Spontaneous Thrombosis of Intracavernous Internal Carotid Artery Aneurysm and Parent Artery Occlusion in Patients With Positive Balloon Test Occlusion

—Two Case Reports—

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Abstract

Two patients with giant intracavernous internal carotid artery (ICA) aneurysms were intolerant to balloon test occlusion of the ICA, and later developed spontaneous thrombosis of the aneurysm and the parent ICA without ischemic sequelae. Case 1: A 60-year-old female with a giant right intracavernous ICA aneurysm presented with right abducens nerve paresis. An unsuccessful extracranial-to-intracraniel bypass graft operation was complicated by transient postoperative ophthalmoplegia. The patient did not tolerate balloon test occlusion of the right ICA after attempted bypass surgery, and was treated conservatively. The patient presented with acute onset of headache 3 years later. Case 2: A 50-year-old female with a giant right intracavernous ICA aneurysm presented with right abducens nerve paresis. The patient was managed conservatively after a positive balloon test occlusion of the right ICA. The patient suffered transient hypopituitarism and acute onset of headache 2 years later. Spontaneous thrombosis of the aneurysms and occlusion of the parent ICA were found in both patients. Neither had major hemispheric infarcts, but the first patient had asymptomatic infarcts, which were presumed to be thromboembolic in nature. Patients with intracavernous ICA aneurysms who have positive balloon test occlusions appear to develop tolerance to spontaneous and gradual occlusion of the ICA without significant sequelae. However, these patients have an increased risk of developing embolic infarctions. The role for anticoagulation and repeat hemodynamic tests remains unclear.

Key words: aneurysm, internal carotid artery, cavernous sinus, natural history, balloon test occlusion

Introduction

Aneurysms of the cavernous segment of the internal carotid artery (ICA) have a low risk of rupture and present with mass effect in the cavernous sinus. The treatment options include aneurysm clipping, endovascular embolization of the aneurysm, operative or endovascular ICA occlusion, or conservative management. A significant number of patients benefit from conservative management, but the natural history of conservatively managed patients remains unclear. Spontaneous thrombosis of the aneurysm with concomitant occlusion of the parent ICA has been reported. No information is available regarding the cerebrovascular reserve of these patients prior to spontaneous proximal ICA occlusion. According to the literature, 75% of patients have adequate cerebrovascular reserve with balloon test occlusion. We treated two patients with giant intracavernous ICA aneurysms who were intolerant to balloon test occlusion of the ICA, and later developed spontaneous thrombosis of the aneurysm and occlusion of the parent ICA without ischemic sequelae.
Case Reports

Case 1: A 60-year-old female presented with worsening diplopia of 8 months duration in August 1995. Right abducens nerve paresis was noted on physical examination. Magnetic resonance (MR) imaging revealed a giant aneurysm of the right cavernous sinus (Fig. 1). Cerebral angiography showed a giant aneurysm of the right ICA cavernous segment (C4), a small aneurysm of the left ICA cavernous segment, a small left middle cerebral artery aneurysm, and a left anterior cerebral artery aneurysm at the genu (Fig. 2). The left middle cerebral artery aneurysm and the left anterior cerebral artery aneurysm were clipped uneventfully.

Balloon test occlusion of the right ICA provoked transient left hemiparesis, during which the mean systemic arterial pressure was elevated to 140 mmHg with an undetectable stump pressure. Proposed treatment included intravascular proximal occlusion of the right ICA after a high-flow vein extracranial-to-intracranial (EC-IC) bypass graft was performed. Angiography confirmed the patency of the EC-IC bypass, but repeated balloon test occlusion indicated intolerance to occlusion of the right ICA. The patient’s postoperative course was complicated by ophthalmoplegia and visual disturbances of the right eye, which began to resolve in one month. Proximal ICA occlusion was abandoned and the patient was managed conservatively. Manual carotid compression was not attempted. The patient’s diplopia resolved in 6 months, and she was well until October 1998, when she experienced sudden progressive throbbing pain in her forehead accompanied by nausea.

MR imaging revealed a thrombosed aneurysm of the right cavernous ICA and old bilateral frontal lobe infarcts (Fig. 3). The patient was treated with non-steroidal anti-inflammatory drugs, and her symptoms gradually improved. One year later, she was symptom-free, and MR imaging showed that the aneurysm remained completely thrombosed.

Case 2: A 50-year-old female presented with sudden onset of diplopia secondary to right abducens nerve paresis in October 1996. The patient had a giant...
right ICA aneurysm in the cavernous sinus (Fig. 4). Balloon test occlusion of the right ICA produced transient left hemiparesis, with a mean stump pressure of 45 mmHg compared to a mean systemic arterial pressure of 90 mmHg. The patient refused further treatment, and was followed as an outpatient. Manual carotid compression was not attempted.

In September 1998, the patient returned to the hospital complaining of headache, sore throat, and nausea, and had a fever of 38.3°C. Neurological examination revealed right abducens nerve paresis. Blood laboratory study revealed a serum sodium level of 112.5 mEq/l and otherwise normal results. The patient developed right oculomotor nerve paresis and hypesthesia in the distribution of the first branch of the right trigeminal nerve. Computed tomography revealed a high-density mass in the right cavernous sinus extending into the sella with no evidence of subarachnoid hemorrhage. The high-density mass was interpreted to be fresh thrombus formation within the aneurysm. Right carotid angiography showed occlusion of the right ICA petrous segment (Fig. 5). MR imaging revealed a thrombosed aneurysm in the right cavernous sinus (Fig. 6). MR imaging showed no evidence of sinusitis. Endocrine evaluation showed poor growth hormone and adrenocorticotropic hormone response to insulin-induced hypoglycemia and low serum active renin concentration.

