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Aneurysm

Treatment strategy for giant aneurysms in the cavernous portion of the internal carotid artery

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Abstract

Background: As direct surgery to treat giant aneurysms of the ICA is difficult, ICA occlusion is the conventional treatment in patients with BTO tolerance. To determine whether bypass surgery should be performed after carotid occlusion by trapping or proximal occlusion, we developed a treatment strategy that includes BTO and SPECT.
Methods: We report 19 patients with symptomatic giant aneurysms in the cavernous portion of ICA. The appropriate type of bypass surgery was determined by the results of BTO and SPECT. The type of ICA occlusion selected was based on the evaluation of retrograde filling of the aneurysm during BTO.
Results: In all 19 patients, the ICA was sacrificed; 10 patients also underwent bypass surgery (low-flow bypass with STA-MCA anastomosis, n = 7; medium-flow bypass with radial artery graft, n = 2; high-flow bypass with vein graft, n = 1). Coil trapping was performed in 11 patients; proximal occlusion in 8. In 18 patients, there were no ischemic complications after treatment; 1 patient who had been treated by proximal ICA occlusion developed transient ischemia due to an intra-aneurysmal thrombus. Cranial nerve palsies were improved in 16 patients.
Conclusions: Based on our experience, we recommend that patients with giant aneurysms in the cavernous portion of the ICA be evaluated by BTO and SPECT. In conjunction with bypass surgery, ICA trapping or proximal occlusion constitutes an effective treatment strategy.

Keywords: Cerebral aneurysm; Internal carotid artery; Balloon test occlusion; Bypass; Interventional neurosurgery

1. Introduction

The mass effect attendant to giant aneurysms arising from the cavernous portion of the ICA may produce compression of the adjacent third to sixth cranial nerves and result in symptoms such as headache and pain. Moreover, if the aneurysm extends into the subarachnoid space, SAH may occur [1,5,6,19]. As direct surgery to treat giant ICA aneurysms is difficult, ICA occlusion is the conventional treatment in patients with BTO tolerance [2,3,8,13,24]. Concurrent with advancements in endovascular techniques, many diagnostic tests have been developed to evaluate the risk of ischemic infarction from carotid occlusion before permanent ICA sacrifice. The most widely accepted of these is BTO [20].

At our institute, we use BTO results to determine whether bypass surgery between ICA and ECA should be performed after carotid occlusion by endovascular techniques (balloon or coils) or direct surgery. Here we report 19 patients with giant aneurysms arising from the cavernous portion of the ICA. They were successfully treated by our

Abbreviations: BTO, balloon test occlusion; CBF, cerebral blood flow; ECA, external carotid artery; ICA, internal carotid artery; GDC, Guglielmi detachable coils; MRI, magnetic resonance imaging; MRA, magnetic resonance angiography; RI, radioisotope; SAH, subarachnoid hemorrhage; SPECT, single photon emission computed tomography; STA-MCA, superficial temporal artery to middle cerebral artery; ^{99m}Tc-HMPAO, hexomethyl propylene amine oxime.

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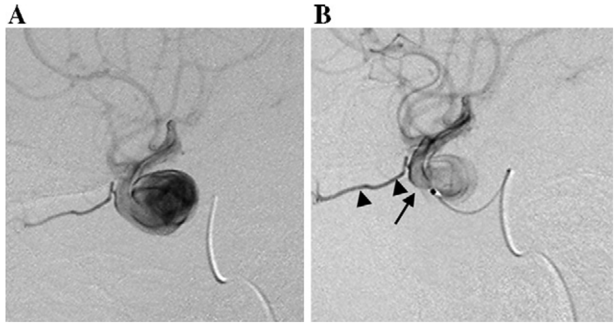

Fig. 1. A: Left internal carotid angiogram showing a giant aneurysm in the cavernous portion of the left internal carotid artery. B: Superselective angiogram demonstrating the distal site of the aneurysmal orifice (arrow) and the ophthalmic artery (arrowheads). The distance between the origin of the ophthalmic artery and the distal site of the aneurysmal orifice is clearly seen.

strategy, which includes BTO and SPECT examination and ICA occlusion by trapping or proximal occlusion.

