Radiology Case Reports 17 (2022) 1483–1486

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journal homepage: www.elsevier.com/locate/radcr

Case Report

Mechanical thrombectomy in acute stroke for superior limb of the fenestration of the middle cerebral artery ☆,☆☆

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ARTICLE INFO

Article history:
Received 18 January 2022
Revised 25 January 2022
Accepted 26 January 2022
Available online 3 March 2022

Keywords:
Mechanical thrombectomy
Acute stroke
Superior limb
Fenestration
Middle cerebral artery

ABSTRACT

Fenestration of the middle cerebral artery (MCA) is a rare anatomic variant, and lenticulostriate arteries (LSAs) often arise from the superior limb of the fenestrated segment. A case of acute occlusion of the superior limb of a fenestrated MCA that successfully underwent mechanical thrombectomy is presented. Digital subtraction angiography performed for a 73-year-old man with acute left hemiparesis showed poor visualization of the upper half of the right M1 segment with maintenance of antegrade peripheral circulation of the MCA territory, and mechanical thrombectomy was successfully performed using a stent retriever with intravenous thrombolysis. After restoration of the MCA, the vascular variant of a fenestrated MCA was found. Clinicians must consider the possibility of acute occlusion of a fenestrated MCA before endovascular thrombectomy. Restoration of acute occlusion of the upper limb of a fenestrated MCA can avoid LSA territory infarction.

Introduction

Endovascular mechanical thrombectomy has been a standard treatment for acute ischemic stroke (AIS), but guiding a microcatheter into occluded invisible vessels poses a potential danger because their detection before restoration is difficult. To recognize anatomic vascular variants including fenestration, duplication, and luminal division is important in performing endovascular treatment to avoid unexpected pro-

Abbreviations: AIS, acute ischemic stroke; MCA, middle cerebral artery; LSA, lenticulostriate artery; NIHSS, national institutes of health stroke scale; CT, computed tomography; DSA, digital subtraction angiography; mRS, modified Rankin scale; BPAS, basi-parallel anatomic scanning; 3D-FIESTA, 3-dimensional fast imaging employing steady-state acquisition.

☆ Acknowledgments: None.

☆☆ Competing Interests: The authors declared that there is no conflict of interest. The authors received no financial support for the research, authorship, and/or publication of this article.

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https://doi.org/10.1016/j.radcr.2022.01.081

cedural complications. Of the anatomic vascular variations, a vascular fenestration is distinguished from a partial duplication or luminal division [1–3]. Fenestration of the middle cerebral artery (MCA) is a rare anatomic variant and is usually detected incidentally. The prevalence of fenestrated MCA has been reported to be 0.02%-1% [1]. In patients with a fenestrated MCA, lenticulostriate arteries (LSAs) often arise from the superior limb of the fenestrated segment [2]. LSA territory infarction results in motor deficit, sensory deficit, and cognitive dysfunction. Furthermore, occlusion of only the larger limb of a fenestrated MCA can be misdiagnosed as atherosclerotic stenosis, and the wrong endovascular procedures may be performed. A case of AIS with occlusion of only the larger superior limb of a fenestrated MCA in which mechanical thrombectomy was successfully performed is presented.

Case presentation

A 73-year-old man with an implanted epicardial pacemaker for cardiac arrhythmias presented with left hemiparesis 63 minutes from onset. His NIHSS score was 10. On computed tomography (CT), the Alberta Stroke Programme Early Computed Tomography Score was 9 (Fig. 1A). CT angiography showed subocclusion of the upper half of the right MCA, and the CT perfusion study showed infarct-penumbra mismatch (Fig. 1B and C). He was diagnosed with right MCA subocclusion due to a cardiac embolus. Digital subtraction angiography (DSA) was performed to confirm circulation of the MCA with intravenous thrombolysis. Right internal cerebral angiography also showed poor visualization of the upper half of the right M1 segment, with maintenance of antegrade peripheral circulation of the MCA territory (Fig. 1D). Although antegrade peripheral circulation of the MCA was maintained, the patient had left hemiparesis. Mechanical thrombectomy was selected for the right MCA subocclusive lesion because of symptomatic miserly perfusion due to cardiac embolus. Under local anesthesia, a 9-Fr balloon-guided catheter (OPTIMO; Tokai Medical Products, Aichi, Japan) was positioned at the right internal carotid artery via the right femoral artery. An attempt was made to pierce the lower half of the subocclusive lesion carefully to prevent distal migration of thrombus using a Phenom 27 microcatheter (Medtronic, Irvine, CA) over a 0.014-inch microguidewire. However, the Phenom 27 microcatheter was unintentionally introduced into the upper half of the subocclusive lesion. Then, thrombectomy was successfully performed using a 4*40-mm Solitaire (Medtronic) (Fig. 1E). Thrombolysis in Cerebral Infarction scale 3 flow restoration was achieved without procedure-related complications. Postoperative internal cerebral angiography showed vascular fenestration of the M1 segment of the right MCA and a prominent LSA arose from the superior limb of the fenestrated MCA (Fig. 1F). His symptoms were improved immediately after thrombectomy, and only right putaminal infarction was confirmed on postoperative CT (Fig. 1G). With training and rehabilitation, he was discharged home with a modified Rankin scale (mRS) score of 1 on the 7th day from onset.

