

Cost effectiveness analysis of laparoscopic hysterectomy compared with standard hysterectomy: results from a randomised trial

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Abstract

Objective To assess the cost effectiveness of laparoscopic hysterectomy compared with conventional hysterectomy (abdominal or vaginal).

Design Cost effectiveness analysis based on two parallel trials: laparoscopic (n = 324) compared with vaginal hysterectomy (n = 163); and laparoscopic (n = 573) compared with abdominal hysterectomy (n = 286).

Participants 1346 women requiring a hysterectomy for reasons other than malignancy.

Main outcome measure One year costs estimated from NHS perspective. Health outcomes expressed in terms of QALYs based on women's responses to the EQ-5D at baseline and at three points during up to 52 weeks' follow up.

Results Laparoscopic hysterectomy cost an average of £401 (\$708; €571) more (95% confidence interval £271 to £542) than vaginal hysterectomy but produced little difference in mean QALYs (0.0015, -0.015 to 0.018). Mean differences in cost and QALYs generated an incremental cost per QALY gained of £267 333 (\$471 789; €380 437). The probability that laparoscopic hysterectomy is cost effective was below 50% for a large range of values of willingness to pay for an additional QALY.

Laparoscopic hysterectomy cost an average of £186 (\$328; €265) more than abdominal hysterectomy, although 95% confidence intervals crossed zero (-£26 to £375); there was little difference in mean QALYs (0.007, -0.008 to 0.023), resulting in an incremental cost per QALY gained of £26 571 (\$46 893; €37 813). If the NHS is willing to pay £30 000 for an additional QALY, the probability that laparoscopic hysterectomy is cost effective is 56%.

Conclusions Laparoscopic hysterectomy is not cost effective relative to vaginal hysterectomy. Its cost effectiveness relative to the abdominal procedure is finely balanced.

Introduction

The advent of laparoscopic approaches to hysterectomy offers the prospect of improved outcomes and gains in cost effectiveness through reduced convalescence and shorter length of inpatient stay. With the exception of data from some observational studies¹⁻³ and small randomised trials,^{4,5} however, little is known about the costs and cost effectiveness of laparoscopic forms of hysterectomy relative to conventional (abdominal and vaginal) approaches.

The eVALuate trial is the largest trial of laparoscopic hysterectomy compared with standard methods yet undertaken.⁶ This report describes a cost effectiveness analysis undertaken with eVALuate data.

Methods

Overview

Over one year we estimated costs from the NHS perspective and expressed benefits in terms of quality adjusted life years (QALYs). We undertook two separate comparisons: laparoscopic hysterectomy versus abdominal hysterectomy, and laparoscopic hysterectomy versus vaginal hysterectomy.

Trial design

Full details of the design of the eVALuate trial are reported in the accompanying paper.⁶ All the women randomised had gynaecological symptoms (excluding malignancy) that indicated the need for a hysterectomy. The surgeon decided which hysterectomy was most appropriate, abdominal or vaginal, and women were then randomised between the selected conventional procedure and laparoscopic assisted procedure in two parallel trials.

Of the 859 women who were allocated to and received treatment in the abdominal part of the study, 573 were randomised to laparoscopic hysterectomy and 286 to abdominal hysterectomy. Of the 487 who were allocated to and received treatment in the vaginal part of the trial, 324 patients were randomised to laparoscopic hysterectomy and 163 to vaginal hysterectomy. We carried out the economic analysis over a median follow up of 52 weeks (range 6-52; mean 46.88).

Measurement of resource use

Theatre—Clinical staff completed case record forms on the use of theatre resources. This included time in theatre and recovery room; type of hysterectomy undertaken; use of prophylactic antibiotics and anticoagulants; type of anaesthetic; method of haemostasis; and use of specific consumables such as disposable trocars and scissors. Details of intraoperative complications were also collected, and additional resources used estimated by a blinded investigator.

Main admission to hospital—Case record forms were used to measure use of resources during a woman's main admission, including total length of stay in hospital and the use of urinary catheterisation. We also collected details of postoperative complications during admission, including any blood transfusion and whether a woman had to be returned to theatre; additional resource use was estimated as for operative complications.

Follow up—At the six week clinic follow up visit, we used case record forms to collect data on the incidence of any complications; any additional resource use was estimated as for the immediate postoperative period.



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Patients also completed a questionnaire at this point, which included questions on number of inpatient days and outpatient, day case, and general practice visits made for any reason after they left hospital. Patients were also asked to complete similar questionnaires 4 and 12 months after hospital discharge.

