Three-Dimensional Angiographic Evaluation of Middle Cerebral Artery Trunk Aneurysms: Demonstration of the Close Relationship Between the Early Frontal Cortical Branches and Lateral Lenticulostriate Arteries

Jung Cheol Park[1], Jae Ho Shim[2], Deok Hee Lee[3], Jae Sung Ahn[1], Dong-Geun Lee[4], Kuhyun Yang[3], Wonhyoung Park[3], Hae-Won Koo[3], Yuan Yuan Jiang[5], Do Hoon Kwon[1], Byung Duk Kwun[1]

BACKGROUND: **For the treatment planning of a patient with a middle cerebral artery (MCA) trunk aneurysm, understanding the anatomic relationship among the aneurysm, branching vessels, and lenticulostriate arteries (LSAs) is important. We aimed to demonstrate the branching-vessel anatomy related to an MCA trunk aneurysm using 3-dimensional (3D) angiography.**

METHODS: **We retrospectively reviewed 3D angiographic findings of 64 cases of MCA trunk aneurysms using a 3D workstation with various postprocessing conditions. We classified the aneurysms into 4 groups (early frontal cortical branch [EFCB], early temporal cortical branch [ETCB], LSA, and nonbranching aneurysms) and analyzed the relationship between the branching vessels and the LSAs.**

RESULTS: **There were 30 EFCB aneurysms, 25 ETCB aneurysms, 7 LSA aneurysms, and 2 nonbranching aneurysms. Twenty-six (86.7%) of the 30 EFCB aneurysms shared common origins and were associated with the LSAs, but none of the 25 ETCB aneurysms were. Three of 24 patients who received clipping for an EFCB aneurysm experienced a postoperative infarction in the LSA territory. In these 3 patients, the LSA originated from the EFCB and was closely related with the aneurysm.**

CONCLUSIONS: **We have identified a clinically important anatomic relationship between the MCA trunk aneurysm and branching vessels, including the LSAs. EFCB aneurysms show a close relationship with the LSAs. Pretreatment identification of the origin of the LSAs is important to obviate any perforator injury in EFCB aneurysms.**

INTRODUCTION

The majority of middle cerebral artery (MCA) trunk aneurysms arise from the origin of the early cortical branches.[1-3] However, because aneurysms have also originated at the branching site of the lateral lenticulostriate artery (LSA) in a small number of cases,[4-6] care must be taken to prevent damage to the LSA during microsurgical or endovascular treatment of these aneurysms. Nonetheless, symptomatic lacunar infarctions occur from time to time after the treatment of MCA trunk aneurysms that are not directly related to the LSA, owing to the common association of the major LSAs with the early cortical branches, especially with the EFCBs.[7-10]

Cadaveric and microsurgical reports have revealed an association between the EFCB and major LSAs in more than 80% of cases, and this is considered a well-known and important surgical point.[4,8,11,12] However, identifying whether or not the LSA shares its origin with the early cortical branches is often difficult using conventional angiography. Owing to recent advances in high-quality 3D angiography, pretreatment angiography can now be used to provide detailed anatomic information regarding the origin of the individual LSAs, as well as their relationship with other branches of the MCA trunk or the aneurysms.

Key words
- Cerebral angiography
- Intracranial aneurysm
- Lateral lenticulostriate artery
- Middle cerebral artery
- Three-dimensional image

Abbreviations and Acronyms
EFCB: Early frontal cortical branch
ETCB: Early temporal cortical branch
LSA: Lenticulostriate artery
MCA: Middle cerebral artery
VR: Volume rendering

From the Departments of [1]Neurosurgery and [3]Radiology, University of Ulsan College of Medicine, Asan Medical Center, Seoul; [2]Department of Radiology, Ulsan Hospital, Ulsan; [4]Department of Neurology, Sejong General Hospital, Bucheon; and [5]Department of Medical Biotechnology, Dongguk University, Ilsan, Korea

To whom correspondence should be addressed: Deok Hee Lee, M.D., Ph.D. [E-mail: dhlee@amc.seoul.kr]

