Cerebral revascularization with superficial temporal – middle cerebral artery anastomosis for complete carotid occlusion: An emerging modality for preventing recurrent stroke

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Abstract

Complete long segment carotid occlusion presents a treatment challenge. These patients cannot be managed adequately by endarterectomy or stenting. Despite best medical management, many continue to develop recurrent strokes. In this select group of patients, there may be role for flow augmentation techniques like superficial temporal-middle cerebral artery bypass. We report a patient who was thus successfully treated and remains asymptomatic. The relevant literature is reviewed.

Key Words

Extra cranial-intracranial bypass, recurrent stroke, superficial temporal – middle cerebral artery bypass, total carotid occlusion

Case Report

A 60-year-old man presented with recurrent episodes of transient ischemic attacks (TIA) in the form of weakness involving the left side of the face, upper limb and lower limb since 3 months. He had recently been detected to be hypertensive and was on antihypertensive medications. He had no other risk factors for stroke (diabetes, hypercholesterolemia, smoking, alcoholism, hyperhomocystenemia). He continued to have episodes of hemodynamic TIA despite best medical management. These were not related to exertion or valsalva maneuver and were thought to be postural, related to hemodynamic factors. While under evaluation in the hospital, he developed a major stroke involving the left upper and lower limbs from which he recovered only partially (power 3/5). Routine blood investigations were normal. Computed tomography (CT) brain revealed multiple infarcts in the right cerebral hemisphere [Figure 1]. Echocardiogram and electrocardiography were normal. Color Doppler scan of the carotid arteries revealed total occlusion of the right ICA. This was confirmed with CT angiogram (CTA) and MR angiogram (MRA). DSA revealed total occlusion of the right ICA at its origin. There was poor collateral flow to the right hemisphere from the left ICA (across the anterior
communicating artery) and from vertebrobasilar system due to an incomplete circle of Willis. There was no evidence of thrombus or embolus in any IC vessel [Figure 2]. This led to an inadequate perfusion of the right cerebral hemisphere resulting in recurrent TIAs. After the major stroke in the hospital, a repeat CT brain revealed a right middle cerebral artery (MCA) territory infarct. Single Photon Emission CT (SPECT) CT of the brain also revealed ischemia of the entire right cerebral hemisphere.

It was decided that medical management alone would not be sufficient to improve the cerebral vascularity of the right cerebral hemisphere and prevent further ischemic events. Hence a decision was made to revascularize the right cerebral hemisphere by performing a bypass procedure from superficial temporal artery (STA) to the MCA. Pre-operative trans-cranial Doppler (TCD) could not pick up any flow in the MCA. The STA was localized using Doppler and superficial temporal-MCA (ST-MCA) anastomosis performed in the standard fashion [Figures 3 and 4].

Post-operative recovery was uneventful. Aspirin was continued throughout the peri-operative period to prevent graft thrombosis. Post-operative CT and MRA and DSA confirmed good flow across the graft [Figure 5]. Post-operative TCD was not performed so as not to apply any pressure over the anastomotic area that would lead to thrombosis of the anastomosis. He did not develop any further episodes of TIA and was discharged after 10 days of hospital stay. At 2 months follow-up, he was asymptomatic and was improving from his previous deficits with grade 4/5 power in the left upper and lower limbs and was ambulant. SPECT is planned at the 6 monthly follow-up visit.

