

in treatment of shock and organ failure that we have examined in the context of meningococcal disease might be equally apparent in the management of children with other life threatening disorders.

We dedicate this paper to the late Professor David Baum. We thank Roddy McFaul for his help; all local hospital staff and regional paediatric intensive care; public health staff at CDSC including Mary Ramsay, Norman Begg, and James Stuart; Ed Kaczmarek of the Meningococcal Reference unit in Manchester; the district consultants in communicable disease control; and the regional epidemiologists. We are grateful to all the parents who participated, especially those recently bereaved.

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## Methods of hysterectomy: systematic review and meta-analysis of randomised controlled trials

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### Abstract

**Objective** To evaluate the most appropriate surgical method of hysterectomy (abdominal, vaginal, or laparoscopic) for women with benign disease.

**Design** Systematic review and meta-analysis.

**Data sources** Cochrane Menstrual Disorders and Subfertility Group Trials Register, Cochrane Central Register of Controlled Trials, Medline, Embase, and Biological Abstracts.

**Selection of studies** Only randomised controlled trials were selected; participants had to have benign gynaecological disease; interventions had to comprise at least one hysterectomy method compared with another; and trials had to report primary outcomes (time taken to return to normal activities, intraoperative visceral injury, and major long term complications) or secondary outcomes (operating time, other immediate complications of surgery, short term complications, and duration of hospital stay).

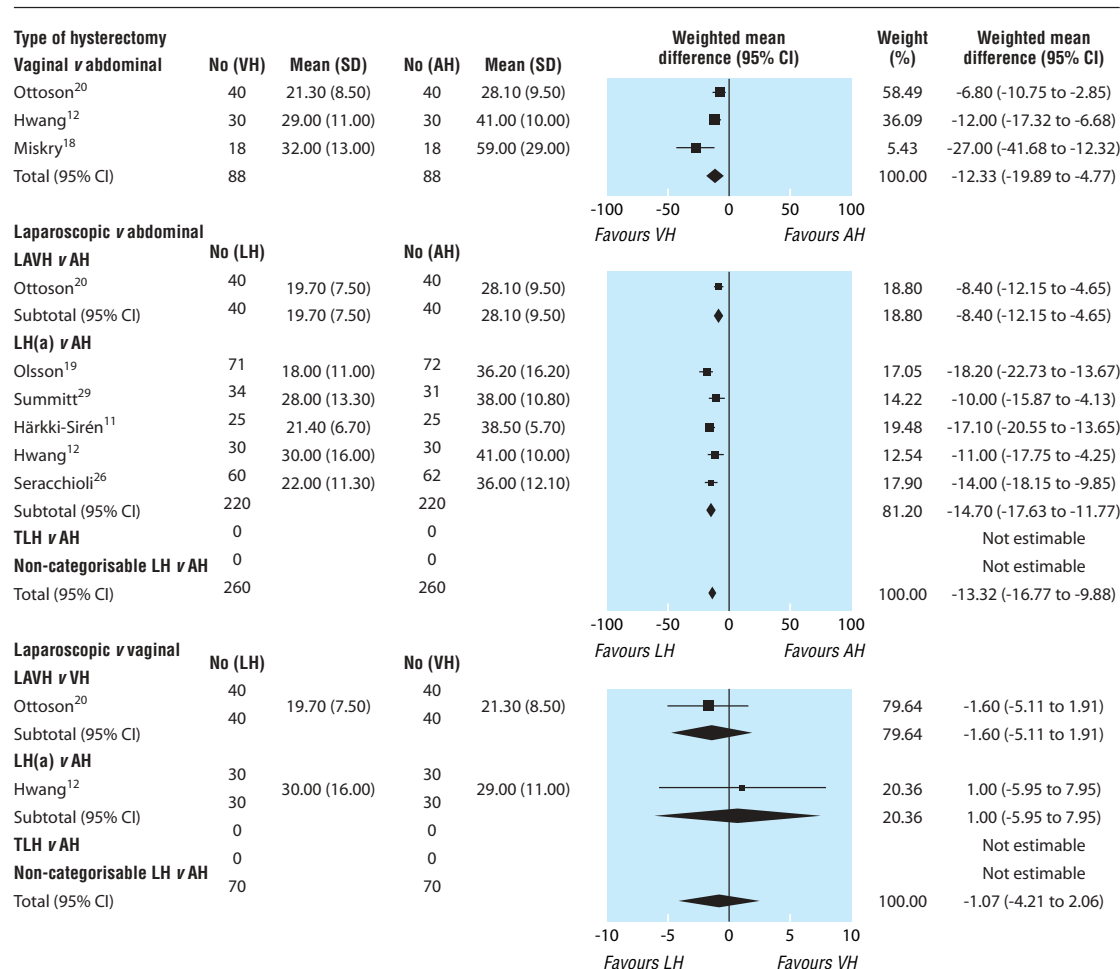
**Results** 27 trials (total of 3643 participants) were included. Return to normal activities was quicker after vaginal than after abdominal hysterectomy (weighted mean difference 9.5 (95% confidence interval 6.4 to 12.6) days) and after laparoscopic than after abdominal hysterectomy (difference 13.6 (11.8 to 15.4)) days, but was not significantly different for laparoscopic versus vaginal hysterectomy (difference -1.1 (-4.2 to 2.1) days). There were more urinary tract injuries with laparoscopic than with abdominal hysterectomy (odds ratio 2.61 (95% confidence interval 1.22 to 5.60)), but no other intraoperative visceral injuries showed a significant difference between surgical approaches. Data were notably absent for many important long term patient outcome measures, where the analyses were underpowered to detect important differences, or they were simply not reported in trials.

