

Posterior Auricular Artery-Middle Cerebral Artery Bypass: A Rare Superficial Temporal Artery Variant with Well-developed Posterior Auricular Artery—Case Report

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Abstract

The posterior auricular artery (PAA) is one of the branches of the external carotid artery, but is usually too small for use as a donor artery for middle cerebral artery (MCA) territory revascularization. An extremely unusual case of PAA-MCA anastomosis was performed in a patient requiring MCA territory revascularization because the superficial temporal artery (STA) parietal branch was absent and the PAA was large enough. A 65-year-old man developed mild motor weakness in the right extremities caused by multiple small infarctions. Single photon emission computed tomography (CT) revealed deterioration of the vascular reserve capacity in the left MCA area. Cerebral angiography showed severe stenosis in the C2 portion of the left internal carotid artery, absence of the parietal branch of the left STA, and a well-developed PAA extending to the parietal area. The patient underwent STA (frontal branch)-MCA and PAA-MCA double anastomosis, and has suffered no stroke or transient ischemic attack. The STA with no bifurcation is known as a rare variation. The PAA also occurs with size variations but well-developed PAA is thought to be extremely rare. PAA can be used as a donor artery for MCA territory revascularization if the vessel size is suitable. Preoperative evaluation of the anatomy is mandatory for harvesting the arteries.

Key words: carotid artery stenosis, extracranial-intracranial bypass, low-flow bypass, revascularization, stroke

Introduction

The superficial temporal artery (STA) is the most widely used donor artery for middle cerebral artery (MCA) territory revascularization, but if the STA cannot be used, other extracranial arteries such as the occipital artery (OA),¹ contralateral STA (bonnet bypass),^{2,3} or arterial graft^{4,5} are well-known substitutes for the donor vessel. The posterior auricular artery (PAA) is a small branch that arises from the posterior aspect of the external carotid artery, courses upward and backward, passes through the groove between the cartilage of the auricle and the mastoid process,⁶ and supplies a relatively small area of skin posterior to the ear.⁷ Conventional cerebral angiography generally shows the PAA as slender and thus too small for use as a donor artery. We treated a patient requiring MCA territory revascularization with a PAA-MCA bypass because the STA parietal branch was

absent and the PAA was unusually large, as if supplying the STA territory.

Case Report

A 65-year-old man, with a long history of diabetes and hypertension, suffered mild motor weakness in the right extremities. Magnetic resonance imaging revealed multiple small infarctions in the left cerebral hemisphere (Fig. 1). Digital subtraction angiography showed a severe stenosis in the left C2 portion of the internal carotid artery (Fig. 2) and a well-developed PAA extending to the parietal area (Fig. 3A). Single photon emission CT using the double injection method⁸ showed the regional cerebrovascular reserve capacity was reduced in the left MCA territory (Table 1). Although the patient was receiving adequate volume expansion and antiplatelet therapies, transient ischemic attacks such as sensory disturbance and/or mild motor weakness in the right were frequently observed. As the patient was thought to be in a hemodynamically

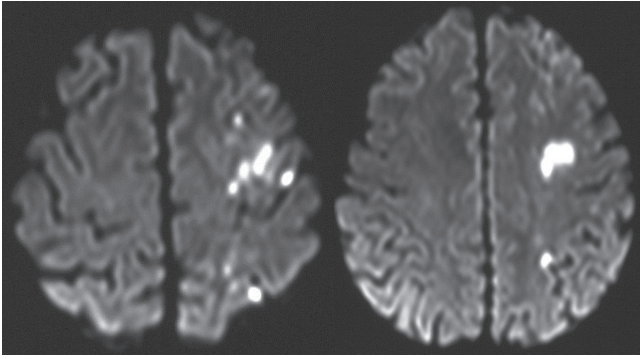


Fig. 1 Diffusion-weighted magnetic resonance (MR) image demonstrating multiple fresh infarctions in both the cortical and subcortical areas of the left cerebral hemisphere, indicating the duplex of hemodynamic compromise and artery-to-artery embolism.

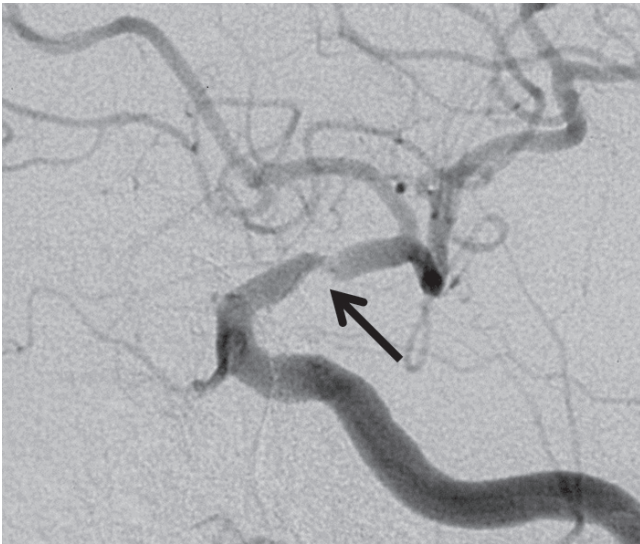


Fig. 2 Digital subtraction angiogram of the left common carotid artery, oblique view, clearly demonstrating severe stenosis (arrow) in the left C2 portion.

