A Patient with an Unruptured Aneurysm in the Internal Carotid Artery-duplicated Middle Cerebral Artery on Whom Coil Embolization with Balloon Remodeling Was Performed


Objective: Treatment of an unruptured aneurysm at the origin of duplicated middle cerebral artery (DMCA) by coil embolization using balloon remodeling has not been reported. We report a case of coil embolization using balloon remodeling for an unruptured aneurysm at the origin of DMCA.

Case Presentation: A 71-year-old female was found to have an unruptured aneurysm at the origin of DMCA during an examination for headache. Coil embolization using balloon remodeling for the wide neck aneurysm to preserve both the internal carotid artery (ICA) and DMCA was successful. The perioperative course was uneventful.

Conclusion: This treatment enables complete embolization, and preserves both the ICA and DMCA. Thus, it is useful for aneurysms at the origin of DMCA.

Keywords: duplication of middle cerebral artery, cerebral unruptured aneurysm, coil embolization, balloon remodeling

Introduction

Duplicated middle cerebral artery (DMCA) is an abnormality of the middle cerebral artery (MCA) branching from the internal carotid artery (ICA). It branches from the distal of anterior choroidal artery origin of the ICA, passes through the Sylvian fissure, and runs through a portion of the MCA region. The incidence of DMCA is 0.2%–2.9% in autopsy cases.1) The incidence of concomitant aneurysms is unclear, but few studies have reported aneurysms at the origin. Regarding unruptured aneurysms, only 11 patients have been reported.2–9) In 9 of the 11 patients, clipping during craniotomy was performed, and the other two underwent conservative treatment due to small aneurysms.

No study has reported coil embolization; however, it is possible in some patients. It is important to embolize aneurysms while preserving the ICA and DMCA. We report a patient in whom an unruptured, wide-neck DMCA origin aneurysm was treated using coil embolization with balloon remodeling to preserve the ICA and DMCA.

Case Presentation

The patient was a 71-year-old female. Magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) as detailed examinations for headache revealed an unruptured aneurysm in the left ICA (Fig. 1). For detailed examination and treatment, she was referred to our department. Left internal carotid angiography confirmed an unruptured aneurysm (5.2 × 5.0 × 4.4 mm) involving the DMCA and its origin, with a neck length of 3.9 mm and dome/neck (D/N) ratio of 1.25 (Fig. 2A and 2B). We also
was no acute-phase cerebral infarction (Fig. 4A). On MRA, the aneurysm was not visualized, and visualization of the ICA and DMCA was favorable (Fig. 4B). There were no symptoms, and the patient was discharged 5 days after surgery. During the 4-year postoperative follow-up, there has been no recurrence on follow-up MRA and the course has been favorable.

**Discussion**

Common abnormalities of the MCA include accessory MCA (AMCA) and DMCA. Crompton et al.\(^1\) reported 10 patients with excess blood vessels originating from an area between the anterior choroidal artery origin of the ICA and its end, running through a portion of the MCA region, and termed such blood vessels as “AMCA.” They also reported arteries originating from the anterior cerebral artery that exhibited a similar distribution. Thereafter, similar abnormal blood vessels were reported. In 1973, Teal et al.\(^10\) termed a blood vessel originating from the ICA “DMCA” and that originating from the anterior cerebral artery “AMCA.” The two arteries run with the MCA (M1) in the Sylvian fissure through a portion of the MCA region. These are anomalies in which the first branch to the frontal lobe, the orbitofrontal artery, and the first branch to the temporal lobe, the anterior temporal artery, directly branch from the ICA.\(^10\)–\(^12\) Concerning the pathogenesis, several studies suggested dilation of a recurrent artery of Heubner\(^13\) and residual anterior cerebral artery-MCA anastomosis.\(^14\),\(^15\)

