Decision analysis of cost-effectiveness of magnetic resonance angiography for mass screening for intracranial aneurysms

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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
Screening for intracranial aneurysms using magnetic resonance angiography.

Type of intervention
Screening.

Economic study type
Cost-effectiveness analysis.

Study population
Hypothetical patients with asymptomatic unruptured cerebral aneurysms. No further details were provided.

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

Dates to which data relate
The effectiveness data relate to studies conducted between 1977 and 1994. The dates for resources were not stated. No price year was given.

Source of effectiveness data
Effectiveness data were derived from a review of the literature.

Link between effectiveness and cost data
Costing was undertaken retrospectively on the same patient sample as that used in the effectiveness analysis.

Study sample
82 consecutive children and adolescents were considered in the analysis. 50 patients underwent LS by lateral approach and 32 underwent OS through a left sub-costal incision. The groups were closely matched for age, weight and diagnosis. Mean age was 7.76 years for LS and 6.9 years for OS. Mean weight was 30.5kg for LS and 27.6kg for OS. Hematologic indications included hereditary spherocystosis in 43 children, sickle cell anaemia with sequestration in 13, immune thrombocytopenic purpura (ITP) in 14 and 12 with other disorders. Concomitant cholecystectomy for cholelithiasis was performed in 10 patients (20%) in the LS group and 6 (19%) in the OS group. Additional procedures were performed in 4 patients in the LS group: inguinal hernia repair, circumcision, incidental appendectomy and liver biopsy. No power calculations were reported in determining sample size.
Study design
Retrospective case controlled study.

Analysis of effectiveness
The analysis was based on the intention to treat principle. The main health outcomes used in the analysis were complication rate, mortality, operative time, postoperative intravenous narcotic, total narcotic dosage, length of hospital stay and response to splenectomy.

Effectiveness results
There were no deaths or major complications in either group. No LS procedures required conversion to OS. Complications in the LS group consisted of ileus in 2 patients and atelectasis in 1. Two patients in the LS group required nasogastric tube insertion for management of postoperative ileus and 6 in the OS group had nasogastric tube in place for 24 hours after the procedure. Operative time was longer in the LS group (115 versus 83 minutes, \( p=0.002 \)), and the mean estimated blood loss was 54.4 mL for LS and 49.0 mL for OS \( (p=0.233) \). There was less need for postoperative intravenous narcotic (51% versus 100%, \( p<0.0001 \)) with LS, lower total narcotic doses (0.239 versus 0.480 mg/kg morphine, \( p=0.006 \)), and shorter length of hospital stay at 1.4 (+/- 0.97) days versus 2.5 (+/- 1.43) days for OS, \( p=0.001 \). There were no readmissions within 30 days of operation in either group. The response to splenectomy for ITP and hereditary spherocystosis was 100% in both groups.

Clinical conclusions
LS is a safe and effective procedure in children with hematologic disorders resulting in longer operative times, less narcotic administration and shorter length of stay.

Modelling
A decision tree model was used to evaluate clinical benefit and cost-effectiveness.

Outcomes assessed in the review
The outcomes assessed in the review were diagnostic accuracy, incidence of permanent neurologic deficits and rate of neurologic complications.

Study designs and other criteria for inclusion in the review
No information was provided on the study designs or other criteria for the papers that were included in this non-systematic review.

Sources searched to identify primary studies
Journal references.

Criteria used to ensure the validity of primary studies
It is unclear what criteria were used to ensure the validity of primary studies.

Methods used to judge relevance and validity, and for extracting data
No information was provided on the methods used to judge the relevance, validity and extraction of data.

Number of primary studies included
17 studies were included in the literature review.
Methods of combining primary studies
Narrative method.

Investigation of differences between primary studies
No investigation of differences between studies was carried out.

Results of the review
The diagnostic accuracy of MR angiography was reported to be 80% for specificity and sensitivity for the detection of one aneurysm ranging from 64% to 87% on MIP and source images in some studies. Other studies have found specificity to be 80% and sensitivity to be 87% for MR angiography. The incidence of permanent neurologic deficits has been reported to be 0.2% - 5.7%. The incidence of neurologic complications was 0.3%, and the incidence of fatal complications was 0.1% or less and the mortality and morbidity were reported to be 0.0001% and 0.3% respectively. Unruptured aneurysms can be treated surgically with a low complication rate. The rates of fatal complications have been reported to be 0.1% and 0.4% for neurologic complications. These data were then used as input parameters to the model.

Measure of benefits used in the economic analysis
The benefit measure was lives saved.

Direct costs
No information was provided on the methods used to determine costs, whether the costs were discounted, and resources used or the quantity/cost boundary adopted. It appears that only the direct screening and treatment costs were included and are probably based on Japanese social insurance reimbursement levels for these procedures.

Statistical analysis of costs
No statistical analysis was carried out on costs.

Indirect Costs
No indirect costs were reported.

Currency
Japanese Yen (Y). Converted to US dollars ($) in the results.

Sensitivity analysis
To test the variability in the data a one-way sensitivity analysis was conducted on the sensitivity and specificity of the screening test.

Estimated benefits used in the economic analysis
At a 5-year follow-up, the estimated rate of lives saved was 64 per 100,000 and the complication rate was 92 per 100,000. Complications were analysed separately and were found to be at a higher rate than the natural course until 18 years of follow-up.

Cost results
The cost of MR angiography was Y25,000, conventional angiography cost Y8,000, surgery for unruptured aneurysms
cost ¥1,000,000 and treatment of ruptured aneurysm cost ¥5,000,000.

**Synthesis of costs and benefits**
The cost to save a life was reported according to sensitivity and specificity. With sensitivity at 87% and specificity at 80% the cost to save a life was estimated to be ¥79,768,830 (around $690,000) at 5-year follow-up and ¥31,170,312 (around $270,000) at 10-year follow-up.

**Authors’ conclusions**
At present, mass screening for cerebral aneurysms is not cost-effective. The costs of MR studies, conventional angiography, surgery and a relatively high complication rate make mass screening with MR angiography infeasible. However, randomised, controlled trials should be undertaken to establish the true cost-effectiveness of such a programme.

**CRD COMMENTARY - Selection of comparators**
The reason for the choice of comparators, namely no screening, is clear.

**Validity of estimate of measure of benefit**
It is difficult to judge the validity of the estimated benefits as they were derived from estimates of effectiveness and other epidemiological data in the literature. As no details of the literature review were provided, it is not possible to determine if this was fully inclusive of all relevant sources. However, the authors did produce estimated benefits under two scenarios of different sensitivities and specificities in taking into account some of the potential variability in the input parameters used in the model.

**Validity of estimate of costs**
It is unclear whether the cost data are valid or not as no sources were reported, although they are likely to be based on social insurance reimbursement levels for Japan which are fixed by the Japanese government. Only the costs of screening and consequential treatment were considered but the lack of specific details limits the generalisability of the results to other settings or countries.

**Other issues**
Given the lack of detail in the costing the authors' conclusions need to be treated with a degree of caution. The generalisability of the study's findings to other settings is not addressed. Although some weaknesses are in evidence in terms of deriving the input parameters for the decision tree used, some sensitivity analysis was performed to account for variability.

**Implications of the study**
The authors suggest that although mass screening is not practical, screening in certain high-risk groups may be more appropriate. High-risk categories include asymptomatic individuals with a family history of subarachnoid haemorrhage and patients with polycystic kidney disease, fibromuscular dysplasia, and severe atherosclerotic disease. As MR accuracy improves, mass screening may become more feasible.

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