**Conclusions** Significantly speedier return to normal activities and other improved secondary outcomes (shorter duration of hospital stay and fewer unspecified infections or febrile episodes) suggest that vaginal hysterectomy is preferable to abdominal hysterectomy where possible. Where vaginal hysterectomy is not possible, laparoscopic hysterectomy is preferable to abdominal hysterectomy, although it brings a higher chance of bladder or ureter injury.

### Introduction

Three main types of hysterectomy are now used—abdominal, vaginal, and laparoscopic. The proportion performed laparoscopically has gradually increased, and, although the procedure takes longer than abdominal and vaginal hysterectomy, proponents have emphasised several advantages: the opportunity to diagnose and treat other pelvic diseases and to carry out adnexal surgery; the ability to secure thorough intraperitoneal haemostasis at the end of the procedure; and a rapid recovery time.<sup>1</sup>

Three subcategories of laparoscopic hysterectomy have been described.<sup>2</sup> In laparoscopic assisted vaginal hysterectomy (LAVH), the procedure is done partly laparoscopically and partly vaginally, but the laparoscopic component does not involve uterine vessel ligation. In uterine vessel ligation laparoscopic hysterectomy (LH(a)), although the uterine vessels are ligated laparoscopically, part of the operation is done vaginally. In total laparoscopic hysterectomy, the entire operation is done laparoscopically; this requires the highest degree of surgical skill and is currently done



Meta-analysis of return to normal activities (number of days). Statistical pooling used random effects statistical model for vaginal versus abdominal hysterectomy and for laparoscopic versus abdominal hysterectomy, and fixed effects statistical model for laparoscopic versus vaginal hysterectomy. AH=abdominal hysterectomy; VH=vaginal hysterectomy; LH=laparoscopic hysterectomy; LAVH=laparoscopic assisted vaginal hysterectomy; LH(a)=laparoscopic hysterectomy where laparoscopic procedures include uterine artery ligation; TLH=total laparoscopic hysterectomy. Reference numbers refer to reference numbers cited in the full version of this article on [bmj.com](http://bmj.com)

only by a very small proportion of gynaecologists. It has been unclear whether total laparoscopic hysterectomy offers benefits over other forms of hysterectomy.

The introduction of laparoscopic approaches in hysterectomies has prompted a much greater interest in the proper scientific evaluation of all forms of hysterectomy. This review aims to assess the most beneficial and least harmful surgical method.

## Methods

In March 2004 we searched the Cochrane Menstrual Disorders and Subfertility Group Trials Register, the Cochrane Central Register of Controlled Trials, Medline, Embase, and Biological Abstracts. We performed data extraction and quantitative data synthesis according to Cochrane guidelines.<sup>3</sup> We selected trials according to the following eligibility criteria: randomised controlled trials for benign gynaecological disease; interventions comprising at least one surgical approach to hysterectomy compared with another (excluding subtotal hysterectomy); and trials had to report primary outcomes (time it took participants to return to normal activities, intraopera-

tive visceral injury, and major long term complications) or secondary outcomes (operating time, other immediate complications of surgery, short term complications, and duration of hospital stay).

## Results

### Trial flow

We identified 42 trials, of which we included 27 with a total of 3643 participants. (For details of the included and excluded trials, see the full version of this article on [bmj.com](http://bmj.com).) Two trials compared vaginal with abdominal hysterectomy, 16 compared laparoscopic with abdominal hysterectomy, four compared laparoscopic with vaginal hysterectomy, one compared LAVH with LH(a), one compared laparoscopic with abdominal and vaginal hysterectomy, and three compared laparoscopic, vaginal, and abdominal hysterectomy.

### Study characteristics and validity assessment

Quality criteria are presented in detail elsewhere.<sup>3</sup> Trial authors might have selectively reported "interesting" results, potentially jeopardising the reliability of conclusions.