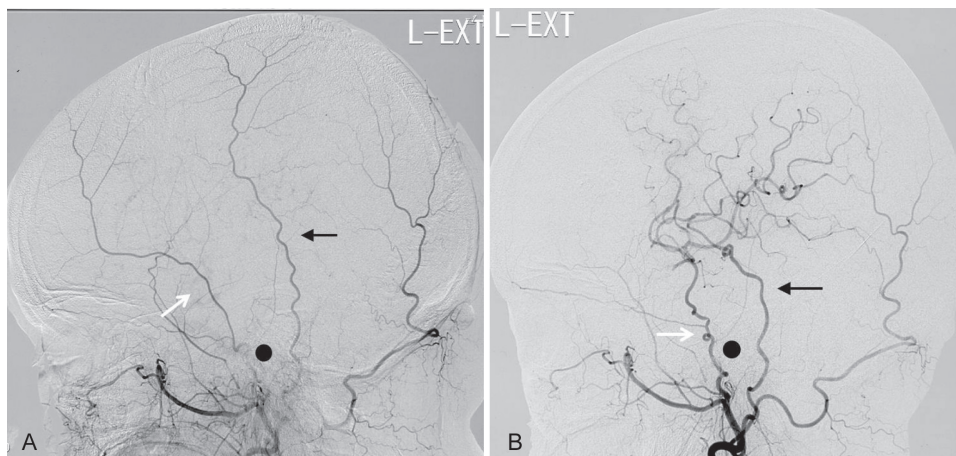


Fig. 3 Pre- (A) and postoperative (B) lateral external carotid arteriograms demonstrating the frontal branch of the superficial temporal artery (STA, white arrows) and posterior auricular artery (black arrows). Note the absence of the parietal branch of the STA in A. Patent anastomoses and sufficient distal flow are demonstrated in B. The black dot indicates the external auditory canal.

compromised state, revascularization for the left MCA territory was performed approximately 2 months after the initial onset.

The patient underwent STA (frontal branch)-MCA and PAA-MCA double anastomosis. The STA frontal branch and PAA were traced with the Doppler probe passed over the skin before the surgery (Fig. 4). The skin incision was started in front of the left ear to expose the proximal portion of the STA. The incision was gently curved posteriorly along the upper edge of the ear until just above the PAA. The PAA was harvested by the cut down method. After an adequate length of the PAA was exposed (approximately as far as the linear temporalis), the incision was gently curved to the frontal skin towards the midline. After reflecting the skin flap, the STA frontal branch was dissected from the bed as far as the proximal portion already exposed earlier. A small craniotomy was made over the sylvian fissure. The recipient branches of the MCA were identified underneath the arachnoid membrane of the sylvian fissure according to the size of the donor and recipient arteries. The STA and PAA were anastomosed with 10-0 nylon to the frontal and temporal branches of the M3 portion, respectively. Blood flow in both the donor and recipient arteries was confirmed with the Doppler probe.

The postoperative course was unremarkable. No skin problems were observed. Postoperative angiography showed good patency of the anastomoses (Fig. 3B). The patient has suffered no stroke or transient ischemic attack.

Discussion

The PAA has received little attention in the neurosurgical field. Even in standard neuroradiological textbooks, discussion of the PAA is limited. In contrast, the PAA is well-documented in the plastic and reconstructive surgery field because the PAA is frequently used for a pedicled skin flap.⁹⁾ This artery arises from the posterior aspect

Table 1 Cerebral blood flow findings on single photon emission computed tomography

	Rest (mL/min/100 g)		Acetazolamide (mL/min/100 g)		Vascular Reserve Capacity (%)	
	Right	Left	Right	Left	Right	Left
ACA	53.79	53.83	48.30	54.17	-10.21	0.63
MCA	55.76	54.26	87.00	60.00	56.03	10.58
M2 anterior	56.21	56.21	85.78	59.16	52.61	5.25
M2 posterior	56.00	53.79	90.01	62.55	60.73	16.29

ACA: anterior cerebral artery, MCA: middle cerebral artery.



Fig. 4 Photograph showing the tracing of the superficial temporal artery frontal branch (white arrows) and posterior auricular artery (black arrows) on the skin, and the skin incision (arrowheads) marked according to the paths of the arteries.

of the external carotid artery and passes dorsal to the external auditory canal, and has a consistent cutaneous distribution based on a cadaver study.¹⁰ However, the PAA supplies not only the skin of the auricle and the postauricular skin, but also the extracranial facial nerve in the stylomastoid foramen area.^{11,12} The PAA gives rise to the stylomastoid artery toward the facial nerve trunk in 70–80% of individuals. Therefore, surgeons must exercise great care when harvesting the artery.

Anatomical studies of the STA have revealed variations or racial differences.^{13–18} A type of STA with no parietal branch was found among 50 autopsy specimens,¹⁴ and another case was found in 27 specimens.¹⁶ This type looks quite similar to our case. However, these previous studies focused purely on the STA, with no description of the PAA. This type is thought to be rare, based on other anatomical studies which did not report this type of STA.^{13,15,18} Our present case is also thought to be a rare type with no parietal branch of the STA and a thick PAA supplying the parietal region of the scalp. We could use this well-developed PAA as a donor artery.

PAA-STA anastomosis was reported in two of 65 cases

over a 5-year period, but no detailed description was available.¹⁹ The other patients were treated by STA-MCA anastomoses. Recently, PAA-STA anastomosis was used in repeat surgery for moyamoya disease.⁷ In their case, the STA and OA had already been used as the donor arteries in previous surgeries, and the changed hemodynamic status may have affected the blood supply to the PAA. The PAA is usually not a candidate donor artery because of the slender appearance on conventional angiography, but neurosurgeons should be aware of the variation in size as in the present case.

The present case shows that the PAA can be used as a donor artery for MCA territory revascularization if the vessel size is suitable. As the branches of the external carotid artery may have some variations, as in our case, meticulous preoperative study is necessary for planning of the revascularization.

Conflicts of Interest Disclosure

The authors have no funding and financial interest.

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