Comparison of vaginal hysterectomy and laparoscopic hysterectomy: a systematic review and meta-analysis

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Abstract

Background: There are various surgical approaches of hysterectomy for benign indications. This study aimed to compare vaginal hysterectomy (VH) and laparoscopic hysterectomy (LH) with respect to their complications and operative outcomes.

Methods: We selected randomised controlled trials that compared VH with LH for benign gynaecological indications. We included studies published after January 2000 in the following databases: Medline, EMBASE, and CENTRAL (The Cochrane Library). The primary outcome was comparison of the complication rate. The secondary outcomes were comparisons of operating time, blood loss, intraoperative conversion, postoperative pain, length of hospital stay and duration of recuperation. We used Review Manager 5.3 software to perform the meta-analysis.

Results: Eighteen studies of 1618 patients met the inclusion criteria. The meta-analysis showed no differences in overall complications, intraoperative conversion, postoperative pain on the day of surgery and at 48 h, length of hospital stay and recuperation time between VH and LH. VH was associated with a shorter operating time and lower postoperative pain at 24 h than LH.

Conclusions: When both surgical approaches are feasible, VH should remain the surgery of choice for benign hysterectomy.

Keywords: Laparoscopic hysterectomy, Vaginal hysterectomy, Meta-analysis

Backgrounds

A substantial number of women undergo hysterectomy annually, and 70 % of hysterectomies are performed for benign indications, including leiomyoma, adenomyosis, severe dysmenorrhea and uterine prolapse [1]. The surgical approach of hysterectomy is the most important factor responsible for postoperative morbidity. Until the present, the approaches for hysterectomies are vaginal, abdominal, laparoscopic and robotic assisted laparoscopic hysterectomy. If feasible, vaginal hysterectomy is associated with a shorter duration of hospital stay, speedier recuperation, fewer unspecified infections or febrile episodes than abdominal hysterectomy [2]. Since Reich first performed laparoscopic hysterectomy (LH) in 1989, various laparoscopic techniques and instruments have been developed, resulting in the vigorous implementation of LH, including laparoscopic-assisted vaginal hysterectomy (LAVH) and total laparoscopic hysterectomy (TLH) at present [3]. In contrast, VH is commonly utilized to treat uterine prolapse, but despite proven safety and effectiveness, it remains underutilized for the surgical treatment of non-prolapse conditions [4]. Gynaecologists perform LAVH or TLH according to their preference, and it is conservative to say that gynaecologists performing LH almost never perform VH [4]. There are several reasons for the widespread implementation of LH. First, LH can facilitate a better anatomical view, which has advantages over VH in cases of severe endometriosis or when there is a history of pelvic inflammatory disease. Second, in cases of large...
uterine size and for uteruses with little or no descent, LH simplifies the separation of the uterus from its attachment to the pelvic wall [5]. There are multiple approaches to hysterectomy, and each method has its procedure-specific advantages and disadvantages. Since VH and LH are minimally invasive techniques for benign indications that are widely performed around the world, we present a meta-analysis of randomised controlled trials (RCTs) comparing LH with VH for benign gynaecological conditions to identify which surgical approach is superior with respect to various surgical outcomes, especially the rates of complications.

Methods
Criteria for considering studies for this review
We selected RCTs that compared VH with LH (LAVH or TLH or unspecified LH) published from January 2000. No language restriction was used. We included women who underwent VH and LH for benign gynaecological indications and excluded women with gynaecological malignancies.

Study outcomes
The primary outcome of the present analysis was the incidence of intraoperative and postoperative complications. Operative complications were classified by the Dindo classification of surgical complications [6]. Secondary outcomes were operating time, blood loss, rate of conversion to laparotomy, postoperative pain, length of hospital stay and length of recuperation.

Search methods for studies: electronic searches
This meta-analysis was prepared in accordance with the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement (PRISMA Statement) [7, 8]. A literature search for articles published from 1 January 2000 to present was conducted within the main international databases. We searched records from the following databases: Medline, EMBASE, and CENTRAL (The Cochrane Library) for combinations of the terms “hysterectomy,” “laparoscop*”, “vagina*”, “laparoscopy*” AND assisted AND vagina*, “and” “benign AND condition”* OR indication* OR disease* OR “disorder*”. Symbol * was used for truncation.