Unit costs and outcomes

We used UK unit costs at 1999-2000 prices to value the use of resources (see bmj.com).

The health outcomes of the alternative forms of hysterectomy were assessed in terms of quality adjusted life years (QALYs). This reflects any mortality and differences in health related quality of life based on women's responses to the EQ-5D questionnaire at baseline and at up to three points after hospital discharge (six weeks, four months, and one year).⁷ Each woman in the trial thus had a health utility score derived from the EQ-5D at up to four time points. We translated these observations into QALYs over each woman's period of follow up. We estimated mean QALYs in each group, after adjusting for differences in baseline EQ-5D utility.

Analysis

As a result of staggered entry into the trial, we estimated mean costs and QALYs over one year by using methods to adjust for censored data. To account for the skewed nature of the data, we calculated 95% confidence intervals for differential costs and QALYs using the bias corrected and accelerated bootstrap method.^{8,9} Cost effectiveness analysis was undertaken to relate differential mean costs and QALYs associated with the alternative arms of the trial, with incremental cost effectiveness ratios (ICERs) calculated as appropriate. To account for uncertainty due to sampling variation in cost effectiveness, we plotted cost effectiveness acceptability curves.¹⁰

Results

Resource use

For the comparison of laparoscopic and vaginal hysterectomy, the main differences in key resources used related to time in theatre (mean 98 *v* 65 minutes, respectively) and the use of disposable equipment in many laparoscopic hysterectomies. No marked differences emerged in length of stay or use of resources after the initial admission.

The comparison of laparoscopic and abdominal hysterectomy again showed time in theatre was longer with laparoscopic hysterectomy (mean 108 *v* 74

minutes). Also, a high proportion of laparoscopies used disposable equipment. Compared with abdominal hysterectomy, however, laparoscopic hysterectomy had a lower mean length of hospital stay (3.95 *v* 5.11 days). During follow up, there were no differences in use of resources that would be expected to have a large effect on differential cost.

Costs

Table 1 shows mean and median costs per patient. For the comparison of laparoscopic and vaginal hysterectomy, the only marked difference related to theatre cost, which reflects differences in theatre times and the use of disposable equipment in a large proportion of laparoscopic procedures. Overall, laparoscopic hysterectomy cost a mean of £401 (95% confidence interval £271 to £542) more per patient.

The comparison of laparoscopic with abdominal hysterectomy showed that costs for laparoscopy were closer to, but still higher than for, conventional hysterectomy. Increased theatre costs again reflect longer theatre times and the use of disposable equipment with laparoscopy. However, the shorter length of admission with laparoscopic hysterectomy offset some of that additional cost. Overall, laparoscopic hysterectomy cost a mean of £186 more per patient, with 95% confidence intervals crossing zero (–£26 to £375).

Health outcomes

In terms of both mean and median EQ-5D values, and for both comparisons, women showed improvements between baseline and six weeks, and between six weeks and four months; and little change between four months and a year (table 2). The utilities were used to calculate QALYs for each woman over a one year period (table 2). These differences were small and 95% confidence intervals crossed zero.

Cost effectiveness

For the comparison of laparoscopic and vaginal hysterectomy, the issue is whether decision makers are willing to pay the implied ICER—that is, the mean difference in cost divided by the mean difference in QALYs—here £267 333 (£401/0.0015). However, we estimated mean differences in costs and QALYs with sampling uncertainty, which is represented in the figure in the form of cost effectiveness acceptability curves. This shows the probability that laparoscopic hysterectomy is more cost effective than vaginal hysterectomy for a range of maximum values that decision makers may place on an additional QALY. The

Table 1 Comparison of costs between laparoscopic and standard hysterectomy (1999-2000 prices)

	Vaginal trial				Abdominal trial			
	Laparoscopy (n=324)		Vaginal (n=163)		Laparoscopy (n=573)		Abdominal (n=286)	
	Mean	Median (IQR)	Mean	Median (IQR)	Mean	Median (IQR)	Mean	Median (IQR)
Theatre cost	807	635 (513-919)	396	362 (309-420)	788	646 (523-890)	453	431 (381-489)
Hospital "hotel" cost	589	542 (407-678)	591	542 (407-678)	548	542 (407-678)	692	678 (542-813)
Other postoperative cost	14	0 (0-0)	18	0 (0-0)	21	0 (0-0)	13	0 (0-0)
Follow up cost at six weeks	144	46 (0-108)	89	46 (0-108)	193	46 (0-108)	128	46 (0-108)
Follow up cost at four months	37	0 (0-46)	47	0 (0-46)	39	0 (0-46)	88	0 (0-46)
Follow up cost at one year	64	46 (0-46)	112	46 (0-46)	115	46 (0-46)	146	46 (0-46)
Total cost	1654		1253		1706		1520	
Differential mean cost* (95% CI)†	401 (271 to 542)				186 (–26 to 375)			

IQR=interquartile range.

