Ruptured distal middle cerebral artery aneurysm

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Object. Ruptured distal middle cerebral artery (MCA) aneurysms are uncommon, and their clinical and radiological features are poorly understood. To clarify characteristics of these lesions, the authors undertook a retrospective analysis of nine patients with ruptured distal MCA aneurysms.

Methods. The medical records of patients who underwent surgical repair of ruptured intracranial aneurysms between 1988 and 2002 at Shinshu University Hospital and its affiliated hospitals were retrospectively evaluated. The authors found only nine patients with a ruptured distal MCA aneurysm, and their clinical, neuroimaging, and intraoperative findings were evaluated.

Conclusions. This study of nine patients with distal MCA aneurysms is the largest series to date. Eight lesions were saccular aneurysms that were clipped and the remaining one was a mycotic aneurysm that was trapped. Eight of the nine patients suffered cerebral hematomas with subarachnoid hemorrhage. All patients had good outcomes after obliteration of their aneurysm, although their preoperative condition was not good.

KEY WORDS • ruptured aneurysm • middle cerebral artery • surgical repair

MIDDLE cerebral artery aneurysms are a common source of aneurysmal SAH.2,6 Because the majority of them arise at the primary bifurcation or trifurcation,2,9 there are few reports dealing with ruptured distal MCA aneurysms,5,7 and the overall management outcome of this rare lesion is unknown. This study was conducted to clarify the characteristics of ruptured distal MCA aneurysms.

Clinical Material and Methods

A retrospective study of ruptured distal MCA aneurysms was conducted in a total of 2788 patients who underwent surgical treatment for ruptured intracranial aneurysms at Shinshu University Hospital and its affiliated hospitals between 1988 and 2002. We investigated the distal MCA aneurysms based on clinical profiles, neuroimaging characteristics, and intraoperative findings. According to Gibo, et al.,3 to locate MCA aneurysms the distal vessel was classified into four segments: M2 (insular segment), M2–3 junction, M3 (opercular segment), and M4 (cortical segment). The outcome was presented according to the Glasgow Outcome Scale.4

Results

In this series, 791 patients underwent operation for ruptured MCA aneurysms, representing 28.4% of the entire series. Figure 1 shows the location of ruptured MCA aneurysms: there were 23 (2.9%) in the M1 segment, 759 (96%) at the bifurcation or trifurcation, and nine (1.1%) in distal MCA branches (summarized in Table 1). Eight distal MCA lesions (Cases 1–8) were considered to be true saccular aneurysms, based on the neuroimaging and intraoperative findings. The remaining lesion (Case 9) was a mycotic aneurysm.

Seven women and two men ranging in age from 40 to 78 years (mean age 58.3 ± 11.9 years) presented with SAH. Aneurysms were found on both sides. Five aneurysms were located in the M2 segment, two at the M2–3 junction, one in the M3 segment, and one in the M4 segment (Fig. 1). The aneurysm sizes ranged from 2 to 10 mm (mean 4.9 ± 3 mm). There were eight patients in whom cerebral hematoma with SAH was demonstrated on CT scans; the insula was mostly affected. Temporal rather than frontal lobe hematoma was also observed. Eight saccular aneurysms were successfully occluded with clips via the transsylvian approach and one was trapped. Multiple aneurysms were found in five patients. The initial angiogram failed to reveal a ruptured distal MCA aneurysm in one patient (Case 1). Of the nine patients, eight had good recovery and one had moderate disability.

Illustrative Cases

Case 1. This 67-year-old woman suffered a sudden onset of severe headache and was admitted to a local hospital, where a CT scan revealed an SAH that was dominant in the peripheral sylvian fissure (Fig. 2A and B). On cerebral an-
Distal middle cerebral artery aneurysms

giography studies we detected an ICA aneurysm without an associated lesion on the left side. The aneurysm was obliterated via the perineal approach; however, it seemed to be an unruptured lesion based on operative findings. Follow-up angiography disclosed a distal MCA aneurysm (Fig. 2C), and the second surgery was performed on Day 38. The aneurysm was found to be embedded in the temporal lobe (Fig. 2D) and two tiny branches arose around its proximal neck; the lesion was occluded with a curved clip. Part of the aneurysm wall was obtained for histological confirmation; examination revealed that bacteria and fungi were absent. The patient was discharged without neurological deficits.

