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SYSTEMATIC REVIEW

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# Robotic single site versus robotic multiport hysterectomy in endometrial cancer: a systematic review and meta-analysis

Weimin Xie[1], Zhangyi Wang[2], Xiaohang Liu[3] and Songhong Tan[1*]

## Abstract

**Objective** This meta-analysis aims to compare the safety and efficacy of robotic single-site hysterectomy (RSSH) with robotic multiport hysterectomy (RMPH) in treating endometrial cancer.

**Methods** We conducted a comprehensive literature search across several databases, including PubMed, the Cochrane Central Register of Controlled Trials (CENTRAL), Embase, the Chinese National Knowledge Infrastructure (CNKI), Wan Fang, and the Chinese Science and Technology Journal Full Text Database (VIP). The search covered literature from inception until October 17, 2024. The primary outcomes included intraoperative complications, postoperative complications, postoperative pain scores, and satisfaction with cosmetic outcomes. The secondary outcomes included operative time (min), estimated blood loss (ml), hemoglobin drop, blood transfusion, conversion, postoperative hospital stay, lymph nodes harvested, sentinel lymph node identification, recurrence, and mortality during follow-up. Data analysis was performed using random-effects or fixed-effects models, calculating combined risk ratios (RR), weighted mean difference (WMD), and 95% confidence intervals (95% CI).

**Results** Five studies describing a total of 448 patients were retained and included for this meta-analysis. No significant differences were found between RSSH and RMPH regarding intraoperative complications, postoperative complications, and postoperative pain scores. There were also no differences in terms of operation time, estimated blood loss, hemoglobin drop, blood transfusion, conversion, postoperative hospital stay, lymph nodes harvested, and sentinel lymph node identification.

**Conclusion** This systematic review and meta-analysis provides evidence that RSSH is effective and safe for the treatment of endometrial cancer, as it is generally equivalent to RMPH regarding perioperative outcomes.

**Keywords** Endometrial cancer, Robotic single-site hysterectomy, Robotic multiport hysterectomy

## Background

Endometrial cancer is the second most common malignancy of the female genital tract worldwide and the most common gynecologic cancer in high-income countries [1]. The incidence of endometrial cancer is increasing, expected to rise by 48% between 2020 and 2030 mainly due to the increasing prevalence of obesity [2, 3]. According to the most recent guidelines, staging surgery is the gold standard for treatment in patients with early-stage endometrial cancer [4, 5]. Whether or not lymphadenectomy is done, and the extent of lymph-node sampling,

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varies between and within institutions. The emergence of sentinel lymph node biopsy (SLNB) has facilitated a more integrated approach to lymph node assessment in endometrial cancer. Minimally invasive surgery, including laparoscopic and robotic techniques, has rapidly evolved due to technological advancements and is now the preferred method according to guidelines [4–6].

Recently, laparoendoscopic single-site surgery has been introduced in minimally invasive surgery, potentially enhancing cosmetic benefits while reducing the morbidity associated with multiple incisions [7]. Since the introduction of robotic techniques, laparoendoscopic single-site surgery has integrated with robotics, leading to the development of the da Vinci single-site platform that combines the benefits of single-port and robotic surgeries [8]. In 2013, Vizza et al. [9] reported the first experience of robotic single-site hysterectomy (RSSH) for the management of early-stage endometrial cancer. Since then, a number of studies have evaluated the feasibility and safety of RSSH for the treatment of endometrial cancer [10–12].

Although there is an increasing number of studies comparing the surgical outcomes of RSSH and robotic multiport hysterectomy (RMPH) for the treatment of endometrial cancer, and the results are conflicting. Therefore, it remains to be confirmed which surgery should be recommended. This systematic review and meta-analysis aims to search and systematically analyze the available studies to compare the safety and efficacy of RSSH with RMPH for the treatment of endometrial cancer.

## Methods

### Protocol and registration

The protocol for the current systematic review and meta-analysis was registered in the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42024595357). This systematic review and meta-analysis followed the recommendations of the AMSTAR (Assessing the methodological quality of systematic reviews) guidelines[13] and was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [14].

### Literature search

We conducted a thorough literature search using both Medical Subject Headings (MeSH) and non-MeSH terms across several databases, including PubMed, the Cochrane Central Register of Controlled Trials (CENTRAL), Embase, the Chinese National Knowledge Infrastructure (CNKI), the Wan Fang database, and the Chinese Science and Technology Journal Full Text Database (VIP), covering the period from inception until October 17, 2024. The search strategy included robotics, robot, 'da Vinci', 'computer assisted surgery', 'single incision', 'single site', 'single port', 'single access', 'single trocar', 'endometrial neoplasm', 'endometrial carcinoma', 'endometrial malignancy', 'endometrial cancer', 'endometrial tumor' and 'endometrial tumour'. Registered and ongoing trials on The International Clinical Trials Registry Platform (ICTRP) from the World Health Organization and ClinicalTrials.gov were also searched. Moreover, the reference lists of all relevant articles were manually screened for potentially eligible studies not found through the initial search. No language restriction was used during the literature search. The details of the search strategy for different databases appeared in Supplementary Table 1.

