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Endovascular Angioplasty and Stenting For Intracranial Atherosclerosis

Randall T. Higashida, M.D.

Clinical Professor of Radiology, Neurology, and Neurological Surgery

Chief, Division of Interventional Neurovascular Radiology

University of California, San Francisco Medical Center

California 94143 - 0628 USA

Introduction

A significant cause of ischemic stroke is from intracranial atherosclerotic disease due either to hypoperfusion or distal embolization. The incidence has been reported to be 6—10% in whites, 6—22% in blacks, 11% in hispanics, and 11—22% in the oriental population. The prognosis and morbidity rate for patients with intracranial stenosis varies widely from 10—46% per year, independent of medical therapy (1) The surgical option of an extracranial to intracranial bypass procedure has not been show to be of significant benefit over best medical therapy for these patients. (2)

Over the past decade, a number of centers have been reporting upon their experience with intracranial angioplasty and stenting, as a treatment option for patients that have failed maximal medical therapy with anti-platelet and anticoagulant medications. Although prospective randomized studies have not yet been performed, results from these centers have indicated that this procedure is technically feasible and there is good early preliminary data demonstrating efficacy.

Technique

A baseline computed tomographic or magnetic resonance brain scan is initially performed to assess for evidence of cerebral ischemia and/or infarction. Hemodynamic quantitative blood flow studies utilizing CT Xenon perfusion imaging, MR perfusion/diffusion imaging, nuclear medicine perfusion imaging, or positron emission tomography are also performed to assess the degree of perfusion to brain tissue. All patients undergo a four vessel diagnostic cerebral arteriogram to determine the site and degree of stenosis, collateral circulation, and other associated vascular pathology. Patients are then systemically anticoagulated with intravenous heparin (100 units/kg), and the lesion is carefully crossed under flourosopic guidance with a microguidewire (.014 inches) and a balloon angioplasty catheter (2.0—4.0 mm diameter) which matches the normal luminal diameter. The balloon is inflated for 5—10 seconds across the lesion until the plaque is sufficiently dilated. In selected cases, a metallic stent may then be placed across the lesion, to further improve the luminal diameter, and decrease the incidence of vessel dissection with secondary restenosis.

Patients are then carefully monitored in the neurological intensive care unit for 24—48 hours, with close attention to anticoagulation levels and blood pressure parameters. They are then discharged on antiplatelet medications, clopidogrel 75 mg/day or ticlopidine 250 mg twice/day for 4—6 weeks, and aspirin

325 mg/day indefinitely.

Results

Higashida et al, in 1996, reported upon their early experience with 33 patients treated by intracranial balloon angioplasty and reported a 69.7% technical success rate with improved neurological outcome, however there was an associated 30.3% rate of stroke and death, in patients that previously failed best medical therapy. (3) Clark et al reported a series of 17 patients, treating 22 vessels with balloon angioplasty, and reported a success rate of 72% and a 30 day morbidity rate of 11.7%. (4) Connors et al reported a retrospective analysis of balloon angioplasty in 70 patients with intracranial atherosclerosis. He reported an overall stroke rate of 4.2%, 2.9% mortality, and no technical failures. (5)

More recently, several centers have reported upon use of intracranial stents for these lesions. Mori et al, reported upon 10 patients with 12 intracranial atherosclerotic lesions. They reported an 80% technical success rate in accessing the lesion with a stent, and in those patients that were stented, there were no periprocedural complications and there was significant improvement of neurological symptoms following treatment during the 8–14 months of follow-up. (6) Gomez et al also reported a series of 12 patients who underwent elective stenting of the basilar artery after episodes of vertebrobasilar ischemia, in patients who failed medical therapy. Stent placement was successful in all cases, with an improvement in luminal diameter from a mean of 71.4%, to a mean of 10.3%, without any procedural complications. Clinical follow-up at 0.5–16 months (mean 5.9 months), demonstrated no new complications, with clinical improvement in all cases, and only 2 patients with residual symptoms. They concluded that intracranial stenting was feasible, with minimal risk to the patient, however the long term impact was still not known. (7)

Discussion

In patients suffering from transient cerebral ischemia, stroke, repetitive strokes, or other focal neurological deficits refractory to best medical therapy, from intracranial symptomatic atherosclerotic lesions, intracranial balloon angioplasty and/or stenting, may be promising as a useful therapeutic procedure. The development of better balloon catheters, and stent delivery systems, have dramatically decreased the technical difficulties and failures previously associated with this technique. Although best medical therapy has not yet been determined for these patients, extrapolation from the extracranial circulation for carotid atherosclerotic disease, does indicate that if a direct surgical revascularization procedure can be performed within acceptable technical success rates (ie : low periprocedural complication rates), than it may be better than medical therapy in certain types of patients. Clearly, once patients have failed medical therapy with anti-platelet and/or anticoagulant medications, than either an endovascular procedure or surgical bypass procedure may be indicated as a possible therapeutic alternative.

Although long term follow up, greater than 2–5 years, is still being collected for patients who have undergone intracranial balloon angioplasty and/or stenting, the short term results appear to be encouraging in terms of improving symptomatic patient outcomes, and decreasing the risk of major stroke.

As continued improvements occur both with optimizing medical therapies, and with technical improvements in the endovascular treatment of these patients, there remains continued hope, that better treatment regimens for intracranial atherosclerotic lesions, will be available to treat these patients.

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