Data collection and analysis
The studies were included after fulfilling the following inclusion criteria: RCTs; hysterectomy performed for benign gynaecological conditions, and VH outcomes compared with those of any LH. Studies were excluded from the analysis if any one of the inclusion criteria was not met. Two reviewers (SR Oh and SH Lee) independently reviewed the articles and extracted the data. Disagreements were resolved by the other reviewers (JH Yoon, SE Choi). Two reviewers (SR Oh and SH Lee) worked independently and examined the potential eligibility of all the studies retrieved from the database after fulfilling the inclusion and exclusion criteria. Next, they extracted and assessed the risk of bias in each full text article. The other reviewers (JH Yoon, SE Choi) resolved inconsistencies between the first two reviewers through consensus of the whole research team.

Data extraction and management
First reviewers extracted data from the included studies. The data was confirmed twice by the second reviewers to minimize potential errors. Conflicts were resolved by consensus and discussion. The data extracted from each study included the author, publication year, type of study, number of patients, routes of hysterectomy (VH, LAVH, TLH and unspecified LH), and outcomes (complications, operating time, blood loss, intraoperative conversion, postoperative pain, length of hospital stay and length of recuperation). We first tried to extract numerical data from tables, text or figures. If these data were not reported numerically, we extracted data from graphs using digital ruler software. When summary data included only the median and range, data were transformed according to the methods described by Hozo et al. [9].

Risk of bias assessment and data analysis
We used tools for assessing quality and risk of bias from the Cochrane Handbook for Systematic Reviews of Interventions to evaluate the methodological quality of RCTs [10]. The following seven items were evaluated:

1. Random sequence generation
2. Allocation concealment
3. Blinding of participants and personnel
4. Blinding of outcome assessment
5. Incomplete outcome data
6. Selective reporting
7. Other bias

The answers for each item included “low” (low risk of bias), “unclear” (either lack of information or uncertainty over the potential for bias), or “high” (high risk of bias). Pairs of independent reviewers assessed the methodological quality. Discrepancies were resolved by consensus of the whole team. A meta-analysis was conducted using Review Manager version 5.3 software, which was designed for and used in Cochrane reviews. Random-effects models were used to calculate a pooled estimate of effect in the meta-analysis. The dichotomous outcomes of each study are represented as the risk ratio (RR) with an estimated 95% confidence interval (CI). The continuous variables are shown as the weighted mean difference (WMD) with 95% CI, which were calculated from the mean, standard deviation (SD), p-
value, and sample size of each study. Heterogeneity was assessed using Higgins I² value that evaluates the percentage of total variation across a study due to heterogeneity rather than by chance alone: low heterogeneity (I² < 25%), moderate heterogeneity (I² = 25 to 75%), and high heterogeneity (I² > 75%). We used GRADEpro GTD web-based software to rate the quality of each outcome according to GRADE guidelines [11–13].

Results
The primary search retrieved 1611 citations with combinations of the terms “hysterectomy”, “laparoscop*”, “vagina*”, “laparoscop* AND assisted AND vagina*” and “benign AND condition* OR indication* OR disease* OR disorder*”, which were screened for eligible studies. After excluding duplicate citations, 1041 potentially eligible citations were identified and examined in detail. Of these, 1023 articles were excluded because of the inclusion of only one surgical approach (VH or TLH or LAVH), non-RCT design or inclusion of patients with malignancies. Eighteen articles reporting results from RCTs comparing VH (n = 677) with LH (n = 941) were included in the present meta-analysis (Fig. 1). The meta-analysis was performed using Review Manager, and the studies comparing VH and LH were divided into three subgroups: VH vs. LAVH; VH vs. TLH; and VH vs. unspecified LH. Hence, the number of studies on VH was duplicated in each outcome. The risks of bias in the included studies are summarised in Fig. 2.

