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Case Report

External Carotid Artery Angioplasty and Stenting Followed by Superficial Temporal Artery to Middle Cerebral Artery Anastomosis

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A 31-year-old man presented with right hemiparesis, and magnetic resonance imaging revealed a small infarct at left basal ganglia. Digital subtraction angiography showed left cervical internal carotid artery (ICA) occlusion and severe stenosis of the ipsilateral external carotid artery (ECA) with collateral cerebral circulation fed by ECAs. Based on the results of a functional evaluation of cerebral blood flow, we performed preventive ECA angioplasty and stenting for advanced ECA stenosis to ensure sufficient blood flow to the superficial temporal artery. Eight weeks later, superficial temporal artery to middle cerebral artery (STA-MCA) anastomosis was performed. His postoperative course was uneventful and no additional transient ischemic attacks have occurred. To our knowledge, this is the first report of preventive angioplasty and stenting for advanced narrowing of an ECA before STA-MCA anastomosis for ipsilateral ICA occlusion.

KEY WORDS : Angioplasty · External carotid artery · Internal carotid artery · Middle cerebral artery.

INTRODUCTION

Cervical internal carotid artery (ICA) occlusion is associated with an annual risk of 6% to 20% of ipsilateral recurrent stroke despite intensive medical management[5,11]. Following the introduction of extracranial-to-intracranial (EC-IC) bypass by Yasargil and Donaghy in 1967, the procedure was rapidly accepted as a means of improving cerebral hemodynamics in patients with ICA occlusion[12]. Despite the disappointing result of the 1985 cooperative study on EC-IC bypass surgery, this approach is still believed to be beneficial in selected patients, especially in those with hemodynamic compromise[3,8,15]. Although, Kawamata et al.[10] described a successful external carotid endarterectomy followed by superficial temporal artery to middle cerebral artery (STA-MCA) anastomosis for the treatment of ICA occlusion with advanced ipsilateral external carotid artery (ECA) stenosis in seven cases, no prophylactic treatment strategy has been established for severe ECA stenosis before EC-IC bypass for ICA occlusion. We describe a case of preventive angioplasty and stenting for ECA stenosis before STA-MCA anastomosis for ICA occlusion.

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CASE REPORT

A 31-year-old man with a history of hypertension presented with profound right extremities weakness and slurred speech. At neurologic examination, the patient was awake, alert, oriented, and dysarthric with mild right hemiparesis. He had previously suffered from several intermittent transient ischemic attacks, which had caused right hemiparesis.

Magnetic resonance imaging revealed acute infarction in left basal ganglia, which corresponded to his symptoms. Magnetic resonance angiography and digital subtraction angiography revealed complete occlusion of the left cervical ICA and severe stenosis of the ipsilateral ECA, but nevertheless, blood flow was satisfactory (Fig. 1). The left cerebral hemisphere was fed by the anterior cerebral artery via the anterior communicating artery, and by anastomotic channels via the ophthalmic artery (Fig. 2). There was no collateral

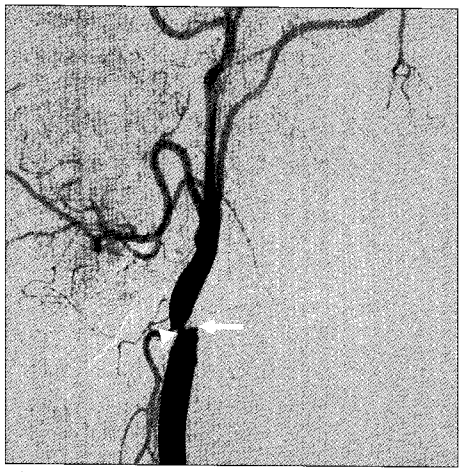

Fig. 1. Angiogram obtained after left common carotid artery injection before stent placement, showing complete occlusion of the left internal carotid artery at its origin (arrow) and high-grade stenosis of the left external carotid artery (arrowhead).

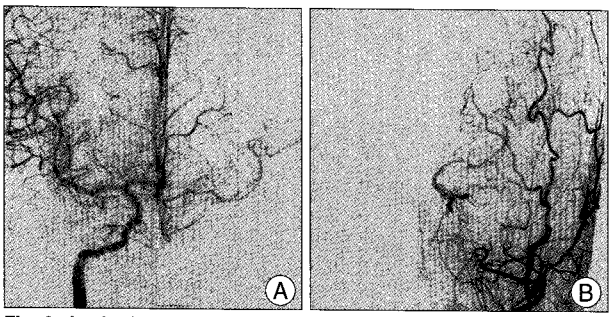

Fig. 2. A : Angiogram obtained after right internal carotid artery injection, demonstrating that the left intracranial anterior circulation is supplied by the anterior cerebral artery via the anterior communicating artery. B : Carotid angiogram showing modest supply of the left intracranial circulation through ECA collateral vessels. ECA : external carotid artery.

circulation from the vertebrobasilar system through the posterior communicating artery. Brain single photon emission computerized tomography (SPECT) with Diamox demonstrated a low resting cerebral blood flow (CBF) with disturbed vasoreactivity in left basal ganglia.

