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Case Report

Emergent surgical embolectomy in conjunction with cervical internal carotid ligation and superficial temporal artery-middle cerebral artery bypass to treat acute tandem internal carotid and middle cerebral artery occlusion due to cervical internal carotid artery dissection

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Abstract

Background: Acute tandem cervical dissecting internal carotid artery (ICA) occlusion and intracranial embolic middle cerebral artery (MCA) occlusion can be devastating, and the optimal treatment strategy for this condition has not been established yet.

Case Description: A 45-year-old male presented with aphasia and right hemiparesis preceded by neck pain. Computed tomography showed a high-density signal along the left MCA, suggesting extensive emboli. Magnetic resonance angiography demonstrated tandem occlusion of the left cervical ICA and intracranial MCA with minimal diffusion-weighted imaging lesion. Emergent surgical embolectomy was performed, and long intracranial MCA emboli were retrieved with collateral cross-flow restoration. The cervical ICA was exposed, and dissection was confirmed. The cervical ICA was ligated, and superficial temporal artery (STA)-MCA anastomosis was added. Postoperatively, the patient demonstrated recovery from right hemiparesis and aphasia. At the 6th postoperative month, follow-up studies demonstrated a robustly patent STA-MCA bypass and no additional ischemic lesion on T2-weighted imaging.

Conclusions: Surgical embolectomy in conjunction with ligation of the cervical ICA followed by STA-MCA bypass might be a safe alternative method to endovascular recanalization, when the cervical dissection is extensive and when huge secondary emboli are present along the MCA.

Key Words: Dissection, internal carotid artery, superficial temporal artery-middle cerebral artery bypass, surgical embolectomy

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INTRODUCTION

Acute tandem cervical dissecting internal cerebral artery (ICA) occlusion and intracranial embolic middle cerebral artery (MCA) occlusion can be devastating. Although endovascular cervical stenting followed by retrieval of intracranial emboli can be an effective alternative to intravenous tissue plasminogen activator (tPA),[7] this treatment strategy has not yet been established.

An endovascular approach using MERCI, Penumbra,

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or stent retrievers can be performed in stroke centers equipped with an interventional neuroradiological service on a 24-h basis, but there is no such center available in our geographic district (Eastern Shizuoka Prefecture, Japan). Our service (Department of Neurosurgery, Fuji Brain Institute and Hospital) can perform microsurgery on a 24-h basis, but there is no endovascular referral center for severe stroke patients in this district of approximately 500,000 inhabitants. Therefore, we have been performing surgical embolectomy as a first-line treatment for patients with intracranial large emboli after excluding malignant profile based on magnetic resonance imaging (MRI).[4,5]

The present study describes a case of ICA/MCA tandem occlusion due to cervical dissection that was treated with emergent surgical embolectomy in conjunction with ligation of the cervical ICA followed by superficial temporal artery (STA)-MCA bypass.

CASE REPORT

History and examination

A 45-year-old male with no particular past medical history was transferred to our department by ambulance after the sudden onset of nausea, aphasia, and right hemiparesis. The patient's family reported that he had been complaining of neck pain for several days prior to admission. Neurological examination revealed right hemiparesis, aphasia, and slight disturbance of consciousness. The National Institutes of Health Stroke Scale score was 10 points. Computed tomography revealed a high-density signal along the left MCA from the M1 portion up to the distal M2 portion, suggesting long and extensive emboli [Figure 1]. MR angiography (MRA) demonstrated tandem occlusion of the left cervical ICA and intracranial MCA. Diffusion-weighted imaging (DWI) showed an ischemic lesion by the left parasylvian area. Magnetization-prepared rapid acquisition gradient echo[3] showed a high signal intensity along the cervical ICA. Considering the patient's young age and lack of atherosclerotic risk factors, such as diabetes mellitus or dyslipidemia, we interpreted this finding as suggestive of intramural blood rather than lipid-rich plaque component. Arterial spin labeling (ASL) demonstrated decreased cerebral blood flow (CBF) in the entire left MCA area [Figure 2]. Axial T1-weighted imaging (T1WI) suggested intravascular or intramural hematoma up to the left petrous ICA. We suspected left cervical ICA occlusion due to dissection with huge secondary embolic occlusion into the intracranial M1–M2 portion. Considering long extensive intracranial M1–M2 emboli and tandem occlusion, and considering the unavailability of endovascular service in the acute setting in our district, we proceeded with surgical embolectomy to retrieve the intracranial emboli and to restore cross-flow, followed by possible cervical ICA dissection repair by cervical exposure. In case, cervical ICA repair proved unsuccessful, STA-MCA bypass was planned to avoid hemodynamic impairment. Informed consent was obtained from the patient's family to proceed with this treatment plan.