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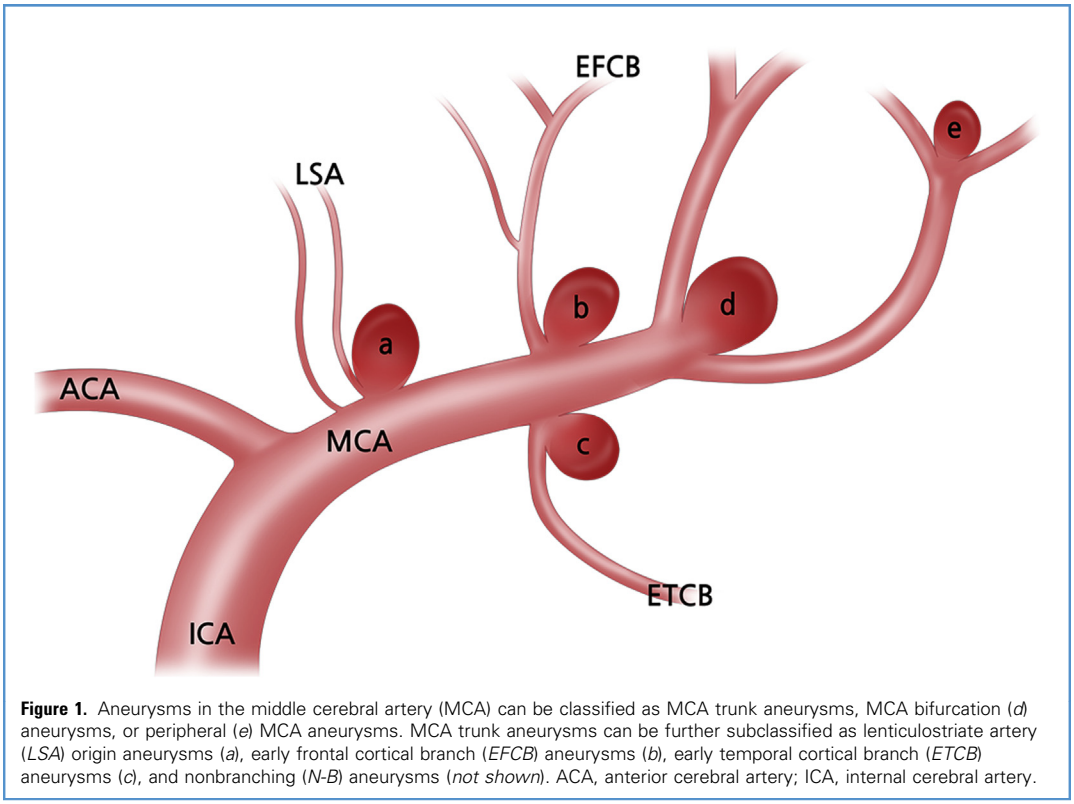

Figure 1. Aneurysms in the middle cerebral artery (MCA) can be classified as MCA trunk aneurysms, MCA bifurcation (*d*) aneurysms, or peripheral (*e*) MCA aneurysms. MCA trunk aneurysms can be further subclassified as lenticulostriate artery (*LSA*) origin aneurysms (*a*), early frontal cortical branch (*EFCB*) aneurysms (*b*), early temporal cortical branch (*ETCB*) aneurysms (*c*), and nonbranching (*N-B*) aneurysms (*not shown*). ACA, anterior cerebral artery; ICA, internal cerebral artery.

The main aim of our present study was to determine a practical role for 3D angiography in assessing the relationship between the early cortical branches and LSAs in cases of MCA trunk aneurysms.

METHODS

Patients and Middle Cerebral Artery Aneurysms

From our neuroangiography database prospectively collected from November 2011—May 2013, we were able to identify 246 patients with 294 MCA aneurysms who had undergone 4-vessel cerebral angiography with rotational angiography. We limited our retrospective patient cohort in this study to this time period because of the availability of back-up 3D volume data to review when the previously created volume-rendering images on the picture archiving and communication system were insufficient to classify the aneurysms or the LSAs were not clearly demonstrated by the analysis.

Table 1. Classification of 294 Middle Cerebral Artery Aneurysms in Study

Aneurysm Type	Total Number (%)
MCA-trunk	64 (22%)
EFCB	30
ETCB	25
LSA	7
Nonbranching	2
Bifurcation	219 (74%)
Peripheral	11 (4%)

MCA, middle cerebral artery; EFCB, early frontal cortical branch; ETCB, early temporal cortical branch; LSA, lenticulostriate artery.

3D Angiography

After the rotational angiography, the data were subsequently transferred to an external processing workstation (Syngo Workplace, Siemens Medical Solutions, Erlangen, Germany) to

Table 2. Proportion of Cases in Study Showing Association with Lenticulostriate Artery According to Type of Middle Cerebral Artery Trunk Aneurysm

Types	Associated with LSA, Number (%)
EFCB	26/30 (86%)
ETCB	0/25 (0%)
LSA	7/7 (100%)
Non-branching	0/2 (0%)

LSA, lenticulostriate artery; EFCB, early frontal cortical branch; ETCB, early temporal cortical branch.