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Microneurosurgical management of distal middle cerebral artery aneurysms

Reza Dashti, MD[a], Juha Hernesniemi, MD, PhD[a,*], Mika Niemelä, MD, PhD[a], Jaakko Rinne, MD, PhD[b], Martin Lehecka, MD[a], Hu Shen, MD[a], Hanna Lehto, MD[a], Baki S. Albayrak, MD[a], Antti Ronkainen, MD, PhD[b], Timo Koivisto, MD, PhD[b], Juha E. Jääskeläinen, MD, PhD[b]

[a]*Department of Neurosurgery, Helsinki University Central Hospital, Helsinki 00260, Finland*
[b]*Department of Neurosurgery, Kuopio University Hospital, Kuopio 70211, Finland*

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Abstract

Background: Distal middle cerebral artery aneurysms originate from branches of MCA distal to its main bifurcation or the peripheral branches. Distal middle cerebral artery aneurysms are the least frequently seen among the middle cerebral artery aneurysms. The purpose of this article is to review the practical anatomy, preoperative planning, and avoidance of complications in the microsurgical dissection and clipping of MdistAs.

Methods: This review, and the whole series on intracranial aneurysms, are mainly based on the personal microneurosurgical experience of the senior author (JH) in 2 Finnish centers (Helsinki and Kuopio), which serve without patient selection the catchment area in Southern and Eastern Finland.

Results: These 2 centers have treated more than 10 000 aneurysm patients since 1951. In the Kuopio Cerebral Aneurysm Database of 3005 patients with 4253 aneurysms, 69 patients carrying altogether 78 MdistAs formed 5% of all MCA aneurysms. Among the 18 patients with ruptured MdistAs (23%), an ICH occurred in 9 (50%).

Conclusions: Distal middle cerebral artery aneurysms are rare. The microneurosurgical treatment of MdistAs is challenging. They are often difficult to localize during the operation, and lack of collateral circulation makes their occlusion more demanding. High rate of ICH and high tendency of rebleeding urge acute or emergency surgery in most of ruptured cases. Microneurosurgical clipping is the most effective treatment of MdistAs.

Keywords: Aneurysm; Middle cerebral artery; Distal; Surgery; Microsurgical technique; Clipping; Subarachnoid hemorrhage

1. Introduction

1.1. Middle cerebral artery bifurcation aneurysms

Middle cerebral artery aneurysms can be classified into proximal, bifurcation, or distal type (Table 1). The proximal MCA aneurysms or M1As are located in the main trunk (M1), between the bifurcation of the internal carotid artery (ICA) and the main bifurcation of MCA [9]. The MbifAs are located in the main bifurcation of MCA [10]. The MdistAs, originating from branches of MCA distal to the main bifurcation or the peripheral branches, are the focus of the present article.

Abbreviations: CTA, computed tomography angiography; DSA, digital subtraction angiography; ICA, internal carotid artery; ICG, indocyanine green; ICH, intracerebral hematoma; LSO, lateral supraorbital approach; MbifA, middle cerebral artery bifurcation aneurysm; MCA, middle cerebral artery; MdistA, Distal middle cerebral artery aneurysm; M1A, middle cerebral artery trunk (M1) aneurysm; SAH, subarachnoid hemorrhage; STA-MCA, superior temporal artery to middle cerebral artery anastomosis.

* Corresponding author. Tel.: +358 50 4270220; fax: +358 9 47187560.
E-mail address: juha.hernesniemi@hus.fi (J. Hernesniemi).

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Table 1
Three categories of middle cerebral artery (MCA) aneurysms

Category	Location
M1A	Main trunk of MCA, between ICA bifurcation and main MCA bifurcation
MbifA	Main MCA bifurcation
MdistA	Branches distal to main MCA bifurcation or cortical branches

Distal middle cerebral artery aneurysms are the least frequent of MCA aneurysms [18,35,36,43,56]. Microneurosurgical treatment of MdistAs is demanding. It is difficult to localize them, the small ones in particular, because they lie deep in the sylvian cistern, among the distal branches of the MCA. Intraoperative navigation may be further complicated by the presence of SAH and ICH. Furthermore, they can be mycotic, inflammatory, or dissecting [29,39,43]. The lack of collateral circulation makes occlusion more challenging, necessitating bypass and revascularization techniques [27,35,36]. Since the first definition by Poppen [30] in 1951, there are only few reports on management of MdistAs [18,29,35,36,56].

