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REVIEW

Analysis of Efficacy and Safety Profile of Vaginal Surgery and Hysteroscopic Electric Resection in the Management of Post-Cesarean Section Isthmocele: a Systematic Review

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ABSTRACT

Introduction: *The present study has discussed the increasing prevalence of isthmocele, which is related to growing cesarean sections. It is also due to enhanced diagnostics, which includes transvaginal ultrasound (TVUS) and magnetic resonance imaging (MRI) that significantly affects women's reproductive health and quality of life. Management differs by defect size, from hysteroscopic to laparoscopic repair, which also highlights the necessity for standardized protocols.*

Aims and objective: *To evaluate the efficacy and safety profile of vaginal surgery and hysteroscopic electric resection in the management of post-cesarean section isthmocele.*

Methods: *This systematic review analyzed the efficacy and safety of vaginal surgery and hysteroscopic electrotomy for managing post-cesarean section isthmocele. Relevant studies were identified from PubMed, Embase, Cochrane Library and Web of Science using terms like "cesarean scar", "isthmocele" and "hysteroscopic electrotomy". We conducted the present review using a PRISMA flowchart, which resulted in the inclusion of eight studies after screening and eligibility assessment.*

Results: *The hysteroscopic method consistently shows a lower risk compared to the vaginal method, with a pooled risk ratio of 0.71 (95% CI 0.59–0.85), indicating statistical significance. Heterogeneity analysis*

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reveals no significant variability among studies (I^2 = 0%), suggesting consistent results. Additionally, the hysteroscopic group outperforms the vaginal group in efficacy for diverticulum recovery, supporting hysteroscopy as the more effective approach across both outcomes.

Conclusion: *The present study has concluded that the hysteroscopic electric resection was safer and more efficient in the management of isthmocele among patients who underwent a cesarean section.*

Keywords: vaginal surgery, hysteroscopic electric resection, isthmocele, cesarean.

INTRODUCTION

Several interrelated factors are likely responsible for the rising prevalence of isthmocele, a defect in the uterine wall which is most commonly caused by cesarean sections (CSs). In particular, the general trend towards increased cesarean deliveries has been one of the major contributors. The reported range of isthmocele largely varies from 19% up to 88% in women with a history of CS and it is even higher in those with multiple cesarean deliveries (1-4). Increasing rates of CSs mirror changes in obstetric practice and trends within society – for example, increased preference of surgical delivery for perceived safety and convenience (5, 6).

Diagnostic methods have evolved. The recent advancements in transvaginal ultrasound (TVUS) and magnetic resonance imaging (MRI) make possible the better detection of isthmocele, so it is evident that the prevalence rate appears to be rising because more cases are detected that may not have been identified before (7-9). The superior diagnostic ability together with a growing number of cesarean deliveries has increased awareness of this clinical entity known as an isthmocele, thus increasing its perceived prevalence (10, 11).

Clinical management of isthmocele has multifaceted implications. The patient who suffers from isthmocele can experience symptoms of abnormal uterine bleeding, dysmenorrhea, dyspareunia and infertility that interfere with their quality of life (6, 12, 13). As it has been noted that isthmocele was associated with secondary infertility, abnormal uterine bleeding and chronic pelvic pain, it should be effectively managed (5, 6, 14).

Management options for isthmocele vary with the size of the defect and symptomatology. Small isthmoceles can be effectively managed with hysteroscopic techniques, which entail fewer complications and are much less invasive (15-17). On the contrary, larger defects may warrant laparoscopic repair, whereby the diseased uterine tissue is resected and the remaining myometrium is sutured together to fortify the uterine wall, thus minimizing complications such as uterine rupture with subsequent pregnancies (3, 15, 18).