### Inclusion and exclusion criteria

The meta-analysis included randomized controlled trials (RCTs) and non-randomized studies (NRSs) that met the following inclusion criteria: (1) population: women with endometrial cancer; (2) intervention: treatment with RSSH, clearly stated in the article; (3) comparison: treatment with RMPH; (4) outcomes: comparison of surgical and prognostic outcomes. Studies were excluded if (1) results were reported in conference abstracts, letters, editorials, case reports, or any publication other than an original research article; (2) patients were partly or totally treated by laparoendoscopic single-site surgery or multiport laparoscopic surgery; (3) studies without appropriate data that could be extracted or calculated; (4) study population and period were covered by another study included in the meta-analysis.

### Outcomes of interest

The following outcomes were used to compare RSSH and RMPH. The primary outcomes included intraoperative complications, postoperative complications, postoperative pain scores, and satisfaction with cosmetic outcomes. The secondary outcomes included operative time (min), estimated blood loss (ml), hemoglobin drop, blood transfusion, conversion, postoperative hospital stay, lymph nodes harvested, sentinel lymph node identification, recurrence, and mortality during follow-up. Conversion was defined as the placement of additional ports or a switch to abdominal hysterectomy; however, conversions required for additional surgery were excluded from this definition.

### Study selection

Following the initial search, two independent reviewers eliminated duplicate records, screened the titles, and retrieved full-text reports for all titles to apply the inclusion and exclusion criteria. Disagreements were resolved through discussion and by seeking the opinion of a third reviewer.

### Quality assessment

Two authors independently assessed the quality of each article using the nine-item Newcastle–Ottawa Scale (NOS) for evaluating the quality of nonrandomized studies [15]. The scale assesses the methodological quality of studies by evaluating selection, comparability, and outcomes for cohort studies, or exposure for case–control studies. A study was considered high quality if it received at least 7 points on the NOS (out of a possible 9), while studies scoring less than 7 points were deemed low quality. During the above process, any disagreement was discussed until consensus was reached, and by seeking the opinion of a third author if necessary.

### Data extraction

The extraction of relevant data from all the included studies was independently completed by two reviewers and disagreement was resolved through discussion under supervision of a third reviewer.

For each included study, we gathered the following information: the first author's name, publication year and country, study design, FIGO stages, sample size, participant age, body mass index (BMI), treatment of lymph nodes, and relevant outcomes of interest. For continuous outcomes, the sample size, mean, and standard deviation (SD) were extracted. If the outcome measure is expressed as a median (range), the mean and SD were estimated [16]. For dichotomous outcomes, the total number and the events number of patients in each group were required. If a study did not show unavailable data, we requested the authors for the missing details via email.

### Statistical analysis

We conducted statistical analysis on the extracted data using RevMan 5.4 software. We analyzed continuous outcomes using weighted mean difference (WMD) with 95% confidence interval (95% CI) and dichotomous outcomes using risk ratio (RR) with 95% CI. Heterogeneity across studies was quantitatively assessed using the Cochran's Chi-squared test (Cochran's Q) and the I-square test ($I^2$), and a P value less than 0.10 or $I^2$ value higher than > 50% was suggestive of statistically significant heterogeneity. If no significant heterogeneity was encountered, a fixed-effects model would be used to calculate the pooled effect estimates, otherwise a random-effects model would be applied. To understand the causes of clinical heterogeneity, we planned to use subgroup and sensitivity analyses. If sufficient studies were available, potential publication bias was examined by visual inspection of funnel plots and Egger's tests for asymmetry. All calculated P-values were two-sided, and a P value lower than 0.05 was considered statistically significant.

## Results

### Study selection

A total of 355 records were identified through initial database searching, including 46 records from PubMed, 3 from CENTRAL, 107 from Embase, 32 from CNKI, 22 from Wan Fang database, 145 from VIP, and none were included via other sources. After excluding 93 records that were duplicated, the remaining 262 articles were screened by title and abstract. After excluding 252 records based on eligibility criteria, the full texts of 10 records were evaluated. Of these, five records were also excluded because of no comparisons, duplicated published data, and conference abstracts. Ultimately, five studies [17–21] were selected for inclusion in this meta-analysis. The PRISMA flow diagram of the study selection was shown in Fig. 1.

### Study characteristics

The study characteristics were summarized in Table 1. All five articles were NRSs, in which 2 were retrospective case–control studies [17, 18], 1 was prospective case–control study [19], and 2 were retrospective cohort studies [20, 21]. Five studies describing a total of 448 patients, published between 2016 and 2024. Studies were conducted in Italy [17–19], United States [20], and China [21]. Based on the mode of operation, 161 patients underwent robotic single-site surgery, while 287 patients underwent robotic multiport surgery. With regard to quality assessment, the NOS scores of the 5 included studies ranged from 7 to 8 points.

