

## Vascular Imaging Before Carotid Endarterectomy

To the Editor:

A variety of neurovascular imaging techniques have been developed to avoid the infrequent but often serious risks of digital subtraction angiography, (DSA)<sup>1</sup> This still remains the “gold standard,” although there is increasing reliance on duplex ultrasound as the sole screening method for evaluating arterial stenosis prior to carotid endarterectomy (CEA). Other forms of neurovascular imaging, including magnetic resonance angiography (MRA) and computerized tomographic angiography (CTA), still lack definite evidence-based data to justify their exclusive use, and at present, no single technique has been demonstrated accurate enough to replace DSA.<sup>2,3</sup>

We recently surveyed current practice of carotid endarterectomy in Canada by questionnaire, to determine the neuroimaging method of choice and whether there were any major differences between vascular surgical and neurosurgical practice. The questionnaire, circulated to all Canadian vascular surgeons (n=204) and neurosurgeons (n=181) via the respective national society registers, requested responses only from those who performed the operation of CEA on a regular basis. No differentiation was made between academic or community surgeons. The methods of choice requested were duplex, DSA, MRA, and CTA.

One hundred two (50%) vascular surgeons responded, of whom 91 (89%) performed CEA and 64 (35%) neurosurgeons responded, of whom 37 (58%) performed CEA. Only 1 respondent (a neurosurgeon) used CTA as the method of choice, so this was excluded from the calculations. None used MRA alone. Most surgeons used a combination of duplex with either DSA or MRA, and there was no difference between vascular and neurosurgeons, except that a significantly larger number ( $P=0.002$ ) of vascular surgeons relied on duplex alone (Table).

Major attempts have been made in recent years to replace DSA as the method of choice for neurovascular imaging, with its 1% stroke and death rate even in experienced hands.<sup>1</sup> Our survey confirms that with 50% (64/128) of surgeons, this still remains the preferred method, either alone or in combination with other imaging modalities. Ultrasound is the quickest and easiest performed of these technologies and in accredited laboratories has a specificity and sensitivity of over 95% as well as a close correlation with all levels of arterial stenosis >40%, using peak-systolic velocities alone.<sup>4</sup> However, this technique has serious limitations, since it is more

operator dependent than other methods of radiological imaging and cannot reliably differentiate between 99% stenosis and occlusion, a critical area for surgical decision making.

MRA images are based on flow (as opposed to anatomy as in DSA), tend to overestimate the degree of stenosis, and suffer from potential artifacts such as “signal gaps.” In one comparison of DSA and MR angiography, where results were blinded between observers, MR consistently exaggerated the degree of arterial stenosis and clinically significant misclassification occurred in 7% of patients, becoming worse with increasing severity of the carotid stenosis.<sup>5</sup>

In a head-to-head comparison of current neurovascular imaging technologies, Johnston and Goldstein<sup>2</sup> found a misclassification rate for CEA eligibility of 28% for duplex alone, 18% for MRA alone, and 7.9% for both combined. This study was performed in ultrasound laboratories with US national accreditation and board-certified radiologists. Many laboratories (especially in countries with no accreditation body to guarantee standards of accuracy) may have far poorer results.

If the published sensitivity and specificity of duplex ranges from 85% to 100%, and for MRA 70% to 99%,<sup>2</sup> then when these technologies are used alone instead of in combination, a small number of patients will have unnecessary carotid endarterectomy, while others will fail to have further investigations and so risk stroke or death in the future. At present, duplex alone cannot be used to evaluate these patients without another modality of neurovascular imaging, and we strongly urge surgeons engaged in carotid endarterectomy to incorporate 2 noninvasive methods of neurovascular imaging when DSA is not the procedure of choice.

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### Comparison of Different Neurovascular Imaging Modalities Used Prior to Carotid Endarterectomy

	Alone		Combination		Total
	Duplex	DSA	Duplex—MRA	Duplex—DSA	
Neurosurgeons	4	7	8	18	37
Vascular surgeons	42	5	10	34	91
<i>P</i> values	0.002	0.025	ns	ns	
Total	46	12	18	52	128

*P* values represent the differences between the 2 groups of surgeons using the particular modality, compared with the total.

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