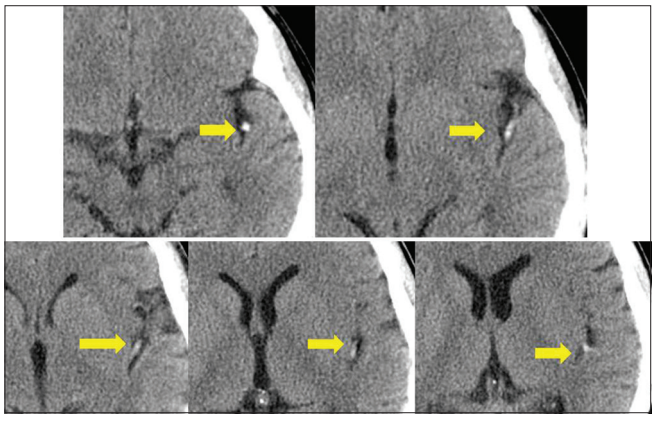

Figure 1: Preoperative computed tomography shows extensive high-intensity signal sign along middle cerebral artery (yellow allow) from the distal M1 portion (upper left) to the distal M2 (lower right)

Operation

Under general anesthesia, a standard frontotemporal craniotomy was performed. After introduction of the microscope, the Sylvian fissure was opened to expose the M1–M2 portion of the MCA [Figure 3]. Then, the emboli were retrieved through a transverse arteriotomy made near the distal end of the M1 and through two other arteriotomies at the superior trunk. Emboli extended far into the inferior trunk, and two additional arteriotomies were required to retrieve the entire clot. Thus, a total of five transverse arteriotomies were performed. All arteriotomies were sutured with 9-0 nylon by intermittent stitches. Restoration of collateral flow was observed via the anterior communicating artery, and a microvascular Doppler assessment confirmed that C2 portion of the ICA was still occluded. Next, the cervical carotid artery was exposed. The cervical ICA showed discoloration suggestive of dissection [Figure 3]. The cervical ICA was opened via a longitudinal arteriotomy. Although the true lumen was identified for shunt insertion, no substantial backflow was aspirated. Rather, copious continuous bleeding from the pseudolumen was observed, indicating that dissection was extensive and restoring anterograde flow would not be possible. The cervical ICA was ligated. Then, the STA was exposed from a skin flap. Two STA branches were prepared, and STA-MCA double anastomosis was performed. Good bypass flow was confirmed by microvascular Doppler assessment [Video 1].

Postoperative course

Immediate postoperative as well as postoperative

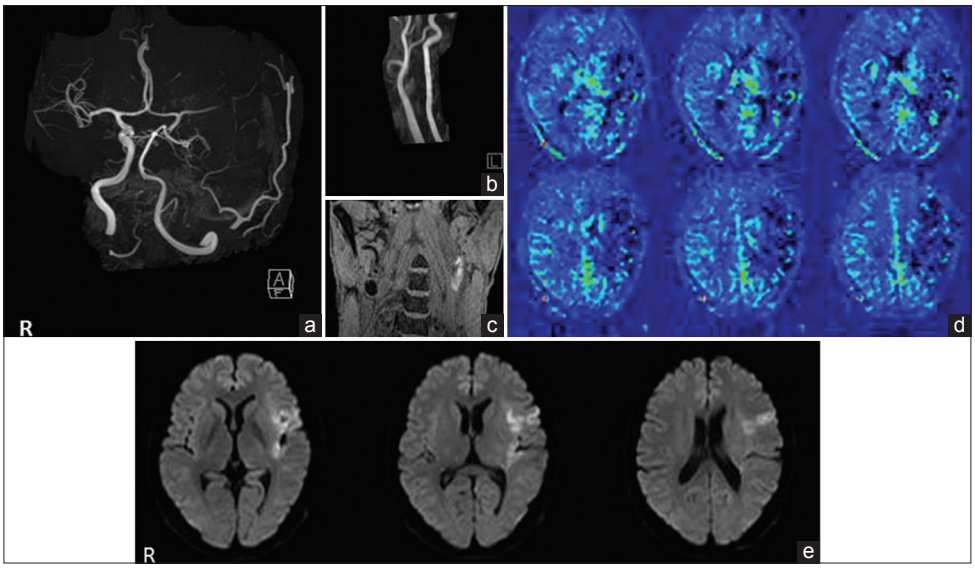

Figure 2: Preoperative intracranial magnetic resonance angiography (a) and left cervical magnetic resonance angiography (b) shows tandem occlusion of the cervical internal carotid artery and middle cerebral artery. Magnetization-prepared rapid acquisition gradient echo (c) reveals a high-intensity signal along the left cervical, middle cerebral artery. Arterial spin labeling (d) demonstrates decreased cerebral blood flow in the left middle cerebral artery area. Diffusion-weighted imaging (e) shows a high-intensity lesion in the left parasylvian area