*Laparoscopic minus standard.

†95% non-parametric confidence interval based on 1000 bootstrap replications.

Table 2 Health outcomes measured in trial comparing different methods of hysterectomy: responses to EQ-5D and quality adjusted life years (QALYs)

	Vaginal trial				Abdominal trial			
	Laparoscopy (n=324)		Vaginal (n=163)		Laparoscopy (n=573)		Abdominal (n=286)	
	Mean	Median (IQR)	Mean	Median (IQR)	Mean	Median (IQR)	Mean	Median (IQR)
EQ-5D utilities:								
Baseline	0.746	0.760 (0.725-1)	0.758	0.796 (0.691-1)	0.716	0.760 (0.691-0.848)	0.690	0.725 (0.689-0.812)
Six weeks	0.875	0.907 (0.812-1)	0.852	0.863 (0.76-1)	0.832	0.869 (0.76-1)	0.833	0.883 (0.76-1)
Four months	0.911	0.971 (0.848-1)	0.918	0.959 (0.848-1)	0.886	0.959 (0.812-1)	0.866	0.888 (0.796-1)
One year	0.920	1 (0.881-1)	0.917	1 (0.861-1)	0.897	0.929 (0.848-1)	0.892	0.959 (0.822-1)
QALYs over one year*	0.899		0.897		0.870		0.862	
Differential QALYs over one year† (95% CI)‡	0.0015 (-0.015 to 0.018)				0.007 (-0.008 to 0.023)			

IQR=interquartile range.
 *Adjusting for baseline EQ-5D utility.
 †Laparoscopic minus standard.
 ‡95% non-parametric confidence interval based on 1000 bootstrap replications.

probability that laparoscopic hysterectomy is the more cost effective is never above 50%.

For the comparison of laparoscopic hysterectomy and abdominal hysterectomy, the ICER is £26 571. The figure shows the cost effectiveness acceptability curve for this comparison, reflecting the imprecision with which these mean differences are estimated. This indicates that the higher the value decision makers place on an additional QALY, the higher the probability that laparoscopic hysterectomy will be more cost effective than abdominal hysterectomy. For example, at a maximum value of £30 000 the probability reaches 56%.

Sensitivity analysis

We conducted a sensitivity analysis to assess how differential costs would have changed if all laparoscopic procedures had been undertaken with reusable equipment. The mean difference in cost between laparoscopic and vaginal hysterectomy was reduced to £260 and the incremental cost effectiveness ratio for laparoscopy fell to £173 334. For the comparison with abdominal hysterectomy, the equivalent figures were £74 and £10 571. If most of the surgical equipment was disposable the incremental cost effectiveness ratios were £1 320 667 for laparoscopic versus vaginal hysterectomy and £259 428 for laparoscopic versus abdominal hysterectomy.

Discussion

We have shown that the mean cost of laparoscopic hysterectomy is higher than that of standard hysterectomy, mainly due to the additional cost of disposable instruments used in the procedure. Compared with vaginal hysterectomy, laparoscopy is unlikely to be considered cost effective as the additional cost associated with generating extra benefit is much higher than the NHS has been willing to pay in other contexts.¹¹

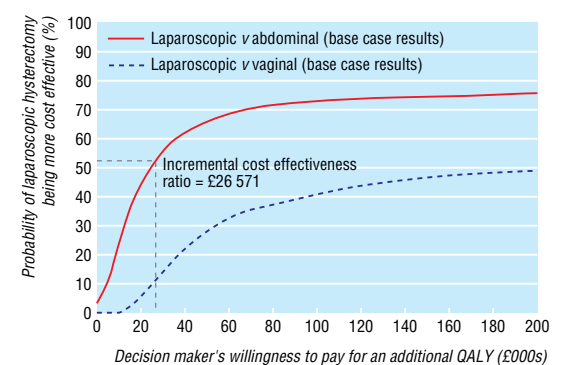
The cost effectiveness compared with abdominal hysterectomy is more finely balanced, mainly because of the shorter mean inpatient stay associated with laparoscopy, which results in lower additional costs. The incremental cost of laparoscopy per additional QALY of £26 571 is towards the top of the range that the NHS has been willing to pay.¹¹ Furthermore, the mean differences in cost and QALYs are measured imprecisely. Reflecting this, the probability of laparoscopy being more cost effective than abdominal hysterectomy is 56% if the NHS is willing to pay up to £30 000 for an additional QALY, indicating that the decision about value for money is finely balanced. If surgeons use