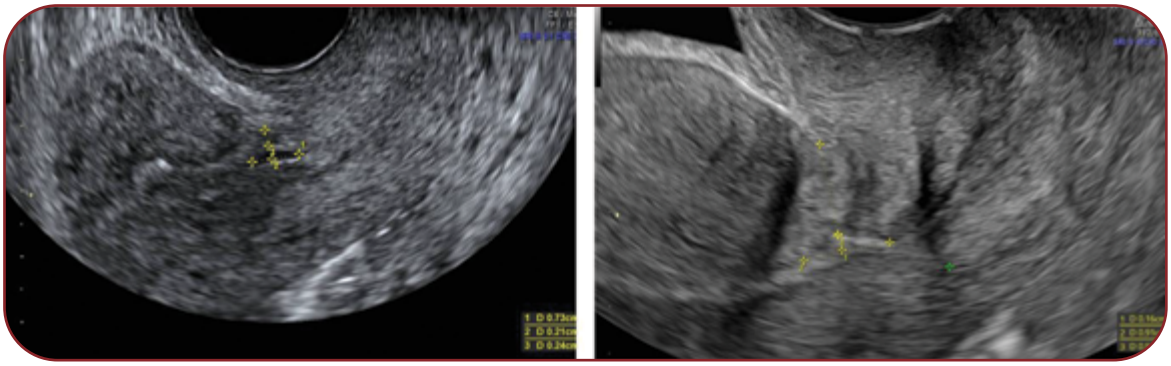

FIGURE 1. Preoperative and postoperative images of transvaginal ultrasound for a case of cesarean scar defect (CSD) – sagittal view indicating measurements of residual myometrial thickness (RMT) along with the base and height of the defect before surgery in the left image and after four months of follow-up on the right side

The surgical approach is very relevant because the short-term and long-term reproductive outcome will depend on it for each patient. For example, laparoscopic repair would be more recommended for larger isthmoceles for restoration of uterine integrity compared to hysteroscopic methods, due to residual myometrium might become thinner (14, 15, 17). Furthermore, treatment of an isthmocele may be further complicated by concomitant pathology such as endometriosis which may contribute to worsening the symptoms and complicate the therapy (6, 14). Other than this, there is no certain criterion set for the diagnosis and treatment of isthmocele, which therefore creates a problem when clinician's management is undertaken. Even though surgery is prescribed to be necessary, especially for symptomatic cases, different clinicians carry out different timetables and types of intervention (19, 20). Thus, there is a call for further research to find defined protocols that will ameliorate the outcomes among women afflicted with this pathology (10, 11).

This increase in prevalence is linked with the rise in the rate of CSs and with enhanced diagnostic methodologies. The management of isthmocele has very broad clinical implications, as the spectrum of symptoms impacts women's quality of life and reproductive health. Therefore, there is a need for either hysteroscopic or laparoscopic management in order to address complications that may be arising with isthmocele and achieve better patient outcomes. A deeper understanding of this condition in time will be followed by further research and standardization of treatment protocol for these women (19, 20). ❑

METHOD

Search strategy

The present systematic review was conducted by using international databases to find the analysis of the efficacy and safety profile of vaginal surgery and hysteroscopic electric resection in the management of post-cesarean section isthmocele. International databases including PubMed, Embase, Cochrane Library and Web of Science were explored to find the most relevant studies for our research. The search terms used to conduct this study were as follows: "cesarean scar", "isthmocele", "diverticulum", "hysteroscopic electrotomy" and "vaginal surgery". By using these terms, subject terms and free-text