Inclusion/exclusion criteria of studies
Table 1 details the inclusion and exclusion criteria for the 18 studies included in this meta-analysis. Two of the studies specified inclusion of hysterectomy for benign uterine diseases only, and 12 studies included benign uterine diseases and limit of uterine or myoma size. Three studies included benign uterine diseases and possible VH. One included myoma size larger than 8 cm. Four of the included trials excluded women with pelvic organ prolapse (POP) beyond stage I, and eight studies excluded women with pelvic inflammatory disease, endometriosis and/or previous uterine surgeries.

Primary outcome
Seventeen trials reported incidences of perioperative complications [5, 14–29], which were classified by Dindo
classification (grade I to V) [6]. No difference in the rate of overall complications was found between VH and LH (RR 1.11, 95% CI: 0.85 to 1.45, p = 0.46). There was also low heterogeneity (I² = 25%) (Fig. 3). Table 2 summarises all the complications in the included studies. Grade I complications were fever, vault haematoma, urinary tract infection, vaginal bleeding, urinary retention and unspecified infections. No significant differences in the incidence of grade I complications were demonstrated between VH and LH (RR 1.20, 95% CI; 0.90 to 1.61, p = 0.22), and there was low heterogeneity (I² = 19%) (Fig. 3). Most of the grade II complications was transfusion (n = 82). One patient in the VH group was treated with heparin because of deep vein thrombosis and experienced a spontaneous resolution. No significant difference in the incidence of grade II complications was demonstrated between VH and LH (RR 0.78, 95% CI; 0.49 to 1.24, p = 0.30), and there was low heterogeneity (I² = 0%) (Fig. 3). Grade III complications included those requiring surgical, endoscopic, or radiological intervention. There was one ureteral injury, seven bladder injuries and two reoperations in the VH group and eight bladder injuries, one vesicovaginal fistula, one ureterovaginal fistula, one reoperation and two pulmonary embolisms in the LH group. No significant difference in the incidence of grade III complications was demonstrated between VH and LH (RR 1.03, 95% CI; 0.49 to 2.16, p = 0.94), and there was low heterogeneity (I² = 0%) (Fig. 3). No significant difference in the incidence of urinary tract injury was demonstrated between VH and LH (RR 1.19, 95% CI; 0.52 to 2.71, p = 0.68), and there was low heterogeneity (I² = 0%). None of the trials included in the present analysis reported any grade IV or V complications after either VH or LH.