### Primary outcomes

Two studies [17, 18] had available data on intraoperative complications. One study [17] reported that neither in RSSH than in RMPH were intraoperative complications observed. The other study [18] reported that there were two (2.6%) and five (3.4%) intraoperative complications respectively in the RSSH and RMPH group. There was no statistically significant difference between the two approaches (RR = 0.78; 95% CI, 0.16 to 3.95; P = 0.77) (Fig. 2).

Four studies [17, 18, 20, 21] had available data on postoperative complications. There was no significant heterogeneity across the studies ($P = 0.51$, $I^2 = 0\%$). The fixed-effects model analysis revealed no difference in the RR for postoperative complications between the RSSH group and the RMPH group (RR, 0.84; 95% CI, 0.32 to 2.12; $P = 0.71$) (Fig. 3).

Two studies [19, 21] reported data on postoperative pain scores. Significant heterogeneity was observed among the studies ($P < 0.001$, $I^2 = 99\%$). The pooled data using the random-effects model showed that there was no statistically significant difference in postoperative

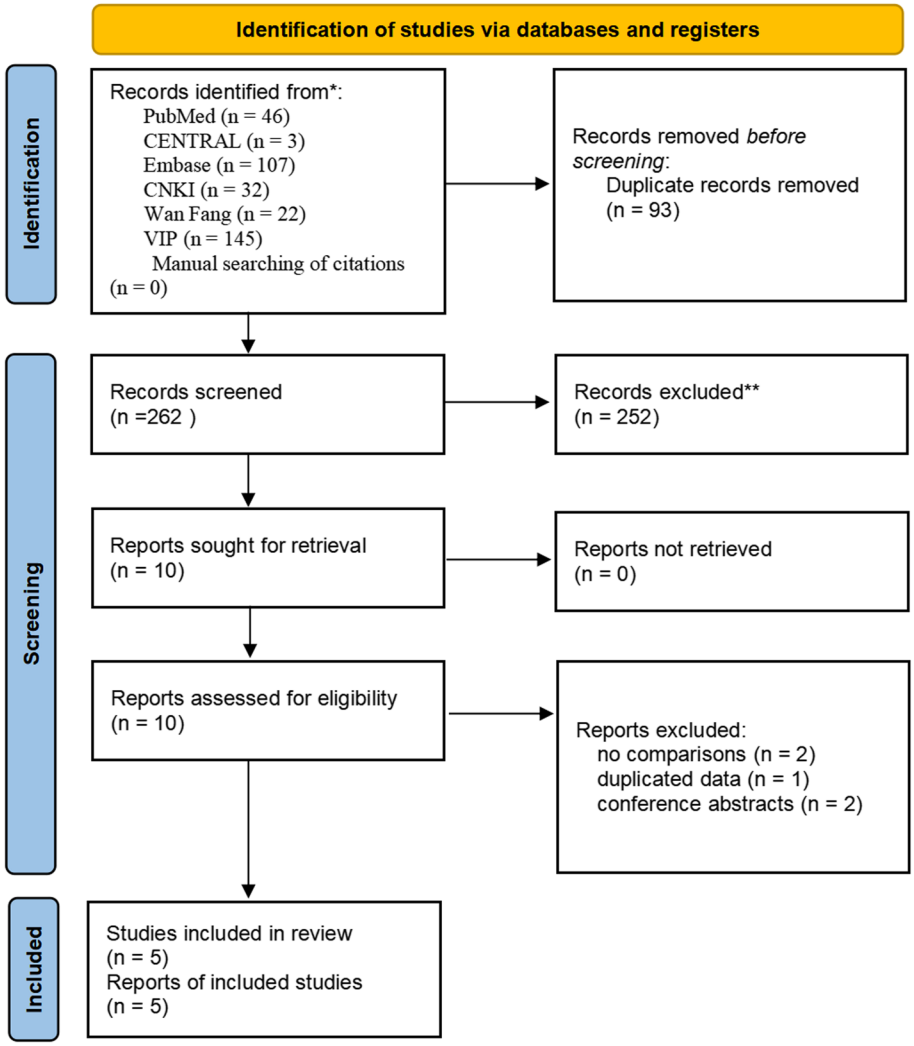


**Fig. 1** The PRISMA flow diagram of the study selection

**Table 1** The basic characteristics of the included studies

| Author (year) | Country | Study type | Sample size | Stage | Age (year) | BMI (kg/m$^2$) | Treatment of lymph nodes | Study quality (NOS scores) |
|---|---|---|---|---|---|---|---|---|
| Corrado et al (2016) [17] | Italy | Retrospective case–control | RSSH: 23<br>RMPH: 46 | IA/IB | 64 (35–85)<br>59 (38–88) | 26.6 (17.8–33.6)<br>28.5 (20–34.6) | Lymphadenectomy | 8 |
| Corrado et al (2020) [18] | Italy | Retrospective case–control | RSSH: 76<br>RMPH: 149 | I-II | Not reported | 33 (30–54)<br>34 (30–55) | Lymphadenectomy | 8 |
| Mereu et al. (2020) [19] | Italy | Prospective case–control | RSSH: 25<br>RMPH: 51 | IA-IIIC | 61.4 ± 10.4<br>61.9 ± 11.4 | 24.8 ± 3.8<br>29 ± 6.1 | SLNB | 8 |
| Moukarzel et al. (2017) [20] | United States | Retrospective cohort | RSSH: 14<br>RMPH: 13 | IA/IB | 53 (45–77)<br>62 (41–82) | 24.6 (20.2 –29.6)<br>27.2 (21–29.7) | SLNB | 7 |
| Zhang et al (2024) [21] | China | Retrospective cohort | RSSH: 23<br>RMPH: 28 | IA/IB | 54.78 ± 5.88<br>57.29 ± 4.70 | 25.42 ± 1.21<br>26.09 ± 1.50 | Lymphadenectomy | 8 |