We used Richardson's classification<sup>4</sup> to categorise 22 of the 25 included studies that involved laparoscopic hysterectomy according to the amount of laparoscopic content. We also subcategorised these 22 trials as either LAVH, LH(a) or total, depending on the extent of the surgery performed laparoscopically and vaginally.

### Meta-analysis results

All meta-analysis graphs are published electronically in the Cochrane Library.<sup>3</sup>

#### Primary outcomes

**Return to normal activities**—The meta-analysis in the figure shows that patients returned to normal activities sooner after vaginal than after abdominal hysterectomy (weighted mean difference 12.3 (95% confidence interval 4.8 to 19.9) days); although statistical heterogeneity was present for this outcome (P value 0.02,  $\chi^2$  test;  $I^2=75.3\%$ ), similar results were obtained with both fixed and random effects models. Return to normal activities was also quicker after laparoscopic than after abdominal hysterectomy (difference 13.3 (9.9 to 16.8) days); although statistical heterogeneity was present (P value 0.004,  $\chi^2$  test;  $I^2=71.2\%$ ), similar results were obtained using both fixed and random effects models. We found no significant difference between laparoscopic and vaginal hysterectomy in return to normal activities (–1.1 (–4.2 to 2.1) days).

**Intraoperative visceral injury**—Where bladder and ureter injuries were pooled as “urinary tract injury,” we found a significant increase in urinary tract injury for laparoscopic versus abdominal hysterectomy (odds ratio 2.61 (95% confidence interval 1.22 to 5.60)) but no significant differences in urinary tract injury for laparoscopic versus vaginal hysterectomy (1.00 (0.36 to 2.75)) or for LH(a) versus LAVH (1.60 (0.29 to 7.83)) (see [bmj.com](#)). No other intraoperative visceral injuries showed a significant difference between surgical approaches.

**Major long term complications**—We found no significant differences in fistula formation, urinary dysfunction, sexual dysfunction, or patient satisfaction. For most of these outcomes the analyses were underpowered and for other important long term outcome measures, data were not reported.

#### Secondary outcomes

**Operation time**—Abdominal hysterectomies were performed significantly faster than laparoscopic hysterectomies (weighted mean difference 18.0 (95% confidence interval 1.0 to 35.1) minutes), although this difference was not apparent in trials where the subcategory LAVH was compared with abdominal hysterectomy. Statistical heterogeneity was present for operation time for laparoscopic versus abdominal hysterectomy (P value < 0.0001,  $\chi^2$  test;  $I^2=96.2\%$ ), but similar results were obtained with fixed and random effects models, except for a significantly shorter operation time for the LAVH subcategory versus abdominal hysterectomy, apparent with a fixed effects model (difference 7.6 (3.0 to 12.2) minutes). Vaginal hysterectomy also had a shorter operation time than laparoscopic hysterectomy (difference 44.5 (26.2 to 62.8) minutes), and, although statistical heterogeneity was present (P value 0.001,  $\chi^2$  test;  $I^2=80.6\%$ ), similar results were obtained with fixed and random effects models. LAVH had a significantly

shorter operation time than LH(a) (difference 25.3 (10.0 to 40.6) minutes).

**Other intraoperative complications**—The number of women with substantial bleeding and the incidence of unintended laparotomy did not differ significantly between surgical approaches.

**Short term outcomes and complications**—Hospital stay was significantly shorter for women who had had vaginal rather than abdominal hysterectomy (weighted mean difference 1.0 (0.7 to 1.2) days) or laparoscopic rather than abdominal hysterectomy (difference 2.0 (1.9 to 2.2) days); statistical heterogeneity was present (P value < 0.0001,  $\chi^2$  test;  $I^2=95.0\%$ ), but similar results were obtained with a random effects model. Duration of hospital stay was not significantly different for laparoscopic versus vaginal hysterectomy or for LH(a) versus LAVH. For vaginal versus abdominal hysterectomy, there were significantly fewer unspecified infections or febrile episodes (odds ratio 0.42 (95% confidence interval 0.21 to 0.83)). For laparoscopic versus abdominal hysterectomy, there were significantly fewer wound or abdominal wall infections (0.32 (0.12 to 0.85)) and significantly fewer unspecified infections or febrile episodes (0.65 (0.49 to 0.87)). There were no significant differences between surgical approaches in the need for blood transfusion, although laparoscopic hysterectomy was associated with a significantly lower mean blood loss than abdominal hysterectomy (weighted mean difference 45.3 ml (95% confidence interval 17.9 ml to 72.7 ml)) and a smaller drop in haemoglobin (0.55 g/l (0.28 g/l to 0.82 g/l)). We found no evidence of a significant difference between surgical approaches for occurrence of pelvic haematoma, vaginal cuff infection, urinary tract infection, chest infection, or thromboembolic events.

