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Case Report

Mechanical thrombectomy for middle cerebral artery occlusion caused by intracranial internal carotid artery stenosis: A case report☆,☆☆

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ARTICLE INFO

Article history:
Received 27 February 2023
Revised 18 May 2023
Accepted 28 May 2023

Keywords:
Middle cerebral artery occlusion
Intracranial internal carotid artery stenosis
Artery to artery embolism
Tandem lesion
Mechanical thrombectomy

ABSTRACT

Tandem internal carotid artery (ICA)/middle cerebral artery (MCA) occlusions are occasionally observed in patients with acute ischemic stroke. Most of them are caused by lesions at the origin of the ICA. In cases of intracranial ICA stenosis, the formation of a large thrombus causing MCA occlusion is extremely rare. Herein We report a case of acute MCA occlusion caused by intracranial ICA stenosis. A 62-year-old female presented with aphasia, right-side weakness, and a National Institute of Health Stroke Scale (NIHSS) score of 5. Magnetic resonance imaging (MRI) showed early ischemic infarction at the precentral gyrus. Left ICA and M1 occlusion were suspected on magnetic resonance angiography. However, the patient had complained of right-side numbness 6 days before the onset. Hence the stroke was assumed to have progressed slowly, and acute occlusion of the left ICA was eliminated as a suspected diagnosis. After admission, the symptoms worsened. MRI showed enlargement of the cerebral infarction. Computed tomography angiography showed complete occlusion of the left M1 and recanalization of the left ICA with severe stenosis of the petrous portion. The etiology of the MCA occlusion was determined to be atherothromboembolism. Percutaneous transluminal angioplasty (PTA) was performed for ICA stenosis, followed by mechanical thrombectomy (MT) for the MCA occlusion. Recanalization of the MCA was achieved. After Seven days, the NIHSS score reduced from a pre-MT assessment of 17-2. PTA followed by MT was safe and effective for treating MCA occlusion caused by intracranial ICA stenosis.

☆ Acknowledgments: We would like to thank Drs Daisuke Mori, Tamio Ito, Yoshihiro Sumi (Department of Neurosurgery, Nakamura Memorial South Hospital) for their support. We would like to thank Editage (www.editage.com) for English language editing.
☆☆ Competing Interests: The authors have declared that no competing interests exist.
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https://doi.org/10.1016/j.radcr.2023.05.070

Introduction

Tandem lesions, which are occlusions of a major cerebral artery combined with steno-occlusive lesions of the ipsilateral internal carotid artery, have been reported to account for approximately 17%-20% of acute ischemic infarctions [1,2]. However, most of them are caused by lesions at the origin of the internal carotid artery. If the internal carotid artery (ICA) stenosis is an intracranial lesion, cerebral infarction commonly occurs as a sporadic infarction of the watershed [3]. Formation of a large thrombus that occludes the major cerebral artery such as the middle cerebral artery(MCA) is extremely rare. Herein, we present a case of mechanical thrombectomy (MT) for acute MCA occlusion caused by ipsilateral intracranial internal carotid artery stenosis.

Case report

A 62-year-old female presented with motor aphasia and mild right-sided weakness, while all other vital signs were normal. The patient's initial National Institutes of Health Stroke Scale (NIHSS) score on presentation was 5 (Table 1). The patient had a medical history of hypertension and diabetes mellitus type 2, did not smoke or drink, had an insignificant family medical history, and electrocardiography showed no evidence of atrial fibrillation.

Brain magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) were performed on arrival. MRI showed early ischemic infarction in the precentral gyrus, with diffusion-weighted imaging (DWI)-Alberta Stroke Program Early Computed Tomography Score, including deep white matter (ASPECTS+W) score of 10 (Fig. 1A). Left extracranial ICA and left distal M1 segment occlusions were suspected on MRA (Fig. 1B).

Six days before the onset, the patient complained of numbness in the right upper extremity. However, acute occlusion of the left ICA was dismissed as a suspected diagnosis because it was assumed that the stroke had progressed slowly. Therefore, conservative treatment was initiated without acute recanalization therapy.

Table 1 – Transition of patient's NIHSS score.

