plus 3D-CTA is ever

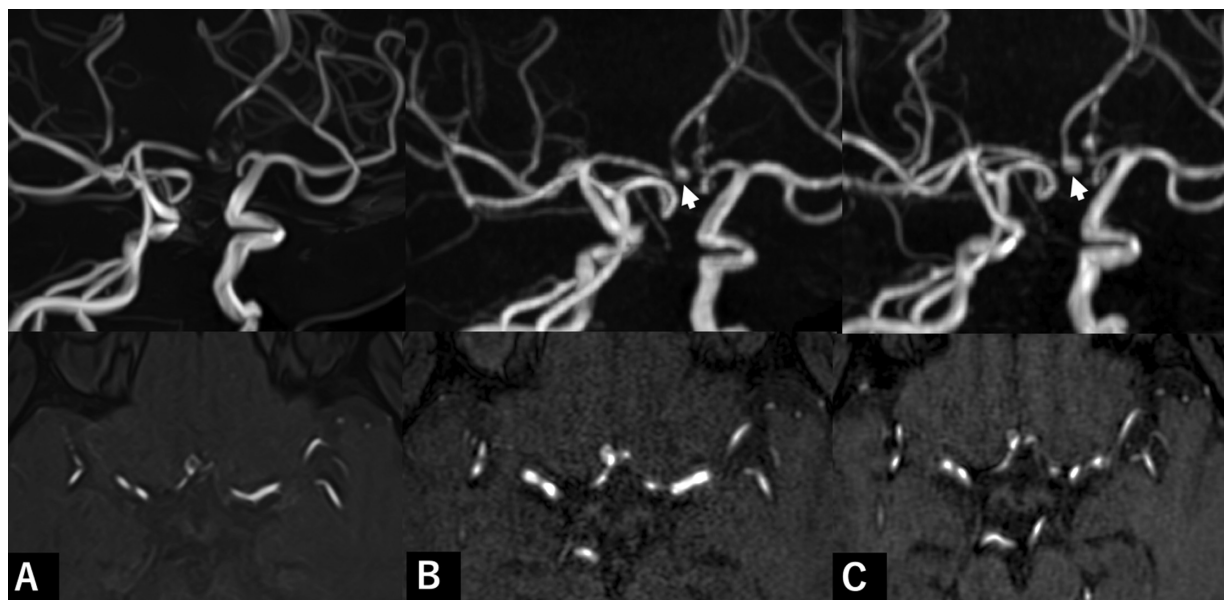


Fig. 1 Magnetic resonance (MR) angiography (upper) and its source image (lower) were taken at the age of 44 (A), 49 (B), and 51 (C) years. The 1.5 Tesla MR angiography showing no obvious aneurysm (A). The 3.0 Tesla MR angiography showing an aneurysm (arrow) arising from the anterior communicating artery complex (B, C). The initial MR angiographs point to an aneurysm arising from the complex of the anterior communicating artery (B, C).