Data are expressed as number, mean ± standard deviation or median (range)

*RSSH* robotic single-site hysterectomy, *RMPH* robotic multiport hysterectomy, *BMI* body mass index, *SLNB* sentinel lymph node biopsy, *NOS* Newcastle–Ottawa Scale

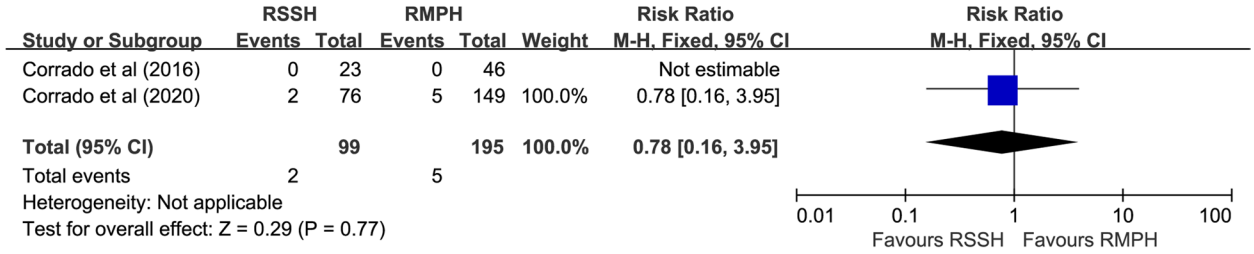


**Fig. 2** Meta-analysis of intraoperative complications

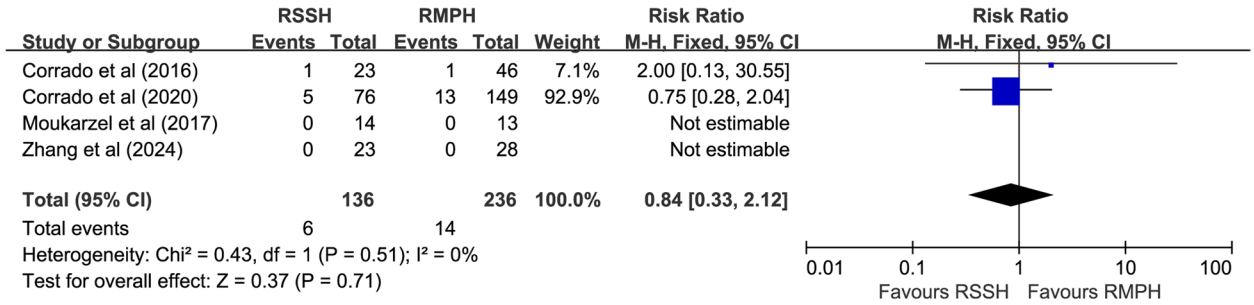


**Fig. 3** Meta-analysis of postoperative complications

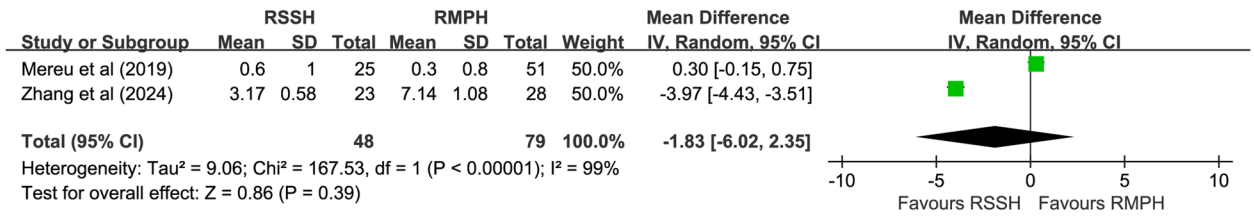


**Fig. 4** Meta-analysis of postoperative pain scores

pain scores between the RSSH group and the RMPH group (WMD, −1.83; 95% CI, −6.02 to 2.35; $P=0.39$) (Fig. 4).

This meta-analysis did not analyze satisfaction with cosmetic outcomes because the two included studies reported these values in a non-standardized manner and did not provide appropriate data for extraction [19, 21]. One study [19] found no statistically significant differences in body image and cosmetic results between the two approaches. The other study [21] reported that 73.91% (17/23) of patients in the RSSH group were very satisfied of incision, compared with that 42.86% (12/28) o f patients in the RMPH group, and the difference was statistically significant ($P<0.05$).

