

Middle Cerebral Artery Variations Associated with Intracranial Aneurysmal Rupture

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Aneurysmal ruptures associated with middle cerebral artery(MCA) anomalies, such as a duplicated MCA and an accessory MCA, are quite rare. The authors reviewed the clinical relevance and possible etiology of these anomalies.

KEY WORDS : Middle cerebral artery variations · Duplicated middle cerebral artery · Accessory middle cerebral artery · Ruptured aneurysm.

Introduction

Vascular neurosurgeons need to recognize the normal anatomy of the basal arteries of the brain as well as their variations. Common abnormalities of these vasculatures, such as anaplasia, hypoplasia, fenestration, and persisting fetal arteries, have been well recognized both angiographically and surgically^{8,13,20}. Most of these anomalies are well known, however, the accessory middle cerebral artery(MCA) and the duplicated middle cerebral artery are very rare. Several cases have been reported^{1,3-16,19,21}, since Crompton³ first reported an anomalous vessel running through the sylvian fissure along with the middle cerebral artery and named it an "accessory middle cerebral artery" in 1962.

Teal et al.²¹ proposed the following two classifications for these arteries : the artery originating from the same side as the internal cerebral artery(ICA) was named "duplication of the MCA", and the artery originating from the anterior cerebral artery(ACA) was named "accessory MCA". These classifications are used in this paper.

We report a case of duplicated MCA associated with multiple aneurysms and accessory MCA which of both associated with a ruptured anterior communicating artery aneurysm.

Case Report

Case 1

A case of duplicated MCA associated with multiple intracranial

aneurysms.

A 46-year-old woman with hypertension was transferred to our department with a history of sudden headache and vomiting. She had no neurological symptoms or signs except for nuchal rigidity. Brain computerized tomography(CT) showed a thin layered subarachnoid hemorrhage in the basal and sylvian cisterns, and that was more severe in the right hemisphere (Fig. 1). The brain CT angiography demonstrated an arterial branch arising from the right ICA be-

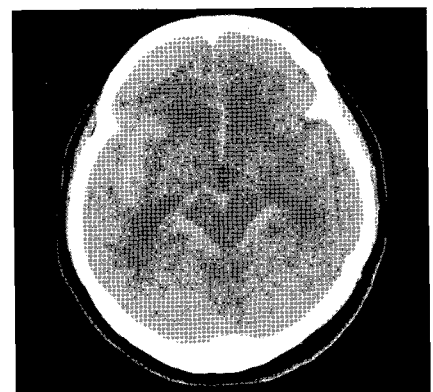


Fig. 1. Computerized tomography showing the subarachnoid hemorrhage more severely in the right sylvian fissure.

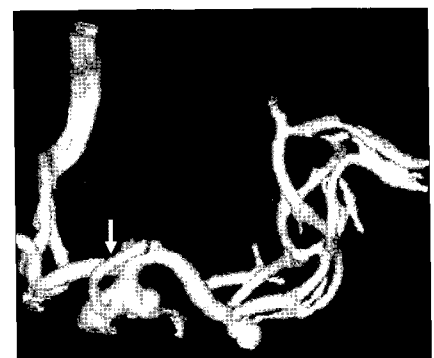


Fig. 2. Computerized tomographic angiography showing the duplication of the middle cerebral artery (arrow), and aneurysms on the origin site of duplicated middle cerebral artery and the middle cerebral artery bifurcation.

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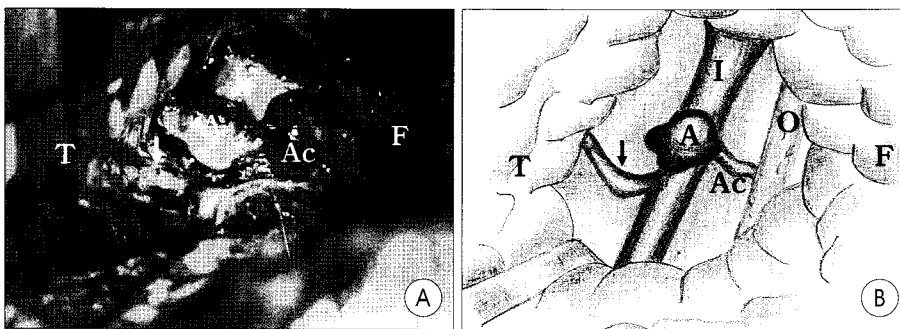


