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Occipital artery bypass importance in unsuitable superficial temporal artery: Two case reports

Hong JH *et al.* OA to MCA bypass

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Abstract

BACKGROUND

Superficial temporal artery-middle cerebral artery (STA-MCA) bypass helps treat cerebral ischemia. However, the STA is not available for bypass in some conditions. Therefore, with some technical tips, the authors introduced a bypass technique using the occipital artery (OA).

CASE SUMMARY

Two female patients complained of hemiparesis. Brain magnetic resonance imaging (MRI) indicated contralateral infarction from the MCA steno-occlusion. On Diamox single photon emission computed tomography or perfusion MRI, the contralateral frontoparietotemporal reserve was diminished. On transfemoral cerebral angiography, the STA was thin with a weak flow; however, the OA was prominent. Direct OA-MCA end-to-side extracranial-intracranial bypass surgery was implemented instead of STA because the caliber was too narrow. The postoperative course was uneventful in both cases, with well-maintained bypass patency and neurological stability during follow-up.

CONCLUSION

OA might be an acceptable alternative for MCA cerebral ischemic cases with an unsuitable STA.

Key Words: Bypass; Occipital artery; Superficial temporal artery; Cerebral ischemia; Case report

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Core Tip: In cases of cerebral ischemic disease or progressive ischemia where ¹the Superficial temporal artery is unsuitable in the middle cerebral artery territory, ²occipital artery might be an acceptable donor artery for a less invasive EC-IC bypass surgery.

INTRODUCTION

Superficial temporal artery-middle cerebral artery (STA-MCA) bypass helps treat cerebral ischemia, complex cerebral aneurysms, and tumors^[1,2]. If the STA is inaccessible after preceding bypass operations, injuries, or atrophy, graft bypass can be attempted through the radial artery, great saphenous vein, or occipital artery (OA). However, the graft would anastomose two sites, increasing bypass occlusion and surgical wound complication risks. In this study, the authors introduced a technique to relieve ischemia *via* direct bypassing of the OA to the MCA.

CASE PRESENTATION

Chief complaints

Case 1: The patient complained of motor weakness in the right extremities and intermittent headaches.

Case 2: The patient complained of motor weakness in the left extremities.

Present illness history

Case 1: In August 2019, a 55-year-old female patient visited this institution's neurology department, reporting intermittent weakness in the right extremities and headaches.

Case 2: In August 2021, a 68-year-old male patient visited this institution's emergency room for left extremities weakness.

Past illness history

Case 1: There was no significant past illness.

Case 2: There was no previous complaint of left-side motor weakness.

Personal and family history

Case 1: There was no significant past or family history.

Case 2: He had right-sided hemiparesis due to the sequelae of traumatic brain injury 15 years ago.

Physical examination

Case 1: There was no significant motor weakness at the outpatient clinic.

Case 2: The left motor grade was IV/IV in the manual muscle test.

Laboratory examinations

There were no significant laboratory test findings in both cases.

Imaging examinations

Case 1: Magnetic resonance imaging (MRI) showed left frontal infarction from the left MCA stenosis (Figure 1A). A follow-up brain MRI on July 2021 indicated that the left MCA stenotic lesion had progressed to occlusion (Figure 1A). Therefore, the patient was referred to this department for surgery. Upon acetazolamide-loading single-photon-emission computed tomography (Diamox SPECT), the left front parietotemporal reserve was diminished (Figure 1C). In addition, the transfemoral cerebral angiography (TFCA) revealed a thin left STA with a weak flow but a prominent OA (Figure 1B).

Case 2: An MRI showed a right MCA territory infarction due to right MCA occlusion. After three months of conservative treatment, a follow-up perfusion MRI exhibited

worsening cerebral perfusion throughout the MCA territory (Figure 2C). On TFCA, the right STA was noticeably thin with a weak flow, yet the OA was prominent (Figure 2A and B).

FINAL DIAGNOSIS

The authors diagnosed the patients with symptomatic steno-occlusive MCA infarction by combining imaging and clinical findings.

TREATMENT

Thus, OA-MCA bypass surgery was decided in both cases. The OA and MCA were end-to-side anastomosed.

OUTCOME AND FOLLOW-UP

Case 1

After bypass, blood flow at the surgical site was intact (Figures 1D and E), with perfusion defect improvement on the postoperative Diamox SPECT (Figure 1F). The patient was discharged without symptoms in a week and has not experienced any follow-up care complications one year after surgery.

Case 2

After bypass, blood flow at the surgical site was intact (Figure 2D and E), with perfusion defect improvement on the postoperative perfusion MRI (Figure 2F). The patient was discharged without any symptom aggravations in a week and has not experienced any follow-up care complications one year after surgery.

