Percutaneous Treatment of Severe Intracranial Carotid and Middle Cerebral Artery Stenosis

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KEYWORDS

• Intracranial stenting • MCA stenosis • Intracranial atherosclerosis

KEY POINTS

- Symptomatic intracranial MCA stenosis carries a high risk of stroke despite medical therapy and is generally not amenable to surgical bypass.
- Due to the lack of efficacy and durability data from prospective, randomized, multicenter trials, intracranial stenting remains investigational and should be used only in carefully selected patients after thorough evaluation of their clinical and anatomic factors.
- Stenting should not be performed in chronic total occlusions and asymptomatic lesions and generally should be avoided in very old patients, especially those with underlying dementia and severe calcification of their vessels.
- Symptomatic patients with angiographically documented greater than 70% stenosis and who have failed medical therapy are appropriate candidates for intracranial angioplasty and stenting and should be enrolled in clinical trials when possible.

INTRODUCTION

Intracranial atherosclerosis disease (ICAD) accounts for 8% to 10% of ischemic stroke in the United States but is more prevalent in Asia.[1–4] The exact prevalence is unknown because many patients with the condition are asymptomatic and the intracranial location has limited noninvasive imaging as well as pathologic analysis. In addition, other causes of intracranial stenosis, such as vasculitis, dissection, embolism undergoing recanalization, moyamoya arteriopathy, postradiation arteriopathy, and infectious vasculitides, may all mimic ICAD and need to be carefully excluded in all symptomatic patients.[5]

Cerebral ischemia is caused primarily by limitation of flow as well as by vessel thrombosis and occlusion with or without distal embolization. The Warfarin-Aspirin for Symptomatic Intracranial Disease (WASID) trial demonstrated that a significant proportion (up to 22% annually) of symptomatic patients with significant intracranial disease (defined as angiographic stenosis between 70% and 99%) who were treated medically experienced recurrent ischemia.[2,6] Surgical bypass has proved ineffective in a randomized trial and endarterectomy is exceedingly difficult to perform.[7]

With advancements in stent technology, endovascular therapy has emerged as a feasible and potentially highly effective means of treating patients with ICAD. The primary goal of endovascular therapy is to improve flow through the stenosis and the increase in lumen diameter need not be significant for clinical benefit. Although desirable, an angiographic endpoint of a smooth, normal caliber lumen is not necessary; because the cerebral vessels are so fragile, the pursuit of such a goal may lead to dissection, arterial rupture, or intracerebral hemorrhage (ICH), which is often catastrophic and not amenable to treatment. This concept is of paramount importance, especially compared with the goals of epicardial coronary

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intervention, for which there are data supporting a more “aggressive” endpoint.

INDICATIONS AND PATIENT SELECTION

The indication for intracranial stenting is the presence of an intracranial atherosclerotic stenosis that is producing symptoms despite optimal medical therapy (OMT) (**Box 1**). The stipulation that patients fail OMT first is based on anecdotal experience that many patients become asymptomatic on initiation of antithrombotic therapy. Treatment of asymptomatic stenoses is not recommended and is generally not performed because the risk of transient ischemic attack (TIA) or stroke is thought to be low. In patients with symptomatic, angiographically proved greater than 50% intracranial stenoses measured via the WASID method, the risk of recurrent stroke is approximately 12% annually regardless of treatment with aspirin or warfarin.[6] In those who have a greater than 70% stenosis, however, the risk of stroke is approximately 22% annually.[8] Therefore, an ideal candidate for intracranial intervention is a patient with a symptomatic, greater than 70% stenosis who has failed OMT.

Additionally a patient’s symptoms should be attributable to the territory distal to the stenotic segment rather than to the territory of a perforator arising from the stenosis.[9] In cases of perforator stroke as the sole manifestation of ischemia, angioplasty and stenting have (anecdotally) a high likelihood of causing complete occlusion of and subsequent infarction in the territory of the perforator. In addition, those patients are effectively asymptomatic in the territory distal to the stenosis if their only manifestation is perforator ischemia and, therefore, they are less likely to benefit from revascularization. Recently symptomatic patients, especially those with a large or disabling infarct, may have an increased risk of ICH.[10,11] Unless the need is pressing, some investigators have advocated delaying treatment for 6 weeks or more in these patients.[12] Functional imaging to assess cerebrovascular reserve (ie, collateral competence) may also be used to select patients at highest risk of stroke with medical therapy and, therefore, those patients most likely to benefit from percutaneous transluminal angioplasty and/or stenting (PTAS).[9,13] Such tests can consist of the widely available acetazolamide single-photon emission CT, breath-holding transcranial Doppler ultrasound studies, or the less widely available acetazolamide perfusion CT and positron emission tomography scanning.

Lesion characteristics play an important role in the likelihood of success and complications. Although the data on this subject are limited in comparison to those in the cardiac literature, it is the author’s belief, based on personal experience and supported by some small case series, that the same risk factors for complications with percutaneous transluminal coronary angioplasty (PTCA) are also applicable to intracranial interventions.[9,14] Lesion length, eccentricity, calcification, and angulation as well as small vessel size, proximity to a bifurcation, and large adjacent branches are all risk factors for complications. Given the fragility of the cerebral vessels, these factors are even more relevant than in the thicker, more muscular coronary arteries.

Another important selection criterion is the feasibility of gaining access to the site to perform the intervention. This was of somewhat greater importance when a majority of patients were treated with coronary stents that were difficult to deliver intracranially. With the availability of the self-expanding cerebral stent systems, deliverability has been less of an issue but remains important.[15] Vessel tortuosity, especially of the internal carotid artery (ICA) or vertebral artery (VA), can be so severe that a guide catheter can not be placed in the parent artery or even prevent intracranial delivery of a balloon. Under such circumstances, the risk of complications (eg, guide catheter–induced dissections and intracranial artery perforation or dissection) increases significantly. Hence, a rule of thumb is if a stent cannot be delivered safely, then an intervention probably should not be performed, in case there is vessel dissection or abrupt closure after PTA, necessitating provisional stenting.

Box 1
Patient selection criteria for intracranial stenting

- Presence of an intracranial atherosclerotic stenosis that produces symptoms despite OMT
- Patient symptoms attributable to the territory distal to the stenotic segment rather than to the territory of a perforator arising from the stenosis
- Lesion characteristics amenable to PTAS
- Feasibility of gaining access to the site to perform the intervention

CEREBROVASCULAR ANATOMY

The intracranial vessels most often associated with ICAD and are the most amenable to endovascular therapy are the paired ICA, middle cerebral