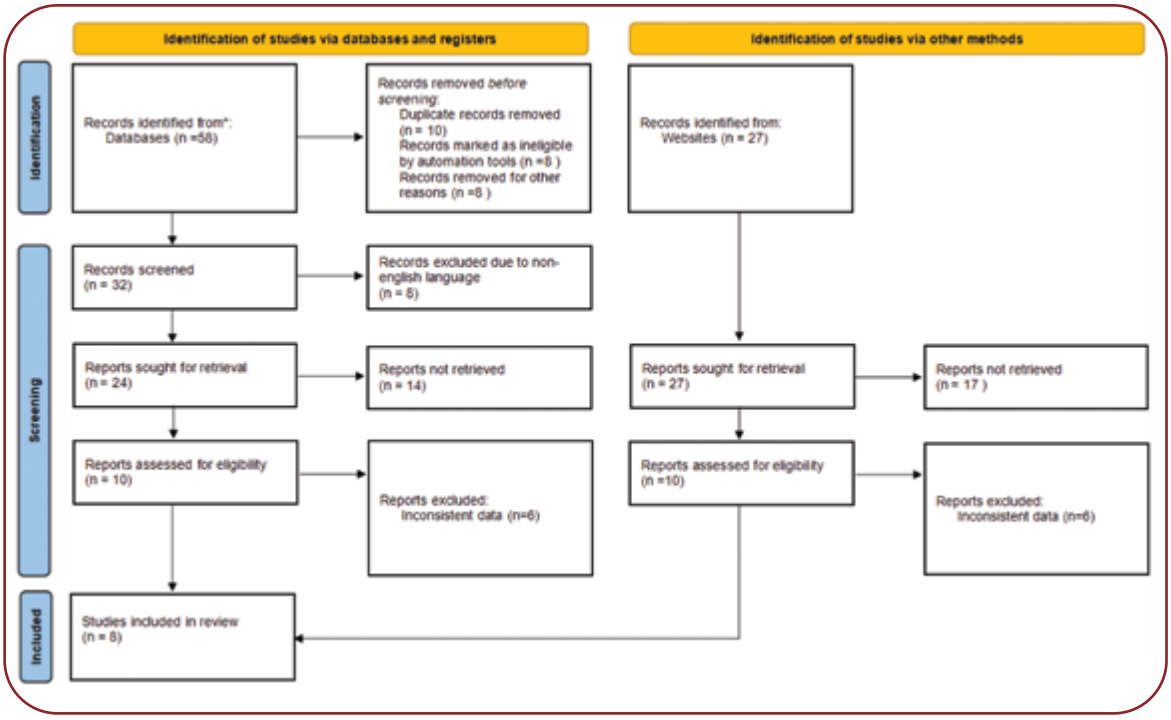

FIGURE 2. PRISMA flowchart

words were combined to optimise search strategies across different databases. This review was conducted from June 2024 to December 2024, starting with each database with language restrictions set to English.

The PRISMA flowchart outlines the systematic process of identifying, screening and including studies in our review. In the identification phase, 58 records were retrieved from databases and registers, of which 26 were excluded due to duplication (n = 10), ineligibility by automation tools (n = 8) or other reasons (n = 8), leaving 32 records for screening. Additionally, 27 records were identified from other methods, such as websites. During the screening phase, 32 records from the databases were screened, with eight being excluded because they were non-English language publications, leaving 24 reports sought for retrieval. For records identified through other methods, all 27 remaining articles were sought for retrieval. In the retrieval phase, 14 reports from the databases and 17 from other methods could not be retrieved, resulting in 10 reports from each source being assessed for eligibility. During eligibility assessment, six reports from each source were excluded due to inconsistent data. Ultimately, eight studies were included in the review (four from databases and four from other methods). This flowchart highlights the rigorous methodology used to ensure the inclusion of high-quality, relevant studies while transparently documenting the reasons for exclusion at each stage (Figure 2).

Eligibility criteria

Studies of female patients who were diagnosed with uterine scar diverticulum (isthmocele) by clinicians, those that evaluated the efficacy and safety of two minimally invasive surgical methods – hysteroscopic electric resection and vaginal surgery – for the control of uterine scar diverticulum and research which provided results of hysteroscopic electric resection *versus* vaginal surgery in treating uterine scar diverticulum were included in the present review.

Studies not meeting the above inclusion criteria (*e.g.*, the literature with an unknown research object source and unclear grouping status), observational studies, case reports, reviews and repeated journals, as well as articles with incomplete data and animal experiment reports were all excluded.

Literature screening and data extraction

This study has two trained reviewers who independently screened the retrieved articles based on the above-mentioned inclusion and exclusion criteria. Firstly, it was scanned to remove irrelevant studies and thoroughly assess the full texts to ensure eligibility. This study resolved discrepancies between reviewers through discussion or third-party arbitration. After completing the selection, reviewers independently extracted data employing a pre-designed data table. The extracted data included basic analysis details such as the title, first author's name, publication year, country, journal, type of research, intervention methods and sample size. Furthermore, result indicators, including menstrual improvement rate, operation time, intraoperative blood loss, hospital stay duration and diverticulum recovery, were all recorded. This strict process guaranteed accuracy and dependability in the review's selection and data extraction phases.