Surgical treatment was chosen based on imaging and CBF findings. Initially, we performed ECA angioplasty and stenting to address the severe left ECA stenosis. Postoperative radiological examinations after ECA angioplasty and stenting demonstrated a reduction in stenosis to less than 10%, and slightly improved collateral circulation to the intracranial right ICA (Fig. 3). After sheath removal and closure of the puncture site, heparin was allowed to wear off naturally. He was neurologically stable at the end of the procedure with no new deficit, and was maintained on aspirin and clopidogrel postprocedurally. Eight weeks after ECA angioplasty and stenting, STA-MCA anastomosis was performed, and a parietal branch of the superficial temporal artery was successfully anastomosed to a cortical branch of the middle cerebral artery. The patient

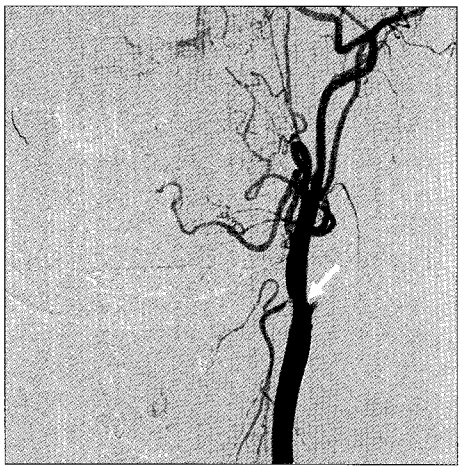

Fig. 3. Left carotid angiogram obtained after external carotid artery (ECA) angioplasty and stenting, demonstrating a reduction in ECA stenosis (arrow).

Fig. 4. Left carotid angiogram obtained at 14 months after external carotid artery angioplasty and stenting, showing good filling of the middle cerebral artery via the superficial temporal artery.

had no postoperative cerebrovascular complications after either operation and experienced no motor dysfunction recurrence. At the 14-month follow-up, he was neurologically intact and reported no further transient ischemic attack. Cerebral angiography studies conducted at the time showed excellent bypass patency and no evidence of restenosis within the left ECA stent (Fig. 4).

DISCUSSION

ICA occlusion is a relatively uncommon, but important cause of transient ischemic attacks and cerebral infarction. Although a sizable proportion of patients can be treated successfully by intensive medical therapy, the annual ipsilateral stroke rate in this population is around 6% to 20%[5,11]. Patients with an occluded ICA may have recurrent carotid territory neurological symptoms due to episodes of cerebrovascular insufficiency, or due to recurrent emboli being

transported to the brain through the collateral supply of the ECA. In so-called "stump syndrome", it has been suggested that thrombi are washed out of the stump of the occluded ICA and through the circulation via the ECA to the brain[13].

The idea of using an EC-IC bypass to circumvent an occluded ICA was first suggested by Fisher in 1951 and realized by Yasargil and Donaghy in 1967 with the introduction of microvascular surgery to neurosurgery[12]. The advent of microsurgical techniques in the 60s and 70s, encouraged increasing numbers of surgeons to adopt EC-IC bypass procedures for occlusive carotid disease in stroke patients. However, the disappointing results of the international study on EC-IC bypass surgery in 1985, led to the virtual abandonment of the procedure for the management of occlusive cerebrovascular disease[3]. However, this trial had several flaws[15]. In particular, selection errors resulted in asymptomatic patients being included, patients were not selected based on pathophysiology, because modern exams were not available, and collateral flow and cerebrovascular reserve were not assessed. Furthermore, methods of functionally evaluating blood flow introduced since these have steadily improved our understanding of the importance of hemodynamic impairment in the pathophysiology of ischemic stroke. Moreover, a recent review of the literature on the benefits of EC-IC bypass in cerebral ischemia demonstrated that neurological function and subsequent stroke attributable to hemodynamic insufficiency in patients with symptomatic carotid occlusion or severe stenosis are markedly improved by EC-IC bypass surgery[14]. In addition, investigators in the St. Louis Carotid Occlusion Study concluded that an increased oxygen extraction fraction is a powerful and independent predictor of stroke[2,6]. In our patient, SPECT at initial admission showed a low resting CBF and low regional vasoreactivity, with evidence of complete occlusion of the ipsilateral internal carotid artery, and thus, the ischemic strokes could be definitely attributed to hemodynamic factors.

In patients with occlusion of the ipsilateral ICA, ECA can provide significant collateral vessels to supply the cerebral and opthalmic circulation[1]. Furthermore, endarterectomy or angioplasty in cases with a severely stenosed ipsilateral ECA can improve collateral circulation[9]. In cases with an occluded ICA, neurological symptoms are likely to be due to low perfusion through a diseased ECA, or possibly due to emboli from the ECA. In a study by Fearn et al.[4], it was demonstrated that the ipsilateral ECA contributes significantly to intracranial blood flow in severe ICA stenosis. Thus, in the presence of symptomatic ipsilateral ICA occlusion, one should surgically remove ulcerated or stenotic lesions of the ipsilateral ECA to improve CBF and remove any embolic source[4,7]. Although endarterectomy of the ECA has been described in the literature, angioplasty and stent placement across the ECA has rarely been reported. In 1983, Vitek[16] described successful angioplasty of the ECA in 9 of 10 cases, but not stent placement. In the present case, we performed ECA angioplasty and stenting to resolve ECA stenosis before EC-IC bypass for ipsilateral ICA occlusion and obtained an excellent postoperative outcome, which demonstrates that our surgical strategy is appropriate.

In 2008, Kawamata et al.[10] described successful external CEA followed by STA-MCA anastomosis in 7 cases of ICA occlusion with advanced ipsilateral ECA stenosis. Nonetheless, it is still too early to conclude how to treat severe ECA stenosis prophylactically before EC-IC bypass for ICA occlusion, because it is impossible to predict the natural course of ECA stenosis with respect to future blood supply disturbances. To our knowledge, this is the first report of preventive angioplasty and stenting for advanced narrowing of an ECA before STA-MCA anastomosis for ipsilateral ICA occlusion.

CONCLUSION

We describe a case pretreated by preventive angioplasty and stenting for ECA stenosis to ensure sufficient blood flow to the superficial temporal artery before STA-MCA anastomosis for ICA occlusion.

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