Resolution of petrous internal carotid artery stenosis after transluminal angioplasty

Case report

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Percutaneous transluminal angioplasty is commonly used for treatment of peripheral vascular disease, but only recently has it been applied to craniocervical lesions. The successful use of percutaneous transluminal angioplasty for treatment of an isolated high-grade stenosis of the petrous internal carotid artery is described in a patient with progressive ischemic symptoms despite maximum medical management. At his 2-year follow-up examination, the patient remained asymptomatic with angiographic evidence of progressive resolution of the stenotic lesion and indirect evidence of improved hemispheric blood flow ipsilateral to the lesion. Percutaneous transluminal angioplasty may provide an effective means of treatment for selective intracranial atherosclerotic stenosis.

KEY WORDS  
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Percutaneous transluminal angioplasty has only recently been utilized for dilatation of stenotic lesions involving the supra-aortic vessels. Advances in catheter technology have reduced morbidity from distal embolism and have enabled cannulation of smaller distal intracranial vessels. Successful percutaneous transluminal angioplasty dilatation has been reported for basilar and vertebral stenoses,1,11,12 extracranial carotid lesions,6,23-25 and vasospasm after subarachnoid hemorrhage (SAH);1,10,15,26 however, there are few reported cases of percutaneous transluminal angioplasty for atherosclerotic stenoses of the petrous or intracranial portion of the internal carotid artery (ICA) or distal cerebral vessels.16,18 Intracranial ICA stenosis due to atherosclerosis has been associated with significant stroke and mortality rates, particularly if the lesion is symptomatic or exists in tandem with extracranial ICA stenosis.3,14 Although extracranial-to-intracranial artery bypass procedures have been utilized previously for these lesions, a randomized prospective trial demonstrated no benefit for this procedure.6

We report the use of percutaneous transluminal angioplasty as an interventional option for treatment of a symptomatic left intrapetrous ICA stenosis. At 2 years postdilatation, the patient remained asymptomatic and angiographic studies demonstrated progressive improvement of the stenosis, displaying evidence of increased perfusion in the distribution of the original lesion. While intracranial ICA stenosis signifies advanced systemic atherosclerotic vascular disease and an overall poor prognosis,3,14 a select group of patients with stable systemic disease and symptoms referable to a surgically inaccessible ICA lesion may benefit from percutaneous transluminal angioplasty.

Case Report

This 68-year-old man presented to the Seattle Veterans Affairs Medical Center in June, 1988, with a 12-month history of progressive transient cerebral and retinal ischemia relating to the left ICA circulation. These spells included multiple episodes of transient numbness and weakness in the right arm, dysarthria, and left monocular blindness lasting minutes to hours.

Examination. Neurological examination showed normal function between episodes. Carotid artery duplex examination revealed decreased flow through the left cervical ICA without focal stenosis, consistent with
a distal flow-restrictive lesion. Cerebral angiographic studies demonstrated a focal 95% stenosis of the left intrapetrous ICA, which filled the left middle cerebral artery (MCA) territory only (Fig. 1). Computerized tomography scans revealed a left thalamic infarct of indeterminate age. Echocardiography did not identify a potential source for cerebral emboli. Transient ischemic episodes became increasingly frequent, involving both the left middle cerebral and the retinal circulations. Anticoagulation therapy with heparin or warfarin did not significantly reduce the frequency of ischemic episodes.

Operation. On July 26, 1988, percutaneous transluminal angioplasty of the left petrous ICA was performed. After administration of 10,000 U heparin, the lesion was diluted in stages. Under routine fluoroscopic guidance, 3- and 4-mm angioplasty balloons* were sequentially inserted via a transfemoral approach. Total balloon inflation time was less than 1 minute. Stenosis was reduced from 95% to less than 40% (Fig. 2). Immediately following angioplasty, the patient was maintained on systemic heparin, which was then changed to warfarin anticoagulation therapy for 6 weeks.

Postoperative Course. In the 2 years since percutaneous transluminal angioplasty, the patient has remained asymptomatic on a low-dose aspirin regimen. Serial carotid artery duplex and transcranial Doppler ultrasound (TDC) evaluations show normal blood flow through the extracranial and intracranial ICA on the left. Because sequential carotid artery duplex examinations revealed rapid progression of a right cervical ICA stenosis from 1% to 99% over a 10-month period, repeat angiographic studies were performed in June, 1990. Compared to those made immediately after percutaneous transluminal angioplasty, the new angiograms demonstrated improvement of the previously dilated left petrous carotid artery stenosis from about 40% to 20%, with remodeling at the angioplasty site; the left anterior cerebral artery was now shown to be filling from the left ICA (Fig. 3).

Discussion

Both symptomatic and asymptomatic intracranial ICA stenoses (with and without tandem cervical ICA stenosis) have been associated with a high rate of morbidity and mortality from stroke and myocardial infarction.3,15 In these studies, stroke and transient ischemic attacks had a higher incidence in the territory of the intracranial ICA lesion. Tandem intracranial and extracranial stenoses have been associated with a higher

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* Angioplasty balloons manufactured by ACS, Temecula, California.

