Treatment of a high extracranial carotid artery aneurysm with CCA-MCA bypass and carotid ligation

Case report

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This article describes a patient who presented with a developmental aneurysm of the internal carotid artery. Because the aneurysm extended from the carotid bifurcation to the base of the skull, direct arterial reconstruction was precluded. A common carotid artery (CCA) to middle cerebral artery bypass was performed with a saphenous vein graft, followed by gradual occlusion of the distal CCA. The operative technique and a review of the treatment for high cervical carotid aneurysms are presented.

KEY WORDS - extracranial carotid aneurysm • extracranial-intracranial bypass • saphenous vein graft • anastomosis

Although numerous techniques for management of external carotid artery (ECA) aneurysms have been documented, few cases have involved aneurysms of the internal carotid artery (ICA) with extension to the base of the skull, and fewer still had a developmental origin. High ICA aneurysms are infrequent in children and are most often associated with infection of the mastoid and peritonsillar area. In adults, ICA aneurysms are usually caused by trauma, although atherosclerotic aneurysms have been reported. Hemorrhage was the most frequent complication causing death in patients with ECA aneurysms in early reports. More recently, rupture has been rare, whereas transient ischemic attacks and cerebral infarction are more common. This change is probably related to the decreasing incidence of inflammatory aneurysms.

Very few developmental aneurysms of the ICA have been reported. In some cases, the presumptive diagnosis was made on the basis of epidemiological factors and the angiographic appearance. In two patients, morphological confirmation was presented, although the histological criteria were not specified.

Because of their location, treatment of high carotid artery aneurysms carries a significant risk of cerebral ischemic complications. This report describes a patient with a developmental ICA aneurysm that extended to the base of the skull. The aneurysm was successfully treated with a carotid-cortical bypass and gradual occlusion of the distal common carotid artery (CCA).

Case Report

This 47-year-old woman was in excellent general health. She had noted a pulsatile non-tender mass in the right side of her neck for 10 to 15 years. The mass became noticeably larger during the 3 to 4 months before admission. There was no concomitant history of infection or trauma.

Examination. Her general physical examination was within normal limits except for a multilobulated pulsatile mass in the right side of the neck, extending from the angle of the jaw to the midcervical region. There was no evidence of peripheral vascular disease. The neurological examination was within normal limits.

A diagnostic screen for collagen vascular disease, infection, or other evidence of developmental arterial defects was negative. Cerebral angiography revealed a multilobulated aneurysm involving the right ICA, extending from the bifurcation to the level of the C-1
vertebral arch (Fig. 1 left). There was slow flow through the aneurysm and delayed intracranial filling. The posterior communicating arteries could not be demonstrated.

**Operation.** The ideal treatment of ICA aneurysms involves proximal and distal exposure, with either resection of the lesion and end-to-end repair or substitution with a graft. In this patient, the high cervical extension made ligation a consideration if direct exposure could not be obtained. Since no collateral vessel could be demonstrated angiographically, prophylactic ECA-ICA bypass was considered as a possible adjunctive procedure.

This case presented several problems for extracranial-intracranial (EC-IC) bypass. In our experience, gradual rather than sudden occlusion of the carotid artery after bypass is preferable to allow enlargement of the bypass and to permit hemodynamic stabilization. In this patient, a Selverstone clamp could not be placed on the ICA because the aneurysm extended to the level of the bifurcation. In order to isolate the aneurysm, it would have been necessary to ligate the ECA and to place the Selverstone clamp more proximally on the CCA. An adequate superior temporal artery to middle cerebral artery (STA-MCA) bypass could not be performed with the ECA occluded, so a CCA-MCA bypass using a saphenous graft was planned.

A longitudinal incision was made parallel to the sternomastoid muscle. The aneurysm was found to extend to the region of the skull base, and a distal margin of normal vessel could not be exposed. A distal segment of the greater saphenous vein was obtained while a right parietal craniectomy was performed. The graft was passed between the incisions through a skin tunnel, without torsion. An end-to-side anastomosis was then performed both proximally on the CCA and distally on the posterior parietal branch of the MCA, which was 1.5 mm in diameter. A Selverstone clamp was placed distal to the anastomosis on the CCA and adjusted to obtain one-half the preocclusion flow, as determined with an electromagnetic probe.

**Postoperative Course.** Angiography demonstrated that the bypass was patent. Three days postoperatively, the patient received heparin for anticoagulation, and the Selverstone clamp was then closed over the next 4 days in a step-wise fashion. Twenty-four hours after complete occlusion, the heparin was discontinued. Follow-up angiography demonstrated that the CCA was completely occluded, and that there was good filling of the MCA tree through the bypass (Fig. 1 right). The incision was then reopened and the CCA ligated, followed by removal of the Selverstone clamp and resection of the aneurysm. The patient tolerated
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Prophylactic EC-IC bypass has been shown to reduce immediate ischemic complications following carotid ligation. In the rare cases of high carotid aneurysms, where it is necessary to ligate the ECA, or where a suitable STA is not available, an immediate high-flow bypass can be constructed with a saphenous graft. It is our experience that an EC-IC bypass followed by graded occlusion with a Silverstone clamp and anticoagulation has been valuable in preventing ischemic complications following carotid occlusion.

References


all procedures without complication, and was discharged 15 days after the first procedure.

Pathological Examination. On gross inspection, the specimen consisted of a multilobulated segment of large artery. On histological examination, the dilated segments demonstrated an absence of internal elastic lamina in addition to absence of all elastic tissue and thinning of the media. The interposed normal-sized portions of vessel were without abnormalities (Fig. 2). Minimal atherosclerotic change existed at the proximal and distal ends of the aneurysm only. These findings are consistent with an aneurysm of developmental origin.

Discussion

Aneurysms of the ICA which extend to the region of the skull base can be difficult to treat. High morbidity and mortality rates are associated with large traumatic and inflammatory aneurysms if they do not receive definitive treatment;11,22 however, small traumatic aneurysms located in the high cervical area have a more benign course and sometimes resolve spontaneously.4 In the latter cases, observation and follow-up angiography would appear to be the treatment of choice. The natural history of congenital and atherosclerotic aneurysms is less well defined, and complications are more apt to be due to ischemia.4

Several approaches have been developed to repair very high aneurysms. In two recently described techniques, the petrous portion of the ICA was exposed in order to provide distal control and direct repair with graft interposition.6,18 Although potentially valuable in selected cases, both techniques carry a significant risk of causing a peripheral facial palsy and, if extensive distal exposure is required, of producing conductive hearing loss from obliteration of the middle ear. Hershey8 has described a method in which a tapered shunt and aneurysmorrhaphy are used to repair high saccular aneurysms. This technique may be useful for aneurysms with a sufficiently strong wall and smooth lumen.

Direct carotid ligation has been used to isolate a number of high extracranial carotid artery aneurysms with either immediate or graded carotid occlusion.11,22 Immediate ligation of the ICA or CCA is associated with a 20% to 30% risk of significant cerebral ischemia,15,17 which cannot be predicted by angiographic criteria.2,10 Although measurement of stump pressure has been advocated,16 used alone it is not sufficiently reliable to select candidates for safe carotid occlusion.14 Miller and co-workers14 have developed a technique with high predictive value which entails the determination of regional cerebral blood flow and carotid stump pressure during temporary ligation. Nevertheless, with this method a small but significant number of patients suffer permanent ischemic complications during the test itself, or in some cases after the subsequent carotid ligation.
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