1.2. Purpose of review

The purpose is to review the practical anatomy, preoperative planning, and avoidance of complications in the microsurgical dissection and clipping of MdistAs. This review, and the whole series on intracranial aneurysms, is intended for the neurosurgeons who are subspecializing in neurovascular surgery.

1.3. Authors

This review is mainly based on the personal microneurosurgical experience of the senior author (JH) in 2 Finnish centers (Helsinki and Kuopio), which serve, without selection, the catchment area in the southern and eastern Finland. These 2 centers have treated more than 10 000 patients with aneurysm since 1951.

The data presented in our series of articles represent 3005 consecutive patients harboring 4253 intracranial aneurysms from the Kuopio Cerebral Aneurysm Database (1977-2005). The aim is to present a consecutive, nonselected, population-based series of intracranial aneurysms without any selection bias. This database is not reflective of the personal series of the senior author (JH) alone.

Table 2
Patients with middle cerebral artery aneurysms (MCA) in a consecutive and population-based series of 3005 patients with 4253 intracranial aneurysms from 1977 to 2005 in the Kuopio Cerebral Aneurysm Database

	No. of patients	No. of aneurysms
Whole series	3005	4253
Patients with primary SAH	2365	3325
Patients without primary SAH	640	928
MCA aneurysms	1456	1704
M1As	221 (15%)	241 (14%)
MbifAs	1166 (80%)	1385 (81%)
MdistAs	69 (5%)	78 (5%)
Ruptured MCA aneurysms	802	802
M1As	73 (9%)	73 (9%)
MbifAs	711 (89%)	711 (89%)
MdistAs	18 (2%)	18 (2%)
Distal MCA aneurysms		
Total	69	78
Unruptured MdistAs	51 (74%)	60 (77%)
Ruptured MdistAs	18 (26%)	18 (23%)

Table 3
Characteristics of MdistAs and comparison between ruptured and unruptured groups

	Ruptured	Unruptured	Total
No. of aneurysms	18	60	78
Median aneurysm size (mm)	8 (range 2–25)	3 (range 1–25)	4 (range 1–25)
Aneurysm size			
Small (<7 mm)	8 (44%)	47 (78%)	55 (71%)
Medium (7–14 mm)	8 (44%)	10 (17%)	18 (23%)
Large (15–24 mm)	1 (6%)	2 (3%)	3 (4%)
Giant (≥25 mm)	1 (6%)	1 (2%)	2 (3%)
Aneurysm side			
Right	8 (44%)	32 (53%)	40 (51%)
Left	10 (56%)	28 (47%)	38 (49%)
ICH	9 (50%)		
Temporal	8		
Frontal	1		
Parietal	0		
Hydrocephalus	4 (32%)		
Fusiform MCA aneurysms	4	14	18
Fusiform M1A	0	6	6
Fusiform MbifA	3	5	8
Fusiform MdistA	1	3	4

Data are given as number of aneurysms.

2. Occurrence of MdistAs

Distal middle cerebral artery aneurysms are the least frequent of the MCA aneurysms reported to form 1.1% to 5% of them [18,35,36,43,56]. Four MdistAs form 2% of the series reported by Yaşargil [56]. In the largest series reported to date, Horiuchi et al [18] reported 9 MdistAs. Tables 2-5 present clinical data of patients with MdistA in a consecutive and population-based series of 3005 patients with 4253 intracranial aneurysms from 1977 to 2005 in the

Table 4
Patients with MdistAs and possible associated aneurysms

	Ruptured	Unruptured	Total
Patients with MdistAs	18	51	69
Patients with a single MdistA only	8 (44%)	10 (20%)	18 (26%)
Patients with multiple aneurysms	10 (56%)	41 (80%)	51 (74%)
Associated MdistAs	3	4	7
Unilateral	1	2	3
Bilateral	2	1	3
Uni- and bilateral	0	1	1
Associated aneurysms at other sites	7	37	44

Data are given as numbers of patients.