

# The combined use of duplex ultrasonography and magnetic resonance angiography most accurately diagnosed carotid artery stenosis

Nederkoorn PJ, Mali WP, Eikelboom BC, et al. Preoperative diagnosis of carotid artery stenosis: accuracy of noninvasive testing. *Stroke*. 2002;33:2003-8.

## QUESTION

What is the accuracy of duplex ultrasonography (DUS), magnetic resonance angiography (MRA), and DUS and MRA combined, compared with digital subtraction angiography (DSA) for the diagnosis of carotid artery stenosis?

## DESIGN

Blinded comparison of separate and combined test results of DUS and MRA with DSA.

## SETTING

3 medical centers in the Netherlands.

## PATIENTS

350 patients (mean age 67 y, 76% men) who had symptoms of carotid artery disease (transient ischemic attack, minor disabling ischemic stroke, or amaurosis fugax) in the previous 6 months. Exclusion criteria were contraindications to MRA.

## DESCRIPTION OF TESTS AND DIAGNOSTIC STANDARD

DUS, MRA, and DSA were done within 4 weeks. The degree of stenosis on DUS

was based on the peak systolic velocity (PSV) in the proximal internal carotid artery; analysis of DUS was based on a threshold of 70% stenosis, represented by a PSV of 270 cm/s. DSA was the diagnostic standard: A positive test result was defined as severe stenosis (70% to 99%) in the internal carotid artery on DSA. In the analyses, only stenosis measurements of the carotid artery on the symptomatic side were used.

## MAIN OUTCOME MEASURES

Sensitivity, specificity, and likelihood ratios.

## MAIN RESULTS

Test characteristics for DUS, MRA, and the combined strategy of DUS and MRA are in the Table.

## CONCLUSION

Magnetic resonance angiography was slightly more sensitive than duplex ultrasonography for diagnosis of carotid artery stenosis, but the combination of both tests had the greatest accuracy.

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### Diagnostic characteristics for duplex ultrasonography (DUS), magnetic resonance angiography (MRA), and combined DUS and MRA for detecting severe stenosis in the internal carotid artery\*

Tests	Sensitivity (95% CI)	Specificity (CI)	+LR	-LR
DUS	88% (82 to 93)	76% (69 to 82)	3.6	0.165
MRA	92% (86 to 96)	76% (68 to 96)	3.8	0.103
Combined DUS and MRA	96% (91 to 99)	80% (73 to 87)	4.9	0.046

\*Diagnostic terms defined in Glossary; LRs calculated from data in article.

## COMMENTARY

Noninvasive vascular imaging for carotid stenosis would be useful if a minor loss of accuracy could be traded for avoiding DSA. Nederkoorn and colleagues found high accuracy for combined MRA and DUS in diagnosing 70% to 99% carotid stenosis.

Assessing the accuracy and effect of noninvasive tests is difficult and varies with patient selection and the proportion with tight carotid stenosis (1). The method of patient selection in this study is not completely clear. The proportion of patients with 70% to 99% stenosis is not as high as would be expected if some prescreening had been done (2).

It is unusual to use DSA in patients with no or only minor stenosis on DUS. Rather, DSA is reserved to confirm the precise degree of stenosis in those with DUS-diagnosed, high-grade stenosis. Currently, the most frequent use of MRA is to confirm DUS-diagnosed, high-grade stenosis before carotid endarterectomy. Thus, it is crucial to know the accuracy of MRA in these patients. The evidence on the usefulness of MRA is not generally of high quality (3) but suggests that the tighter the stenosis, the more difficult it is to interpret the MRA (4).

MRA is more expensive than DUS, takes longer to do, and is less practical to use and patients do not prefer it to DSA. In many clinics, using MRA on every patient with carotid territory ischemic symptoms is impossible.

Other studies also suggest that a combination of noninvasive tests could replace DSA to confirm tight stenosis (5), but it is important to consider the effect on patient survival as well as accuracy. 1 study suggested that loss of accuracy with noninvasive tests might reduce quality-

adjusted life-years gained after carotid endarterectomy (5).

Noninvasive technology is continuing to improve. Physicians and radiologists need to consider the context in which they would use noninvasive tests before replacing DSA. 1 strategy is to use DUS as the first-line test for identifying high-grade stenosis and MRA as a second noninvasive test to confirm tight stenosis, reserving DSA for patients in whom the noninvasive tests disagree.

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