Secondary outcomes
Secondary outcomes were operating time, blood loss, intraoperative conversion, postoperative pain, length of hospital stay and length of recuperation. Eighteen studies reported on operating time [5, 14–18, 20–31]. VH was associated with a shorter operating time than LH (WMD −34.01 min, 95% CI; −43.54 to −24.48 min, p < .0001) (Fig. 5), and there was high heterogeneity between the trials (I² = 98%). However, all studies except one favored VH [31]; thus, the risk of inconsistency for this outcome was not severe. There was no difference in blood loss between VH and LH (WMD −35.91 mL, 95% CI; −102.26 to 30.43 mL, p = 0.29) in 12 studies [5, 14, 17, 21–29]. There was high heterogeneity (I² = 97%) between trials. Twelve studies assessed intraoperative conversion [14, 17–19, 21, 23–29]. No difference was found between VH and LH (RR 1.16, 95% CI; 0.60 to 2.26, p = 0.66), and there was low heterogeneity (I² = 0%). Postoperative pain scores were evaluated using the visual
| First author, year | Type of study | Method | Number of patients | Inclusion criteria | Exclusion criteria | Outcomes | Risk of bias according to Cochrane risk of bias tools |
|-------------------|--------------|--------|--------------------|-------------------|-------------------|----------|-----------------------------------------------------|
| Agostini, 2006    | RCT          | LAVH vs. VH | 48                 | Benign uterine diseases, uterine size below pubis, favorable to BSO$^1$ | Adnexal mass | Operative data, complications | high |
| Allam, 2015       | RCT          | TAH vs.TLH vs. VH | 60                | Benign uterine diseases | Malignancy | Operative data, complications, complications | unclear |
| Candiani, 2009    | RCT          | TLH vs. VH | 47                 | Benign uterine diseases | Malignancy, estimated uterine volume > 300 mL, POP$^2$, ovarian pathology, PID$^3$, endometriosis | Operative data, complications | high |
| Darai, 2001       | RCT          | LAVH vs. VH | 80                 | Estimated uterine size > 280 g, contraindications to VH | Malignancy | Operative data, complications | high |
| Drahonovsky, 2010 | RCT          | LAVH vs. TLH vs. VH | 125            | Benign uterine diseases | Impossible VH, prior abdominal surgery, endometriosis, medical disorders | Operative data, complications | high |
| Eggemann, 2018    | RCT          | LAVH vs. VH | 192                | Benign uterine diseases, possible VH | Malignancy, POP$^4$, medical disorders | Operative data, complications | high |
| Garry, 2014       | RCT          | Unspecified LH vs. VH | 504            | Benign uterine diseases | Malignancy, POP$^4$, uterine size > 12 week gestation | Operative data, complications | high |
| Ghezzi, 2010      | RCT          | TLH vs. VH | 82                 | Benign uterine diseases | Malignancy, POP$^4$, uterine size > 14 week gestation, large adnexal mass | Operative data, complications | high |
| Hwang, 2002       | RCT          | LAVH vs. TAH vs. VH | 60              | Myoma > 8 cm | other benign gynecological conditions except myoma | Operative data, complications | high |
| Mohammed, 2017    | RCT          | LAVH vs. VH | 50                 | Benign uterine diseases, age (40–70 years), estimated uterine weight < 280 g | BMI > 30, endometriosis, previous myomectomy, medical disorder | Operative data, complications | unclear |
| Ottosen, 2000     | RCT          | LAVH vs. TAH vs. VH | 80              | Benign uterine disease, myoma < 15 cm | Malignancy, uterine size > 16 week gestation, ovarian pathology, dense pelvic adhesion, possible VH | Operative data, complications | high |
| Ribeiro, 2003     | RCT          | TAH vs. TLH vs. VH | 40              | Benign uterine diseases | Estimated uterine volume > 400 cm$^3$, medical disorders | Operative data, complications, inflammatory response | high |
| Roy, 2011         | RCT          | LAVH vs. TLH vs. VH | 90              | Benign uterine diseases, estimated uterine weight < 400 g | Malignancy, PID$^3$, POP$^4$ | Operative data, complications | high |
| Soriano, 2001     | RCT          | LAVH vs. VH | 77                 | Estimated uterine size > 280 g, contraindications to VH | Malignancy | Operative data, complications | high |
| Sesti, 2014       | RCT          | LAVH vs. TLH vs. VH | 108            | Symptomatic myoma, age < 55 years, uterine size > 12 week gestation | Malignancy, nulliparity, uterine size > 16 week gestation, previous uterine surgery, | Operative data, complications, complications | low |
| Sesti, 2008       | RCT          | LAVH vs. TLH vs. VH | 100            | Symptomatic myoma, age < 55 years, uterine size > 12 week gestation | Malignancy, nulliparity, uterine size > 16 week gestation, previous uterine surgery, | Operative data, complication | unclear |
| Sesti, 2008       | RCT          | LAVH vs. VH | 80                 | Symptomatic myoma, age < 55 years, uterine size > 12 week gestation | Malignancy, nulliparity, uterine size > 16 week gestation, previous uterine surgery, | Operative data, complication | unclear |
| Zhu, 2009         | RCT          | LAVH vs. VH | 69                 | Benign uterine diseases | Malignancy | Operative data, complication | high |