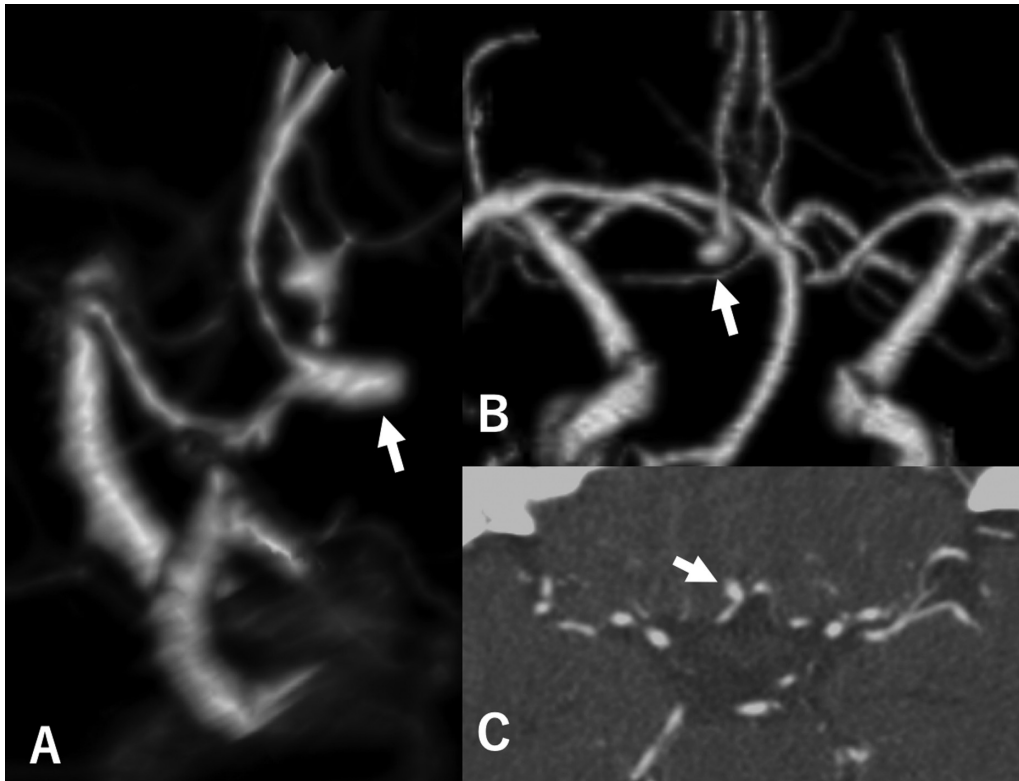


Fig. 2 The three-dimensional computed tomography (CT) angiography (A; lateral view, B; A-P view) showing suspected aneurysm (arrow) arising from the right A1-A2 junction. The source image of the CT angiography also showing the lesion arising from the anterior communicating artery complex.

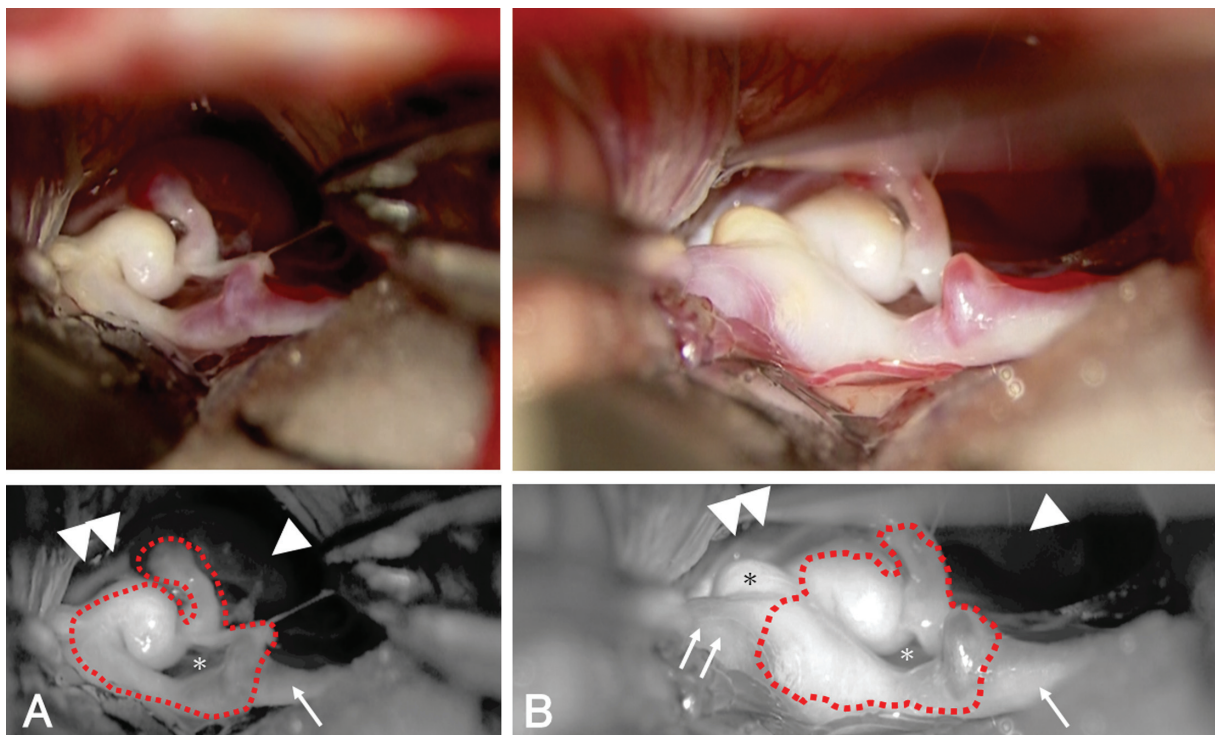


Fig. 3 Intraoperative images showing fenestrated anterior communicating artery (ACoMA) complex with no obvious aneurysm (dotted line: fenestrated ACoMA, arrow: right A1 segment, arrowhead: left A1 segment, double arrowhead: left A2 segment, white asterisk: fenestration). The magnified view (right) with the vessels forming the fenestration showing dilatation and meandering with pronounced atherosclerosis. The right A2 segment (double arrow) and a small aneurysm-like bulge (black asterisk) with strong arteriosclerosis in the right A2- fenestrated ACoMA junction were also found.