**Discussion**

The accurate prevalence and incidence rates of complete ICA occlusion are difficult to ascertain as this can remain asymptomatic. In a retrospective, population-based study on patients with symptomatic ICA occlusion, an incidence rate of 6/100,000 has been reported. However, many patients with TIA do not seek medical attention or undergo carotid imaging. The same study suggests that about 15% of large-vessel infarctions may be caused by ICA occlusion. In a study in Manchester, UK, Mead et al. reported ICA occlusion in 50 of 380 consecutive patients with ischemic stroke over a year. In a study on the correlation of arteriographic findings and symptoms in patients with cerebrovascular disease, 25% of patients with ischemic stroke had ICA occlusion. The prevalence of asymptomatic ICA occlusion is unknown.
ICA occlusion can produce brain ischemia by the two mechanisms:

- Embolism from the distal or proximal stump or from atherosclerotic plaques in the common carotid artery or external carotid artery (most common mechanism accounting for nearly two-thirds of strokes in ICA occlusion. This is less common with complete ICA occlusion
- A compromised cerebral blood flow (CBF) resulting in perfusion failure (misery perfusion syndrome) with distal insufficiency as seen in the present case.

Sometimes both the above factors act synergistically in causing cerebral ischemia.

Ultrasoundography is usually the initial imaging modality for the evaluation of symptomatic ICA disease. Gadolinium-enhanced MRA is probably better than ultrasonography at diagnosing near-occlusions. Recently, CTA has been used to diagnose ICA disease with a high degree of accuracy. DSA remains the “gold standard” for the evaluation of carotid occlusive disease. However, it is an invasive procedure and therefore should be used only when ultrasonography or MRA fail to provide a definitive distinction between a near-occlusion and a complete occlusion.[14]

Symptomatic ICA occlusion increases the risk of future cerebrovascular events. In a study on angiographically proved ICA occlusion, the rate of recurrent stroke was 4.8% at 1 year, 12.2% at 3 years and 17.1% at 5 years.[9-12] In a meta-analysis of 20 follow-up studies on patients with symptomatic ICA occlusion, the annual risk of stroke was 5.5% and that of ipsilateral stroke was 2.1%. Those with evidence of hemodynamic compromise on functional imaging are at an even higher risk (all strokes, 12.5%; and ipsilateral stroke, 9.5%).[13] Patients with bilateral carotid occlusion have a high-risk of stroke.

Management of ICA Occlusion

As it is technically difficult to open a chronically occluded ICA, the management of a chronic ICA occlusion mainly includes strategies to reduce the risk of future strokes and other cardiovascular events. In patients with previous stroke or TIA, antiplatelet treatment leads to a 22% reduction in the risk of future non-fatal stroke. Addition of dipyridamole may further reduce the risk of strokes. Although anticoagulants are often used in ICA occlusion caused by dissection, the evidence base for this is poor. Similarly, it is unclear whether antithrombotic agents reduce the risk of future strokes in the subset of patients with a hemodynamic basis for the cerebral ischemia.

There is, thus, a definite role for flow-augmentation bypass procedures in select patients with complete carotid occlusion. The ST-MCA bypass can improve CBF in patients with symptomatic unilateral carotid occlusion. An ongoing carotid occlusion surgery study is aiming to re-examine its effectiveness in reducing subsequent ipsilateral ischemic stroke in patients with recent cerebral ischemic symptoms.[14] Endarterectomy or stenting is only useful if the occlusion involves a short segment. Long segment stenosis as in the present case may not be suitable for the endarterectomy. The addition of encephaloduroarteriosynangiosis to an ST-MCA anastomosis is of doubtful value, especially since the muscle could compress and compromise the patency of the anastomosis.

Conclusion

ICA occlusion is an important cause of cerebral ischemia. The clinical course of ICA occlusion is variable, from being a completely asymptomatic to one leading to devastating strokes. Our understanding of the role of hemodynamic factors in the pathogenesis has greatly improved in recent years which resulted in developing newer modalities of management like STA-MCA bypass which greatly helps in revascularizing the ischemic cerebral hemispheres, thereby preventing further strokes.

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How to cite this article: Roopesh Kumar VR, Narayan SK, Madhugiri VS, Sasidharan GM, Gundamaneni SK. Cerebral revascularization with superficial temporal - middle cerebral artery anastomosis for complete carotid occlusion: An emerging modality for preventing recurrent stroke. Ann Indian Acad Neurol 2013;16:521-4.

Source of Support: Nil, Conflict of Interest: Nil

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