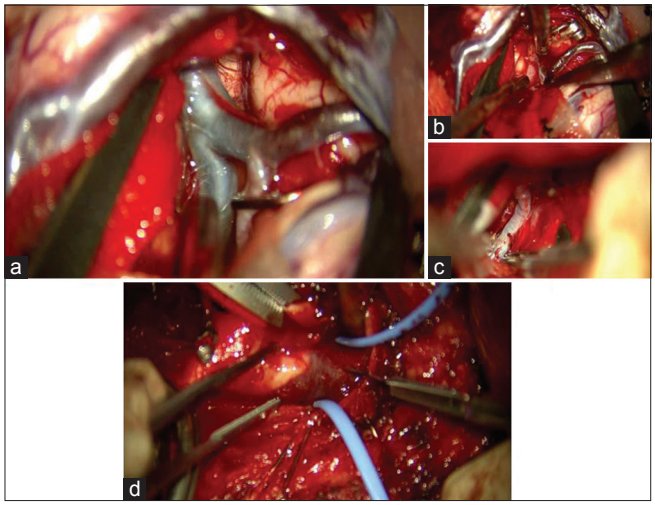

Figure 3: Intraoperative photographs demonstrate extensive bluish discoloration due to emboli in the M1–M2 bifurcation (a), up to the distal superior trunk (b) and distally into the inferior trunk (c). Cervical internal carotid artery with blue vessel tape (d) shows dark discoloration, suggestive of dissection

day 1 MRI studies showed a slightly increased DWI lesion in the basal ganglia, patent whole left MCA branches, and patent STA-MCA bypass. ASL showed slightly increased CBF in the left MCA area when compared with that on the contralateral side [Figure 4]. The patient experienced marked recovery from his right hemiparesis, although he remained aphasic, which necessitated in-house rehabilitation for several months. At the 6th postoperative month, follow-up MRI studies demonstrated a robustly patent STA-MCA bypass on MRA, symmetrical CBF on ASL, and no additional ischemic lesions on T2WI

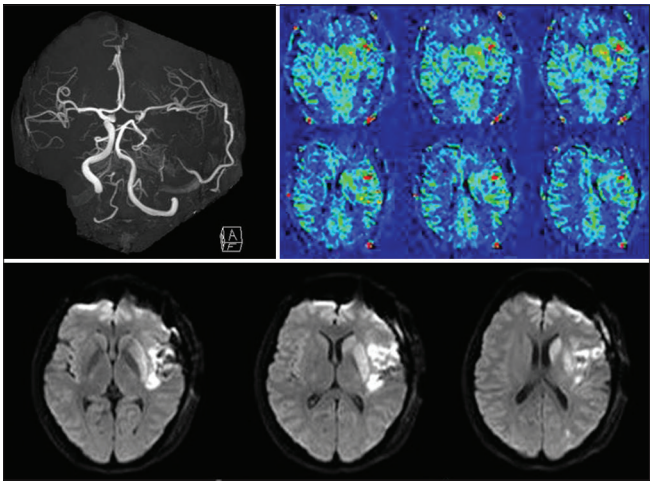

Figure 4: Magnetic resonance imaging studies on postoperative day 1. Intracranial magnetic resonance angiography (upper left) shows complete recanalization of the left middle cerebral artery as well as a robustly patent superficial temporal artery-middle cerebral artery bypass. Arterial spin labeling (upper right) demonstrates slightly increased cerebral blood flow in the left middle cerebral artery area when compared with that on the contralateral side. Diffusion-weighted imaging (lower) shows a high-intensity lesion in the left parasylvian area and basal ganglia

[Figure 5]. The patient subsequently experienced marked recovery from his aphasia and was able to resume his previous occupation.

