The cost-effectiveness of exclusion arteriography in extremity trauma

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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 use of exclusion arteriography for the diagnostic workup of patients with penetrating or blunt trauma to the extremity.

Type of intervention
Diagnosis.

Economic study type
Cost-utility analysis.

Study population
The hypothetical study population comprised asymptomatic patients with injuries in proximity to arteries. Unstable patients needing immediate surgical exploration were excluded.

Setting
The setting was a hospital trauma centre. The economic study was conducted in Chicago, USA.

Dates to which data relate
The effectiveness and resource use data were derived from studies published between 1970 and 1996. The price year was 1990.

Source of effectiveness data
The effectiveness data were derived from published studies, augmented by the authors' assumptions.

Modelling
A decision tree-based model was constructed to calculate the costs and QALYs of the two alternative diagnostic tools, on the basis of the possible scenarios resulting from the diagnostic decisions.

Outcomes assessed in the review
The health outcomes used as model inputs were:

- the utility values associated with amputation, claudication and morbidity;
- the probability values of amputation for vascular injury, iatrogenic surgical morbidity from exploration, exploration failure, probability of arteriogram injury, probability of missed arteriogram returning for normal repair, and prevalence of injury for suspected vascular injury;
the sensitivity and specificity of the arteriogram.

**Study designs and other criteria for inclusion in the review**
Not stated.

**Sources searched to identify primary studies**
Not stated.

**Criteria used to ensure the validity of primary studies**
Not stated.

**Methods used to judge relevance and validity, and for extracting data**
Not stated.

**Number of primary studies included**
The effectiveness data were derived from 28 primary studies.

**Methods of combining primary studies**
The authors made some assumptions to select the value of the outcomes used in the decision model, within the range of values found in the literature.

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

**Results of the review**
The utility values were 40 and 48.4 for amputation, 80 for claudication, and 90 for morbidity.

The probability values ranged from 0.7 to 9.6% for amputation for vascular injury, from 3 to 9% for iatrogenic surgical morbidity from exploration, from 0.6 to 0.15% for probability of arteriogram injury, and from 36 to 20% for prevalence of injury for suspected vascular injury.

The probability values were 28 and 20% for exploration failure, and were 86 and 80% for probability of missed arteriogram returning for normal repair.

The sensitivity of the arteriogram was 97% and the specificity was 90%.

**Methods used to derive estimates of effectiveness**
The authors chose the data used in the decision model from within the ranges of values found in the literature. The data were deterministic.

**Estimates of effectiveness and key assumptions**
The utility values used in the base-case decision model were 40 for amputation, 80 for claudication, and 90 for morbidity.

The probability values used in the base-case decision model were 4% for amputation for vascular injury, 5% for
iatrogenic surgical morbidity from exploration, 24% for exploration failure, 97% for sensitivity and 90% for specificity of arteriogram, 0.4% for probability of arteriogram injury, 83% for probability of missed arteriogram returning for normal repair, and 28% for prevalence of injury for suspected vascular injury.

Measure of benefits used in the economic analysis
The benefit measure used in the decision analysis was the QALYs. The utility values were derived from the literature then converted into QALYS (linear transformation: 1 QALY = 0.5 x 1 Util), assuming the average age of the typical patient at injury was 28 and an additional life span of 50 years.

Direct costs
Discounting was not performed since the costs were incurred during less than two years. The unit costs were reported separately from the quantities of resources. The health service costs included in the economic evaluation were for hospital stay, arteriogram, surgical exploration, operating room, repair or amputation, rehabilitation or prosthesis. The extra costs associated with the outcomes of claudication or iatrogenic exploration or arteriographic harm were not included in the analysis. The cost/resource boundary adopted in the study was that of the federal, state and county taxpayers who subsidise urban hospital and trauma centres. The costs and the quantities were estimated using published data. The authors assumed that surgical exploration took two operating room hours, while vascular injury repair took four operating room hours. The costs of rehabilitation or prosthesis were assumed to be covered by Medicaid. All of the costs were inflated to 1990 (price year) using the medical care component of the US consumer price index.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The indirect costs were not included in the analysis.

Currency
US dollars ($).

Sensitivity analysis
Univariate sensitivity analyses were conducted to assess the robustness of the estimated costs and QALYs to variations in several model inputs. The variables studied (ranges in brackets) were prevalence (10 - 50%), amputation rate for vascular injury (1 - 10%), iatrogenic surgical morbidity from exploration (1 - 10%), exploration failure (20 - 30%), sensitivity (85 - 100%) and specificity (85 - 100%) of exclusion arteriography, probability of arteriogram injury (0.1 - 1%), and the costs of both the arteriogram ($500 - $1,500) and exploration ($1,000 - $3,000/hour).

Estimated benefits used in the economic analysis
Surgical exploration had an expected utility of 97.624, while exclusion arteriography had an expected utility of 98.226. This gave an incremental utility of 0.602, corresponding to 0.30 QALYs.

Cost results
The total costs per patient were $5,200 for exclusion arteriography and $7,100 for surgical exploration. Thus, the cost-savings associated with exclusion arteriography over surgical exploration were $1,900 (27%).

Synthesis of costs and benefits
An incremental analysis was planned to combine the costs and the benefits. However, an incremental cost-effectiveness
ratio was not calculated since exclusion arteriography dominated surgical exploration, which was both more costly and less effective. This conclusion was robust to all the variations performed in the sensitivity analyses.

Authors' conclusions
Exclusion arteriography was the dominant strategy over surgical exploration. It cost less and produced greater utility.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparator was clear. The authors stated that surgical exploration represented the standard diagnostic tool for patients with extremity trauma before the development of extremity arteriography. You should decide whether it represents a widely used intervention in your own setting.

Validity of estimate of measure of effectiveness
The analysis of effectiveness used data derived from published studies. However, a formal review of the literature was not undertaken. In addition, it was unclear whether the authors considered differences across the primary studies when estimating the effectiveness outcomes. The primary study estimates were combined using narrative methods. The authors did not report the design of the primary studies. The authors made several assumptions to identify the outcome values within the ranges found in the literature. Most of these assumptions were investigated in the sensitivity analysis.

Validity of estimate of measure of benefit
QALYs were used as the benefit measure in the economic analysis, while utility weights were derived from the literature. The use of QALYs allows the benefits of the intervention under study to be compared with those from other interventions funded in the health care system.

Validity of estimate of costs
The perspective adopted in the study was reported. It would appear that all the relevant categories of costs were included in the analysis. The unit costs were reported separately from the quantities of resources and the price year was appropriately given. These factors enhance the reproducibility of the study results in other settings. The costs were treated deterministically and only the costs of the two diagnostic tools were varied in the sensitivity analyses. Statistical analyses of the quantities of resources used were not conducted. The sources of the cost and resource data were reported. The authors made some assumptions in the cost analysis.

Other issues
The authors did not compare their findings with those from other studies. They also did not address the issue of the generalisability of the study results to other settings, although several sensitivity analyses were conducted. The study referred to patients with extremity trauma and this was reflected in the conclusions of the analysis.

Implications of the study
The implication of the study was that, considering 250 equivocal trauma patients a year undergoing exclusion arteriography in place of surgical exploration, the savings for the taxpayers would range from $344,000 at a disease prevalence of 40% to $558,000 at a disease prevalence of 20%, with better outcomes.

Source of funding
None stated.

Bibliographic details
Keen J D, Keen R R. The cost-effectiveness of exclusion arteriography in extremity trauma. Cardiovascular Surgery