	Admission	D 1 (Pre-MT)	D 2	D 7
NIHSS scale	5	17	5	2

The morning after hospitalization, the right-side weakness worsened, and the patient began developing facial droop, hemineglect, and total aphasia with an NIHSS score of 17 (Table 1).

MRI showed enlargement of the cerebral infarction, with a DWI-ASPECTS+W score of 8 (Fig. 2A). Computed tomography angiography (CTA) showed complete occlusion of the left M1 segment and recanalization of the left ICA with severe stenosis of the petrous portion (Fig. 2B). Collateral circulation developed through the leptomeningeal anastomoses, and the MCA beyond the M2 segment was visualized. A computed tomography (CT) perfusion scan revealed an ischemic core within the M2 anterior branch vascular territory and an ischemic penumbra within the M2 posterior branch vascular territory (Fig. 2C).

A superficial temporal artery-to-MCA (STA-MCA) bypass was scheduled because of the DWI-perfusion mismatch. Finally, digital subtraction angiography (DSA) was performed to determine the etiology before surgery. Conventional angiography revealed occlusion of the left distal M1 segment. Although there was no significant stenosis at the origin of the cervical ICA, severe stenosis was observed at the petrous portion of the left ICA. In addition, a contrast deficit at the ICA stenosis lesion confirmed the suspicion of a thrombus (Fig. 3A).

The etiology of the left MCA occlusion was determined as an "arterial to artery embolism"; hence, we decided to perform MT. A trans-right brachial artery approach was selected due to the bovine aortic arch. After inserting a 6-Fr guiding sheath into the right brachial artery with the patient under local anesthesia, heparin was intravenously administered such that the activated clotting time was >250 seconds. Subsequently, a 6-Fr guiding sheath was introduced into the left cer-

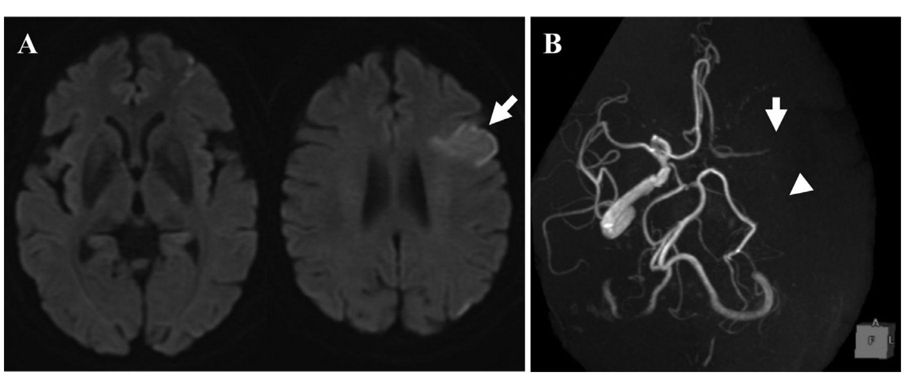

Fig. 1 – (A) DWI showing early ischemic infarction in the precentral gyrus (white arrow), with a DWI-ASPECTS+W score of 10. (B) MRA showing left extracranial ICA (white arrowhead) and left distal M1 (white arrow) occlusion. DWI, diffusion-weighted magnetic resonance imaging; ASPECTS+W, Alberta stroke program early computed tomography score, including deep white matter; MRA: magnetic resonance angiography; ICA, internal carotid artery.

