Cost-effectiveness analysis of endovascular versus open surgical repair of acute abdominal aortic aneurysms based on worldwide experience
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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.

CRD summary
This study investigated the cost-utility of endovascular aneurysm repair (EVAR) compared with open surgical repair of an acute or ruptured abdominal aortic aneurysm, in an emergency setting. The authors concluded that EVAR was cost-effective compared with open surgical repair. The study methods were generally transparent and thorough and the authors' conclusions are a fair assessment of the evidence, but this evidence was uncertain.

Type of economic evaluation
Cost-utility analysis

Study objective
The aim was to assess the costs and effects of endovascular aneurysm repair (EVAR) compared with open surgical repair of an abdominal aortic aneurysm in an emergency setting. The hypothetical cohort of patients, with an average age of 70 years, presented to the emergency department with acute or ruptured abdominal aortic aneurysms.

Interventions
EVAR was compared with open surgical repair.

Location/setting
UK/secondary care.

Methods
Analytical approach:
A two-stage model was used to assess the lifetime costs and effects. A decision tree modelled the short-term (30 days) costs and outcomes and then a Markov model evaluated the long-term (from 30 days to death) costs and outcomes. The inputs for the model were from published clinical studies, national schedules, and expert opinion. The authors implied that the study perspective was that of the UK NHS.

Effectiveness data:
The short-term clinical outcomes were survival, re-intervention, and conversion to open surgery for the EVAR group. The long-term outcomes included mortality, endoleaks, stent-graft migration, kinking, and device failure. One meta-analysis of 22 studies, with 7,040 patients, treated electively or in the emergency setting, informed the analysis (Sadat, et al. 2008, see ‘Other Publications of Related Interest’ below for bibliographic details). Data from a subset of 730 patients undergoing emergency EVAR or open surgery were used for the model inputs. Authors' assumptions were necessary to determine the relationships between emergency presentations and repairs, where only estimates from elective settings were available; this included the long-term mortality and long-term device-related complications data.

Monetary benefit and utility valuations:
The utility scores for the different health states were from a published study of elective patients (EVAR trial participants. 2005, see ‘Other Publications of Related Interest’ below for bibliographic details).

Measure of benefit:
The measure of benefit was quality-adjusted life-years (QALYs).
Cost data:
The direct medical costs were included for hospitalisation, intensive care unit stay, surgery, blood transfusions, surveillance (follow-up and imaging), devices, and secondary interventions. The unit costs were from national tariffs and published literature. They were reported in UK pounds sterling (£).

Analysis of uncertainty:
The model parameters and assumptions were examined in one-way sensitivity analyses, varying the data by standard deviations, confidence limits, or ±50% of the mean value. Threshold analyses were undertaken and the results for the twenty most influential parameters were presented. A probabilistic sensitivity analysis with 10,000 Monte Carlo simulations was performed. The sensitivity analysis results were presented in scatter plots on the cost-effectiveness plane and a tornado diagram.

Results
At 30 years after surgery, the total costs were £17,422 for EVAR compared with £18,930 for open repair. The QALYs were 3.09 for EVAR compared with 2.45 for open repair. The incremental cost per QALY gained for EVAR over open repair was -£2,359, meaning that EVAR produced higher QALYs at lower costs than open surgical repair; EVAR dominated open repair.

The results were sensitive to the intensive care unit stay in both arms, the ward stay, and the cost of EVAR devices, but they varied little with different mortality, relative risk of death, conversion rates to open surgery, and secondary interventions. In the probabilistic sensitivity analysis, the mean incremental cost per QALY for EVAR compared with open repair was below £20,000 to £30,000 in almost 100% of simulations.

Authors’ conclusions
Based on the evidence from their 22-study meta-analysis, the authors concluded that EVAR was cost-effective compared with open surgical repair and this strongly supported the use of EVAR to manage ruptured aortic aneurysms.

CRD commentary
Interventions:
The devices and patient cohort characteristics were clearly described. The emergency setting should be considered when assessing if these interventions are valid options in other settings.

Effectiveness/benefits:
Most of the effectiveness data were from a subset of patients (730) included in a meta-analysis of observational data. The authors acknowledged that this might have resulted in bias in patient selection for the two treatments. They also had to make some assumptions for the long-term outcomes because data were not available for the patient population. Both of these issues increase the uncertainty and potential bias in the effectiveness estimates. The utility values were from a previous study involving patients with abdominal aortic aneurysm. The population might have been comparable, but the measurement and valuation methods were not reported, making it difficult to judge the validity of the utility data.

Costs:
The perspective appears to have been that of the UK NHS and the analysis covered all the major direct medical resources, including complications from treatment, devices, and repeat procedures. The cost data were from public sources. There was no mention of discounting or other adjustments that might have been necessary and appropriate for a long-term model. The price year was not reported making any future reflation exercises difficult.

Analysis and results:
The use of a two-stage model was appropriate and the methods were well described. The authors clearly reported the model inputs, their sources, and the assumptions required to facilitate modelling. The results were clearly and comprehensively reported. The study had some limitations, which the authors reported, including the reliance on non-randomised control data and the exclusion of some complications and the EVAR set-up costs. The results were compared with those of other economic evaluations conducted in Europe and found to be broadly similar. Overall, the analysis was well reported.
Concluding remarks:
The transparent reporting allows a clear understanding of the methods used and the assumptions made. The conclusions reached by the authors appear to be reasonable and robust in the sensitivity analysis undertaken. Some uncertainty remains and this should be considered alongside the authors' conclusion.

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