$^1$ Bilateral salpingo-oophorectomy
$^2$ Pelvic organ prolapse
$^3$ Pelvic inflammatory disease
analog scale (VAS) on the day of surgery in four studies [5, 19, 27, 29], at 24 h after surgery in three studies [5, 17, 29] and at 48 h after surgery in three studies [5, 19, 29]. VH was associated with significantly lower VAS pain scores than LH at 24 h after surgery (WMD -0.53, 95% CI; -0.70 to -0.35, p < .0001, I² = 0%), with low heterogeneity (Fig. 4). There was no difference between the two groups on the day of surgery (WMD 0.80, 95% CI; -0.08 to 1.68, p = 0.07) and at 48 h after surgery (WMD -0.20, 95% CI; -0.61 to 0.22, p = 0.35). Eleven studies reported on the length of hospital stay [14, 17, 19, 21–28]. There was no difference in the length of hospital stay between VH and LH (WMD 6.57 h, 95% CI; 18.65 to 5.50 h, p = 0.29), and there was high heterogeneity (I² = 99%). Three studies assessed the duration of recuperation [14, 17, 25]. A difference in the recuperation time between VH and LH was not found (WMD 0.65 days, 95% CI; -6.01 to 7.30 days, p = 0.85), and there was high heterogeneity (I² = 92%).

Assessment of the quality of evidence

We used the GRADEpro GTD web-based software to rate the quality of each outcome according to GRADE guidelines, and the results are summarized in Table 3.

Discussion

The surgical approach of hysterectomy is the most important factor responsible for postoperative morbidity. Many studies have compared the surgical approach and complications according to the type of surgery to determine which method is best for the patient. The conclusion suggests that abdominal hysterectomy is inferior to VH and LH [32]. There were few randomized trials comparing VH and LH for postoperative complications, operative time, hospital stay, and recovery. The results of our meta-analysis showed no difference between the two groups for the overall rate of complications, including grade I, II and III complications of intraoperative blood loss, intraoperative conversion, length of hospital stay and length of recuperation after surgery. VH was associated with a shorter operative time and less pain at 24 h after surgery than LH. An important matter of concern about LH is a higher incidence of urinary tract injuries [33]. Our meta-analysis showed no significant difference in urinary tract injuries between VH and LH (10 of 887 vs. 10 of 1055; p = 0.68). A recent study of 839 women undergoing hysterectomy for benign indications reported that the incidence of urinary tract injuries was 4.3%, including an incidence of 2.9% for bladder injury and 1.8% for ureteral injury [34]. One review article reported that the incidence of ureteral injury is estimated to be 0.03 to 2% for AH, 0.02 to 0.5% for VH and 0.2 to 6% for LH [35]. In this meta-analysis, we found that the incidence of urinary tract injuries was 1.02%. Hence, the incidence of ureteral injury was unlikely to be underreported in the included studies. Interestingly, we found two fistula formations following TLH but no fistula formations following VH. During TLH, many surgeons use electrical laparoscopic instruments to cauterize the uterine artery and dissect the vesicouterine fold; the incidence of fistula formation might thus increase as a consequence of thermal injury [36]. A Cochrane review in 2015 concluded that VH appears to be superior to LH for
| First author, year | VH(n) | Overall complications | Grade I complications | Grade II complications | Grade III complications | LH(n) | Overall complications | Grade I complications | Grade II complications | Grade III complications |
|-------------------|-------|-----------------------|-----------------------|-----------------------|------------------------|-------|-----------------------|-----------------------|-----------------------|------------------------|
| Agostini, 2006    | 24    | 1                     | Vault hematoma [1]    | 0                     | 0                      | 24    | 3                     | Fever [1], vault hematoma [2] | 0                     | 0                      |
| Allam, 2015      | 30    | 9                     | Vault hematoma [2]    | Transfusion [6]       | Ureteral injury [1]    | 30    | 1                     | Fever [3]              | 0                     | Transfusion [1]         |
| Candiani, 2009    | 30    | 6                     | Fever [5]             | DVT† [1]              | 0                      | 30    | 3                     | Fever [3]              | 0                     |                         |
| Darai, 2001      | 40    | 5                     | Fever [2], infection [1], vault hematoma [1] | Transfusion [1] | 0 | 40 | 9 | Fever [3], infection [3], vault hematoma [1] | Transfusion [1] | Cystotomy [1] |
| Drahonovsky, 2010| 40    | 20                    | Fever [8], vault hematoma [10] | Transfusion [1] | Cystotomy [1] | 85 | 25 | Fever [4], UTI‡ [3], vault dehiscence [5], vault hematoma [9] | Transfusion [1] | Cystotomy [1] | UVF§ | VVF§§ |
| Eggemann, 2018    | 97    | 3                     | Fever [1]             | Transfusion [1]       | Cystotomy [1]          | 95    | 3                     | Fever [1]              | Transfusion [1] | Cystotomy [1] |
| Garry, 2004      | 168   | 65                    | Anesthetic problem [1], fever [12], infection [24], vaginal bleeding [2], vault hematoma [10] | Transfusion [14] | Cystotomy [2] | 336 | 123 | Anesthetic problem [3], fever [18], infection [36], vaginal bleeding [8], vault hematoma [14] | Transfusion [39] | Cystotomy [3] | Pulmonary embolism [2] |
| Ghezzi, 2010     | 41    | 4                     | Fever [2], urinary retention [2] | 0                     | 0                      | 41    | 1                     | Urinary retention [1] | 0                     | 0                      |
| Hwang, 2002      | 30    | 5                     | Fever [4]             | Transfusion [1]       | 0                      | 30    | 6                     | UTI§ [1]              | Transfusion [5] | 0                      |
| Mohammed, 2017   | 25    | 4                     | 0                     | Transfusion [2]       | Cystotomy [2]          | 25    | 6                     | 0                      | Transfusion [4] | Cystotomy [2] |
| Ottosen, 2000    | 40    | 7                     | Fever [1], UTI‡ [1], vault infection [1], vault hematoma [1] | 0                     | Reoperation [2], cystotomy [1] | 40 | 4 | Fever [1], urinary retention [1], vault infection [1] | 0 | Reoperation [1] |
| Ribero, 2003     | 20    | 1                     | 0                     | 0                     | Cystotomy [1]          | 20    | 0                     | 0                      | 0                     | 0                      |
| Roy, 2011        | 30    | 8                     | Fever [4], vaginal bleeding [4] | 0                     | 0                      | 60    | 22 | Fever [10], UTI§ [4], vaginal bleeding [8], wound infection [2] | 0 | 0 | 0 |
| Sesti, 2014      | 36    | 1                     | Fever [1]             | 0                     | 0                      | 72    | 5                     | Fever [2], urinary retention [1] | 0 | Transfusion [2] |
| Soriano, 2001    | 35    | 1                     | 0                     | Transfusion [1]       | 0                      | 37    | 1                     | 0                      | Transfusion [1] | 0                      |