Fig. 3. A : Operative finding : An artery (arrow) is observed arising from the right internal carotid artery just distal to the origin of the anterior choroidal artery and coursing into the sylvian fissure along with the main right MCA, B : Schematic drawing. (I : internal carotid artery. A : aneurysm. Ac : anterior choroidal artery. O : optic nerve. F : frontal lobe. T : temporal lobe).



Fig. 4. A postoperative follow-up angiography showing duplicated middle cerebral artery (arrow) with complete obliteration of aneurysms at the origin site of duplicated middle cerebral artery and the middle cerebral artery bifurcation.

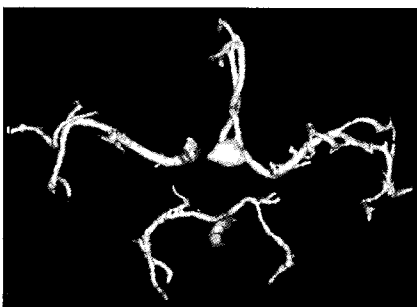


Fig. 5. Computerized tomographic angiography showing the aneurysm of the anterior communicating artery.

anterior temporal artery and the anterior surface of the temporal pole. A ruptured aneurysm was detected at the origin of this duplicated MCA and clipped. After clipping the symptomatic aneurysm, an ipsilateral MCAB aneurysm was clipped in order to prevent rupture. A follow-up angiography demonstrated a right duplicated MCA with a mild vasospasm and complete obliteration of clipped aneurysm (Fig. 4). The postoperative course was uneventful.

tween its terminal bifurcation and the origin of the posterior communicating artery (Fig. 2). Another aneurysm was detected on the right middle cerebral artery bifurcation (MCAB).

The patient underwent surgery using the right pterional approach. During the operation, an artery was observed arising from the right ICA just distal to the origin of the anterior choroidal artery and coursing into the sylvian fissure along with the main right MCA (Fig. 3). It was believed that at this duplicated MCA supplied the territory of the an-

terior temporal artery and the anterior surface of the temporal pole. Upon admission, he was alert and showed no neurological symptoms or focal signs. Brain CT angiography was performed and an aneurysm arising from the anterior communicating artery was detected (Fig. 5). The patient was diagnosed with a subarachnoid hemorrhage and underwent surgery on the second day after admission via the left pterional approach.

During surgery, the accessory MCA, which was not detected by technical mistake on CT angiography, was found to originate from the proximal portion of the left A1, and was clearly observed to pass parallel to the MCA. It was believed that this accessory MCA had many perforating arteries. The ruptured aneurysm was clipped after a careful sharp dissection. No intraoperative complications were presented. A follow-up angiography demonstrated the left accessory MCA with an obliterated anterior communicating artery aneurysm (Fig. 6). The postoperative clinical course was uneventful.

Discussion

Anomalies and variations in the middle cerebral artery (MCA) are less frequent than those in the other major intracranial arteries⁸⁾. The frequency of MCA duplication was reported to range from 0.2% to 2.9% and that of an accessory MCA from 0.3% to 4.0%⁹⁾. Several explanations have been

Case 2

A case of accessory MCA associated with an anterior communicating aneurysm rupture.

A previously healthy 46-year-old man visited a community hospital suffering from a severe headache, nausea, and vomiting. Brain CT showed no hemorrhage. However, a lumbar puncture on that day revealed bloody cerebrospinal fluid suggesting a subarachnoid hemorrhage. The patient was referred to