DISCUSSION

Spontaneous dissection of the internal carotid artery (ICA) is one of the main cause of ischemic stroke in young- to middle-aged patients.[2,7] When cervical ICA

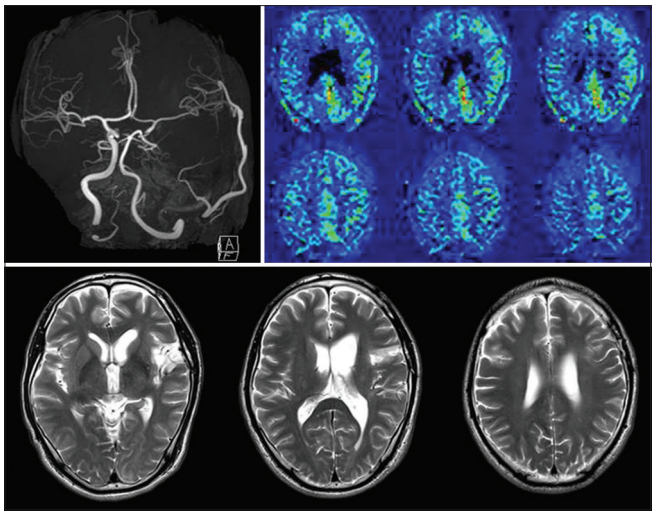

Figure 5: Magnetic resonance imaging studies at the 6th postoperative months. Intracranial magnetic resonance angiography (upper left) shows a robustly patent superficial temporal artery-middle cerebral artery bypass. Arterial spin labeling (upper right) demonstrates symmetrical cerebral blood flow in the bilateral middle cerebral artery area. T2-weighted imaging (lower) shows no additional ischemic lesion

dissection causes tandem ICA and MCA occlusion, it can cause malignant brain infarction.[7] In addition, tandem ICA and MCA occlusion independently predict poor outcomes in response to intravenous tPA.[6,10] Thus, any method to improve outcomes in patients with this devastating entity warrants investigation.

Endovascular treatment with stent deployment to recanalize cervical carotid dissection followed by intracranial emboli retrieval promises alternative treatment. Lavallée *et al*. compared clinical outcomes in consecutive patients presenting with cervical ICA dissection and tandem MCA occlusion who were treated either by endovascular stent-assisted thrombectomy or intravenous tPA. Of 10 patients, 6 were treated with endovascular therapy, and 4 were treated with intravenous tPA. In the endovascular group, all patients achieved recanalization of tandem occlusion, and 4 out of 6 patients had favorable outcomes (modified Ranking score = 0). In the intravenous tPA group, 1 out of 4 patients showed recanalization, and 3 patients had dismal outcomes. Those investigators concluded that most patients with acute symptoms of tandem ICA/MCA occlusion and cervical ICA dissection had poor outcomes when treated with intravenous tPA, whereas most patients treated with stent-assisted endovascular thrombectomy showed marked improvement.[7]

However, theoretically, stent deployment for cervical ICA dissection could cause distal migration of secondary emboli, vessel laceration, and in-stent thrombosis. Therefore, when cervical ICA dissection is extensive with large secondary distal emboli migration (as in the present case), endovascular stent deployment and recanalization of the cervical ICA might be difficult. Furthermore, recurrent intracranial distal emboli migration from residual intramural or intravascular cervical ICA emboli is also possible.

When the intracranial embolic occlusion is caused by an extremely high clot burden (as in the present case), and when the response to intravenous tPA therapy is expected to be poor, we utilize surgical embolectomy as the first-line treatment after excluding malignant profile (i.e., minimal DWI lesion less than one-third of the entire MCA region despite large ICA/MCA occlusion on MRA).[4,5] Even with advances in endovascular/protection strategies, as long as retrievers are deployed proximally into long emboli, the risk of clot fragmentation/distal migration to a location deemed not accessible cannot be eliminated. In contrast, with immediate distal clip application before embolus manipulation, we were able to retrieve the entire long emboli that had extended from M1 distally into both M2 trunks.

The carotid occlusion surgery study failed to show a benefit for the surgical group when compared with the medical treatment group with respect to ipsilateral stroke recurrence at 2 years after treatment.[9] Aside from reducing the incidence of stroke in the chronic stage, the impact of acute revascularization for hemodynamically unstable/progressing stroke patients is an important area of investigation.[1] There is little information on the use of STA-MCA bypass for urgent cerebral revascularization after introduction of sophisticated imaging technique, such as MRI. Nussbaum *et al*. demonstrated excellent clinical results of emergency STA-MCA bypass, mainly for young patients with extremely limited collateral circulation caused by ICA dissection. They also discussed the advantage of STA-MCA low-flow bypass to prevent reperfusion injury in acute severe ischemia, and the amount of flow can increase over time as the anastomosis matures, based on demand.[8] In the present case, additional emergent STA-MCA bypass would be preferable, even though the MCA embolectomy restored moderate cross-flow, considering the technical difficulty of performing STA-MCA bypass in chronic reoperation after confirming hemodynamic impairment in the future.

Therefore, surgical embolectomy in conjunction with cervical carotid ligation and STA-MCA bypass might provide an advantage over endovascular embolectomy in patients with extensive cervical ICA dissection with huge distal embolic occlusion.

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Conflicts of interest
There are no conflicts of interest.

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