### Secondary outcomes

Five studies [17–21] compared operation time between RSSH and RMPH. The operation time did not significantly differ between the two types of surgery (WMD = 7.49; 95% CI, −17.30 to 32.27; P = 0.55), although there was significant heterogeneity (P < 0.001, I2 = 94%) (Fig. 5).

Four studies [17, 18, 20, 21] compared estimated blood loss following RSSH or RMPH. Analysis of the pooled results showed that there was no significant difference between RSSH and RMPH (WMD = −28.98; 95% CI, −59.29 to 1.33; P = 0.06), with significant heterogeneity ($P<0.001$, $I^2=90\%$) (Fig. 6).

Two studies [17, 19] reported hemoglobin drop in RSSH and RMPH. The pooled data revealed that there was no significant difference in hemoglobin drop between the two groups (WMD = 0.02; 95% CI, −0.87 to 0.92; P = 0.96), with significant heterogeneity ($P<0.001$, $I^2=95\%$) (Fig. 7).

Three studies [17, 18, 21] reporting the results of blood transfusion. The pooled analysis showed that there was no difference in blood transfusion between the RSSH group and the RMPH group (RR = 0.39;

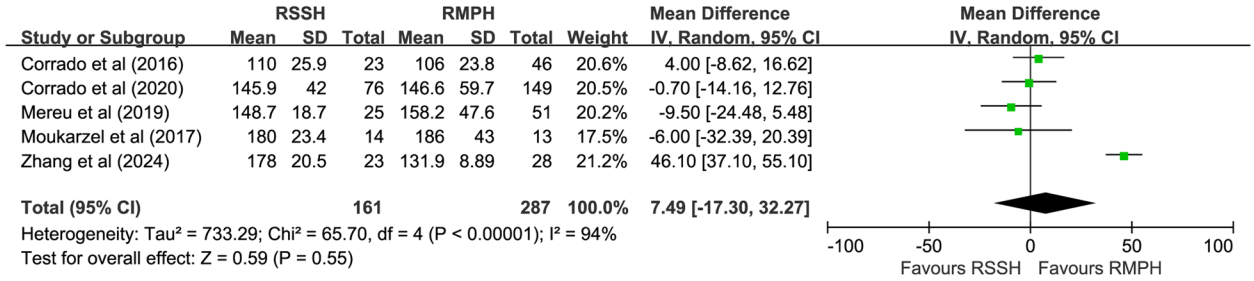


**Fig. 5** Meta-analysis of operative time

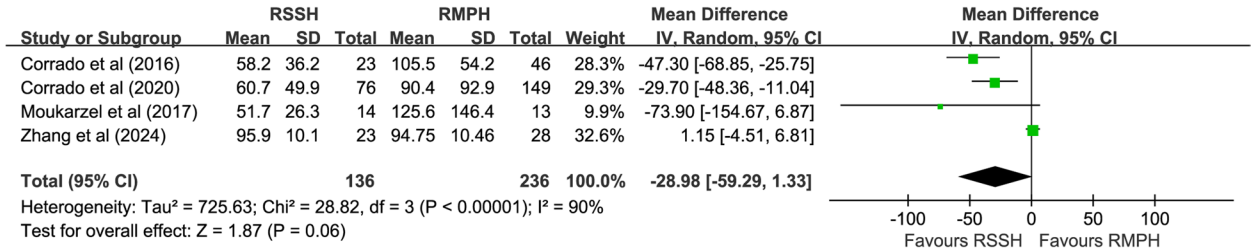


**Fig. 6** Meta-analysis of estimated blood loss during surgery

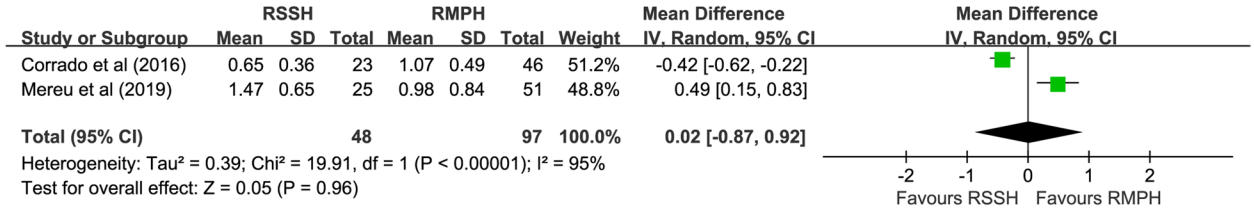


