

# Accurate, practical and cost-effective assessment of carotid stenosis in the UK

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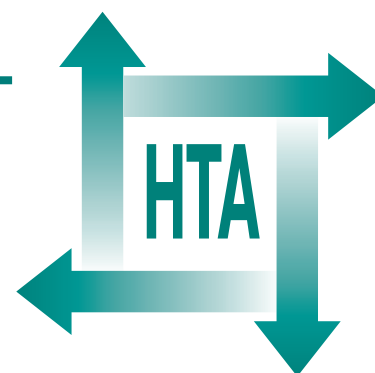
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## Executive summary

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## Executive summary

### Background

Carotid endarterectomy reduces the risk of stroke in patients with tight symptomatic carotid stenosis [70–99% on North American Symptomatic Carotid Surgery Trial (NASCET) criteria] and may also benefit patients with milder (50–69% NASCET) stenoses. The particularly high risk of stroke early after transient ischaemic attack (TIA) has recently been emphasised. Accurate carotid imaging is important to avoid operating on patients with less severe stenoses in whom the risk of surgery may outweigh the benefit. Carotid stenosis was measured originally on intra-arterial angiography (IAA), which is risky. Less invasive imaging tests [ultrasound (US), magnetic resonance angiography (MRA), computed tomographic angiography (CTA) and contrast-enhanced MRA (CEMRA)] have improved and could be accurate enough to replace IAA.

### Objectives

The aim of the study was to determine whether less invasive imaging tests, alone or combined, could replace IAA, what effect this would have on strokes and deaths, endarterectomies performed and costs, and whether less invasive tests were cost-effective.

### Methods

The authors constituted a panel of experts in stroke, imaging, vascular surgery, statistics and health economic modelling. The accuracy of less invasive carotid imaging was systematically reviewed using Standards for Reporting of Diagnostic Accuracy (STARD) methodology, supplemented by individual patient data from primary research and audit studies in the UK. A systematic review of the costs of less invasive tests, outpatient clinics, endarterectomy and stroke was performed, along with a microcosting exercise. A model of the process of care following a transient ischaemic attack (TIA)/minor stroke was developed, populated with data from stroke epidemiology studies in the UK, effects of medical and surgical interventions, outcomes, quality of

life and costs. A survey of UK stroke prevention clinics provided typical timings. Twenty-two different carotid imaging strategies were evaluated for short- and long-term outcomes, quality-adjusted life-years and net benefit.

### Results

In 41 included studies (2404 patients, median age 60–65 years), most data were available on 70–99% stenosis. CEMRA was the most accurate [sensitivity 0.94, 95% confidence interval (CI) 0.88 to 0.97; specificity 0.93, 95% CI 0.89 to 0.96], compared with US, MRA and CTA, which were all similar (e.g. for US: sensitivity 0.89, 95% CI 0.85 to 0.92; specificity 0.84, 95% CI 0.77 to 0.89). Data for 50–69% stenoses and on combinations of tests were too sparse to be reliable. There was heterogeneity between studies for all imaging modalities except for CTA. The individual patient data (2416 patients) showed that the literature overestimated test accuracy in routine practice and that, in general, tests perform with higher sensitivity and specificity in asymptomatic than in symptomatic arteries. In the cost-effectiveness model, on current UK timings, strategies allowed more patients to reach endarterectomy very quickly, and where those with 50–69% stenosis would be offered surgery in addition to those with 70–99%, prevented most strokes and produced greatest net benefit. This included most strategies with US as first or repeat test, and not those with IAA. However, the model was sensitive to less invasive test accuracy, cost and timing of endarterectomy. In patients investigated late after TIA, test accuracy is crucial and CEMRA should be used before surgery.

### Conclusions

In the UK, less invasive tests can be used in place of IAA if radiologists trained in carotid imaging are available. Imaging should be carefully audited. Stroke prevention clinics should reduce waiting times at all stages to improve speed of access to endarterectomy. In patients presenting late after TIA, test accuracy is very important and US results should be confirmed by CEMRA, as patients with 50–69% stenosis are less likely to benefit.

## Recommendations for research

The first six recommendations are as follows:

- More data are required to define the accuracy of less invasive tests used at 50–69% stenoses, and in combination (e.g. US plus CEMRA).
- The methodology for primary studies of the accuracy of less invasive imaging tests needs to improve.
- Clearer presentation of data in reports of primary studies of diagnostic test accuracy would enable more key sensitivity analyses to be performed in future meta-analyses.
- Methods of evaluating new technologies as they emerge are required.

- Consideration should be given to new randomised trials to evaluate different less invasive imaging strategies before endarterectomy.
- Streamlined methods of collecting data to audit less invasive tests when used in routine clinical practice are required to monitor test accuracy.

## Publication

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