The patient was water-restricted and hydrocortisone treatment was started. The nausea and headache diminished in one week, and the patient was discharged with residual right oculomotor and abducens nerve pareses. The oculomotor nerve paresis resolved in 6 months.

### Discussion

Aneurysms of the cavernous segment of the ICA rarely present as subarachnoid hemorrhage. They often present with third, fifth, or sixth cranial nerve paresis. Cranial nerve deficits associated with an intracavernous ICA aneurysm can be expected to resolve spontaneously in 40% of patients. Ophthalmoplegia in both of our patients resolved without treatment. Spontaneous resolution of cranial nerve deficits supports the hypothesis that these deficits result from nervous tissue ischemia rather than degenerative changes due to direct compression of the nerves by the aneurysm. The transient ophthalmoplegia that occurred after EC-IC bypass graft in the first case may also have resulted from ischemia. Cranial nerves in the cavernous sinus are supplied by the meningohypophyseal artery and the inferolateral trunk, both arterial branches of the cavernous ICA. These arteries form anastomoses with branches of the internal maxillary artery and

**Fig. 3 Case 1. left:** T2-weighted magnetic resonance (MR) image 3 years later showing the aneurysm as mixed signal intensity, suggesting thrombus formation in the aneurysm. **right:** T2-weighted MR image showing frontal lobe infarcts.

**Fig. 4 Case 2. upper left:** Right carotid angiogram, lateral view, showing a 25-mm aneurysm in the C4 segment of the internal carotid artery. **upper right:** Right carotid angiogram, anteroposterior (AP) view, showing the same aneurysm. **lower left:** Left carotid angiogram, AP view, during manual compression of the right carotid artery showing moderate cross filling in the right cerebral vessels through the anterior communicating artery. **lower right:** Right vertebral angiogram showing a normal pattern of vessels. **Neurol Med Chir (Tokyo) 41, September, 2001**
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Fig. 5 Case 2. left: Right carotid angiogram 2 years later showing occlusion of the right internal carotid artery petrous segment. center: Left carotid angiogram showing adequate circulation in the bilateral anterior cerebral arteries via the anterior communicating artery. right: Right vertebral angiogram showing the right middle cerebral artery perfused through the right posterior communicating artery.

Fig. 6 Case 2. T2-weighted magnetic resonance image showing the aneurysm as mixed intensity consistent with intra-aneurysmal thrombosis.

the accessory meningeal artery. The arterial supply to the cavernous sinus in Case 1 may have arisen from the external carotid circulation because angiography did not clearly demonstrate the branches of the cavernous ICA. Ligation of the external carotid artery during EC-IC bypass surgery may have compromised the arterial flow to the cavernous sinus and caused the ophthalmoplegia and visual disturbance.

Intracavernous ICA aneurysms are rarely associated with hypopituitarism. Hypopituitarism was possibly exacerbated by intraneurysmal thrombosis. Steroid administration resulted in clinical recovery, either by reduction of brain tissue edema or by hormone replacement. Thrombosis in giant aneurysms is associated with surrounding brain edema and increased mass effect. Therefore, steroids may have a role in the management of thrombosed giant aneurysms.

Intracavernous ICA aneurysms can be treated by aneurysm clipping via a direct surgical approach to the cavernous sinus or by occlusion of the proximal ICA. Clipping of the aneurysm preserves flow through the parent artery, but is associated with significant risk of hemorrhage from the cavernous sinus. Endovascular parent artery occlusion is a less invasive, safer, and equally effective way of treating these aneurysms. Tolerance of permanent ICA occlusion depends on the patient's cerebrovascular reserve. A significant number of patients with intracavernous ICA aneurysms have been treated conservatively with favorable outcomes. No aneurysm ruptures occurred in a series of 16 aneurysms treated conservatively during follow up from 11 months to 10.5 years. In another series, no aneurysm ruptures occurred in 20 aneurysms with follow up from 5 months to 13 years.

Spontaneous thrombosis of a cavernous ICA aneurysm and ipsilateral ICA occlusion has been reported in six cases (Table 1). All of the aneurysms were large (>12 mm) and projecting posteriorly. We suspect that aneurysms with these features tend to compress the ICA against the anterior clinoid process and cause stenosis of the parent artery. The resultant decreased flow into the aneurysm assists intra-aneurysmal clot formation,
ultimately resulting in thrombosis of the aneurysm and the ICA. The cerebrovascular reserve of these six patients is not recorded. The aneurysm was detected after complete thrombosis of the aneurysm in five cases. One patient who was followed prior to aneurysm thrombosis did not undergo balloon test occlusion. The literature estimates that 75% of patients tolerate unilateral ICA circulation with balloon test occlusion. Only two of six patients had ischemic symptoms, which were associated with small infarcts. The patients presented here did not tolerate unilateral ICA occlusion prior to spontaneous thrombosis of the aneurysm. They later developed spontaneous thrombosis of the aneurysm and occlusion of the parent ICA without any ischemic symptoms. It is likely that slow and gradual progression from ICA stenosis to occlusion allowed their brains to adapt to unilateral ICA circulation. It should be noted that embolic infarction occurred in one of the cases. The safety and efficacy of anticoagulation is not known in these patients. However, it may be reasonable to treat these patients with antiplatelet medications and repeat the balloon test occlusion after 1-year observation to evaluate if they would be a candidate for proximal ICA occlusion.

In conclusion, observation of intracavernous ICA aneurysms is an acceptable clinical practice since a small proportion of aneurysms may spontaneously thrombose. However, the risk of embolic showers exists during the natural history of the aneurysm, necessitating close follow up.

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