

Dissecting Aneurysm at the Proximal Segment of the Anterior Cerebral Artery Associated with Infraoptic Course Anterior Cerebral Artery

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A 48-year-old man presented a subarachnoid hemorrhage caused by a rupture of a dissecting aneurysm at the proximal segment (A1 segment) of the right anterior cerebral artery (ACA). He also had an anomalous artery named infraoptic course ACA and an agenesis of the contralateral ACA A1 segment. Balloon occlusion test at the bifurcation of the right internal carotid artery demonstrated that the distal segments of the bilateral ACAs were perfused through the infraoptic course ACA. Therefore, we surgically trapped the A1 segment including the aneurysm. The patient got discharged without any neurological deficit. Natural course of ACA dissecting aneurysms is unclear because of rarity of the disease and treatment strategy is still controversial. Most of the dissecting aneurysms in the A1 segment are surgically treated, because they often present with massive hemorrhage and poor prognosis. In the present case, the contralateral A1 segment was absent but trapping of the dissecting aneurysm could be achieved without vascular reconstruction (e.g., bypass surgery) because of the presence of the infraoptic course ACA.

Keywords: anterior cerebral artery, cerebrovascular anomaly, dissecting aneurysm, infraoptic course, proximal segment

Introduction

Intracranial dissecting aneurysms generally occur in the posterior circulation. Anterior cerebral artery (ACA) dissecting aneurysms are very rare, but the number of reports regarding ACA dissecting aneurysms is increasing recently.^{1,2} In dissecting aneurysms with hemorrhagic events, risk of rebleeding is high during the first 24 hours.³ Especially, hemorrhagic dissecting aneurysms in the A1 segment of ACA tend to bleed massively and the prognosis is poor. Therefore, most of the reported cases in the literature have been surgically treated. The curative surgical treatment is trapping of the affected artery with vascular reconstruction when necessary.^{4–6}

We experienced a case of subarachnoid hemorrhage (SAH) originate from a ruptured dissecting aneurysm in the A1 segment of ACA. In this case, the contralateral A1 segment was absent, and an anomalous cerebral artery named “infraoptic course ACA” was present instead. We could trap the dissecting aneurysm without vascular reconstruction,

because the distal segments of the bilateral ACAs were perfused by this infraoptic course ACA.

Infraoptic course ACA is a rare cerebral vascular anomaly and about 50 cases have been previously reported.^{7–10} Infraoptic course ACA is considered as a persistence of embryonal arteries. Although cerebral aneurysms associated with infraoptic course ACA have been reported,¹⁰ there has been no case of dissecting aneurysm in the A1 segment associated with infraoptic course ACA. In this article, we present the clinical course of this patient and discuss treatment strategy as well as the embryogenesis of this anomalous artery.

Case Report

I. Clinical course

A 48-year-old man without past medical history suffered from sudden headache and was admitted to our hospital. His consciousness was clear and he had no neurological deficit. Computed tomography (CT) showed diffuse SAH (Fig. 1a). CT angiography and digital subtraction angiography revealed irregularity of the arterial wall in the A1 segment of the right ACA associated with an agenesis of the A1 segment of the left ACA (Fig. 1b, c). We also found an infraoptic course ACA, which arose from the right internal carotid artery (ICA) near the origin of the ophthalmic artery (OphA), passed beneath the right optic nerve and through the prechiasmatic cistern, and then, anastomosed with the right A1 segment near the anterior communicating artery (ACoMA), and extended further to a cortical artery of the left frontal lobe. A diagnosis of a dissecting aneurysm of the right A1 segment was made and conservative treatment was selected. Fortunately, no rebleeding occurred during the 2 weeks of conservative treatment, but the irregularity of the arterial wall did not improve.

II. Balloon occlusion test (BOT)

On day 18, balloon occlusion test (BOT) was performed. A hyperform microballoon catheter was introduced to the bifurcation of the right ICA and the balloon was inflated. By doing this, both direct antegrade blood flow from the right ICA and retrograde blood flow from the right middle cerebral artery were disrupted. Contrast agent was injected into the right ICA proximal to the branching of the infraoptic course ACA and blood flow supplied by the infraoptic course ACA was examined. The ACoMA and bilateral distal ACA were visualized through the infraoptic course ACA (Fig. 2) and no neurological deficit including paralysis of the lower