**Fig. 7** Meta-analysis of hemoglobin drop

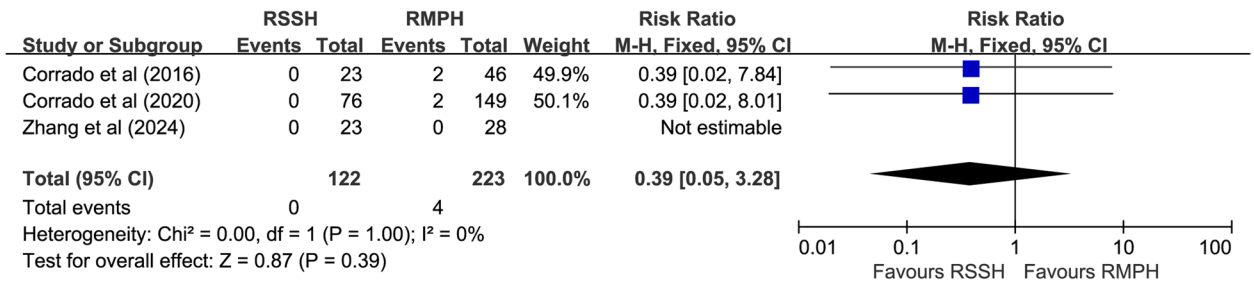


**Fig. 8** Meta-analysis of blood transfusion

95% CI, 0.05 to 3.28; $P=0.39$), with low heterogeneity ($P=1.00$, $I^2=0\%$) (Fig. 8).

Four studies [17, 18, 20, 21] provided data on conversion rates. Among these, three studies [17, 20, 21] reported that neither single-port nor multiport approaches required conversion to laparotomy or laparoscopy. One study [18] reported that the conversion rate was 6.6% (5/76) and 3.4% (5/149) in the RSSH and the RMPH groups, respectively. There was no statistically significant difference in conversion between the two approaches (RR = 1.96; 95% CI, 0.59 to 6.56; $P=0.27$) (Fig. 9).

Four studies [17–19, 21] reporting the results of postoperative hospital stay. The pooled analysis showed

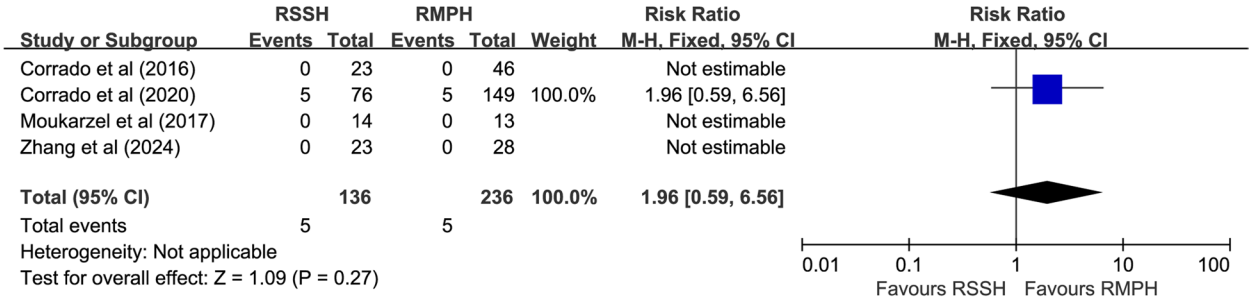


**Fig. 9** Meta-analysis of conversion

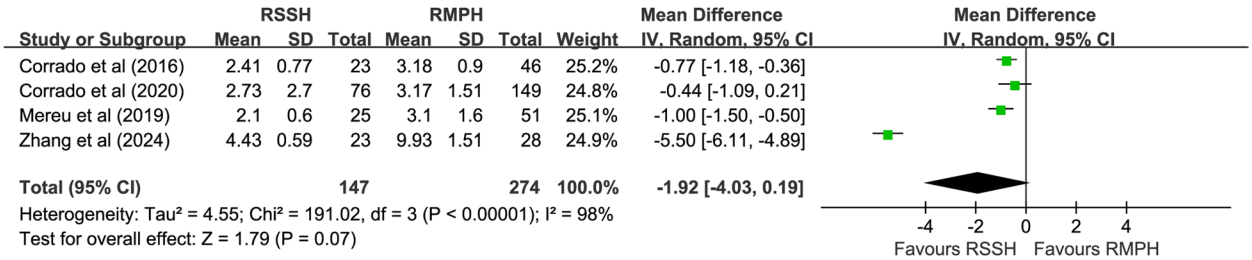


**Fig. 10** Meta-analysis of postoperative hospital stay

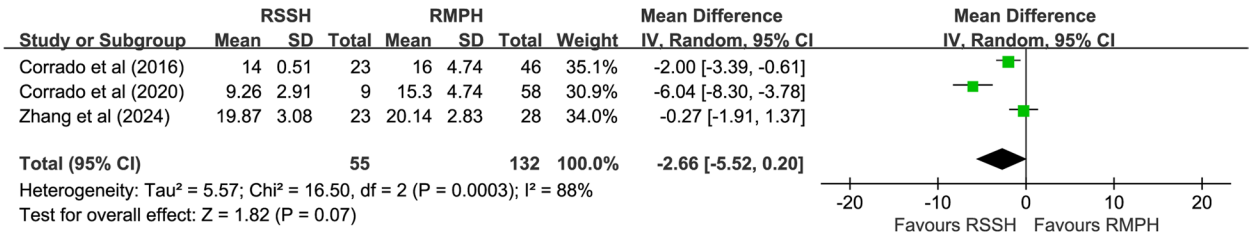


**Fig. 11** Meta-analysis of lymph nodes harvested

that there was no difference in postoperative hospital stay between the RSSH group and the RMPH group (WMD = −1.92; 95% CI, −4.03 to 0.19; $P = 0.07$), with significant heterogeneity ($P < 0.001$, $I^2 = 98\%$) (Fig. 10).