Quality and risk assessment

This systematic review assessed the quality and risk, including randomised controlled trials (RCTs), independently evaluated by two reviewers using the Cochrane Collaboration's Risk of Bias 2 (RoB 2.0) assessment tool. We could determine whether allocation concealment was adequately enforced by using random allocation for grouping issues and the option for selection bias; the fact of double-blinding among participants and researchers, blinding of outcome assessors and possible performance or measurement bias; the completeness of result data and potential loss to follow-up bias, whether there was particular reporting of results or publication bias in the included studies and identification of other potential biases. Furthermore, studies that addressed these criteria were assessed as low risk, those that did not meet the requirements were classified as high risk and those with insufficient data were rated as having unclear risk. Furthermore,

this complete evaluation provided a robust assessment of the quality and dependability of the included studies.

Statistical analysis

The Chi-squared (χ^2) test was employed to assess the heterogeneity of each effect magnitude. In the Cochrane Handbook, an $I2 \leq 50\%$ shows a low heterogeneity among trials, indicating a fixed-effects model. Nonetheless, $I2 > 50\%$ signified substantial heterogeneity among the selected research, necessitating the application of a random-effects model. The 95% confidence interval (CI) was utilised to denote the 95% CI of each effect magnitude. We utilised RevMan 5.20 (Cochrane Collaboration) for statistical analysis. We used $\alpha = 0.05$ as the test standard and $P < 0.05$ indicated significant differences between groups. Meanwhile, $P > 0.05$ suggested that the group disparity was not statistically significant. The funnel plot and Egger's test were employed to assess publication bias, with $P < 0.05$ being statistically significant. ❑

RESULTS

Table 1 summarizes the basic characteristics of several studies on the treatment of CSD. All the studies are from China, conducted between 2014 and 2021. The table shows the number of participants treated using hysteroscopic and vaginal methods in each study. The sample sizes for both methods vary, with hysteroscopic treatment ranging from 12 to 45 participants and vaginal treatment ranging from 13 to 48 participants across the studies. The studies typically include small to moderate sample sizes, with some studies having more participants in the vaginal treatment group.

TABLE 1. Basic characteristics of articles included in the present review

Author	Country	Year	Hysteroscopic (n)	Vaginal (n)
Guo *et al* (21)	China	2019	41	46
Liang *et al* (22)	China	2014	16	20
Zhang *et al* (23)	China	2017	12	13
Zhang *et al* (24)	China	2019	26	32
Yu *et al* (25)	China	2015	14	16
Xia *et al* (26)	China	2020	18	23
Zhou *et al* (27)	China	2021	45	48
Zhang *et al* (28)	China	2016	19	14

Figure 3 presents a comparison between the hysteroscopic and vaginal groups across four studies, assessing their relative risks (RR) for a specific outcome. For individual studies, the results show that the hysteroscopic group generally has a lower risk, although statistical significance varies. For instance, the study by Xa (2020) reveals a significant reduction in risk for the hysteroscopic group (RR = 0.61, 95% CI 0.40–0.94), while other studies, such as those conducted by Yu (2015), Zhang (2017) and Zhang (2019), show a trend favoring the hysteroscopic group but with confidence intervals crossing the line of no effect, making them statistically non-significant. The overall pooled risk ratio across all studies is 0.71 (95% CI 0.59–0.85), indicating a significant reduction in risk in favor of the hysteroscopic group. Additionally, the heterogeneity analysis ($Chi^2 = 2.29$, $P = 0.51$, $I^2 = 0\%$) shows no significant variability among the studies, reflecting consistency in their results. Overall, the findings suggest that the hysteroscopic method is associated with a lower risk for the studied outcome compared to the vaginal me-