Case 4. This 78-year-old woman suddenly lost consciousness. A CT examination revealed an SAH on the right side (Fig. 3A) and cerebral angiograms disclosed multiple lesions (bilateral ICA and MCA aneurysms). The ruptured distal MCA aneurysm (Fig. 3B and C) and the unruptured ICA–PcoA aneurysm were obliterated with clips. Postoperatively, the patient recovered fully.

Case 7. This 63-year-old woman had suffered an SAH caused by a ruptured right ICA–PcoA aneurysm that occurred 3 years before the current presentation. The aneurysm was obliterated and no other lesions were observed at that time. In her last presentation, the patient lost consciousness and was transferred to our institution. On admission, right hemiparesis and global aphasia were noted. A CT scan revealed a left temporal and insular hematoma with SAH, and on angiography studies we detected de novo aneurysms at the distal MCA and ICA on the left side (Fig. 4). The aneurysms were occluded with clips and the temporal hematoma was evacuated. Postoperatively, the patient’s speech disturbance improved and she was discharged in good condition.

Case 9. This 40-year-old man was admitted because of an infectious endocarditis diagnosed at the Department of Internal Medicine. The patient suddenly experienced motor aphasia, and neuroimaging revealed a left frontal hematoma with SAH caused by a mycotic aneurysm at the precentral artery (Fig. 5). Delayed surgery was scheduled because of his general condition. The motor aphasia improved and the aneurysm was trapped without revascularization on Day 36; the outcome was good recovery.

Discussion

Clinical and Neuroimaging Characteristics

Although distal anterior cerebral artery aneurysms are a relatively common source of SAH, distal MCA aneurysms are very rare. Since Poppen8 first reported the distal MCA aneurysm in 1951, there have been some case reports fea-

TABLE 1

Summary of nine patients with ruptured distal MCA aneurysms*

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (yrs), Sex</th>
<th>Preop WFNS Grade</th>
<th>Side &amp; Location</th>
<th>Size (mm)</th>
<th>Intracerebral Hematoma</th>
<th>Treatment</th>
<th>Op Timing (days)</th>
<th>GOS Score</th>
<th>Other Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67, F</td>
<td>I</td>
<td>lt M3, middle temporal</td>
<td>2</td>
<td>none</td>
<td>clipping</td>
<td>38</td>
<td>GR</td>
<td>not revealed on initial angiogram</td>
</tr>
<tr>
<td>2</td>
<td>64, F</td>
<td>III-A</td>
<td>rt M3, angular</td>
<td>7</td>
<td>temporal</td>
<td>clipping</td>
<td>0</td>
<td>GR</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>48, M</td>
<td>III-A</td>
<td>rt M3, posterior temporal</td>
<td>3</td>
<td>temporal &amp; insular</td>
<td>clipping</td>
<td>1</td>
<td>GR</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>78, F</td>
<td>III-B</td>
<td>rt M3, tempororooccipital</td>
<td>8</td>
<td></td>
<td>clipping</td>
<td>1</td>
<td>GR</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>65, F</td>
<td>IV</td>
<td>lt M3, precentral</td>
<td>6</td>
<td>frontal &amp; insular</td>
<td>clipping</td>
<td>1</td>
<td>GR</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>50, F</td>
<td>II</td>
<td>rt M3, precentral</td>
<td>2</td>
<td></td>
<td>clipping</td>
<td>1</td>
<td>GR</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>63, F</td>
<td>IV</td>
<td>lt M3, middle temporal</td>
<td>2</td>
<td>temporal &amp; insular</td>
<td>clipping</td>
<td>0</td>
<td>GR</td>
<td>de novo aneurysm</td>
</tr>
<tr>
<td>8</td>
<td>50, F</td>
<td>IV</td>
<td>rt M3, central</td>
<td>4</td>
<td></td>
<td>clipping</td>
<td>0</td>
<td>MD</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>40, M</td>
<td>I</td>
<td>lt M3, precentral</td>
<td>10</td>
<td></td>
<td>trapping</td>
<td>36</td>
<td>GR</td>
<td>infectious endocarditis</td>
</tr>
</tbody>
</table>

* GOS = Glasgow Outcome Scale; GR = good recovery; MD = moderate disability; WFNS = World Federation of Neurosurgical Societies.
turing this lesion. Our study, with nine distal MCA aneurysms, is the largest series to date. Ruptured distal MCA aneurysms are rare, constituting 0.3% of intracranial aneurysms and 1.1% of MCA lesions in the present study. In previous studies it has been reported that the incidence of distal MCA aneurysms ranged from 2 to 4% of total lesions of this type.