increasing. A recent systematic review and meta-analysis of MRA in the detection of intracranial aneurysms reported sensitivity and specificity of 95% and 89%, respectively, when compared to DSA.¹¹ Similar studies have been conducted with CTA and found a sensitivity and specificity of 90% or more.^{12–14} Recently, MRA at 3.0 Tesla has a good correlation with DSA and aneurysms as small as 1 mm in size can be detected.^{15,16}

According to the latest research, about 70% of cases undergo microsurgery without preoperative DSA.³ Therefore, when planning the treatment of an aneurysm without DSA, it is essential to be familiar with the diagnostic pitfalls of MRI and CTA. As a pitfall of MRI, we assume that the aneurysm-like lesion appeared larger because of the change from 1.5 T to 3.0 T and/or because of the different slice thickness, and probably not because of the small AN-like bulge seen in the operative field. We should note that lesions are seen differently when we change MRI models or imaging conditions.

The usual preoperative evaluation of unruptured cerebral aneurysms is performed solely by MRA plus 3D-CTA in our hospital. DSA is added in cases to clarify features or where endovascular treatment seems to be more suitable than craniotomy. However, noninvasive imaging methods may result in false-positive or false-negative findings for aneurysms with a diameter of 3 mm or less, anomalies located near bony structures, or lesions of the AComA complex, internal carotid artery, or posterior circulatory system.^{17–20} In our case, DSA was not performed because the aneurysm was identified on both MRA and CTA and the size of the aneurysm was over 3 mm in diameter. The 3D images of MRA and CTA were carefully reviewed again after surgery, but the lesion could not be diagnosed as a fenestrated AComA complex rather than an aneurysm.

DSA remains the gold standard for imaging quality and detection sensitivity in the evaluation of intracranial vessels.²¹ If DSA or 3D rotational catheter angiography had been performed preoperatively, the correct diagnosis could have been obtained in our case. However, there are reports of cases in which DSA or 3D rotational angiography mistook a vascular abnormality of the AComA complex for an aneurysm.^{22,23} Therefore, it should be recognized that even DSA does not have 100% diagnostic ability. In particular, DSA has difficulty assessing aneurysm thrombosis and calcification around the aneurysm neck. Consequently, physicians need to understand the strengths and weaknesses of each imaging method when choosing an imaging modality.

Interestingly, careful, retrospective observation of this case's source MRA images revealed a secant line in the lesion (→Fig. 4), suggestive of fenestration. Therefore, a detailed interpretation of the source images from MRA and CTA, as well as 3D images, may be helpful for accurate diagnosis in some cases. Because the AComA complex itself has diverse phenotypes and can be difficult to diagnose, the use of multiple diagnostic methods, including DSA, can be definitely recommended. Our case thus draws further attention to the preoperative diagnostic modalities used for this region.

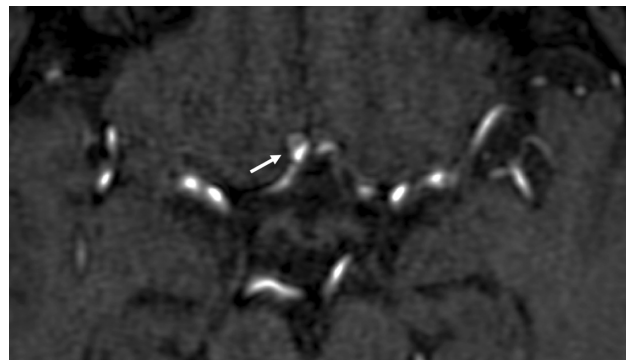


Fig. 4 Review of original MR angiography images taken at the age of 51 years with a suspected secant line in an aneurysm-like lesion (arrow).

Conclusion

The AComA complex is often associated with various vascular malformations and it is essential to consider this association in the preoperative evaluation. The interpretation of source images may be helpful for accurate diagnosis and surgical planning.

Authors' Contributions

Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work: Atsushi Tsukada and Kiyoyuki Yanaka. Drafting the work: Atsushi Tsukada. Revising it critically for important intellectual content: Kiyoyuki Yanaka, Hayato Takeda, Kuniyuki Onuma, Maya Takada, Kazuhiro Nakamura, and Eiichi Ishikawa. Final approval of the version to be published: Eiichi Ishikawa and all other coauthors. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: Eiichi Ishikawa.

Conflict of Interest

None declared.

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