Is carotid endarterectomy cost-effective in symptomatic patients with moderate (50% to 69%) stenosis?

Patel S T, Hase P B, Korn P, Bash H L, Deitch J S, Kent K C

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
The health technology examined in the study was carotid endarterectomy in symptomatic patients with moderate carotid stenosis of 50% to 69%.

Type of intervention
Secondary prevention.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients with symptomatic 50% to 69% carotid stenosis.

Setting
The setting was secondary and primary care.

Dates to which data relate
The effectiveness evidence relate to published sources up to 1998. The evidence on utilities was based on a source published in 1994. The cost data relate to a publication from 1994. No price year was reported.

Source of effectiveness data
The effectiveness evidence was based on a review/synthesis of the literature, supported by assumptions made by the authors.

Modelling
A Markov model was developed to enable evaluation of long-term survival and costs following CEA or medical treatment for a hypothetical 66-year-old man suffering from moderate carotid stenosis. After a 30-day period during which the treatment could result in different outcomes (such as perfect health, minor or major stroke, or death), the patient entered a Markov process, moving to different health states in cycles of one year.

Outcomes assessed in the review
The outcomes assessed were the 30-day probabilities of minor stroke, major stroke and death of CEA for medical treatment patients, the risk of major and minor strokes for symptomatic patients in the first, second and subsequent years after an ischemic event for patients who underwent medical or surgical treatment respectively, fatality among major strokes and excess mortality of survivors of major stroke, age-specific annual mortality of patients with...
symptomatic 50% to 69% carotid stenosis and the quality of life of stroke survivors (after major and minor stroke).

**Study designs and other criteria for inclusion in the review**
The estimates for the risks of strokes and death were based on the North American Symptomatic Carotid Endarterectomy Trial (NASCET), a randomised controlled trial analysing the carotid endarterectomy versus best medical treatment. The design of studies providing evidence for the other outcomes was not reported.

**Sources searched to identify primary studies**
Not reported.

**Criteria used to ensure the validity of primary studies**
Not reported.

**Methods used to judge relevance and validity, and for extracting data**
Not reported.

**Number of primary studies included**
Seven references providing the outcome estimates were cited.

**Methods of combining primary studies**
The parameters for which estimates were identified were combined into a Markov decision analytic model.

**Investigation of differences between primary studies**
Not reported.

**Results of the review**
The results of the review were as follows:

The 30-day probabilities of stroke and death were 6.6% for CEA (minor stroke, 4.6%; major stroke, 0.8%; and death, 1.2%) and 2.4% for the medically treated patients (minor stroke, 1%; major stroke, 1%; and death, 0.4%).

The decremental risk of an ipsilateral stroke after the first 30 days for the medically treated patients was 9.3% for the first year (major 2.6%, minor 6.7%); 4% for the second year (major 1.1%, minor 2.9%); and 3% for subsequent years (major 0.4%, minor 1.6%).

The decremental risk of an ipsilateral stroke after the first 30 days surgical patients was 3% for the first year (major 0.6%, minor 2.4%); and 2% for subsequent years (major 0.9%, minor 2.1%).

Fatality of major strokes was estimated at 18% and the survivors had an excess mortality rate of 7.7% per year.

The mortality rate of the patients with 50% to 69% carotid stenosis was estimated to be 6.3% higher per annum than the age-specific mortality of the US population.

The quality of life of survivors of major stroke was estimated at 0.4 annually.

**Methods used to derive estimates of effectiveness**
The authors made some assumptions to support the data used in the decision model.
Estimates of effectiveness and key assumptions
A minor stroke was estimated to result in an overall disutility of 0.25 years. The benefit of the surgical treatment was assumed to persist for 5 years after endarterectomy. After 5 years, medical and surgical stroke risks were equivalent at 3% per year.

Measure of benefits used in the economic analysis
The benefit was measured in Quality-Adjusted Life-Years (QALYs). The valuation technique was not reported. A 3% discount rate was used for future QALYs.

Direct costs
A 3% discount rate was used since the time horizon of the study was considerably longer than two years. The analysis of costs included costs of CEA, health care costs of stroke (inpatient, outpatient, home health care and nursing home care cost) and cost of aspirin therapy. The cost/resource boundary adopted in the analysis was not explicitly stated. The cost of carotid endarterectomy (including anaesthesia) of $6,420 was based on the cost at New York Presbyterian Hospital - Cornell Campus. The direct costs of stroke ($9,300 for hospitalisation for minor stroke, $798 annual outpatient cost after minor stroke, $51,150 for the first year after major stroke and $26,880 for subsequent years) were estimated from the literature. It was assumed that 30% of survivors of major stroke would undergo inpatient rehabilitation followed by outpatient and home health care, while the remainder would reside in nursing homes. Patients who did not develop stroke were assumed to be on aspirin therapy at an annual cost of $63. The quantities of resources were not reported separately from the unit costs. The price year was not reported.