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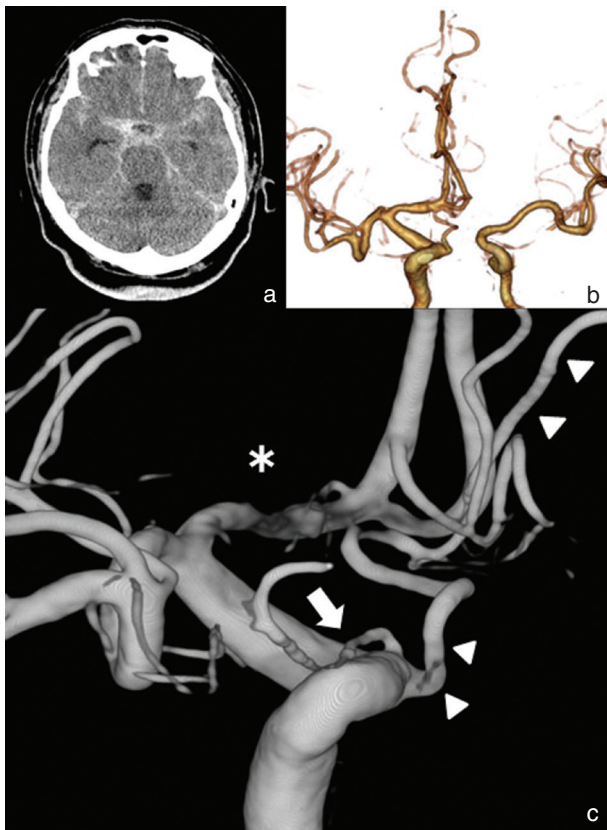


Fig. 1 a: Initial computed tomography (CT) scan showing diffuse subarachnoid hemorrhage. b: CT angiography showing an anomalous artery arising from right internal carotid artery (ICA) and the agenesis of the left anterior cerebral artery (ACA) A1 segment. c: Three dimensional digital subtraction angiography of the right ICA. We can see an irregular shape of the arterial wall at the right ACA A1 segment (asterisk) and an anomalous artery (arrow head). The anomalous artery arises from internal carotid artery near the ophthalmic artery (arrow), passes through medially, anastomoses with right ACA near the anterior communicating artery, and extends to the cortical artery of the left frontal lobe.

limbs was observed during BOT. We decided to trap the right A1 dissecting aneurysm without vascular reconstruction.

III. Surgical findings and postoperative course

On day 24, trapping of the right A1 dissecting aneurysm was performed by right frontotemporal craniotomy. We detected a fusiform dilatation of the right A1 segment and an anomalous artery ascending between the optic nerves in the prechiasmatic cistern (Fig. 3). Both the proximal and distal segments of the aneurysm were occluded with titanium clips. The intraoperative indocyanine green videoangiography demonstrated occlusion of the aneurysm and blood flow to the bilateral ACA from the infraoptic course ACA (not shown). Postoperative CT revealed a right caudate head infarction due to occlusion of the perforating artery. The patient got discharged on day 47 without any neurological deficit.

Discussion

Spontaneous intracranial artery dissecting aneurysms are



Fig. 2 Right internal carotid angiogram is showing the blood flow to anterior communicating artery and bilateral distal anterior cerebral arteries (ACAs) through the infraoptic course ACA during the distal portion of the right internal carotid artery occlusion.

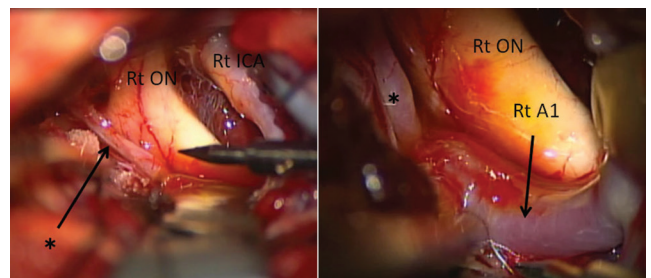


Fig. 3 Intraoperative view is showing the infraoptic course anterior cerebral artery (asterisk) ascending between optic nerves, and the fusiform dilatation of the right anterior cerebral artery A1 segment. Asterisk: infraoptic course anterior cerebral artery, Rt ON: right optic nerve, Rt ICA: right internal carotid artery, Rt A1: right anterior cerebral artery A1 segment.

an important cause of cerebral infarction and SAH in young and middle-aged people and occur most frequently in the posterior circulation. Anterior circulation dissecting aneurysms account for only 7–19% and especially those in ACA are very rare.^{1,2)}