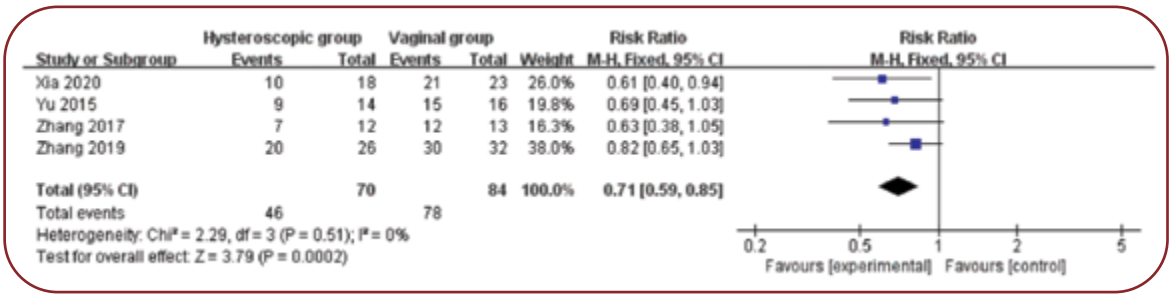

FIGURE 3. Forest plot showing the menstrual improvement (efficacy) between the two study groups

thod, with the pooled result being statistically significant.

The forest plot in Figure 4 compares the efficacy of diverticulum recovery between the hysteroscopic and vaginal groups based on four studies. The results indicated that the hysteroscopic group consistently outperformed the vaginal group in terms of recovery rates. In the study by Guo (2019), the relative risk (RR) was 0.69 (95% CI 0.50–0.84), demonstrating a statistically significant benefit for the hysteroscopic group. Similarly, Liang (2014) reported an RR of 0.66 (95% CI 0.50–0.87), again favoring the hysteroscopic group significantly. Xia (2020) showed an even greater benefit with an RR of 0.38 (95% CI 0.20–0.75), further supporting the efficacy of the hysteroscopic approach. In contrast, Zhang (2017) reported an RR of 0.63 (95% CI 0.38–1.05), showing a trend favoring the hysteroscopic group, but the result was not statistically significant because the CI crossed the line of no effect. The pooled analysis across all studies resulted in an overall RR of 0.60 (95% CI 0.50–0.73), indicating a significant reduction in risk favoring the hysteroscopic group. Moreover, the heterogeneity analysis ($Chi^2 = 2.77$, $P = 0.43$, $I^2 = 0\%$) suggests consistency across the studies. These findings collectively highlight the superior efficacy of the hysteroscopic method for diverticulum recovery.

The forest plot in Figure 5 compares the loss of blood (a safety parameter) between the hysteroscopic and vaginal groups across multiple studies. The results consistently showed that the hysteroscopic group experienced significantly less blood loss compared to the vaginal group. In Guo's study (2019), the mean difference (MD) was -21.12 (95% CI -41.55 to -0.77), indicating a statistically significant reduction in blood loss for the hysteroscopic group. Similarly, Liang (2014) reported an MD of -30.00 (95% CI -35.94 to -24.09), demonstrating a substantial reduction in blood loss. Xia (2020) and Yu (2015) also found significant advantages for the hysteroscopic group, with MDs of -19.32 (95% CI -24.37 to -14.27) and -10.21 (95% CI -15.72 to -4.69), respectively. Other studies, such as those conducted by Zhang (2016) and Zhang (2019), also favored the hysteroscopic group, with MDs of -17.40 (95% CI -25.19 to -9.61) and -31.99 (95% CI -37.74 to -26.24), respectively. The pooled analysis across all studies resulted in an overall MD of -25.23 (95% CI -34.18 to -16.28), confirming significantly less blood loss in the hys-