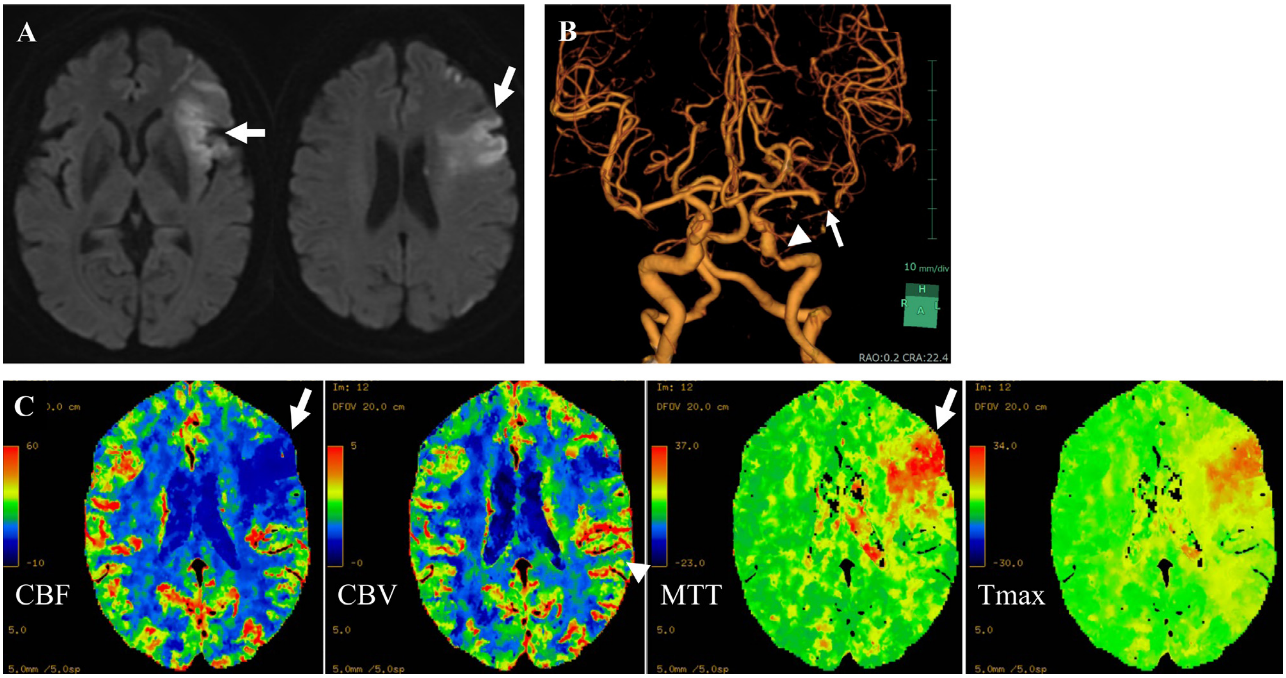

Fig. 2 – (A) Follow-up MRA, the morning after hospitalization, showing an enlargement of cerebral infarction (white arrow) with DWI-ASPECTS+W score 8. (B) CT angiography showing complete occlusion of the left M1(white arrow) but recanalization of the left ICA with severe stenosis of the petrous portion (white arrowhead). (C) CT perfusion imaging; CBF map showing reduced flow within the left M2 anterior branch vascular territory (white arrow). CBV map showing increased blood volume within the left M2 posterior branch of the vascular territory (white arrowhead). MTT map displaying delayed MTT within the left M2 anterior branch vascular territory (white arrow). Tmax map displaying delayed Tmax within the entire left middle cerebral artery vascular territory. MRA, magnetic resonance angiography; DWI, diffusion-weighted magnetic resonance imaging; ASPECTS+W, Alberta stroke program early computed tomography score, including deep white matter; CT, computed tomography; ICA, internal carotid artery; CBF, cerebral blood flow; CBV, cerebral blood volume; MTT, mean transit time; Tmax, time-to-maximum.

vical internal carotid artery, and angiography was performed. A Cerulean DD6 catheter (Terumo, Tokyo, Japan), used as a distal access catheter, was placed proximal to the ICA stenosis (Fig. 3B). A Gateway Monorail balloon catheter (Stryker, Kalamazoo, MI) was coaxially inserted along the microguidewire, and then percutaneous transluminal angioplasty (PTA) was performed with the microballoon (Fig. 3C). Simultaneously, 80 mg of ozagrel sodium was administered intravenously as an antiplatelet agent.