Three studies [17, 18, 21] addressed the lymph nodes harvested in RSSH and RMPH. The pooled results showed that there was no significant difference in the lymph nodes harvested between the two groups (WMD = −2.66; 95% CI, −5.52 to 0.20; $P = 0.07$), with significant heterogeneity ($P = 0.0003$, $I^2 = 88\%$) (Fig. 11).

Two studies [19, 20] reported sentinel lymph node identification in RSSH and RMPH. The pooled data revealed that there was no significant difference in the rate of sentinel lymph node identification between the two groups (RR = 1.02; 95% CI, 0.93 to 1.12; $P = 0.62$), with low heterogeneity ($P = 0.47$, $I^2 = 0\%$) (Fig. 12).

Only one study [17] provided data for recurrence; it reported no events in in the RSSH group while one relapse in the RMPH group: a patient (stage IA; G3) had lung metastasis 12 months after surgery. One study [18] provided follow-up mortality data, showing no significant differences in overall survival between the RSSH and RMPH groups ($P = 0.83$) during a median follow-up of 42 months.

### Subgroup analysis

We performed subgroup analyses for operation time based on the treatment of lymph nodes and study type. The subgroup analyses of operation time revealed no significant differences compared to the original analysis (Supplementary Fig. 1–2). Subgroup analysis was not performed for estimated blood loss, postoperative hospital stay, postoperative pain scores, hemoglobin drop, and lymph nodes harvested because of insufficient data.

### Sensitivity analysis

We conducted a sensitivity analysis on operation time, estimated blood loss, postoperative hospital stay, and

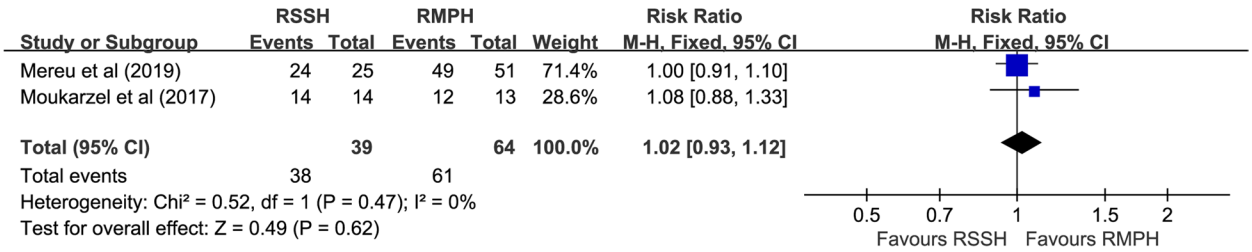


**Fig. 12** Meta-analysis of sentinel lymph node identification

lymph nodes harvested. The analysis demonstrated that the result for lymph nodes harvested was robust because none of the individual studies markedly affected the pooled effect. Even though sensitivity analyses were conducted by repeating the whole analysis after excluding one study [21] with a high risk of bias for operation time, estimated blood loss, and postoperative hospital stay, the results remained unchanged.

## Discussion

During the last decade, minimally invasive surgical approaches has been widely introduced in the treatment of gynecological malignancies. Laparoendoscopic single-site surgery was first proposed to minimize tissue trauma and enhance cosmetic outcomes. One major technical disadvantage in laparoendoscopic single-site surgery is the collision between the surgeon's hands and those of the assistant duing to using of a single incision for multiple instruments. Recently, robotic single-site surgery has emerged as a minimally invasive alternative to conventional laparoscopy and is expected to enhance the effectiveness of laparoendoscopic single-site surgery. Compared with laparoendoscopic single-site surgery, robotic single-site surgery provides easier manipulation and makes an enhanced approach in a narrow space without colliding instruments. A systematic review [22] found preliminary data indicating that the robotic single-site da Vinci Surgical System is technically feasible and safe for gynecologic surgery. It requires only minimal adjustments to the surgical technique. Riemma et al. [23] reviewed the existing literature on robotic single-site hysterectomy (RSSH) in patients with benign gynecological diseases and demonstrated that RSSH is a safe and feasible option. Currently, an increasing number of studies have confirmed that RSSH is feasible for treating endometrial cancer. To validate the safety and efficacy of RSSH, we conducted a systematic review and meta-analysis to compare surgical outcomes and prognostic outcomes between RSSH and RMPH in the treatment of endometrial cancer.