2. Material and methods

Between 1995 and 2004, 19 patients with a giant aneurysm in the cavernous portion of the ICA were treated at our department. There were 2 males and 17 females ranging in age from 43 to 75 years (mean, 62.8 years). Their clinical presentation included mass effect with symptoms of diplopia (n = 16), retro-orbital pain (n = 1), and visual disturbance (n = 2). Diagnostic, high-magnification cerebral, and rapid-sequence digital subtraction angiograms (DSAs) were obtained to assess the aneurysmal size and shape, and the relationship of the aneurysm neck to the ICA. The aneurysms ranged from 20 to 36 mm (mean, 27.8 mm). In 13 patients, MRI revealed aneurysmal wall thrombosis.

To develop a treatment strategy, 30-minute BTO was carried out. In general, a 4-vessel cerebral angiogram was obtained after complete neurologic examination to determine baseline values. A 5-Fr double-lumen occlusion balloon catheter (Celecon multi-catheter, Clinical Supply Co Ltd, Tokyo, Japan) was introduced into the femoral artery and advanced to the ICA at the level of the C2 vertebral bodies. An intravenous 5000-U bolus of heparin was injected, and the balloon was inflated until a decrease in distal ICA pressure was recorded. Upon completion of ICA occlusion, contrast material was injected through a 4-Fr catheter introduced into a femoral artery to confirm complete occlusion of the ICA.

In 2 patients whose vasculature was highly tortuous, the balloon was introduced into the common carotid artery by direct puncture using a 5-Fr introducer. These patients underwent continuous neurologic evaluation during the first 5 minutes of BTO followed by examinations at 5-minute intervals. Balloon inflation was maintained for 30 minutes. In patients who developed neurologic deficits, the balloon was deflated immediately, and the contralateral ICA, ipsilateral ECA, and dominant vertebral artery were studied to assess the collateral circulation across the circle of Willis to detect retrograde filling of the aneurysm. Moreover, the distal pressure in the balloon catheter was continually monitored during TBO occlusion. For correct placement of the first coil, the precise distance between the ophthalmic artery and the distal site of the aneurysmal orifice must be known. Therefore, using a microcatheter, we obtained angiograms during BTO (Fig. 1).

In patients who did not develop neurologic deficits in the course of 30-minute BTO, the balloon was deflated but not removed and the patient was taken to the RI suite. There it was reinflated, and CBF study was performed. Single photon emission computed tomograms using ^{99m}Tc-HMPAO were obtained. After completion of the first scan within less than 10 minutes, stress was induced with an intravenous injection of 1 g acetazolamide. At 5 minutes after the second intravenous delivery of ^{99m}Tc-HMPAO, a second scan was performed; the balloon remained inflated throughout these procedures (Fig. 2).

Fig. 3 shows our method of carotid artery occlusion with selective revascularization. Patients with clinical evidence of profound ischemia during BTO may require a high-flow bypass with vein grafting before ICA sacrifice. In patients without ischemic symptoms during BTO, at-rest SPECT study may demonstrate hypoperfusion of the hemisphere ipsilateral to the occlusion site. These patients may require a medium-flow bypass with radial artery grafting. Alternatively, SPECT study may demonstrate normal perfusion at rest and hypo-vasoreactivity of the hemisphere ipsilateral to the occlusion site during acetazolamide stress. These patients may require a low-flow bypass (STA-MCA bypass). Patients

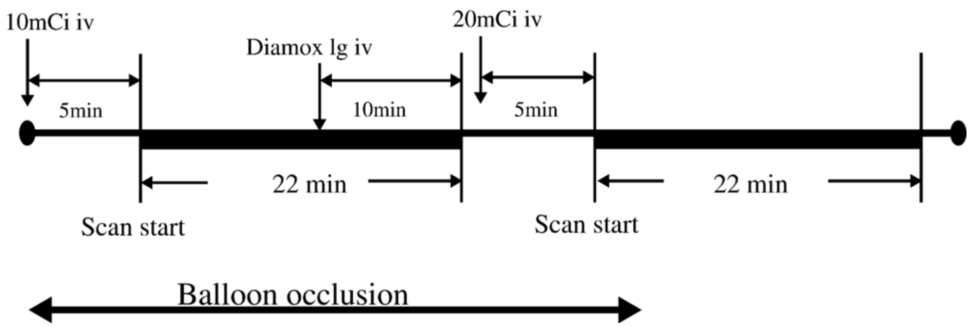

Fig. 2. Time course of BTO and at-rest and acetazolamide-stressed SPECT procedures.