For Severe Carotid Stenosis Found on Ultrasound, Further Arterial Evaluation Prior to Carotid Endarterectomy Is Unnecessary: The Argument Against

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Carotid endarterectomy reduces the risk of stroke in certain patients with recently symptomatic carotid stenosis and to a lesser extent inpatients with severe asymptomatic stenosis. Screening of patients for inclusion in the randomized controlled trials (RCTs) was usually performed with Doppler ultrasound (DU), but conventional arterial angiography (CAA) was required prior to randomization in the RCTs in symptomatic stenosis and prior to surgery in ACAS. However, CAA is costly, time-consuming, and can cause stroke. A systematic review of prospective studies of the risks of CAA inpatients with cerebrovascular disease reported a 0.1% risk of death and a 1.0% risk of permanent neurological sequelae. More recent studies have reported lower risks in both academic centers and community hospitals, but many centers have already adopted a policy of operating on the basis of DU alone.

What Are the Advantages of Doppler Ultrasound?

The main advantage of DU over CAA is the absence of a procedural risk. However, it should be noted that most studies of the risk of CAA classified all strokes that occurred within 24 hours of CAA as procedural complications. Given that the risk of stroke shortly after presentation with symptomatic carotid stenosis and prior to endarterectomy is about 0.5% per day, the excess stroke risk due to CAA in recently symptomatic patients is probably only about 0.5%.

Has Practice With Ultrasound Alone Been Shown to Be Adequate?

In contrast to pharmaceutical products, new diagnostic or imaging strategies are not subject to regulatory control, and no standards are set for validation. Given that the available techniques of carotid imaging use completely different source data to estimate stenosis, and that there is major variation in carotid bifurcation anatomy between individuals and between the sexes, translation of measurements of stenosis from one technique to another is not straightforward. Although several hundred studies of carotid imaging have been published over the past 2 decades, the majority are undermined by poor design, inadequate sample size, and inappropriate analysis and presentation of data. However, a meta-analysis of methodologically sound studies of noninvasive carotid imaging published prior to 1995 concluded that DU could not substitute for CAA as the sole pre-endarterectomy imaging because of the frequency with which the degree of stenosis was misclassified. More recent studies have confirmed this.

Does Misclassification of the Degree of Carotid Stenosis Matter?

Benefit from endarterectomy is highly dependent on the degree of symptomatic carotid stenosis as measured on CAA. Misclassification of stenosis with DU will lead to some patients being operated on unnecessarily and others being denied appropriate surgery. This harm must be balanced against the 0.5% excess risk of stroke associated with CAA, ie, 1 additional stroke per 200 patients. For example, given the 33.8% reduction in the 8-year absolute risk of stroke with endarterectomy in patients with 90% to 99% symptomatic stenosis, for every 3 patients who are not operated on, possibly because a complete occlusion is seen with DU, 1 stroke will go unprevented. A rate of misclassification of 90% to 99% stenosis as complete occlusion of 1.5% would therefore be sufficient to offset the risk of CAA. Similarly, given the 15.1% reduction in the 8-year risk of stroke with endarterectomy in patients with 60% to 69% symptomatic stenosis, misclassification of 10% of such patients as <50% stenosis with DU would offset the risk of CAA. In practice, misclassification rates can be much higher. A recent comparison of CAA with DU in 569 consecutive patients in “accredited” laboratories with experienced radiologists found that 28% of decisions about endarterectomy based on DU alone were inappropriate. The reliability of DU varies significantly between laboratories, and misclassification in nonaccredited laboratories is likely to be even greater.

What Other Useful Information Is Lost With Use of Doppler Ultrasound Alone?

Plaque surface ulceration on CAA indicates a particularly high risk of stroke on medical treatment, increased benefit from endarterectomy, and identifies patients at high risk of coronary vascular events. Currently available DU techniques do not provide reliable data on plaque surface morphology. In contrast, the risk of stroke on medical treatment...
When DU and MRA are concordant, further studies of the combination of imaging method for selection of symptomatic patients for endarterectomy for asymptomatic stenosis justify the use of CAA is less certain. Further studies of the combination of DU and MRA are required.

Is the Combination of Doppler Ultrasound With Other Noninvasive Techniques Adequate?

Given the major shortcomings of DU alone in selection of patients for endarterectomy, the combination of DU with other noninvasive methods of imaging, usually magnetic resonance angiography (MRA), has been studied. The rate of inappropriate decisions in comparison with CAA is reduced to <10% in patients in whom the results of DU and MRA are concordant. MRA provides useful information about tandem lesions and distal disease, but contrast-enhanced MRA does not appear to offer any additional benefit. CAA is still required in the 25% of patients in whom DU and MRA do not produce concordant results.

Conclusions

Even very low rates of misclassification of symptomatic patients as appropriate or inappropriate for surgery, by DU or other noninvasive methods of imaging used in isolation, will nullify any gain that is obtained by avoiding the risk of CAA. Although CAA is far from ideal, the accurate determination of degree of stenosis and demonstration of other clinically useful information mean that it remains the “gold standard” imaging method for selection of symptomatic patients for endarterectomy, provided that it can be performed without significant delay to surgery. Whether the very small benefits of endarterectomy for asymptomatic stenosis justify the use of CAA is less certain. Further studies of the combination of DU and MRA are required.

References


Key Words: carotid endarterectomy ■ carotid stenosis ■ magnetic resonance angiography ■ ultrasonography, Doppler, transcranial
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