In our meta-analysis, 448 patients were included in five studies. All of the studies were high-quality assessed by the Newcastle–Ottawa Scale. The results showed that RSSH was generally equivalent to RMPH in terms of intraoperative complications, postoperative complications, postoperative pain scores, operation time, estimated blood loss, hemoglobin drop, blood transfusion, conversion, postoperative hospital stay, lymph nodes harvested, and sentinel lymph node.

Safety is a crucial factor in developing new surgical techniques. This meta-analysis found two intraoperative complications in the RSSH group and five in the RMPH group, and the pooled data showed no significant difference. The pooled data indicated that the RR for postoperative complications was statistically comparable between the RSSH and RMPH groups, resulting in homogeneity across the studies. These results indicated that RSSH is as safe as RMPH for the treatment of endometrial cancer patients.

The meta-analysis revealed no significant difference between the two groups in terms of operation time, estimated blood loss, hemoglobin drop, blood transfusion, conversion, postoperative hospital stay, lymph nodes harvested, and sentinel lymph node, which demonstrated that RSSH was a feasible procedure for endometrial cancer. These results were consistent with a previous meta-analysis that compared robotic single-site versus multi-port myomectomy, in which the results showed that no significant differences were detected when single-site robotic myomectomy was compared to the multiport technique concerning operative time, blood loss, and total complication rate [24].

A major advantage of robotic single-site surgery is its improved cosmetic results and higher patient satisfaction due to the smaller incision [25]. There is only a single incision in RSSH compared to RMPH for the treatment of endometrial cancer which requires 4 or 5 incisions. According to Fagotti et al. [26], patients' perception of surgical scars is not simply a "cosmetic problem", but rather reflects a body image that brings to mind memories and experiences of cancer. Owing to this minimally invasive feature, robotic single-site surgery, which leaves a scar only in the umbilicus, could be a great alternative solution for patients. A meta-analysis compared robotic

single-site radical prostatectomy to robotic multi-port radical prostatectomy, demonstrating that the single-port technique has significant advantages in cosmetic outcomes [27]. Because the included studies lacked sufficient data to compare the cosmetic outcomes of RSSH and RMPH, future well-designed RCTs with long-term follow-up are necessary to assess whether RSSH provides better cosmetic results than RMPH. To minimize biases, the satisfaction reports concerning cosmetic outcomes should be standardized.

This systematic review and meta-analysis has several limitations. First, all of the included studies were non-randomized studies and most of the included studies were retrospective. As a result, inherent biases, including selection bias, may have been introduced. Second, some studies with relatively small sample sizes were included. The small sample sizes may reduce statistical power, and some operators might not have fully developed their skills during the initial learning phase. Therefore, the conclusions of this systematic review and meta-analysis must be interpreted with caution. Finally, there is a lack of long-term follow-up data to explore the effect of the operative approach on long-term clinical outcomes, such as port site hernia, cosmetic outcome, and oncologic outcomes.

## Conclusion

RSSH is not inferior to RMPH for the treatment of endometrial cancer in regards to intraoperative complications, postoperative complications, postoperative pain scores, operation time, estimated blood loss, hemoglobin drop, blood transfusion, conversion, postoperative hospital stay, lymph nodes harvested, and sentinel lymph node. The da Vinci single-site platform may be ideal for endometrial cancer patients seeking to minimize surgical incisions while preserving surgical dexterity. However, further large research, including prospective studies and randomized controlled trials, is necessary to continue evaluating its efficacy and to evaluate longer term outcomes including cosmetic and oncologic outcomes.

## Disclosure statement

The authors have nothing to disclose.

### Abbreviations

| | |
|---|---|
| RSSH | Robotic single-site hysterectomy |
| RMPH | Robotic multiport hysterectomy |
| SLNB | Sentinel lymph node biopsy |
| AMSTAR | Assessing the methodological quality of systematic reviews |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| MeSH | Medical Subject Headings |
| CENTRAL | Cochrane Central Register of Controlled Trials |
| CNKI | Chinese National Knowledge Infrastructure |
| ICTRP | International Clinical Trials Registry Platform |
| RCT | Randomized controlled trial |
| NRS | Non-randomized study |
| NOS | Newcastle-Ottawa Scale |
| FIGO | International Federation of Gynecology and Obstetrics |
| BMI | Body mass index |
| SD | Standard deviation |
| WMD | Weighted mean difference |
| RR | Risk ratio |

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12885-025-13968-6.

Supplementary Materials 1: Fig. 1. Forest plots of operation time in subgroup analysis based on the treatment of lymph nodes

Supplementary Materials 2: Figure 2. Forest plots of operation time in subgroup analysis based on the study type

Supplementary Material 3

### Acknowledgements

Not applicable.

### Disclosure statement

The authors have nothing to disclose.

### Authors' contributions

W.X. and S.T. contributed the study concept and design. Z.W. and X.L. contributed to the data acquisition. W.X. and Z.W. were responsible for data analysis and editing the manuscript. S.T. contributed to critical revision of the manuscript. All authors approved the final version of the manuscript.

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### Data availability

Full data sets are available upon reasonable request. The corresponding authors can be contacted at tansonghong2020@163.com.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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