A systematic review and meta-analysis of randomized trials of carotid endarterectomy vs stenting

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CRD summary
The authors concluded that, compared with endarterectomy, carotid artery stenting significantly increases the risk of any stroke and decreases the risk of myocardial infarction. The review was generally well conducted, and the findings appear to reflect the available evidence.

Authors' objectives
To evaluate the relative efficacy and safety of carotid endarterectomy compared with stenting in patients with carotid artery disease.

Searching
MEDLINE, EMBASE, Web of Science and Cochrane Central Register of Controlled Trials (CENTRAL) were searched without language restrictions for publications from 2008 to July 2010; these additional studies were used to update those from a previous review (see Other publications of related interest). Details of the search are available from the authors.

Study selection
Randomised controlled trials (RCTs) that compared carotid endarterectomy with endovascular treatment (stenting) in patients with carotid artery disease regardless of symptoms were eligible for inclusion. Outcomes of interest were death, stroke, and myocardial infarction (MI) measured at the longest follow-up point.

The mean age of included patients ranged from 63 years to 72.6 years (where reported); the degree of stenosis ranged from more than 50% to more than 80%. The majority of patients were symptomatic (80%) and one trial exclusively selected asymptomatic patients. Cerebral protection devices were reported in five studies for between 72% and 100% of patients.

Two reviewers independently performed the study selection.

Assessment of study quality
Two reviewers independently assessed the methodological quality of the included trials by evaluating allocation concealment, blinding, number of patients lost to follow-up, premature cessation of trials and funding sources.

Data extraction
Two reviewers independently extracted intention-to-treat data, where possible, to permit the calculation of relative risks (RR), risk differences (RD) and 95% confidence intervals (CI) for deaths, stroke and myocardial infarction.

Methods of synthesis
Pooled RR, RD and 95% CI were calculated using a random-effects model of meta-analysis. The $I^2$ statistic was used to evaluate statistical heterogeneity across the trials. Subgroup analyses were undertaken to examine the impact of patient symptoms, use of cerebral protection devices, premature cessation of trials and date of trial.

Results of the review
Thirteen RCTs were included in the review (n=7,484 patients, range 20 to 2,502). Overall study quality was considered to be high. Allocation concealment was reported in eight trials. Blinding of outcome assessors was reported in four trials. There was no blinding of patients reported in any of the RCTs. Five RCTs were stopped prematurely for futility (two trials), harm (two trials), funding shortages (one trial), and slow enrolment (one trial). Follow-up ranged between one to 66 months.
Outcome data in asymptomatic patients were sparse and imprecise.

Stenting, compared with carotid endarterectomy, was associated with increased risk of any stroke (RR 1.45, 95% CI 1.06 to 1.99; 10 studies, I²=40%), decreased risk of periprocedural myocardial infarction (RR 0.43, 95% CI 0.26 to 0.71; 7 studies, I²=0%), and nonsignificant increase in mortality (8 studies, I²=5%).

For every 1000 patients choosing stenting rather than endarterectomy, 19 (95% CI 2 to 42) more patients would have strokes and 10 (95% CI 5 to 13) fewer would have MIs and would result in 3 (95% CI -1 to 11) more deaths.

Restricting the analysis to the most recent trials with the better methodology and more contemporary technique, stenting was associated with a significant increase in the risk of any stroke (RR 1.82, 95% CI 1.35 to 2.45; 2 studies) and mortality (RR 2.53, 95% CI 1.27 to 5.08; 2 studies) and a nonsignificant reduction of the risk of MI (2 studies).

**Authors' conclusions**

Compared with endarterectomy, carotid artery stenting significantly increases the risk of any stroke and decreases the risk of perioperative myocardial infarction in symptomatic patients.

**CRD commentary**

The review addressed a clear question. Inclusion criteria for the review were clearly defined. Several relevant databases were searched without language restrictions. Steps were taken to minimise reviewer error and bias throughout the review process. Study quality was assessed using appropriate criteria; there were methodological shortcomings for a number of studies. The decision to statistically combine the results appeared to be justified, although moderate heterogeneity was observed in the results for stroke outcomes. Reasonable measures were taken to assess and explore statistical heterogeneity. The review was generally well conducted, and the findings appear to reflect the available evidence.

**Implications of the review for practice and research**

Practice: The authors stated that these findings support the Society for Vascular Surgery guidelines on the management of carotid artery disease.

Research: The authors stated that future trials in neurologically asymptomatic patients should include a medical intervention arm that receive the best available medical management.

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