Discussion

Fenestration of the MCA is a rare vascular anomaly due to abnormal development of the congenital primitive embryonic vessel, in which the lumen of an arterial segment is divided into 2 distinct but parallel channels. However, the mechanism underlying the fenestration of the MCA remains unclear [2]. Fenestration of the M1 segment of the MCA is classified into 3 types based on the location as the proximal, intermediate, and distal types [4]. It has been reported that the proximal type and the right side are the most common, affecting from 60% to 100% and from 50% to 80%, respectively [5–7]. The LSA often arises from the superior limb of the fenestrated MCA, which perfuses the caudate nucleus, putamen, pallidum, and internal capsule [2]. Therefore, occlusion of even only the superior limb of a fenestrated MCA may cause LSA territory infarction, which results in motor deficit, sensory deficit, and cognitive dysfunction. However, subocclusion of the upper half of the MCA, and occlusion of only the superior limb of the fenestrated MCA may result in LSA territory infarction. Although the efficacy and safety of thrombectomy for large vessel subocclusion and occlusion of only the superior limb of the fenestrated MCA remains unclear, thrombectomy seems to be effective to avoid LSA territory infarction for subocclusion of the upper half of the MCA and occlusion of only the superior limb of the fenestrated MCA. On the other hand, since the hydrodynamic flow resistance at the small limb is significantly larger than that of the large limb, the small-diameter limb may lead to blood clotting, and atherosclerosis-related occlusions with a fenestrated MCA [7]. If occlusion of the superior limb of a fenestrated MCA due to atherosclerotic disease is considered, it may be better to perform thrombectomy using a dilating stent retriever or balloon with a diameter smaller than that of the patent limb.

In contrast, awareness of the vascular anatomy of the MCA is important for the safety of endovascular mechanical thrombectomy. However, in an urgent situation to treat an AIS patient, it is difficult to recognize a fenestrated MCA in an occluded vessel before endovascular recanalization, as in the present case. Basi-parallel anatomic scanning (BPAS) using 3-dimensional fast imaging employing steady-state acquisition (3D-FIESTA) makes it possible to show clear vascular information of the outside of the MCA even if there is no blood flow [8]. BPAS may be useful to recognize anatomic information about an obstructive lesion of the MCA. In the present case, it was not possible to consider the possibility of occlusion of the superior limb of a fenestrated MCA. Then, an attempt was made to pierce the lower half of the subocclusive lesion. Had the lower half of the subocclusive lesion been pierced, revascularization would never have been achieved. In addition, repeated thrombectomy or balloon angioplasty of the inferior limb of the MCA would have resulted in postoperative hemorrhagic complications. Clinicians must consider the possibility of occlusion of the acute superior limb of a fenestrated MCA, especially when the upper half is partially occluded in the proximal segment of the right MCA. In cases of subocclusion of the upper half of the MCA, performing thrombectomy needs to be considered to avoid LSA territory infarction.