DISCUSSION

The cerebrovascular steno-occlusive disease can cause acute cerebral infarction or transient ischemic accident (TIA) symptoms. An unstable TIA can originate from decreased cerebral perfusion; therefore, immediate and adequate blood supply is the

most crucial consideration in bypass surgery. STA-MCA bypass is a relatively simple and efficient surgical modality, especially for cerebrovascular occlusive diseases with a high patency rate during a short period. However, the STA is inaccessible for bypass in cases of previous operations, injuries, or atrophy. In this condition, interposition graft surgery is considered. The graft technique is more complex and requires additional anastomosis, increasing operation difficulty and requiring more time. However, there are disadvantages to this technique, such as donor site complications and size discrepancy-related graft failure. Moreover, there is a hyperperfusion syndrome risk if the donor artery is large^[3].

Direct OA bypass can be an alternative to the interposition graft with the advantage of arterial graft use. In cases 1 and 2 presented here, the OA was selected as an alternative because the STA was too thin. Direct OA-MCA bypass for ischemic stroke has rarely been reported in literature^[4-7]. OA is a frequently used donor artery for trapping and bypassing aneurysm surgeries arising from posterior circulation. Meanwhile, bypass from the OA to the MCA is not commonly performed because of its technical difficulties. The OA is more onerous to harvest than the STA because it passes through several tortuous layers^[8].

Successful OA-MCA bypass techniques

In the three-quarter position, the retrosigmoid area was at the top, ¹ and the vertex was slightly raised to reduce venous pressure (Figure 3A). After marking the OA path, as confirmed through angiography and fingertip palpation, a microscopy-guided incision was made on the OA course (Figure 3A). The artery was located, and the soft tissue was bluntly dissected. Small OA branches were identified and cut after meticulous cauterization. The proximal part was secured through dissection to where the OA penetrated the splenius capitis muscle. The large branch in the main artery's subgaleal portion was likely to be used for a second anastomosis and could be cleaned of the donor artery to ensure its preservation to the greatest extent^[9]. The splenius capitis muscle was incised along the OA. Free space was secured by dissecting and retracting

the muscle, creating a vascular groove. The descending branch that supplies blood flow to the suboccipital muscle was preserved as much as possible; however, if OA's full length was not long enough, it was selectively cut after ligation. A length sufficient for MCA bypass is approximately 7 cm above the proximal stump, which is just below the superior nuchal line. However, this varies depending on OA functionality and condition.

The posterior Sylvian fissure area should be exposed to access the donor artery for MCA bypass^[5]. The incision was extended according to the recipient's target craniotomy location. To achieve an MCA bypass, the skull was exposed enough to incise the skin by anteriorly turning it vertically along the superior temporal line. If the OA was bent superomedially, a separate incision was conducted in the temporal region for craniotomy of the recipient artery. Following this, the OA can be passed through the subcutaneous tunnel for an OA-MCA bypass^[5]. To prevent donor artery compression in the supine position, a route between the craniotomy site and the OA's proximal part was cut to create a sough (Figure 3C). Particular caution was exercised on the secured OA when making the furrow. Small fabrics were not typically placed around the drill. An end-to-side anastomosis was performed with nylon 10-0 in the recipient artery, such as the angular artery. As the OA had a tortuous path, the surgeon did not point the anastomotic end in a direction that twisted the blood vessel. The recipient artery was a peripheral artery and thinner than the M4 used for STA-MCA bypass. Therefore, the arteriotomy must be slightly longer than the STA-MCA bypass to match the anastomosis length accurately. With these points in mind, the authors successfully performed a less invasive bypass surgery.

A particular postoperative wound necrosis risk is possible due to insufficient collateral superficial blood circulation if an ipsilateral bypass surgery has been performed previously^[10]. In patients who have undergone the indirect bypass alone, additional surgery might worsen the overlying scalp's blood circulation, resulting in ischemia in the existing bypass area. Therefore, accurate confirmation is necessary for

the donor artery course based on preoperative imaging tests, including angiography, and to minimize collateral blood vessel damage during skin incision and dissection.

The recipient artery choice is controversial. Bypassing at the best location is vital for improving the patient's symptoms; however, it might be preferred to select a nearby artery considering the OA's available length. Hirano *et al.* have proposed two incision methods to approach the recipient artery regarding the OA's travel direction and distance to the recipient artery: an extension of the OA incision and an additional incision, respectively^[5]. The recipient artery was accessed through a single incision in the cases presented here. When an OA of sufficient length is harvested, bypass surgery can be performed less invasively without additional incision. This is also advantageous from a cosmetic point of view.

CONCLUSION

In cases where the STA is unsuitable in cerebral ischemic disease or progressive ischemia of the MCA territory, OA may be an acceptable donor artery for less invasive extracranial-intracranial bypass surgery.

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SIMILARITY INDEX

PRIMARY SOURCES

1	Toshikazu Kimura, Akio Morita. "Occipital Artery to Middle Cerebral Artery Bypass: Operative Nuances", World Neurosurgery, 2017	22 words — 1%
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2	www.frontiersin.org	11 words — 1%
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