Of nine patients with distal MCA aneurysms, women outnumbered men by seven to two, and there was no obvious laterality. In our series, eight of nine ruptured distal MCA aneurysms were accompanied by cerebral hematoma, which contributed to poor preoperative grades. Nevertheless, a favorable outcome was achieved in all cases after surgical treatment. In contrast, Rinne, et al., reported unfavorable outcomes in patients with distal MCA aneurysms, probably due to the intracerebral hematomas. In ruptured MCA aneurysms, it has been reported that the incidence of intracerebral hematoma was up to 44%. Thus, cerebral hematoma developed easily in patients with distal MCA aneurysms. The location of the aneurysms varied in this study, but the M segment was most often affected. Eight ruptured distal MCA aneurysms seemed to be saccular types based on operative findings, and the remaining one was a mycotic lesion. Although a dissecting aneurysm can develop at the distal MCA, no dissecting lesion was observed in this series.

Pathogenesis of Lesions

Because cerebral aneurysms usually arise along the main
trunks of the circle of Willis due to hemodynamic stress and/or congenital factors, distal aneurysms are uncommon. Infection caused by mycotic emboli and trauma can lead to aneurysm formation at the distal cerebral artery1 (one mycotic aneurysm at the distal MCA was observed in this study). In the patient in Case 1, we obtained a sample of the aneurysm wall to rule out mycotic origins. Histological confirmation of the lesion’s origin was not available, however, in the other cases. Based on clinical, operative, and neuroimaging findings, most of the ruptured distal MCA aneurysms were thought to be typically saccular ones in our series.

Although it remains unclear what kind of factors facilitate distal MCA aneurysm formation, congenitally fragile portions of the distal MCA may be the main feature responsible. We believe this is a possibility because five of nine patients with ruptured distal MCA aneurysms had multiple lesions.

Surgical Treatment

Direct microsurgical repair remains the most common method used to treat distal MCA aneurysms, although endovascular surgery has been favored recently. In this study, eight aneurysms were accessible for clipping via the trans-sylvian approach and one was trapped without revascularization. Fortunately, no ischemic complications occurred. Nevertheless, some distal MCA aneurysms need trapping of the parent artery and revascularization.7 Thus, neurosurgeons should prepare for superficial temporal artery-MCA anastomosis for insurance during distal MCA aneurysm surgery.

A sufficient dissection of the distal sylvian fissure is essential to expose distal MCA aneurysms. Nevertheless, dissection in the distal sylvian fissure is usually more difficult than in the proximal one. In addition, it is sometimes hard to know the exact location of distal MCA aneurysms during surgery because there are many anatomical variations of the MCA, and the lesions are embedded in the brain. Although we used no special equipment to confirm the location of the aneurysms, intraoperative angiography is useful. The surgical team should be prepared to perform intraoperative angiography if the location of a distal MCA aneurysm is complex. In general, we recommend the following surgical strategy, although our surgical procedures were not constant because the locations of distal MCA aneurysms ranged from M2 to M4 segments in this study. It is important to determine which trunk of the MCA contains the distal MCA lesion based on preoperative angiograms. At surgery, a cortical segment of the MCA (M1 segment; frontal or temporal artery) whose proximal portion is not a parent vessel of the aneurysm over the sylvian fissure, is dissected proximally to expose the bifurcation of the MCA. Second, another trunk containing the aneurysm distally should be identified at the bifurcation of the MCA. Third, the affected trunk is followed from the proximal to the distal side to locate the

Fig. 4. Case 7. A and B: Axial CT scans demonstrating left temporal and insular hematoma with SAH. C and D: Left ICA angiograms (C: anteroposterior view, D: lateral view) revealing distal MCA (arrows) and ICA–anterior choroidal artery aneurysms.

Fig. 5. Case 9. A: Axial CT scan demonstrating left frontal hematoma. B: Left ICA angiogram (lateral view) demonstrating a distal mycotic MCA aneurysm.
aneurysm. Finally, the aneurysm neck is secured and obliterated.

Although evacuation of cerebral hematoma is useful to obtain an adequate operative field, special care should be taken to avoid premature rupture because the aneurysm is pointing toward the cavity. After obliteration of the aneurysm neck, the rest of the hematoma should be removed.

Conclusions
Ruptured distal MCA aneurysms are rare and easily cause intracerebral hematoma with SAH. Appropriate direct surgical treatment can achieve a favorable outcome.

References

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