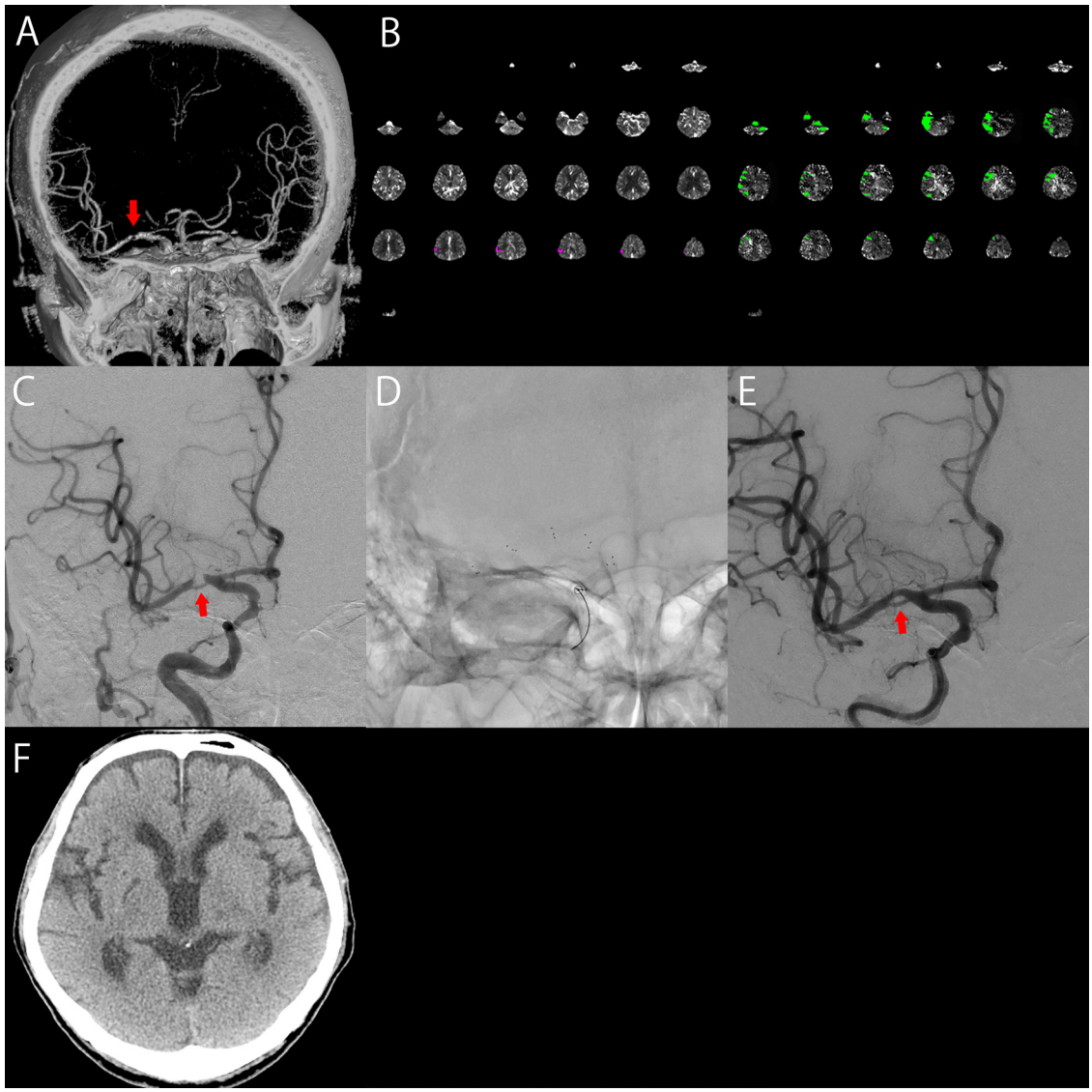

Fig. 1 – (A) On computed tomography (CT), the Alberta stroke Programme early computed tomography score is 9. (B, C) CT angiography shows subocclusion of the upper half of the right middle cerebral artery (MCA), and the CT perfusion study shows infarct-penumbra mismatch in the right MCA territory. (D) Right internal cerebral angiography also shows poor visualization of the upper half of the first segment of the right middle cerebral artery (MCA), with maintenance of antegrade peripheral circulation of the middle cerebral artery territory. (E) Thrombectomy is performed using a stent retriever. (F) Postoperative internal cerebral angiography shows vascular fenestration of the first segment of the right MCA and some lenticulostriate arteries arise from the superior limb of the fenestrated MCA. (G) Postoperative CT shows only right putaminal infarction.

Conclusion

Clinicians must consider the possibility of acute occlusion of a fenestrated MCA before endovascular mechanical thrombectomy. Restoration of acute occlusion of the upper limb of a fenestrated MCA can avoid LSA territory infarction.

Authorship

All listed authors of this work made substantial contributions to the conception and design, acquisition of data, analysis, and interpretation of data, drafting, critical revising, and final approval of the manuscript. All authors agreed that they are accountable for all aspects of the work.

Patient consent

We have obtained written consent for experimentation with human subjects and publication. Written informed consent was obtained from each patient, their nearest relative, or a person who had been given authority to provide consent for admission, and surgery for the patient.

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