largely reusable equipment in preference to relatively expensive disposables, the additional cost of laparoscopic compared with abdominal hysterectomy would fall to £74 and the incremental cost effectiveness ratio to £10 571. This sensitivity analysis should be interpreted with caution as it assumes that the greater use of reusable equipment would not affect outcomes.

Limitations

Health outcomes were not measured until six weeks after the women were discharged from hospital. This may have missed some of the health gains associated with reduced convalescence with the laparoscopic procedure. Differences in utility over a six week period would have a limited effect on QALYs, although the effect on utility may be important in the comparison with abdominal hysterectomy given that the cost effectiveness in this group is more finely balanced.

The eVALuate trial collected data on time away from paid work. These showed that the mean (SD) number of days it took women to return to work after laparoscopic hysterectomy (78.68, SD 44.2) was similar to that in patients undergoing the vaginal procedure (70.21, SD 34.4). However, women who underwent laparoscopic hysterectomy took fewer days off work than women who underwent the abdominal procedure (77.8 (39.5) v 94.87 (60.0)). If all or part of this difference can reasonably be reflected in terms of productivity savings in monetary terms, this would strengthen the case for laparoscopic hysterectomy to be considered more cost effective than abdominal hysterectomy.



Cost effectiveness acceptability curves for laparoscopic hysterectomy v conventional hysterectomy (abdominal or vaginal). The ICER (incremental cost effectiveness ratio) for laparoscopic hysterectomy is not shown as it exceeds £200 000

What is already known on this topic

Hysterectomy is one of the most widely undertaken procedures in the healthcare systems of developed countries

Laparoscopic assisted hysterectomy is being used as an alternative to conventional (abdominal or vaginal) hysterectomy

The differential cost of the conventional and laparoscopic procedures has been assessed only in observational studies and small trials

What this study adds

Laparoscopic hysterectomy is more costly than conventional hysterectomy, though additional costs are lower in comparison with abdominal than with vaginal hysterectomy

The laparoscopic procedure has a small beneficial effect in terms of quality adjusted life years (QALYs)

Laparoscopic hysterectomy is unlikely to be considered cost effective relative to vaginal hysterectomy. Its cost effectiveness relative to the abdominal procedure is finely balanced

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Autopsy after termination of pregnancy for fetal anomaly: retrospective cohort study

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Abstract

Objective To study trends in termination of pregnancy for fetal anomaly over 10 years and to assess the contribution of autopsy to the final diagnosis and counselling after termination.

Design Retrospective study with cases from a congenital anomaly register and a defined unselected population.

Data sources Pregnancies resulting in termination for fetal anomaly identified from the Oxford congenital anomaly register. Details about the prenatal diagnosis and autopsy findings were retrieved from case notes.

Results Of the 57 258 deliveries, 309 (0.5%) were terminated because of prenatally diagnosed abnormality. There were 129/29 086 (0.4%) terminations for fetal anomaly carried out in 1991-5 and 180/28 172 (0.6%) in 1996-2000. The percentage of fetuses that underwent autopsy fell from 84% to 67%. Autopsy was performed in 132 cases identified by ultrasound scan, with no evidence for abnormal

karyotype. In 95 (72%) the autopsy confirmed the suspected diagnosis and did not add important further information, two cases were not classified, and in 35 (27%) the autopsy added information that led to a refinement of the risk of recurrence (reduced in 17, increased in 18); in 11 of these 18 cases it was increased to a one in four risk.

Conclusions Though there has been an increase in the rate of terminations of pregnancy for fetal anomaly, there has been a decline in the autopsy rate. When a prenatal diagnosis was based on the results of a scan only, the addition of information from a autopsy by a specialist paediatric pathologist provided important information that changed the estimated risk of recurrence in 27% of cases and in 8% this was to a higher (one in four) risk.

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