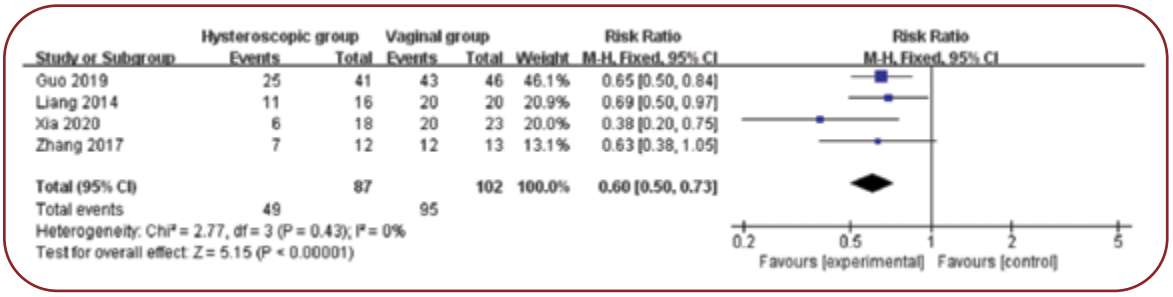

FIGURE 4. Forest plot showing the diverticulum recovery (efficacy) between the two study groups

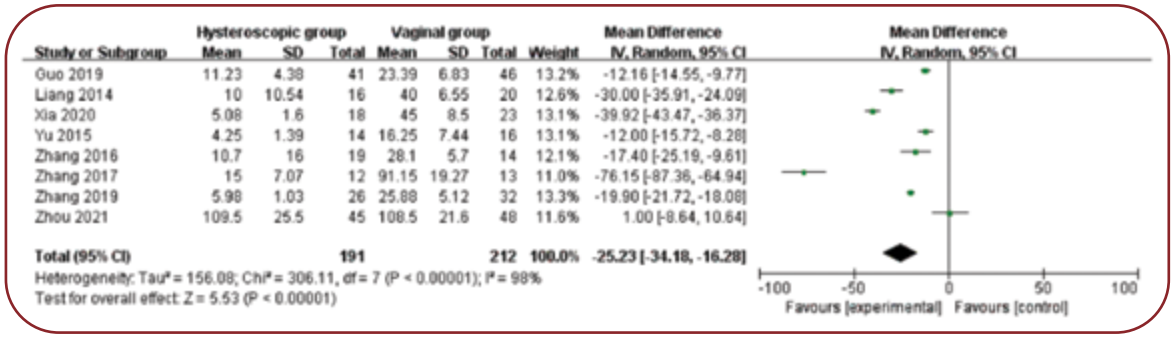

FIGURE 5. Forest plot showing the loss of blood (safety) between the two study groups

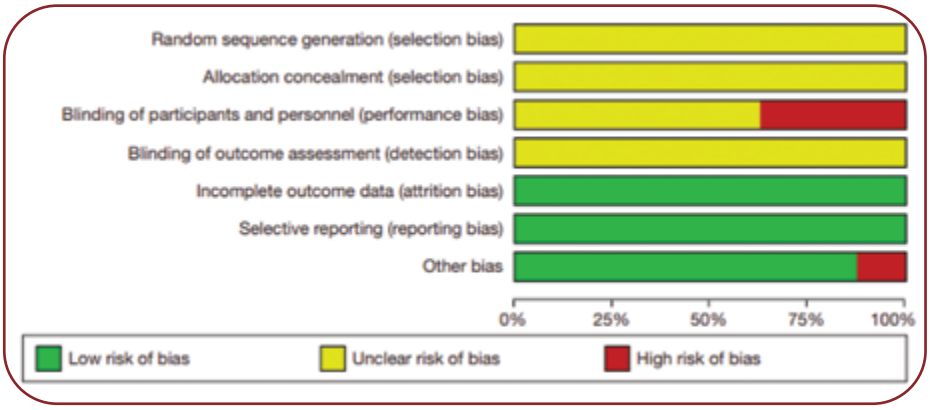

FIGURE 6. Bias summary of the included studies

teroscopic group. Despite the high heterogeneity (I^2 = 99%), the consistent direction of results highlights the safety advantage of the hysteroscopic method in terms of reduced blood loss.

