Cost-effectiveness of carotid endarterectomy
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Carotid endarterectomy (CEA) in patients with high-grade internal carotid artery stenosis.

Type of intervention
Primary prevention.

Economic study type
Cost-utility analysis.

Study population
Cohorts of 100, 65-year-old patients who had experienced transient ischemic attacks (TIA), but who were well at the initiation of therapy.

Setting
Hospital. The study was set in the USA.

Dates to which data relate
Effectiveness and resource use data were collected from studies published between 1973 and 1994. Cost data were collected from studies published between 1983 and 1994 and from a single retrospective study that collected data between 1989 and 1994. The price year was not reported.

Source of effectiveness data
Effectiveness data were derived from 150 CEAs at the University of Minnesota Hospital and Clinic (UMHC), the North American Symptomatic Carotid Endarterectomy Trial (NASCET), and a literature review.

Study sample
135 consecutive patients who underwent 150 CEAs at UMHC. 95 were male, and the average age of patients was 64.5 years. 100 patients had symptomatic internal carotid artery stenosis.

Study design
This was a retrospective cohort study with no controls.

Analysis of effectiveness
The outcomes assessed were the risk of perioperative stroke, the perioperative mortality rate and perioperative complications.
Effectiveness results
Not reported.

Clinical conclusions
Not reported.

Modelling
A lifetime Markov decision analytic model was used to determine the cost-utility of the three strategies.

Outcomes assessed in the review
The review assessed the incidence of stroke, case-fatality and mortality rates.

Study designs and other criteria for inclusion in the review
Not stated.

Sources searched to identify primary studies
Not stated.

Criteria used to ensure the validity of primary studies
Not stated.

Methods used to judge relevance and validity, and for extracting data
Summary statistics from individual studies.

Number of primary studies included
At least 14 studies were included.

Methods of combining primary studies
Narrative method.

Investigation of differences between primary studies
Not stated.

Results of the review
The probability of untreated incidence of stroke after TIA was 0.1188 for 65-year olds, 0.0480 for the 66-74 age band, 0.0614 for the 75-84 age band, and 0.1356 for the 85-100 age band. The relative risk of stroke with aspirin therapy versus untreated rates was 0.85. The monthly stroke recurrence rate was 0.0055. 40% of strokes were major and 60% were minor. The monthly stroke recurrence rate after non-fatal stroke was 0.55%. Age-specific baseline population mortality rates were 0.0265 for the 65-74 age band, 0.0614 for the 75-84 age band, and 0.1503 for the 85-100 age band. The 30-day patient-fatality rate for stroke was 15%.

Measure of benefits used in the economic analysis
NHS Economic Evaluation Database (NHS EED)
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Quality-adjusted life years (QALYs) were used as the measure of benefit. Utility weights, derived from the published literature, were 1 for stroke-free survival, 0.8 for survival after minor stroke, 0.2 for survival after major stroke, and 0 after death. Benefits were discounted at an annual rate of 5%.

**Direct costs**

Direct costs were discounted at an annual rate of 5%. Quantities and costs were reported separately. Direct costs were based on Medicare reimbursements for professional fees, and on hospital charges for diagnosis-related group at an urban teaching hospital. An average of values from centres in the Northeast, the Midwest, and the West Coast was used. Costs included the costs of congestive heart failure, costs of wound hematoma, costs of wound infection, costs of aspirin therapy, costs of treatment for gastrointestinal haemorrhage, and costs of stroke treatment. The quantity/cost boundary adopted was that of society. The estimation of quantities and costs was based on actual data. The price year was not reported.

**Indirect Costs**

Indirect costs were not included.

**Currency**

US dollars ($).

**Sensitivity analysis**

Sensitivity analyses were conducted on the incidence of perioperative and late stroke and the costs of stroke treatment and endarterectomy. Break-even cost analyses were also performed.

**Estimated benefits used in the economic analysis**

Among UMHC patients, neurological complications included major stroke (0.67%) and minor stroke (1.33%). Systemic and local complications included myocardial infarction (1.33%), pulmonary edema (0.67%), and wound hematoma requiring surgical evacuation (3.33%). There were no deaths or intracerebral haemorrhages. The lifetime incidence of stroke was 42.5% in patients who were observed without intervention, 37.6% in patients treated with aspirin, 18% in patients after CEA based on NASCET results (CEA-NASCET), and 14.3% in patients after CEA based on UMHC results (CEA-UMHC). Life expectancy in patients without intervention was 7.18 years after TIA. This was compared with 7.26 years in patients receiving aspirin, 7.63 years after CEA-NASCET, and 7.69 years after CEA-UMHC. QALYs were 6.03 years in patients without treatment, 6.25 years in patients receiving aspirin, 7.18 years after CEA-NASCET, and 7.35 years after CEA-UMHC.

**Cost results**

Lifetime costs after TIA were $26,535.79 per patient without treatment, $24,069.83 per patient receiving aspirin, $23,538.29 per patient after CEA-NASCET, and $20,805.17 per patient after CEA-UMHC.

**Synthesis of costs and benefits**

No synthesis of costs and benefits was performed. CEA dominated the other interventions. The results were relatively insensitive to small variations in individual parameters. The costs of observation and aspirin treatment were most sensitive to changes in the stroke rate. Using NASCET data, if CEA cost $16,765.00, the lifetime costs of CEA and observation would be equivalent, although patients undergoing CEA would still live an additional 13.8 quality-adjusted months. If the perioperative stroke rate exceeds 12%, the benefit of CEA becomes small, with the cost-effectiveness increasing to more than $20,000 per QALY gained.

**Authors' conclusions**
This analysis demonstrates that, when performed with low perioperative morbidity and mortality rates, CEA is a highly cost-effective therapy for symptomatic carotid stenosis and results in substantial societal costs and life savings.

CRD COMMENTARY - Selection of comparators
A justification was given for the comparators used, namely current therapy. You, as a user of the database, should decide if these health technologies are relevant to your setting.

Validity of estimate of measure of benefit
The authors did not state that a systematic review of the literature had been undertaken and more details could have been provided about the design of the review and the method of combining primary effectiveness estimates. The estimation of benefits was obtained directly from the effectiveness analysis. Moreover, the estimates based on the single effectiveness study were potentially biased since the study was a retrospective cohort analysis with no controls.

Validity of estimate of costs
Some good features of the cost analysis were that all relevant cost categories were included, quantities and costs were reported separately and sensitivity analyses were conducted on costs and on quantities. However, the validity of the cost analysis was limited by the fact that cost estimates were based on charges and the price year was not reported.

Other issues
The authors did make appropriate comparisons of their findings with those from other studies but did not address the issue of generalisability to other settings. The authors did not present their results selectively. The study considered patients with symptomatic carotid stenosis and this was reflected in the authors’ conclusions. The model only applied to 65-year-old patients who have suffered a TIA. Although the authors used age-specific mortality rates, this may not have fully accounted for the effects of comorbidity on the quality of life and the cost of medical care in this population.

Implications of the study
When performed with low perioperative morbidity and mortality rates, CEA is a highly cost-effective therapy for symptomatic carotid stenosis and results in substantial societal costs and life savings.

Source of funding
None stated.

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