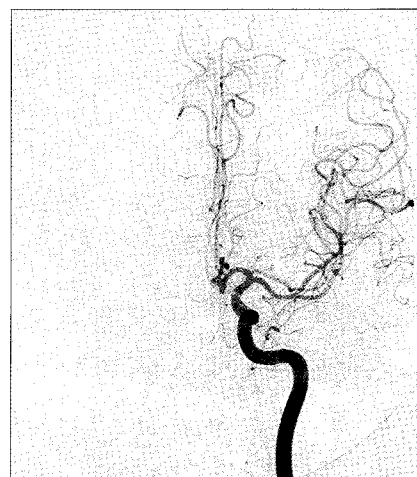


Fig. 6. A postoperative follow-up angiography showing accessory middle cerebral artery (arrow) with complete obliteration of the aneurysm of the anterior communicating artery.

en offered to explain the development of MCA anomalies. Handa et al.⁷⁾ suggested that an accessory MCA represents hypertrophied recurrent artery of Heubner(RAH). Takahashi et al.¹⁹⁾ reported that a variation of the MCA phylogenetically represents a primitive vascular anastomosis that is formed between the anterior cerebral artery(ACA) and MCA. However, Teal et al.²¹⁾ disagreed with Handa⁷⁾ on the following grounds : a) perforating arteries have only occasionally been shown to arise from the accessory MCA, b) the RAH was repeatedly demonstrated in the presence of the accessory MCA, and c) the RAH enters the anterior perforating substance medial to the perforating branches of the MCA and the accessory MCA clearly courses lateral to this point. Abanou et al.¹⁾ suggested that MCA anomalies originate as an outward budding of the ACA or ICA, which then develop as a distinct entity. Komiyama et al.⁹⁾ extended Abanou's idea¹⁾ and suggested that MCA anomalies are embryological and anomalous early ramifications of the early branch of the MCA. In the proximal location, the early branch runs to the anterior temporal lobe as a duplicated MCA. In the distal location, it runs to the anterior frontal lobe as an accessory MCA.

The relationship between MCA anomalies and cerebral aneurysms is not well documented. Stehbins¹⁸⁾ reviewed a series of autopsies of 252 cases with cerebral aneurysms and found no evidence of an increased prevalence of cerebral aneurysms in those cases with MCA anomalies. Umansky et al.²³⁾ reviewed the association between anomalies of the MCA and intracranial aneurysms and reported no possible structural changes in the wall of the anomalous vessels. However, it is not clear whether they are related by an unknown mechanism or whether this association is a chance of occurrence⁹⁾. In this report, the occurrence and rupture of the aneurysm at the site where the duplicated MCA originated suggests that a MCA anomaly can influence the hemodynamic state and might be associated with the occurrence and rupture of an aneurysm^{2,4,9,20)}. Therefore, further clinical studies of the mechanism of an aneurysm combined with MCA anomalies will be necessary¹⁵⁾.

Both a duplicated MCA and an accessory MCA are clinically important because these arteries can contribute to normal cerebral circulations. Komiyama et al.⁹⁾ reported that a duplicated MCA consistently supplies the anterior temporal lobe while an accessory MCA consistently supplies the anterior frontal lobe^{9,16)}. The duplicated MCA in case 1 was similar to the anterior temporal artery, which might contribute to the normal cerebral blood supply. Therefore, this duplicated MCA can be regarded as an early bifurcation of the anterior temporal artery¹⁾. Clinically, the accessory MCA is much more significant than a duplicated MCA²²⁾. It may have perforating arteries and can coexist with the RAH. It is relatively large and functions as a collateral blood supply in cases of an MCA occlusion. In case 2,

the vessel had perforating arteries that terminated in the orbito-frontal territory. In ischemic stroke, the accessory MCA can be collateral to the anterior frontal lobe, such as the duplicated MCA can be collateral to the anterior temporal lobe^{10,11,14,21,22,24,25)}.

Therefore, it is important to recognize these vascular anomalies preoperatively and preserve these arteries during surgery because the existence of MCA variations carries a higher surgical risk and can lead to a modification of the therapeutic strategy.

Conclusion

We report two cases involving MCA variations, a duplicated MCA and an accessory MCA, which were associated with ruptured aneurysms. Although anomalies and variations of the MCA are less frequent than in other major intracranial arteries, it is important to preserve these vessels during surgery because these arteries can contribute to normal cerebral circulation. Further clinical studies of the etiology, preoperative diagnosis, and preservation of an aneurysm combined with MCA anomalies will be necessary.

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