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risk for ischemic events than has intracranial stenosis alone. The severity of intracranial stenosis in patients treated surgically for carotid bifurcation disease does not appear to influence the incidence of immediate or delayed ischemic symptoms following endarterectomy. Therefore, carotid endarterectomy has been advocated as the initial treatment in symptomatic tandem lesions. The report of a case in which ICA siphon stenosis resolved after carotid endarterectomy for tandem stenosis underscores the rationale for this approach. However, in the absence of effective surgical measures, therapeutic options are limited for patients with isolated symptomatic intracranial ICA lesions who fail conservative medical treatment.

The present report describes the successful use of percutaneous transluminal angioplasty for treatment of isolated symptomatic intracranial ICA stenosis with a 2-year symptom-free follow-up period and angiographic confirmation of a progressively resolving lesion. To our knowledge, only two case reports have described the use of percutaneous transluminal angioplasty for symptomatic atheromatous intracranial ICA lesions. In one case, clinical improvement in ischemic symptoms was noted after angioplasty of a cavernous carotid artery lesion, but no angiographic follow-up study was provided. A recent case report described the percutaneous transluminal angioplasty of a symptomatic atheromatous MCA stenosis with evidence of clinical and hemodynamic improvement, despite early angiographic evidence of restenosis. In the present case, repeat angiographic studies revealed evidence of improved hemodynamic status in the left ICA distribution in response to progressive stenosis of the contralateral ICA, and showed an enlarged caliber of the previously dilated petrous carotid artery segment.

The introduction of percutaneous transluminal angioplasty in 1964 by Dotter and Judkins provided a noninvasive alternative for the treatment of occlusive vascular disease. Although primarily used for distal lower-extremity and coronary stenoses, percutaneous transluminal angioplasty has only recently been advocated for use on the extracranial and intracranial vasculature. In symptomatic vasospasm after SAH, this procedure has been shown to provide long-standing increases in vessel caliber as demonstrated by angiography and by decreased TCD velocity. However, its potential efficacy and the natural history of intracranial atheromatous lesions dilated by percutaneous transluminal angioplasty can only be inferred from experience with other vascular territories.

In coronary vessels, percutaneous transluminal angioplasty has been associated with acute occlusion rates of 2% to 4% and delayed restenosis in up to 30% of cases, usually within the first 6 months. Certain risk factors for restenosis, such as stenosis location at vessel angiulations, have been identified and may be helpful in considering candidates for future cerebral percutaneous transluminal angioplasty. Dilatation of coronary vessels by this procedure is considered to be complicated by "plaque-splitting," which then allows for stretching of the media and adventitia. Fisher, et al., analyzed atherosclerotic changes in human cerebral vasculature at autopsy, and showed a predilection for stenosis in the carotid siphon with flat, often calcified, atheromatous plaques. Whether these atheromatous changes in intracranial vessels would respond to percutaneous transluminal angioplasty through a mechanism similar to that shown for coronary vessels is unknown. Currently, only preliminary experimental work has been performed with this procedure on normal intracranial vessels in animals.

Advances in catheter technology have reduced the risks of distal embolism during percutaneous transluminal angioplasty; nevertheless, greater experience is needed to confirm the safety and efficacy of this procedure in preventing stroke related to a stenotic lesion of the intracranial ICA. Subsequent to the case presented here, we have performed angioplasty on four patients with isolated intracranial (three cases) and extracranial carotid artery (one case) lesions, with only one complication of an asymptomatic ICA dissection, which healed. In two of these four patients, angioplasty was unsuccessful due to the technical limitations of the catheter. The advent of a new Food and Drug Administration-approved microcatheter should facilitate safe cannulation of distal intracranial vessels.

Patient selection will also play an important role in the success of future attempts at percutaneous transluminal angioplasty for intracranial atherosclerotic disease. The selection process may be facilitated by cerebral blood flow estimates and assessments of circulatory reserve to confirm a hemodynamically significant lesion prior to percutaneous transluminal angioplasty. Follow-up blood studies could then be correlated with clinical and angiographically determined changes to characterize the factors that influence outcome. Further experimental work and analysis of pathological material may help to establish whether clinical improvement is based on increased vessel caliber and concomitant hemodynamic changes alone or whether an alteration of plaque morphology occurs, which reduces embolic risk as well. This report establishes the potential application of percutaneous transluminal angioplasty for the treatment of isolated symptomatic focal intracranial ICA stenosis in a patient who failed medical therapy. In a similar group of patients at high risk for stroke, percutaneous transluminal angioplasty may provide long-standing maintenance of adequate vessel caliber with a concomitant improvement in hemodynamic status.

References


† Microcatheter manufactured by Target Therapeutics, Los Angeles, California.
Transluminal angioplasty


