Cost-effectiveness of uterine artery embolization and hysterectomy for uterine fibroids
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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 uterine artery embolisation (UAE) versus hysterectomy for the treatment of symptomatic uterine fibroids.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised 40-year-old premenopausal women with a diagnosis of symptomatic uterine fibroids and no desire for future pregnancy.

Setting
The setting was secondary care. The economic study was conducted in the USA.

Dates to which data relate
The effectiveness evidence was derived from literature published between 1982 and 2002. Resource use referred to 1999. Prices relating to 1999 were used.

Source of effectiveness data
The effectiveness data were derived from a review or synthesis of completed studies. Some estimates of effectiveness were based on opinion.

Modelling
A Monte Carlo Markov decision model (fully detailed in the original paper) was developed to evaluate the costs and quality-adjusted life expectancy associated with UAE, compared with hysterectomy and no treatment, for patients with symptomatic uterine fibroids. A cohort of women aged 40, with no desire for future pregnancy, was followed-up after undergoing UAE, hysterectomy or no treatment, until menopause. Menopause was assumed to occur at age 51 (average age of menopause), so the follow-up period lasted 11 years. The cycle length was one month. It was assumed that the patients did not undergo any further investigations or treatment after hysterectomy. Future events related to UAE and hysterectomy, such as heart disease and cancer, were not considered in the model. The no treatment strategy included only the management of symptoms and the possibility of natural death.

Outcomes assessed in the review
The outcomes assessed and used as input parameters for the model were:
the mortality, technical failure rate, cure rate, complication rate and annual recurrence rate for UAE;
the mortality, cure rate and complication rate for hysterectomy;
the quality of life related to menorrhagia, cure after UAE and cure after hysterectomy; and
age- and gender-specific mortality rates.

Study designs and other criteria for inclusion in the review
The authors stated that, in the absence of randomised controlled trials, they gave priority to studies with larger sample sizes and longer follow-up times.

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
Approximately 7 primary studies were included in the review.

Methods of combining primary studies
The results of the primary studies were not combined.

Investigation of differences between primary studies
No investigation of differences between the primary studies was discussed.

Results of the review
The rates of UAE-related events were 0.00015 for mortality, 0.02 for technical failure rate, 0.90 for cure rate, 0.005 for major complication rate, 0.065 for minor complication rate, and 0.00 for annual recurrence rate.

The rates of hysterectomy-related events were 0.002 for mortality, 0.96 for cure rate, and 0.02 for major complication rate.

The values for health-related quality of life were 0.78 for menorrhagia, 0.90 for cured after UAE, and 0.88 for cured after hysterectomy.

The age- and gender-specific mortality rates used in the model were not presented.

Methods used to derive estimates of effectiveness
Some estimates of effectiveness were based on expert opinion. The authors appear to have made some further assumptions concerning the health-related quality of life values.
Estimates of effectiveness and key assumptions
The recurrence rate for UAE was assumed to be zero. It was assumed that patients who were not cured with UAE or hysterectomy had a postoperative quality of life similar to that before treatment, when menorrhagic. Although after hysterectomy uncured patients no longer had menorrhagia, the effect of their symptoms on their quality of life was assumed to be similar to that of menorrhagia. The utilities for the cured state after UAE were assumed to be similar to those of women in the same age group in the general population. It was assumed that the quality of life values were reduced by 20% for the duration of the recovery (post-procedural) period. This was 1 week for UAE and 6 weeks for hysterectomy. Major complications were also assumed to reduce quality of life by 20% during the additional time required to recover from them.

Measure of benefits used in the economic analysis
The measure of benefits used was the quality-adjusted life-years (QALYs). The benefits were discounted at an annual rate of 3%.

Direct costs
It was stated that a societal perspective was adopted in the study. The direct costs included procedural costs and mortality costs. The procedural costs covered the hospital and physician, the treatment of complications, follow-up visits, and follow-up magnetic resonance imaging for patients who had undergone UAE. The mortality costs were assumed to be 150% of the procedural costs. The costs and the quantities were not reported separately. The data were obtained from the 1999 Medicare Provider Analysis and Review database. Additional information, used in the sensitivity analysis, was obtained from a hospital's accounting database, which calculated relative value units to represent both the technical difficulty costs and the time costs associated with the procedures. The total costs associated with the interventions evaluated were derived using modelling. The costs were discounted at an annual rate of 3% since they were incurred during 11 years. All the costs were converted to 1999 prices using the medical component of the consumer price index.

Statistical analysis of costs
The costs were treated deterministically. No statistical analysis of the costs was carried out.

Indirect Costs
The indirect costs reflected lost patient time due to recovery, complications and follow-up. The quantities and the costs were reported separately. Estimates of time lost were based on assumptions. Median weekly wage rates were adopted from the US Bureau of Labor Statistics for 2001. Productivity losses for patients who were not cured after treatment were based on the National Health Interview Survey, 1996. The total indirect costs were derived using modelling. The costs were incurred during 11 years and were therefore discounted at an annual rate of 3%. 1999 prices were used.

Currency
US dollars ($).