Statistical analysis of costs
The costs were not treated stochastically.

Indirect Costs
No indirect costs were included in the analysis.

Currency
US dollars ($).

Sensitivity analysis
A wide range of sensitivity analyses was performed to explore the sensitivity of the cost-effectiveness results. These included one-way sensitivity analyses of the 30 day risk of stroke and death in medical and surgical patients from 3% to 11%, reduction of the first year risk of stroke in the range 1% to 8%, reduction in the 3rd to 5th year risk of stroke in the range 0% to 2%, unit costs of CEA, annual cost of major and minor strokes, patients’ age, and QALY score for major stroke in the range 0.2 to 1.

Estimated benefits used in the economic analysis
The benefits were estimated for the lifetime of the patients. CEA provided an additional 0.13 QALYs (6.75 QALYs for CEA; 6.62 QALYs for medical treatment) in the base case analysis.

Cost results
CEA resulted in an incremental lifetime cost of $580 ($16,269 for CEA; $15,689 for medical treatment).

Synthesis of costs and benefits
The estimated costs and benefits were combined in an incremental cost-effectiveness ratio (ICER) of $4,462. With a perioperative risk of stroke or death for CEA of 5%, the ICER would have been $654. A two-fold reduction in the perioperative risk of strokes and death, or 8 years duration of benefits from surgery, would have made CEA a cost saving treatment. If the perioperative risk of stroke and death were 11.3% or the reduction of strokes due to CEA were less than 1.3%, CEA would not be cost-effective (ICER greater than $60,000). If the benefit of surgery at the 3rd to 5th year were 0, the ICER would be $12,332. If the cost of CEA diminished to $5,000 or if patients were under 60 years of age the CEA would be cost saving. If the cost of CEA rose to $13,200 or more, or the patients were 83 years or over, then the ICER of CEA would be more than $60,000. The ICER of CEA decreased when the quality of life after major stroke was less than 0.4 QALYs annually and when the annual cost of major stroke increased and vice versa.

Authors’ conclusions
The authors concluded that the CEA for moderate symptomatic carotid stenosis of 50% to 69% represents an economically efficient use of health care resources at an ICER of $4,462 per QALY (0.13 incremental QALYS at $580 incremental costs). The result is sensitive towards the perioperative risk of stroke or death, medical and surgical stroke risk, cost of CEA, and age of patients.

CRD COMMENTARY - Selection of comparators
The authors justified the choice of medical treatment as an alternative to CEA treatment of patients with moderate symptomatic carotid stenosis. You, as a user of this database, should assess whether it represents a widely used health intervention in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness was measured based on a Markov decision model informed by estimates of effectiveness derived from published sources and supported by assumptions made by the authors. It is unclear whether the authors conducted a systematic search to identify relevant research and minimise biases. Although a number of studies exploring the effectiveness of CEA compared to medical treatment were cited, the authors based their model mainly on only one of them (the trial including the largest number of patients) and did not discuss the differences between studies (apart of sample sizes) that could have informed the differences in results. The estimates of risks of stroke and death and quality of life scores were based on other studies and insufficient information was provided in this study to enable assessment of their validity. These issues tend to limit the internal validity of the effectiveness analysis.

Validity of estimate of measure of benefit
The estimate of benefit was modelled based on estimates of the patients’ stroke experience and impact on their quality of life. The validity of the QALYs estimates of stroke survivors based on the literature was not explicitly discussed. The sensitivity of the results to these estimates was tested in one-way sensitivity analyses.

Validity of estimate of costs
The perspective of the analysis was not explicitly stated, thus it was not clear whether all relevant categories of costs were included in the analysis. The analysis did not include the costs of informal care or other societal costs that could be important cost components in the case of patients experiencing stroke. Cost estimates were quite specific to the study setting. Quantities of resources used and unit costs were not reported. The structuring of the model, the sensitivity analyses and ranges of values for model parameters appear to have been appropriate.

Other issues
The authors made appropriate comparisons of their findings with those from other studies and partially addressed the issue of the generalisability of their results to other settings. The authors did not present their results selectively. The users of this database are advised to consider the limited generalisability of the study results to their settings. The conclusions of the analysis should be limited to the patient population considered in the study (especially as regards patient age).
Implications of the study
The main implication of the analysis was that CEA in patients with symptomatic moderate carotid stenosis of 50% to 69% proved to be a cost-effective intervention.

Source of funding
None stated.

Bibliographic details

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10587386

Other publications of related interest


Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Aspirin /administration & dosage /economics; Carotid Stenosis /economics /mortality /surgery; Cohort Studies; Cost-Benefit Analysis; Decision Support Techniques; Endarterectomy, Carotid /economics; Female; Humans; Male; Markov Chains; Postoperative Complications /economics /mortality; Quality-Adjusted Life Years; Stroke /economics /prevention & control; Survival Rate

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