Following PTA, angiography was performed to determine the degree of dilatation and occurrence of dissection. MT was continued because the left MCA remained occluded. After removing the Cerulean DD6 catheter to perform MT, a TrevoTrak 21 microcatheter (Stryker, Kalamazoo, MI) and CHIKAI guidewire (Asahi Intecc, Nagoya, Aichi, Japan) were navigated into the ICA using a REACT 71 catheter (Medtronic, Dublin, Ireland). After the REACT 71 catheter was placed in the ICA distal to the stenosis, the TrevoTrak 21 microcatheter was guided to the MCA M2 segment. Next, the contrast injection was administered adequately distal to the occlusion site. The stent retriever (EmboTrap III 5 × 22 mm; CERENOVUS, Johnson & Johnson Medical Devices, Irvine, CA) was deployed in the M2 segment to cover the thrombus and pulled into the REACT 71 catheter to prevent intimal damage at the stenosis by the stent retriever (Fig. 3D). Recanalization of the MCA was achieved on the first attempt, resulting in an "extended thrombolysis in cerebral infarction" (eTICI) score of 2C (Fig. 3E). After the completion of MCA recanalization, follow-up observation was performed for 20 minutes. No elastic recoil was observed at the ICA stenosis site during angiography, and the procedure was completed. Immediately after MT, the patient was administered dual antiplatelet therapy comprising clopidogrel sulfate 300 mg and aspirin 300 mg; both medicines were administered orally (p. o.). Thereafter, clopidogrel sulfate 75 mg/d p. o. and aspirin 100 mg/d p. o. were continued for 1 month and then switched to monotherapy with clopidogrel sulfate.

The postoperative course was uneventful. Follow-up MRI performed the day after MT showed no enlargement of the ischemic infarction and no worsening of the ICA stenosis (Figs. 4A and B). After 7 days, the patient's NIHSS score improved, dropping from the pre-MT assessment of 17-2 (Table 1). Nine months have passed since the MT, with no evidence of ischemic recurrence.

Discussion

Due to a low recanalization rate, tandem lesions are independent predictors of poor outcomes after intravenous thrombolysis alone [1]. Hence MT is considered necessary for tandem

Fig. 3 – (A) DSA of the left common carotid artery showing severe left ICA stenosis and left middle cerebral artery occlusion (white arrow). A contrast deficit suspected of thrombus was confirmed at the lesion of ICA stenosis (black arrow). (B) DAC proximal to the ICA stenosis (white arrow). (C) A microballoon catheter is positioned at the ICA stenosis for PTA. After PTA, DAC was removed. (D) An aspiration catheter is placed in the ICA distal to the stenosis (white arrow). After a stent retriever was deployed in the M2 segment to cover the thrombus (black arrow), it was extracted in such a way as to be pulled into the aspiration catheter. (E) Recanalization of the MCA was achieved on the first attempt, resulting in an eTICI score of 2C. DSA, digital subtraction angiography; ICA, internal carotid artery; DAC, distal access catheter; PTA, percutaneous transluminal angiography; MCA, middle cerebral artery; eTICI, extended thrombolysis in cerebral infarction.

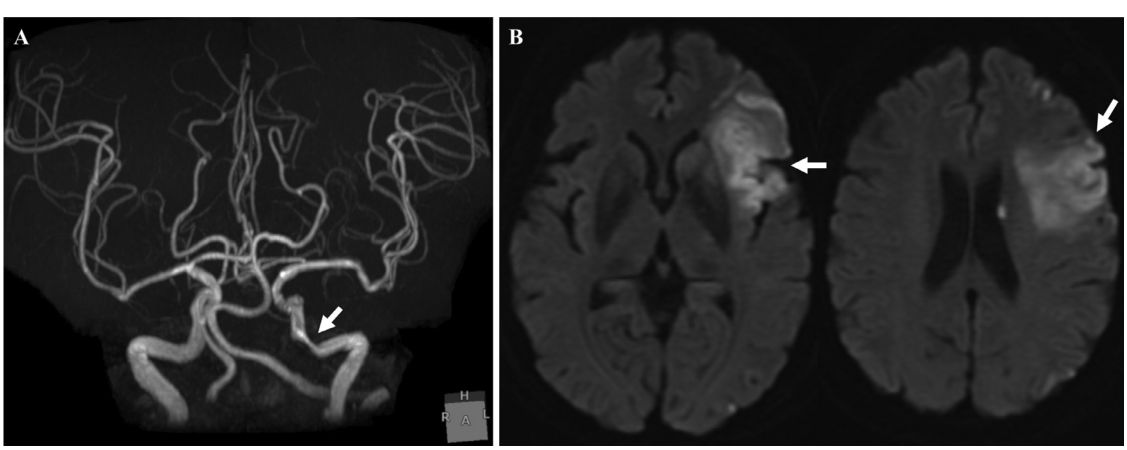

Fig. 4 – (A) Follow-up MRA, the next day after MT, showing mild stenosis at the petrous portion of the left ICA (white arrow). (B) Follow-up DWI showing no enlargement of ischemic infarction (white arrow). MRA, magnetic resonance angiography; MT, mechanical thrombectomy; ICA, internal carotid artery; DWI, diffusion-weighted magnetic resonance imaging.