Sensitivity analysis
One-way sensitivity analyses were performed. These tested the robustness of the results under a range of model assumptions, uncertain model transition probabilities and estimated costs. The parameters used were all transition probabilities of events following UAE or hysterectomy, recovery time, procedural costs, mortality costs, health-related quality of life weights, including no quality adjustments, mean age of cohort at the time of procedure, mean age at start of menopause, and discount rate. A wide range of values was used. These were based on expert opinion, alternative sources of cost data, and different assumptions on the model structure. No justification was provided for the ranges of some values, for example, those related to events following the procedures (e.g. mortality, complication and cure rates). A two-way sensitivity analysis was performed by simultaneously varying the utilities of cured patients after UAE and after hysterectomy.
Estimated benefits used in the economic analysis
The number of QALYs per patient was 8.29 for UAE, 8.18 for hysterectomy and 7.31 for no treatment. These benefits were estimated for an 11-year period after the intervention was performed, taking treatment-related complications into consideration. The values were discounted at a rate of 3% per annum.

Cost results
The total costs per patient were $6,916 for UAE, $7,847 for hysterectomy and $4,949 for no treatment. The costs associated with treating procedural complications were included. The total costs were estimated for 11 years and were discounted at 3% annually.

Synthesis of costs and benefits
The costs and benefits were combined in the form of incremental cost-effectiveness ratios (ICERs). In the case of a strategy being more effective and less costly than its comparator (dominant strategy), the ICER was not calculated as this was unnecessary. ICERs expressed the additional costs per QALY gained. UAE dominated hysterectomy as it was both less expensive and more effective. The ICER of UAE compared with no treatment was $2,007 per QALY gained.

From the sensitivity analysis, the results were robust to changes in most model assumptions. UAE dominated hysterectomy in most scenarios. The exceptions were reducing the cure rate of UAE, increasing the procedural costs of UAE, increasing the recovery time following UAE, and reducing the recovery time following hysterectomy. All of these scenarios resulted in UAE being still more effective, but also more expensive, than hysterectomy. The ICER ranged from $1,771 to $15,940 per QALY gained. In addition, the results were sensitive to changes in the utilities for cure following treatment. When utilities for cure following UAE decreased or for cure following hysterectomy increased, then hysterectomy became more effective. With the elimination of the quality of life adjustments, UAE and hysterectomy became equally effective. Compared with no treatment, the maximum ICER of UAE was found to be $15,285 per QALY, after the whole range of values was examined in one-way analysis. Across most model assumptions UAE was more effective and more expensive than no treatment. There were two exceptions. Reducing the mean age of the patient cohort to 30 years resulted in no treatment being more expensive than UAE (UAE was therefore dominated in this case). Moreover, eliminating the quality of life adjustment made no treatment more effective than UAE.

The two-way sensitivity analysis showed that, if utilities for cure following UAE were reduced and those for cure following hysterectomy were increased, then hysterectomy became more effective and had an ICER that did not exceed $75,000 per QALY.

Authors' conclusions
Uterine artery embolisation (UAE) was a cost-effective alternative to hysterectomy for the treatment of symptomatic uterine fibroids in women with no desire for future pregnancy. However, the results were sensitive to changes in quality of life values.

CRD COMMENTARY - Selection of comparators
The selection of hysterectomy was implicitly justified since it represented routine practice. The no treatment comparator only partially allowed for the active value of the health technology to be evaluated, as it reflected symptomatic treatment. You should consider whether the comparators account for widely adopted practices in your own setting.

Validity of estimate of measure of effectiveness
The authors did not state that a systematic review of the literature had been undertaken. The results from the primary studies were not combined and the impact of differences between the primary studies was not discussed. Some estimates of effectiveness and assumptions in the model structure were based on expert opinion. The estimates were investigated in sensitivity analyses, using ranges that appear to have been appropriate although their selection was not
Fully justified.

**Validity of estimate of measure of benefit**
The estimation of benefits was appropriately modelled. The Markov model developed for this purpose was appropriate as it included potential events resulting from the performance of UAE or hysterectomy, each associated with relevant quality of life values.

**Validity of estimate of costs**
It was stated that a societal perspective was adopted in the study. However, categories of cost such as direct non-health care costs and potential informal care costs following treatment were not included in the analysis. This may have affected the results. The costs and the quantities were not reported separately, which reduces the generalisability of the results. A sensitivity analysis of the costs was, however, conducted. Most of the ranges used appear to have been appropriate, although some ranges, such as those referring to the cost of procedural death, were based on assumptions and could not be fully justified. In the base-case analysis, Medicare reimbursement rates were used, which represented charges. However, it was stated that the values used in the sensitivity analysis reflected resource use even more accurately than charges converted to costs using cost-to-charge ratios. The date to which the prices referred was reported, which increases the reproducibility of the results.

**Other issues**
The authors did not compare their findings with those of other studies, but they stated that there had been no published studies evaluating the cost-effectiveness of UAE. The issue of the generalisability of the results to other settings was not addressed. The authors considered that the assumptions they made about uncertainty associated with the input parameters of the model, especially those related to quality of life issues, to be limitations of the study, although these were necessary given the lack of data in the published literature. Moreover, they considered the assumptions made in the model structure to be further limitations. These included the lack of interventions following hysterectomy, the lack of alternative options of management for uncured women following UAE (e.g. myomectomy), and the omission of ovarian failure as a potential complication of UAE. Limitations also arose due to the assumption that magnetic resonance imaging, which was associated with substantial costs, was performed once after UAE instead of before and after, or not at all according to practices that were adopted by different hospitals depending on institutional standards of care. Nevertheless, the results of the study appear to have been fully presented. The target population was women with symptomatic uterine fibroids and no desire for future pregnancy, and this was reflected in the authors’ conclusions.

**Implications of the study**
UAE may be considered an alternative option to hysterectomy for the treatment of symptomatic fibroids in women with no desire for future pregnancy. However, the authors recommended that research on quality of life values in relation to the treatment of symptomatic fibroids with UAE or hysterectomy should be conducted.

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