The incidence of DMCA is 0.2%–2.9% in autopsy cases.\(^1\) Some patients with excess blood vessels develop cerebral aneurysms, but DMCA aneurysms arising at its origin are rare, although their incidence remains to be clarified. In all, 11 patients with unruptured aneurysms at the origin,\(^2\)–\(^9\) including an autopsy case reported by Crompton et al.\(^1\) have been reported. The 12 patients, including the present case, are summarized in **Table 1**. The mean age was 57.8 years. In most patients, the aneurysms measured \(\leq 5\) mm, excluding one patient with an aneurysmal diameter of 12 mm. The aneurysms were present on the right in four patients and on the left in eight patients. In one patient, bleb formation was observed. In two patients with small aneurysms, conservative treatment was performed, whereas clipping during craniotomy led to favorable results in the other nine patients. No study has reported coil embolization of unruptured aneurysms.
The DMCA is an important source of blood flow for the temporal lobe and basal ganglia. Therefore, it should be preserved during treatment. Kai et al. performed superficial temporal artery-DMCA bypass on a patient in whom it was difficult to separate the aneurysm from the DMCA due to adhesion, and reported treatment by occlusion of the aneurysm involving a parent artery. For neck clipping, a clip as short as possible should be used to preserve the anterior choroidal artery adjacent to the aneurysm and medial lenticulostriate artery. Regarding endovascular treatment, aneurysms at the origin of DMCA, making it difficult to perform coil embolization while preserving the DMCA. Therefore, only a few case reports on ruptured aneurysm at the origin of DMCA treated by endovascular treatment have been published. To our knowledge, no study has reported endovascular treatment for unruptured aneurysm at the origin of DMCA.

During the past few years, coil embolization of wide-neck aneurysms with balloon neck remodeling has been established. Recently, stent-assisted embolization has been routinely performed. In particular, clipping during craniotomy is more appropriate for MCA aneurysms in many cases. However, recent advances in remodeling devices, such as stents and balloons, have improved the results of endovascular treatment for MCA aneurysms to the same level as achieved by clipping. In the present case, the aneurysm was present in an area deeper than standard MCA aneurysms, and we selected endovascular treatment because we considered it difficult to separate the aneurysm from the MCA and DMCA.
In our patient, coil embolization was considered to be possible based on the shape. The D/N ratio was 1.25 (wide neck), facilitating coil embolization with balloon neck remodeling for DMCA preservation.

## Conclusion

DMCA aneurysms arising at its origin are rare. Previous studies reported clipping of unruptured aneurysm at the origin of DMCA, but no study has reported endovascular treatment. This is the first report of endovascular treatment for an unruptured DMCA aneurysm. Balloon-assisted coil embolization facilitates intra-aneurysmal embolization with preservation of the ICA and DMCA. Whether this treatment procedure is useful depends on aneurysmal or neck shapes.

## Disclosure Statement

We declare no conflict of interest.

## References


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**Table 1** Reported cases of an internal carotid artery - duplicated middle cerebral artery unruptured aneurysms

<table>
<thead>
<tr>
<th>Case</th>
<th>Author</th>
<th>Sex</th>
<th>Age</th>
<th>Aneurysm size</th>
<th>Bleb</th>
<th>Side</th>
<th>Therapy</th>
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<tr>
<td>1</td>
<td>Takano et al. Neurol Med Chir, 1988&lt;sup&gt;a&lt;/sup&gt;</td>
<td>M</td>
<td>74</td>
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<td>R</td>
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<td>Nomura et al. Acta Neurochir, 2000&lt;sup&gt;b&lt;/sup&gt;</td>
<td>F</td>
<td>63</td>
<td>&lt;5 mm</td>
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<td>L</td>
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<td>3</td>
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<td>M</td>
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<td>–</td>
<td>R</td>
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<tr>
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<td>M</td>
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<td>–</td>
<td>L</td>
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<td>6</td>
<td>Miyahara et al. No Shinkei Geka, 2009&lt;sup&gt;e&lt;/sup&gt;</td>
<td>F</td>
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<td>–</td>
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<td>M</td>
<td>58</td>
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<td>Elsharkawy et al. World Neurosurg, 2013&lt;sup&gt;g&lt;/sup&gt;</td>
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<td>–</td>
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<td>10</td>
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<td>12</td>
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<td>5.2 mm</td>
<td>–</td>
<td>L</td>
<td>Coil embolization</td>
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F: Female; M: male; R: Right; L: Left


