The cost-effectiveness of repairing ruptured abdominal aortic 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
The surgical repair of ruptured abdominal aortic aneurysm (AAA) was examined in this study.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients undergoing surgical repair of ruptured AAA. Further inclusion criteria were not reported.

Setting
The setting was a hospital. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness evidence and the resource use data were derived from studies published between 1988 and 1999. Data on the resources used were also derived from actual data. The price year was 1997.

Source of effectiveness data
The effectiveness evidence was derived from a review of published studies. In addition, the authors made assumptions about the effectiveness.

Modelling
A Markov decision-model was used to reflect the lifetime treatment costs and the quality-adjusted survival associated with the treatment of a hypothetical cohort of 72-year-old patients with ruptured AAAs, who were undergoing emergency operation or no intervention. The authors assumed that if a patient received no intervention, then death would follow immediately. Once presented at the emergency department for initial evaluation, the patient underwent laboratory testing. The surgical intervention was followed by four possible outcomes:

- successful repair;
- irreversible complications, such as dialysis-dependent renal failure, stroke, major amputation or myocardial infarction;
- reversible complications, such as graft thrombosis, haemorrhage or ischaemic colitis; or
- operative death.
Patients were followed until death.

**Outcomes assessed in the review**
The outcomes assessed in the review were the mortality rate, the probabilities of both reversible and irreversible complications, and the quality adjustment values. These were also used as inputs for the model.

**Study designs and other criteria for inclusion in the review**
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**
The effectiveness evidence was derived from thirty-one primary studies.

**Methods of combining primary studies**
The probability values used in the analysis were mainly the weighted averages obtained from the primary studies. The authors used a range of values (minimum and maximum estimates) in the sensitivity analysis.

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

**Results of the review**
The mortality rate was 50% (range: 20 - 90).

The probabilities of irreversible complications were 3.8% (range: 0.9 - 5) for dialysis-dependent renal failure, 1.1% (range: 0 - 2.9) for stroke, 0.5% (range: 0 - 1.7) for major amputation, and 2.9% (range: 2 - 4.8) for myocardial infarction.

The probabilities of reversible complications were 3.2% (range: 0 - 10) for graft thrombosis, 2.3% (range: 1.7 - 7.2) for haemorrhage, and 2.6% (range: 1.4 - 4.9) for ischaemic colitis.

The quality adjustment was 0.68 (range: 0 - 1) for dialysis-dependent renal failure, 0.40 (range: 0 - 1) for stroke, 0.80 (range: 0 - 1) for major amputation, 0.88 (range: 0 - 1) for myocardial infarction, and 52 (range: 0 - 356) for days of disutility of operative repair.

**Methods used to derive estimates of effectiveness**
The authors made one recorded assumption to estimate a parameter value range.
Estimates of effectiveness and key assumptions
It was stated that the ranges used for quality adjustment were all assumed. The range of probability for graft thrombosis was 0 to 10%.

Measure of benefits used in the economic analysis
The benefit measure used in the economic analysis was the number of quality-adjusted life-years (QALYs) gained by the surgical repair of ruptured AAAs. This was obtained by combining the utility values with the life expectancy data. The benefits were discounted at a rate of 3%.

Direct costs
Discounting was relevant due to the long time horizon of the study. The costs were discounted at a rate of 3%. The quantities of the resources consumed were not reported separately from the unit costs given. The cost/resource boundary appears to have been that of the hospital. The cost analysis included the cost of initial hospitalisation and all the expenses associated with treating reversible and irreversible complications. The costs of initial hospitalisation included preoperative (laboratory tests), operative (transfusions, operating room time), and postoperative (ward or intensive care units) costs.

The costs and the quantities were estimated from both actual data and the literature. The actual costs were derived from the cost accounting system at the New York Presbyterian Hospital, and from Medicare reimbursement rates. All the costs were converted into 1997 US dollars using the medical care component of the Consumer Price Index for All Urban Consumers.

Statistical analysis of costs
No statistical analysis of costs was reported.

Indirect Costs
No indirect costs were included.

Currency
US dollars ($).

Sensitivity analysis
Sensitivity analyses were carried out to test the robustness of the incremental cost-effectiveness ratio to variations in the following variables (ranges given):

the mortality rate;
the morbidity rates for reversible and irreversible complications;
the patient's age;
the cost of the operation; and
other variables, such as the discount rate and the cost of morbidity.

The analyses conducted were mainly one-way, although some multi-way sensitivity analyses were also reported.

Estimated benefits used in the economic analysis
In the base-case, the estimated average number of QALYs associated with surgical repair of ruptured AAA was 3.35.
No intervention resulted in zero QALYs, because it was assumed that if a patient received no intervention then death would follow immediately.

**Cost results**
The lifetime costs associated with no intervention were $580, while the total costs related to the surgical repair of a ruptured AAA were $36,606 (the costs of the initial hospitalisation were equal to $28,356). This resulted in an extra cost equal to $36,026.

**Synthesis of costs and benefits**
The costs and the benefits were combined by an incremental cost-utility analysis. In the base-case, the incremental cost per QALY for the surgical repair of a ruptured AAA, over no intervention, was $10,754. Sensitivity analyses showed that the model was fairly robust to the assumptions made. In particular, the surgical repair of a ruptured AAA only became no longer cost-effective at a threshold of $60,000, if the operative mortality rate was greater than 87.7% or if the cost of the operation was greater than $195,000.

**Authors’ conclusions**
The surgical repair of a ruptured abdominal aortic aneurysm (AAA) was proven to be a highly cost-effective strategy. Its cost-utility ratio was well below the commonly used threshold of $60,000 per QALY, which a society is usually willing to pay for the implementation of health treatments.

**CRD COMMENTARY - Selection of comparators**
No intervention was used as the comparator. The authors stated that this was the only alternative to AAA. You should consider whether other interventions are usually performed in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness analysis used data obtained from the literature. However, although a formal review of the literature was not performed, the authors have reported the method used to combine the primary studies. In addition, numerous sensitivity analyses were conducted on the model inputs, on account of the uncertainty and likely variability between the settings. The results demonstrated the effect of variability around the data used.

**Validity of estimate of measure of benefit**
The benefit measure was represented by the QALY. It appears to have been appropriate to measure the health impact of the intervention, because AAA is likely to heavily affect both the life expectancy and the quality of life of the patients. The estimation of the QALYs was obtained through a (Markov) decision model. This seems to have been appropriate to simulate the progression of the disease after the intervention.

**Validity of estimate of costs**
The costs were estimated on the basis of institutional data and published studies. As for the effectiveness, sensitivity analyses were conducted to reduce the uncertainty around the estimations used. The model was shown to be robust to reasonable variations in the cost data. However, the quantities of the resources consumed were not reported, therefore reducing the external validity of the analysis. In addition, it appeared that no statistical analyses were conducted on either the cost or quantity data.

**Other issues**
The authors made several comparisons of their findings with those from other studies. The issue of the generalisability of the study to other settings was not specifically addressed. However, sensitivity analyses were conducted on almost every parameter in the decision model.
Implications of the study
The authors pointed out that in their analysis, the age of the patient was considered an independent factor and its impact on the results was negligible. However, it was noted that age could affect other variables, such as operative mortality. A sensitivity analysis was therefore conducted with simultaneous variations in age and mortality, but AAA remained cost-effective for all age groups. Consequently, the main implication of the analysis was that AAA should be performed, in particular on those patients who may benefit from the intervention, that is, those at less risk of high mortality rates. However, the authors have highlighted the difficulties in reliably predicting if a patient has a high mortality probability.

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