Figure 6 presents a summary of the risk of bias across the included studies, categorizing different types of bias into low risk, unclear risk and high risk. The chart shows that most studies have a low risk of bias for "blinding of outcome assessment (detection bias)", "incomplete outcome data (attrition bias)", "selective reporting (reporting bias)" and "other bias," as these categories are predominantly represented by green bars. However, for "random sequence generation (selection bias)" and "allocation concealment (selection bias)" there is a significant proportion of studies with unclear risk of bias, indicated by yellow bars. A notable concern is observed in "blinding of participants and personnel (performance bias)", where a mix of unclear risk (yellow) and a substantial portion of high risk (red) is evident, suggesting a lack of proper blinding procedures in some studies, which could influence the results. Overall, while generally studies demonstrate low bias in several domains, certain areas such as allocation concealment and participant blinding reveal a potential weaknesses in study design that may affect the reliability of the findings. ❑

DISCUSSION

Comparatively, vaginal surgery with electric resection of isthmocele via hysteroscopy is emerging to become one of the critical research areas of study, considering that cases of this condition have significantly increased in the last years due to a greater rise in cesarean delivery rates. Isthmocele is an abnormal defect in the uterine wall caused by inadequate healing at the cesarean delivery site and may lead to severe symptoms, including abnormal uterine bleeding, pelvic pain and infertility. Consequently, the long-term outcomes and safety profiles of these surgical techniques are essential for ensuring optimal care of patients (29, 30).

Hysteroscopic electric resection has been proven to be effective in the treatment of isthmocele and several studies have indicated that it may result in significant symptom relief. A systematic review pointed out that, in approximately 87% of patients, there was a symptom improvement after correction by hysteroscopy, with the remarkably low risk of complications associated with the procedure. It is a technique that can visualize the uterine cavity directly and remove fibrotic tissue associated with isthmocele in an accurate manner, thereby effectively relieving symptoms like postmenstrual spotting and pelvic pain (30).

However, vaginal surgery offers another kind of advantages and considerations. One of the benefits of the vaginal procedure is that there is no minimum myometrial thickness requirement, a significant limitation for hysteroscopic procedures. This aspect makes the vaginal procedure an appropriate method for treatment in patients who have thinly myometrial walls to prevent uterine perforation during the procedure due to hysteroscopy. Also, the presence of specialized equipment for conducting the hysteroscopic operation is not mandatory for performance of the vaginal procedure (31).

Long-term results of both the techniques have been studied. A comparative study was conducted on hysteroscopic versus laparoscopic techniques for treating isthmocele. Both methods produced remarkable diminutions in midcycle vaginal bleeding and postmenstrual spotting (32). Further studies are necessary regarding long-term outcomes, especially regarding recurrence of symptoms as well as overall satisfaction rates of the patients. Although hysteroscopic surgery has been shown to provide a high cure rate with symptom relief, the risk is that some patients may again develop symptoms that require further interventions (25, 26).

Another safety aspect, when comparing these two types of surgical interventions, has to do with the complications, wherein the overall complications experienced during and after the performance of the surgery are typically less with the hysteroscopic procedure than in other methods (27, 28). However, on the other hand, this would raise a concern with complications such as uterine perforation when the myometrial thickness is not sufficient. In contrast, vaginal surgery exposes the patients to risks of infection and bleeding associated with the vaginal approach, but most of these are often considered manageable within the context of the procedure (29).

The decision between vaginal surgery and hysteroscopic electric resection may further depend on the patient – for instance, the size and nature of the isthmocele, patient's reproductive intentions, as well as comorbid conditions that may influence the risk of surgery. For example, patients who wish to conceive in the future would require a technique that will preserve the integrity of the uterus, which may influence the choice of technique (31, 32). ❑

CONCLUSION

The present review has concluded that the hysteroscopic method showed a lower risk for the studied outcome. While individual studies show varying degrees of statistical significance, the overall pooled risk ratio strongly supports the hysteroscopic method as significantly more effective in reducing risk. Similarly, the comparison of efficacy in diverticulum recovery indicates that the hysteroscopic method consistently outperforms the vaginal approach, with studies such as Guo (2019) and Liang (2014) demonstrating significant benefits for hysteroscopy in terms of recovery rates. These findings suggest that hysteroscopic interventions offer superior outcomes in both risk reduction and efficacy, supporting their preference over vaginal methods in the studied context. ❑

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