A recent review of 82 ACA dissecting aneurysm cases demonstrated that 55% presented with infarction, 32% with hemorrhage, and 13% with both ischemia and hemorrhage.⁶⁾ About 90% of the ACA dissections with ischemic event occurred in the A2 or more peripheral segments, while 56% of those with hemorrhagic event occurred in the A1 segment. The 78% of the cases with ischemia were treated conservatively, of which only 3 patients (9%) had a poor outcome. In contrast, the outcome was relatively poor in patients with hemorrhage. In the cases with hemorrhagic events, the dissected segment affected the prognosis. Thine et al. reviewed 30 cases of the ACA dissecting aneurysms with hemorrhagic events.⁵⁾ The 58% of dissecting aneurysms in the A2 or more

peripheral segment were conservatively treated, of whom only two had a poor outcome due to rebleeding.^{11,12} On the other hand, 84% of cases with the A1 segment dissecting aneurysm were treated surgically and only 2 cases received conservative therapy, of which one died and the other had good outcome. In this case with good prognosis, the initial SAH was slight and localized in the sylvian fissure.^{5,13} The initial hemorrhagic volume tends to be massive in the A1 segment dissection and localized in the A2 and more distal segment dissection, suggesting that the bleeding volume is a prognostic factor.⁴

Most of the cases of A1 dissecting aneurysm were treated surgically, therefore the natural course of these cases is not well known. However, two cases with palliative surgical therapy (clipping or wrapping only) presented postoperative rebleeding.^{5,14} Therefore, trapping (and vascular reconstruction when necessary) is required as the curative treatment in the cases with A1 segment dissection. Fortunately, rebleeding did not occur in the present case during the first 24 days after SAH, though the initial SAH was quite massive. We consider that trapping was the most appropriate therapy for this patient but that we should have performed surgical intervention at an earlier stage to prevent life-threatening rebleeding.

The infraoptic course ACA is a rare cerebral vascular anomaly and approximately 50 cases have been reported since the first case described by Robinson in 1959.¹⁵ This anomalous artery usually arises from ICA at or near the origin of OphA. The artery then passes beneath the ipsilateral optic nerve, goes up on the midline in front of the optic chiasma, and finally joins the distal A1 segment of the normal ACA or the AComA. The 68% of the cases were predominant to the right side and 19% were bilateral, though the reason is unknown.¹⁰ Wong et al. classified the infraoptic course ACA cases into four types according to the status of the ipsilateral and contralateral A1 segment.¹⁶ In Type I, the ipsilateral A1 segment is normal. In this type, the infraoptic course ACA acts like a collateral channel, and therefore, Nutik and Dilenge reported the artery as the carotid ACA anastomosis.¹⁷ In Type II, the ipsilateral A1 segment is absent. In Type III bilateral A1 segments are absent and the bilateral distal ACAs are perfused by the infraoptic course ACA alone. In Type IV (only one case¹⁸), the anomalous artery did not anastomose with A1 segment or AComA but extended to the orbitofrontal or frontopolar artery.

The infraoptic course ACA is considered as persistence of the embryonal artery. Though the embryogenesis is still controversial, it is hypothesized that anomalies in the arterial ring around the optic nerve are related to this variation.¹⁰ These may include (1) persistence of an anastomotic loop of the primitive dorsal and ventral OphAs which disappear as OphA is formed, (2) enlargement of a small anastomosis among the superior hypophyseal branch of ICA, the prechiasmatic branch of OphA, and the chiasmatic branch of ACA, and (3) persistence of an anastomosis between the primitive maxillary and olfactory arteries. The primitive maxillary and olfactory arteries appear in the earliest fetus

stage,¹⁹ and Wong et al. indicated that the arterial ring consisting this two arteries can explain the origin of all types infraoptic course ACA.¹⁶

In the present case, the ipsilateral A1 segment is normal. The anomalous artery arises from the ipsilateral ICA near the origin of OphA, anastomoses with the ipsilateral A1 segment, and then extends to a cortical artery of the contralateral frontal lobe. This artery has the feature of the accessory ACA reported by Ladziński et al.,¹⁸ which resembles Type IV classified by Wong et al.¹⁶ However, the anomalous artery in the present case makes anastomosis with normal ipsilateral A1 segment like Type I–III infraoptic course ACAs and also extends to the contralateral frontal lobe. This type has not been reported previously.

The infraoptic course ACA has been known to be associated with cerebral aneurysms and 44.7% of the previous reported cases presented with SAH.¹⁰ Ruptured aneurysms are usually located in AComA (51%) and in ACA (19%) and 12.5% had multiple aneurysms. Majority of the previous reported aneurysms were located in the ACA-AComA complex and no dissecting aneurysm in the A1 segment, as in the present case, has been reported. In the present case, the aneurysm was successfully excluded from the circulation by trapping without vascular reconstruction, because blood flow distal to the aneurysm was supplied via the infraoptic course ACA. Detailed pre-operative assessment, including BOT if necessary, of such anomalous arteries is useful to determine the optimal treatment strategy.

Conflicts of Interest Disclosure

The authors declare that they have no conflicts of interest. All authors who are members of The Japan Neurosurgical Society (JNS) have registered online Self-reported COI Disclosure Statement Forms through the website for JNS members.

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