

Preface

Neuroendovascular Surgery: Techniques, Indications, and Patient Selection



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Catheter-based treatments for cerebrovascular disease are displacing open surgical techniques at a rapid pace. The impetus for this is fueled by the medical consumer's appetite for minimally invasive solutions for complex surgical problems. A technologic revolution has occurred over the past 10 years based on the introduction of percutaneous catheter-based vascular devices. The interventional cardiology community has provided a framework for technology development and clinical trial design that has laid the foundation for the use of catheter-based treatments in the intracranial and extracranial cerebrovascular circulation.

Until recently, prospective randomized clinical trial data have not been the primary driver of practice habits for cerebrovascular disease. Historically, the Extracranial-to-Intracranial (EC-IC) Bypass Study [1], the North American Symptomatic Carotid Endarterectomy Trial (NASCET) [2], and the Asymptomatic Carotid Atherosclerosis Study (ACAS) [3] represented the entire body of the level I data on cerebrovascular disease. With the completion of the International Subarachnoid Aneurysm Trial (ISAT) [4], it became clear that coil occlusion of ruptured aneurysms had become established as an alternative to open surgical ligation based on a randomized prospective trial

of more than 2000 patients. Recent results in the control arms of large aneurysm trials indicate that coils may be superior to open surgery for unruptured intracranial aneurysms (Congress of Neurological Surgeons Annual Meeting, San Francisco, October 16–21, 2004, personal communication).

Medical device manufacturers have driven the adoption of endovascular techniques for treating intracranial aneurysms. There are now at least six different detachable coil manufacturers competing for aneurysm patients worldwide. In the United States, the percentage of aneurysms treated with interventional techniques has increased to almost 50%. In some countries, aneurysms are treated with coils as a primary therapy. Surgery is reserved for aneurysms that cannot be coiled.

The evolution of the development of detachable coils for cerebral aneurysms has been rapid. Presently, biologic coatings made of suture material, hydrogels, and other substances claim to improve healing at the aneurysm neck. Clinical evidence of the biologic healing has been limited, but randomized trials are underway. The future should see new devices for treating wide-necked aneurysms increase the percentage of unruptured and ruptured aneurysms that can be treated by endovascular techniques.

The treatment of cerebral arteriovenous malformations (AVMs) pairs embolization with stereotactic radiosurgery or open resection. Embolization of these lesions with N-butyl-cyanoacrylate (NBCA; histoacryl) alone did not produce a significant number of permanent occlusions. Recent approval of Onyx (Micro Therapeutics, Irvine, California), a dimethyl sulfoxide-based liquid embolic precipitate, has increased the likelihood of embolic material penetrating the AVM nidus. Embolization with Onyx forms a cast of the malformation and may lead to an increase in the number of permanent occlusions using embolization therapy in cerebral AVMs.

Dural arteriovenous fistulae still present a challenge for open surgery and catheter-based therapy. It seems that the most successful catheter-based treatments occlude the fistulae by filling the proximal venous vasculature with embolic material. Transvenous access plays an important role in treating these inoperable lesions. Improved embolic materials should see the eradication of these lesions using endovascular therapy.

Standard surgical techniques for extracranial carotid artery stenosis have been challenged by angioplasty and stent techniques. Large clinical trials comparing patients with symptomatic and asymptomatic carotid stenosis have defined a role for stent-assisted angioplasty in patients with high-risk characteristics, including excessive medical comorbidities, unstable angina, carotid restenosis, laryngeal nerve palsy, and radiation-induced stenosis. The Carotid Revascularization Endarterectomy versus Stent Trial (CREST) [5,6], a randomized trial for symptomatic patients with carotid stenosis, is well underway; the final results should be available sometime during the latter part of this decade.

An increasing incidence of intracranial stenosis has been identified as a result of the availability of minimally invasive imaging techniques, such as computed tomographic and magnetic resonance angiography. The results of the Warfarin-Aspirin Symptomatic Intracranial Disease (WASID) trial indicate that warfarin may not provide adequate stroke protection [7–9]. As a result, high-grade symptomatic intracranial stenosis is being treated with stent-assisted angioplasty. Although drug-eluting stents have reduced the incidence of in-stent stenosis in coronary arteries, these stents have not been widely used in the intracranial circulation. Presently available drug-coated stents tend to be difficult to track into the intracranial

circulation. More flexible stent designs are being developed for intracranial atherosclerotic lesions and should become available over the next few years.

Acute ischemic stroke patients comprise a population that is at least one order of magnitude larger in number than that of cerebral aneurysm patients. Ischemic cerebrovascular disease accounts for 80% of all strokes in the United States. Although thrombolytic agents have been the first line of treatment for acute ischemic stroke, atherosclerotic cerebrovascular disease may be more effectively treated using stent-assisted angioplasty in combination with multiagent drug administration. A combination of antiplatelet, thrombolytic, and anticoagulation agents may help to keep mechanically recanalized vessels open.

The application of high-resolution noninvasive neuroimaging techniques to the cerebral vasculature is identifying an increasing number of patients with asymptomatic stenosis. The results of the WASID trial indicate that warfarin provides suboptimal stroke protection in patients with symptomatic intracranial atherosclerotic disease. The role of stent-assisted angioplasty in this patient population remains to be seen.

The ever-increasing role of catheter-based treatments for cerebrovascular disease mandates that future cerebrovascular surgeons have the skills to perform open surgery and catheter-based interventions. The successful treatment of cerebrovascular disease represents a final frontier in medicine. Treatment of patients with cerebrovascular disease represents an exciting challenge that should reward those who accept it with dedication and enthusiasm.

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References

- [1] EC/IC Bypass Study Group. Failure of extracranial-intracranial arterial bypass to reduce the risk of ischemic stroke. Results of an international randomized trial. *N Engl J Med* 1985;313:1191–200.
- [2] North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. *N Engl J Med* 1991;325:445–53.
- [3] Executive Committee for the Asymptomatic Carotid Atherosclerosis Study. Endarterectomy for asymptomatic carotid artery stenosis. *JAMA* 1995;273:1421–8.
- [4] Molyneux A, Kerr R, Stratton I, et al. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial. *Lancet* 2002;360:1267–74.
- [5] Hobson RW II. CREST (Carotid Revascularization Endarterectomy versus Stent Trial): background, design, and current status. *Semin Vasc Surg* 2000;13:139–43.
- [6] Hobson RW II, Brott T, Ferguson R, et al. CREST: Carotid Revascularization Endarterectomy versus Stent Trial. *Cardiovasc Surg* 1997;5:457–8.
- [7] Chimowitz MI. WASID trial. Neurosurgery Grand Rounds: Millard Fillmore Gates Circle Hospital, Buffalo, NY, August 5, 2004.
- [8] Chimowitz MI, Kokkinos J, Strong J, et al. The Warfarin-Aspirin Symptomatic Intracranial Disease Study. *Neurology* 1995;45:1488–93.
- [9] Yarab N. Warfarin-Aspirin Symptomatic Intracranial Disease (WASID) study. Presented at the American Stroke Association 28th International Conference. Phoenix, Arizona, February 13–15, 2003. Available at: http://www.strokeconference.org/sc_includes/pdfs/CTP10.pdf.