Review: Noninvasive imaging techniques may be useful for diagnosing 70% to 99% carotid stenosis in symptomatic patients

Wardlaw JM, Chappell FM, Best JJ, Wartolowska K, Berry E. **Non-invasive imaging compared with intra-arterial angiography in the diagnosis of symptomatic carotid stenosis: a meta-analysis.** Lancet. 2006;367:1503-12.

Clinical impact ratings: Cardiology ★★★☆☆☆ Neurology ★★★★☆☆

QUESTION

In symptomatic patients, are noninvasive imaging techniques as accurate as intraarterial angiography (IAA) for diagnosing carotid stenosis?

METHODS

Data sources: MEDLINE and EMBASE/Excerpta Medica (1980 to April 2004), specialized journals (1990 to 2002), and bibliographies of relevant studies.

Study selection and assessment: Prospective studies that compared a noninvasive imaging technique (Doppler ultrasonography [DUS], computed tomographic angiography [CTA], magnetic resonance angiography [MRA], or contrast-enhanced MRA [CEMRA]) with IAA for diagnosing carotid stenosis in ≥ 20 adult patients, ≥ 70% of whom had symptoms of transient ischemic attack or minor stroke in the carotid artery territory, amaurosis fugax, or retinal artery occlusion. Other inclusion criteria included imaging tests blindly assessed to the reference test, reference tests done in all patients, descriptions provided for the imaging techniques, and statement of the method used for defining the degree of stenosis provided. 41 studies (n = 2541 patients and 4876 arteries) met the selection criteria.

Outcomes: Pooled sensitivity and specificity of each imaging technique compared with IAA.

MAIN RESULTS

For diagnosing 70% to 99% stenosis (by North American Symptomatic Endarterectomy Trial [NASCET] criteria), sensitivity was highest for CEMRA and lowest for CTA; specificity was highest for CTA and lowest for DUS and MRA (Table). Heterogeneity among studies was present for all imaging techniques except CTA. A funnel plot suggested publication bias. Evidence for the accuracy of the imaging techniques in diagnosing 50% to 69% stenosis was sparse.

CONCLUSION

Noninvasive imaging techniques may be useful for diagnosing 70% to 99% carotid stenosis in symptomatic patients.

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Accuracy of 4 noninvasive imaging techniques for diagnosing 70% to 99% carotid stenosis compared with intraarterial angiography*

Imaging technique	Number of studies (*n*)	Sensitivity (95% CI)	Specificity (95% CI)	+LR	–LR
CEMRA	9 (380)	94% (88 to 97)	93% (89 to 96)	13	0.06
DUS	8 (916)	89% (85 to 92)	84% (77 to 89)	5.6	0.13
MRA	12 (774)	88% (82 to 92)	84% (76 to 97)	5.5	0.14
CTA	11 (372)	77% (68 to 84)	95% (91 to 97)	15	0.24

*CEMRA = contrast-enhanced magnetic resonance angiography; DUS = Doppler ultrasonography; MRA = magnetic resonance angiography; CTA = computed tomographic angiography. Diagnostic terms defined in Glossary.

COMMENTARY

The results of the review by Wardlaw and colleagues are unsettling, given the emerging status quo of relying only on noninvasive techniques before proceeding to carotid endarterectomy (CEA) (1). First, it is likely that in routine clinical practice the sensitivity and specificity for detecting severe stenosis (70% to 99%) are considerably lower than what the authors report. Second, even under the best of circumstances, CTA may miss 1 in 5 severe stenoses and DUS or MRA may result in inappropriate surgery on 1 in 7 patients. Third, the abysmal sensitivity and specificity of DUS and MRA in detecting moderate stenosis (50% to 69%) suggests that patients may be unconsciously downgraded to 0% to 49% or upgraded to 70% to 99% stenosis.

Finally, the medical community and public are given few assurances that the thousands of vascular laboratories and radiology facilities in operation can validly and reliably perform such procedures. Although vascular laboratories can be accredited, some are not, and the results of the ongoing validation required as part of quality assurance programs for DUS are not readily transparent. No such accreditation or validation requirement even exists for CTA, MRA, or CEMRA.

However, even though the risks of carotid IAA are relatively small, all stakeholders prefer to avoid IAA if possible (2). In addition, noninvasive technologies have continued to improve. It is not clear at what point the risks associated with carotid IAA outweigh the consequences of misclassifications using noninvasive techniques and the foregone benefits of complete intraarterial examination (e.g., information on intracranial arteries, tortuous vessels, complex anatomy, and proper assessment of critical stenosis—"string" sign).

Until more research addresses the methodological limitations of previous studies and the providers of noninvasive imaging technologies establish better mechanisms of quality assurance, we cannot confidently and comfortably recommend the routine practice of CEA without carotid IAA. If one does rely on noninvasive studies only, they should be used with cautious restraint and the knowledge that some patients will have surgery who do not need it and some medically treated patients will have preventable strokes. When symptomatic severe stenosis is discovered, CEA should be performed, preferably within 2 weeks of the patient's last symptomatic event, with aspirin (81 or 325 mg/d) given before and after surgery (3).

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References

1. **Osarumwense D, Pararajasingam R, Wilson P, Abraham J, Walker SR.** Carotid artery imaging in the United Kingdom: a postal questionnaire of current practice. Vascular. 2005;13:173-7.
2. **Johnston DC, Chapman KM, Goldstein LB.** Low rate of complications of cerebral angiography in routine clinical practice. Neurology. 2001;57:2012-4.
3. **Chaturvedi S, Bruno A, Feasby T, et al.** Carotid endarterectomy: an evidence-based review. Neurology. 2005;65:794-801.