† Deep vein thrombosis  
‡ Urinary tract infection  
§ Ureterovaginal fistula  
§§ Vesicovaginal fistula
Fig. 4 Forest plots of grade II (a) and grade III (b) complications

Fig. 5 Forest plot of operating time
| Certainty assessment | Number of studies | Study design | Risk of bias | Inconsistency | Indirectness | Imprecision | Other considerations | Number of patients | Effect | Absolute (95% CI) | Other (95% CI) |
|----------------------|-------------------|--------------|--------------|---------------|--------------|-------------|---------------------|-------------------|--------|------------------|---------------|
| Overall complications| 17                | randomised   | serious      | not serious   | not serious  | not serious | none                | 169/887 (19.1%) | RR 1.11 | (0.85 to 1.45)   | 22 more per 1000 (from 30 fewer to 90 more) |
| Grade I complications| 17                | randomised   | serious      | not serious   | not serious  | not serious | none                | 128/887 (14.4%) | RR 1.20 | (0.90 to 1.61)   | 27 more per 1000 (from 14 fewer to 83 more) |
| Grade II complications| 17               | randomised   | serious      | not serious   | not serious  | not serious | none                | 29/887 (3.3%)  | RR 0.78 | (0.49 to 1.24)   | 11 fewer per 1000 (from 13 more to 27 fewer) |
| Grade III complications| 17               | randomised   | serious      | not serious   | not serious  | not serious | none                | 12/887 (1.4%)  | RR 1.03 | (0.49 to 2.16)   | 0 fewer per 1000 (from 7 fewer to 15 more) |
| Urinary tract injuries| 17              | randomised   | serious      | not serious   | not serious  | not serious | none                | 9/781 (1.2%)  | RR 1.20 | (0.50 to 2.85)   | 2 more per 1000 (from 5 fewer to 18 more) |
| Operating time       | 18                | randomised   | serious      | not serious   | not serious  | not serious | none                | 922              | MD 3401 h lower (45.54 lower to 24.48 lower) |
| Length of hospital stay| 14               | randomised   | serious§      | not serious   | not serious  | none        | none                | 636              | MD 657 h lower (18.65 lower to 55 higher) |
| Blood loss           | 16                | randomised   | serious§      | not serious   | not serious  | none        | none                | 595              | MD 3591 mL lower (102.26 lower to 3043 higher) |
| Intraoperative conversion| 7               | randomised   | serious†      | not serious   | not serious  | none        | none                | 12/1055 (2.3%) | RR 2.04 | (0.90 to 4.88)   | 3 more per 1000 (from 3 fewer to 27 more) |
| Recuperation         | 4                 | randomised   | serious†      | not serious   | not serious  | none        | none                | 157              | MD 0.54 days higher (0.77 lower to 0.35 higher) |
| Pain on day of surgery (assessed with: Visual analogue scale) | 5 | randomised | serious†      | not serious   | not serious  | none        | none                | 491              | MD 0.8 higher (0.08 lower to 1.68 higher) |
| Pain at 24 h after surgery (assessed with: Visual analogue scale) | 4 | randomised | serious†      | not serious   | not serious  | none        | none                | 157              | MD 0.53 lower (0.7 lower to 0.35) |