lesions. Pienimäki et al. [4] reported that patients with severe ipsilateral carotid stenosis (≥75%) were 4 times more likely to have very good intracranial collaterals. Patients with tandem lesions may likely have a wider interval before irreversible changes than those without tandem lesions. However, favorable outcomes cannot be achieved without the recanalization of the MCA.

The superiority of anterograde or retrograde treatment when performing MT for tandem lesions remains debatable. A large multicenter series and systematic review [5] for endovascular management of extracranial ICA steno-occlusive lesions in patients with acute ischemic stroke and tandem occlusion showed no differences in terms of procedural times, the number of MT passages, time to recanalization, and final thrombolysis in cerebral infarction (TICI) score were observed between the antegrade and retrograde approaches. However, Da Ros et al. [5] found that patients treated using an antegrade approach had a lower chance of being independent at 3 months than those treated using a retrograde approach. In the present case, the intracranial ICA diameter was originally narrower than that of the cervical ICA. Severe stenosis of the intracranial ICA is difficult to treat with the retrograde approach because there is no space to pass devices such as a stent retriever or an aspiration catheter. Therefore, an antegrade approach should be chosen to perform PTA for ICA stenosis before MT for distal occlusions. Recanalization takes time when MT is performed after PTA; nonetheless, a favorable outcome can be achieved if a TICI score of 2b-3 is obtained [6,7].

In our case, an aspiration catheter was placed in the ICA distal to the stenosis. This was intended to prevent recoil during the procedure if multiple passes were required. Additionally, pulling the stent retriever into the aspiration catheter might prevent intimal damage to the stenosis due to its stent retriever. However, it should be noted that recanalization of the MCA must be achieved quickly because the anterograde flow is stagnant when passing an aspiration catheter through the stenosis.

Ryu et al. [8] reported that the progression rate of intracranial arterial stenosis differed significantly between symptomatic and asymptomatic patients, indicating a 3-fold risk of progression for symptomatic stenosis compared to asymptomatic stenosis.

Therefore, careful follow-up should be performed, and PTA and stenting (PTAS) should be considered when ICA stenosis reoccurs. Concerning the placement of stents in patients with tandem occlusion in the acute phase, Marko et al. [9] reported that cervical carotid stenting and no stenting were not associated with different outcomes. In contrast, a recent study by Sami et al. [10] suggested the benefit of rescue therapy with angioplasty/stenting in patients with underlying intracranial atherosclerosis evident during mechanical thrombectomy. Since the present case was rare, it is necessary to accumulate reports and find the optimal treatment.

Conclusion

The formation of a large thrombus in intracranial ICA stenosis is extremely rare. In the present case, PTA followed by MT was safe and effective in a patient with MCA occlusion caused by ICA stenosis. Although it is necessary to discuss stent placement for intracranial ICA stenosis, recanalizing the MCA would lead to a favorable outcome.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institution and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Ethics Committee of Nakamura Memorial South Hospital (No. S2022102101).

Author contributions

Shindo Koichiro: Conception and design, acquisition of data, analysis, and interpretation of data, drafting the manuscript and reviewed submitted version of manuscript. Kohei Ishikawa: Acquisition of data, critically revision for intellectual content and reviewed submitted version of manuscript. Masahiro Morishita: Acquisition of data, critically revision for intellectual content and reviewed submitted version of manuscript. Ryota Nomura: Critically revision for intellectual content and reviewed submitted version of manuscript. Koji Oka: Critically revision for intellectual content, administrative/technical/material support and reviewed submitted version of manuscript. Hirohiko Nakamura: Reviewed submitted version of manuscript and study supervision.

Patient consent

Written informed consent was obtained from the patient.

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