Elective surgery for asymptomatic, unruptured, intracranial aneurysms: a cost-effectiveness analysis

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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
Treatment of asymptomatic, unruptured, intracranial aneurysms.

Type of intervention
Treatment; rehabilitation.

Economic study type
Cost-effectiveness analysis.

Study population
Hypothetical cohort of patients with asymptomatic, unruptured, intracranial aneurysm. Baseline assumptions related to a 50-year-old patient.

Setting
The study was conducted in Pennsylvania, USA.

Dates to which data relate
The effectiveness and resource data related to previous studies and literature between 1977 and 1994. Cost data were determined between 1991 and 1992. All costs were expressed in 1992 prices.

Source of effectiveness data
Effectiveness data were derived from estimates.

Modelling
A Markov model was used to estimate final health outcomes and costs.

Methods used to derive estimates of effectiveness
The authors constructed a model which determined the number of QALYs associated with each of the two strategies, based on data derived from previous studies.

Estimates of effectiveness and key assumptions
Estimates, based on previous studies, were obtained for the following parameters:

1) Annual probability of subarachnoid hemorrhage (SAH), estimated to be 1%.
2) Probability of prehospitalization death after SAH, estimated to be 12%.

3) Morbidity and mortality from aneurysmal SAH, estimated to be 26% and 16% respectively after 6 months.

4) Risks from elective aneurysm surgery. The morbidity rate was estimated to be 4.1% and the mortality rate 1%. Due to insufficient statistical power from the studies examined all aneurysm patients were assumed to have similar surgical outcomes.

5) Morbidity and mortality from causes other than SAH. This was determined from Health Statistic life tables using the declining exponential approximation of life expectancy from comorbid disease. All morbidity was assumed to have come from the sequelae of SAH or surgery.

**Measure of benefits used in the economic analysis**
The benefits were measured in terms of the number of QALYs gained with each strategy.

**Direct costs**
Direct costs included the cost of hospitalization, physician costs, rehabilitation costs for the first and subsequent years. Data were derived from mean nationwide Medicare Cost Report data, Medicare resource-based relative-value units, and two studies which examined the costs of rehabilitation in the first year and long-term care of stroke patients in the Swedish population. Price year was 1992 and a discount rate of 5% was applied.

**Currency**
US Dollars ($)

**Sensitivity analysis**
Sensitivity and threshold analyses were carried out on key variables to test the cost/QALY gained ratios. These were: age, annual probability of SAH from an unruptured intracranial aneurism, elective surgical morbidity, elective surgical mortality, postoperative recovery period duration (0-6 months), postoperative recovery period function (50-100% of eventual function), value of living with a neurological deficit (0.5-1.0), value of knowingly living with an asymptomatic, unruptured, intracranial aneurysm (0.9-1.0) and discount rate. The effect on outcomes of decreased life expectancy from comorbidity was also assessed.

**Estimated benefits used in the economic analysis**
QALY benefits of 0.95, 0.94, 0.88, 0.75, and 0.56 were achieved for patients of 30, 40, 50, 60 and 70 years of age respectively when comparing prompt elective surgery with medical management. Benefits were discounted at a rate of 5%.

**Cost results**
The cost of non-surgical hospital admission for stroke after aneurysmal SAH was estimated to be $6,500, and the costs of an admission for aneurysm surgery was $19,300. The average cost of acute care, rehabilitation, and chronic care for stroke patients in the first year after stroke ranged from $13,800 to $20,200, and after the first year the average annual cost ranged from $6,500 to $16,400. All costs were discounted at a rate of 5%.

**Synthesis of costs and benefits**
The costs and benefits were represented in cost per QALY gained. For elective surgery a figure of $24,200 per QALY was determined, which varied according to the age of the patient. The cost per QALY of the comparator (medical management) was not explicitly stated.
Authors' conclusions
The study demonstrated that for a wide range of clinically relevant model assumptions, prompt elective surgery always yielded more discounted QALYs than expectant medical management.

CRD Commentary
The study was very thorough and comprehensive in terms of its methods, however few details were given on the method of derivation of the QALYs. The necessity to approximate in order to place discrete figures in the Markov model, however, did create some limitations as follows:

1) Methods used to estimate costs, as acknowledged by the authors, were fraught with difficulties, exemplified by the use of European data for rehabilitation costs. Differentiation between post-operative costs of elective surgery and emergency admission for SAH was also not possible and may have led to a bias favouring expectant medical management.

2) The model assumed constant patient preference and further research into refining this factor was acknowledged as being a requirement.

3) All aneurysm patients were assumed to have similar natural histories and outcomes following elective surgery. Insufficient data were available on factors such as aneurysm size, location, age of patient and the natural history and surgical results associated with this condition.

4) Surgery was considered to be the only treatment modality. The authors acknowledged developments in alternative endovascular techniques, but justified their exclusion as they had not been sufficiently evaluated or reported on.

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