EDITORIAL COMMENT

Assessing Carotid Revascularization

Should We Abandon the Neurological Examination?*

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Carotid stenting has become the treatment of choice in patients who need carotid endarterectomy (CEA) but are at high surgical risk (1,2). Concern remains about the incidence of stroke, particularly in the community hospital setting and in certain patient groups, particularly the elderly and symptomatic patients (3). Clearly, there is a need to make carotid revascularization, be it endarterectomy or stenting, safer. A blood test for stroke that is analogous to troponin or creatine phosphokinase-myocardial band for the heart would be ideal; the blood-brain barrier has posed a significant challenge and as yet none of these tests has been found acceptable (4,5).

In this issue of JACC: Cardiovascular Interventions, Schofer et al. (6) report on the use of serial diffusion weighted (DW) magnetic resonance imaging (MRI) as a surrogate marker for brain ischemia during carotid stenting. They are to be congratulated on continuing their previous work in this important area (7). They studied 59, mostly asymptomatic (86%), consecutive patients undergoing protected carotid stenting and performed sequential DW MRI scans after the procedure. One type of emboli prevention device (Emboshield, Abbott Laboratories, Abbott Park, Illinois) and 1 type of stent (Acculink, Abbott Laboratories) were used in the vast majority of cases. Clopidogrel (75 mg/day) was given for 3 days prior to the procedure or alternatively 600 mg was given immediately before the procedure.

None of the patients suffered a stroke or transient ischemic attack. Twelve (20.3%) patients had lesions, all ipsilateral, on the initial diffusion weighted imaging (DWI) scan, and 10 patients had lesions on the second scans, with 7 of these patients having had normal initial scans. In total, 19 of 59 (32%) patients had a lesion on 1 of the MRI studies. Interestingly, of the abnormal delayed scans, 4 of the 10 lesions were in the contralateral hemisphere. The lesions were very small, mean 0.29 mm² for the first scan and 0.37 mm² for the second scan, and typically only 1 lesion was present in a patient.

This is 1 of the few studies to do sequential scans and provides valuable insights into the timing of brain ischemia. There are, however, some methodological concerns that affect the interpretation of these results. Clopidogrel dosing immediately prior to the procedure may not allow sufficient time for platelet inhibition and may lead to increased microembolization; at least 2 h are needed to obtain adequate platelet inhibition after a 600-mg loading dose (8). Their practice of not pre-dilating prior to stent placement may also contribute to increased embolization as the stent is forced through the lesion.

Interestingly, the filter used in this study has 1 of the largest pore sizes, 140 μm, and the stent used has 1 of the largest cell sizes, 11.48 mm² (9). The pivotal study of the Acculink stent did not use this filter; it used the Accunet filter, which has a substantially smaller pore size (10). It may well be that combining the filter with the largest pore size with the stent with the largest cell size created a “perfect storm” leading to high rates of microembolization. It is important to think of carotid devices as systems, because the pivotal studies were all done with a single filter and a single stent; the results of these trials may not be reproducible if various devices are combined, particularly if the devices have similar shortcomings, which may lead to an amplification of that deficiency.

Diffusion weighted imaging (DWI) measures the apparent coefficient of distribution of water, which becomes reduced in minutes after the onset of ischemia. Diffusion weighted imaging is a measure of ischemia, not infarction. Most small lesions indicated by DWI are not present on repeat MRI scanning several weeks later. In a study of 105 carotid stenting patients, 22 (21%) of the patients demonstrated 64 new lesions at 24 h after the procedure and at 6 months, 62 had resolved (11). The 2 lesions that did not resolve were the only ones also visible on T2-weighted MRI. The assumption is that lesions indicated by DWI are due to microembolization, but in 1 study there was no correlation between the number of microembolic signals on transcranial doppler (TCD) and the number of lesions on DW MRI (12).

To help put the incidence of lesions indicated by DWI that were reported by Schofer et al. (6) in perspective, it is worthwhile to look at the incidence of lesions indicated by

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DWI in some other common procedures. Diagnostic cerebral angiography had a higher incidence (26%) of lesions indicated by DWI than neurointerventional procedures (18%); this was felt to be due to heparinization during the interventional procedures (13). Addition of heparin and the use of air filters dramatically reduced the number of lesions indicated by DWI (14). Carotid endarterectomy has been associated with lesions indicated by DWI in 4% to 34% of patients (15,16). Cardiac surgery is associated with DWI prevalence post-operatively in 31% to 47% of patients (17,18). Even coronary angiography is associated with lesions in 14% to 15% of patients and crossing the aortic valve increases the prevalence of lesions to 22% (19,20).

Diffusion weighted MRI appears to be a very sensitive tool for detecting even minor cerebral ischemia, but it correlates poorly with clinical events. There has been speculation that these clinically silent lesions may have, however, result in cognitive deficits that require neuropsychological testing for detection. The CAVATAS (Carotid and Vertebral Transluminal Angioplasty Study) trial has been the only randomized study of CEA versus carotid angioplasty/stenting to perform neuropsychological testing in even a subset of patients (21). No difference was found between the CEA and angioplasty arms, even though emboli protection was not used during the carotid interventions.

The findings on DW MRI should not be disregarded, however, and can provide a very sensitive marker to help us further improve carotid stenting. Certainly, substantial improvements could be made in access devices and techniques. Similarly, although the current generation of filters is more operator friendly, it is clear from the results in the elderly and symptomatic patients that capture efficiency needs to improve. An additional filter during stent dilation may be a straightforward technique to dramatically improve capture efficiency during the critical portion of the procedure. Diffusion weighted MRI should be used as a research tool to increase our understanding of carotid intervention and other medical procedures, but it cannot replace clinical end points in randomized trials.

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