Cost-effectiveness of screening for asymptomatic carotid atherosclerotic disease

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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
Using Doppler ultrasound as a screening tool for asymptomatic carotid atherosclerotic disease to select subjects for arteriography and subsequent surgery.

Type of intervention
Screening and treatment.

Economic study type
Cost-utility analysis.

Study population
The study population was a hypothetical cohort of asymptomatic men aged 60 years. Two different sub-population were the focus of the study: a population with a high prevalence of ≥60% stenosis with risk factors such as prior myocardial infarction, bruit, or peripheral disease and a population with low prevalence of ≥60% stenosis (more akin to the general population).

Setting
Hospital. The economic study was carried out in USA.

Dates to which data relate
Doppler ultrasound values of sensitivity and specificity were extracted from a study previously carried out and published during the period January 1993 through December 1994. The data relevant to other parameters of the model came from several single studies conducted between 1985-1995. The cost data were collected in 1995. 1995 prices were used for the cost calculation.

Source of effectiveness data
Single study and review of previously completed studies.

Study sample
The study sample included 215 subjects assessed with both Doppler ultrasound and transfemoral selective carotid arteriography. The sample consisted of both symptomatic and asymptomatic patients. The exclusion criteria were as follows: (1) patients whose arteriography was carried out more than 1 month before or after the ultrasound examination, and (2) patients who had undergone interval surgery.

Study design
Case series. The study was carried out at a single centre. The duration of follow-up was not reported.
Analysis of effectiveness
It was not mentioned whether the analysis was based on intention to treat or treatment completers only. The health outcome measures were sensitivity and specificity of the diagnostic tests.

Effectiveness results
The Doppler sensitivity and specificity (when used with colour flow imaging) for the diagnosis of carotid occlusion were 97.8% (95% CI: +/-4.2%) and 99.7% (95% CI: +/-0.5%).

Modelling
A simulation model for each of the two populations investigated was designed to calculate the marginal cost per marginal QALY gained by screening followed by arteriography and endarterectomy, if necessary, for a cohort of asymptomatic patients during a 20-year period. The purpose of the model was to project effectiveness and cost estimates beyond the timescale of the observation.

Methods used to derive estimates of effectiveness
Authors’ opinion based on related evidence from the literature.

Estimates of effectiveness and key assumptions
The angiographic complication (stroke and death) rate was 1.2%. The 30-day postoperative stroke and death rate was 1.5%. The annual rate of stroke after arteriography and surgery was 0.56%. In turn, the patients with >= 60% stenosis missed by Doppler Ultrasound had a 2.2% annual risk of stroke, while patients with less than 60% stenosis in the high prevalence population had a 0.6% stroke risk per year. The corresponding figure for the low-prevalence population was 0.1%, whereas for patients with >= 60% stenosis the after-surgery stroke risk was 0.56% per year. The benefit of surgery was assumed to be permanent.

Measure of benefits used in the economic analysis
The measure of benefits were Quality Adjusted life years (QALYs) gained with the two diagnostic and treatment strategies in turn relative to "natural history". The quality weights were based on information from a previously published study, which used the time-trade off technique.

Direct costs
The costs were discounted. Quantities of resource use were reported separately from the costs. The following costs were reported: the cost of an outpatient Doppler ultrasound examination, the cost of outpatient arteriography and endarterectomy, the cost of death, the cost of stroke in the first year and for each year thereafter. It was not specified whose costs were included. The estimations of costs was derived from local Medicare reimbursement information. 1995 prices were used. The marginal costs were reported.

Currency
US dollars ($).

Sensitivity analysis
One-way sensitivity analysis was performed on the wide range of base case variables (including discount rate) and costs. The Doppler ultrasound cut-off point was also varied based on local data.

Estimated benefits used in the economic analysis
Total QALYs gained for the one-time screening, annual screening, and no screening options for the high-prevalence population were 7,036, 7,014 and 7,007, respectively. The corresponding values for the low-prevalence population were 9,708, 9,692, and 9,701, respectively. The marginal QALYs gained for the one-time screening and annual screening options for the high-prevalence population were 30 and 7, respectively. The corresponding values for the low-prevalence population were 7 and -9 respectively. All QALYs were discounted at a 3% annual rate. The duration of the benefits was assumed to be 20 years.

Cost results
The total costs of the one-time screening, annual screening, and no screening options for the high-prevalence population were $9,153,994, $11,320,978, and $8,101,477, respectively and the corresponding values for the low-prevalence population were $3,470,486, $6,768,842, and $3,115,620, respectively. The marginal costs for the one-time screening and annual screening options for the high-prevalence population were $1,052,517 and $3,219,501, respectively. The corresponding values for the low-prevalence population were $354,886 and $2,653,222, respectively. The duration of the costs was assumed to be 20 years. The discount rate was assumed to be 3% for all costs.

Synthesis of costs and benefits
The measure of cost-utility was the incremental discounted cost per discounted QALY gained relative to no-screening. The values for the one-time screening and annual screening options for the high-prevalence population were $35,130 and $457,773, respectively. The corresponding value for the one-time screening option in the low-prevalence population was $52,588. The annual screening in low-prevalence population had a negative figure. The most critical parameters in the simulation model were the long-term stroke risk reduction after surgery and the discount rate.

Authors' conclusions
One-time screening of an asymptomatic population with a high prevalence of 60% stenosis with Doppler ultrasound followed by arteriography and endarterectomy, if indicated, may be cost-effective. Annual screening of this population was very expensive. There does not appear to be a role for Doppler ultrasound screening in a low-prevalence population. One time screening of a low-prevalence population was borderline cost-effective and annual screening was detrimental, producing negative QALYs.

CRD COMMENTARY - Selection of comparators
A justification was given for the comparators used, the main reason being that there is no other universally accepted method (as a gold standard) of identifying patients for endarterectomy. No-screening and annual-screening were therefore, according to the authors, the only remaining logical choices.

Validity of estimate of measure of benefit
The values for most of the benefit measures were extracted from two or three single studies. There is not enough information in the paper to justify such a selective approach. The authors themselves note the potential biases arising from the likely differences between the study population and that from which the estimate of effectiveness of the Doppler ultrasound was obtained.

Validity of estimate of costs
The resource quantities were not reported separately from the prices. Adequate details of methods of quantity/cost estimation were not given.

Other issues
The conclusions reached by the authors were based on the results from the sensitivity analyses. The Doppler ultrasound accuracy may differ sharply from one setting to another. The comparison with technologies in other medical areas was reported (league table), which led the authors to the conclusions reported above. The results were not reported selectively.

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