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| Certainty assessment | Number of patients | Effect | Certainty | Importance |
|----------------------|--------------------|--------|------------|------------|
| Number of studies    | Study design       | Risk of bias | Inconsistency | Indirectness | Imprecision | Other considerations | LH | VH | Relative (95% CI) | Absolute (95% CI) | |
| 4                    | randomised         | serious  | not serious | not serious | not serious | none         | 295 | 461 | – | MD 0.2 lower (0.61 lower to 0.22 higher) | ⨁⨁⨁◯ | MODERATE |

LH: Lower; VH: Higher.

Confidence interval, RR: risk ratio, and MD: mean difference.

† High risk of allocation and blinding.
‡ High risk of blinding and incomplete outcome data.
§ High heterogeneity.
The limitation of our study is that all included studies had a high risk of bias in blinding despite the RCT design. Hence, no outcome had high-quality evidence according to the GRADE methodology. However, given that our primary outcome was the comparison of complication risk between the two groups, outcomes such as overall complications, grade 3 complications and risk of urinary tract injuries had moderate-quality evidence. Additional large-scale, multicenter, long-term randomized trials including objective outcome assessment will be required to definitively establish the value of LH vs VH.

Conclusion
The results of this study suggest that VH should be the treatment of benign gynecologic disease when both operative methods are available. Large randomized controlled trials should be performed to identify differences in VH and LH outcomes for operation time, postoperative pain, perioperative complications and cost.

Additional file

**Additional file 1:** The raw data of the enrolled studies. (XLSX 12 kb)

**Abbreviations**
AH: Abdominal hysterectomy; CI: Confidence interval; LAVH: Laparoscopic-assisted vaginal hysterectomy; LH: Laparoscopic hysterectomy; RCTs: Randomised controlled trials; RRs: Risk ratios; TLH: Total laparoscopic hysterectomy; VH: Vaginal hysterectomy; WMDs: Weighted mean differences

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**Authors’ contributions**
Substantial contributions to conception and design; JWB, Authors who participated in drafting the article or revising it critically for important intellectual content; JWB, SRO, SHL, Authors who participated in selection of studies and analysis and interpretation of data; SRO, SHL, Author who gave final approval of the version to be submitted and any revised version; JWB, Authors who participated in data extraction; SRO, SHL, SJK, Authors who participated in resolving all conflicts in data extraction and management; SHL, SRO, YJC, MSH, JWP, HYK, SJK, JHY, SYC, JSC, JWB

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**Availability of data and materials**
All data generated or analysed during this study are included in this published article and its Additional file 1.

**Ethics approval and consent to participate**
Not applicable because this study is a review article and a meta-analysis.

**Consent for publication**
Not applicable because this study is a review article and a meta-analysis.

**Competing interests**
The authors declare that they have no competing interests.
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