### Sensitivity analyses

Exclusion of the three trials in which surgeons for one intervention were unequivocally different from those performing the other intervention did not alter the significance of any meta-analysis results.

When laparoscopic hysterectomy was subcategorised, the longer operating time compared with abdominal hysterectomy was not apparent for LAVH. All other subcategory meta-analyses of laparoscopic versus abdominal hysterectomy and laparoscopic versus vaginal hysterectomy showed results that were similar to the respective meta-analysis of laparoscopic hysterectomy as a pooled group.

### Data not included in meta-analysis

Lower postoperative pain scores were found for laparoscopic than for abdominal hysterectomy, in addition to improved quality of life, body image scores, and increased sexual frequency at six weeks, but these differences disappeared by one year. Mean total hospital cost was significantly higher for laparoscopic than vaginal hysterectomy.

## Discussion

Our data suggest that vaginal hysterectomy is preferable to abdominal hysterectomy, provided that it can be done safely. Claims that laparoscopic hysterectomy can allow identification of pelvic disease that might otherwise lead to complications during vaginal hysterectomy and that the meticulous haemostasis achievable during laparo-

### What is already known on this topic

Abdominal hysterectomy has been regarded as the most invasive approach to hysterectomy for women with benign disease

Laparoscopic hysterectomy requires greater surgical expertise

Previous reviews have reached different conclusions about the relative merits of laparoscopic, abdominal, and vaginal hysterectomy

### What this study adds

Important gaps in outcome data have been highlighted, especially for long term outcomes

No outcomes are significantly worse for vaginal hysterectomy than for any other method of hysterectomy—vaginal is preferable to abdominal hysterectomy where possible

No evidence supports the use of laparoscopic hysterectomy rather than vaginal hysterectomy if the latter can be done safely

Compared with abdominal hysterectomy, laparoscopic hysterectomy is associated with less blood loss, shorter hospital stay, speedier return to normal activities, and fewer abdominal wall infections or febrile episodes, but it takes longer and urinary tract injuries are more likely

scopic hysterectomy might reduce pelvic haematomas or vaginal cuff infections have not been borne out in this review. However, a laparoscopic approach may be appropriate if an oophorectomy is needed. Whether the increased detection of unexpected disease at laparoscopic hysterectomy (compared with vaginal hysterectomy) affects subsequent clinical outcomes remains uncertain.

#### Operating time

Operating time is longer for laparoscopic than for both abdominal and vaginal hysterectomy. However, LAVH had a significantly shorter operating time than abdominal hysterectomy, and LAVH had a significantly shorter mean operating time than LH(a), the latter being the lengthiest operation.

#### Urinary tract injury

The increased incidence of urinary tract injury from laparoscopic hysterectomy seen in our review supports that reported elsewhere in non-randomised studies.<sup>5,6</sup> Our study was not powerful enough to detect an increase in ureteric injury independently. The largest randomised controlled trial included in this review found a significant increase in this outcome for laparoscopic versus abdominal hysterectomy (but not laparoscopic versus vaginal hysterectomy). It could be speculated that laparoscopic uterine artery ligation is the manoeuvre most likely to increase the risk of ureteric injury, especially by an unskilled surgeon. But we were unable to confirm this as trials of LAVH versus abdominal hysterectomy did not report on ureteric injury.

#### Methodological challenges and surgical training

Until the past few years, the vast majority of hysterectomies for benign disease were still performed abdominally,<sup>2</sup> and this is likely still to be the case in most settings.<sup>7</sup> Although many gynaecologists in training are now exposed to laparoscopic hysterectomy, very few newly trained gynaecologists will have sufficient expertise and confidence to tackle total laparoscopic hysterectomy, which requires the highest level skills. More surgeons will be trained to do LAVH (and indeed some gynaecologists who have not received specific training have acquired the skills to perform LAVH and LH(a)).

One important benefit of the introduction of LAVH and LH(a) into gynaecology training has been to increase surgeons' confidence and skill with vaginal surgery, thus making vaginal hysterectomy a more feasible option for many.

#### Conclusions

Our review found no important disadvantages of vaginal hysterectomy compared with any other surgical approach, thus it remains an excellent option. Avoiding abdominal hysterectomy accelerates recovery, diminishes postoperative pain, and avoids abdominal wall infections and general postoperative febrile illness. Finally, with laparoscopic hysterectomy, urinary tract injury is a genuine concern.

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#### Endpiece

##### Shallow animals

A Physician who should even be a Theist, still more a Christian, would be a rarity indeed. I do not know one. And I know a great many Physicians. They are shallow Animals: having always employed their minds about Body and Gut, they imagine that in the whole system of things there is nothing but Gut and Body.

*Collected letters of Samuel Taylor Coleridge*, edited by Earl Leslie Griggs, quoted in Vickers N. *Coleridge and the doctors*. Oxford: Oxford University Press, 2004:18

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