META-ANALYSIS

Systematic Review and Meta-Analysis: Impact of Various Hemostasis Methods on Ovarian Reserve Function in Laparoscopic Cystectomy for Ovarian Endometriomas

Xiujuan Gao, MM; Yanan Jin, MM; Guixiang Zhang, MM

ABSTRACT

Background • Ovarian endometriomas, resulting from the invasion of endometriosis into ovarian tissue, can significantly affect ovarian reserve, potentially leading to infertility. When conservative treatments fail, it may further aggravate ovarian reserve decline by invading the ovarian cortex and, in severe cases, result in premature ovarian failure and infertility.

Objective • This study aimed to investigate the impact of various hemostasis methods on ovarian reserve function in cases of laparoscopic cystectomy for ovarian endometriomas.

Methods • We conducted a systematic review and meta-analysis to assess the effects of different hemostasis techniques used during laparoscopic cystectomy for ovarian endometriomas. A comprehensive analysis of relevant literature was performed, focusing on the impact of bipolar electrocoagulation, ultrasonic scalpel, and suture hemostasis on ovarian reserve function. The evaluation criteria included Anti-Müllerian hormone levels and antral follicle counts.

Results • Our analysis revealed significant variations in the impact of hemostasis methods on ovarian reserve function. While all methods aimed to stop bleeding during surgery, the thermal damage to surrounding tissues differed. Bipolar electrocoagulation, ultrasonic scalpel, and suture hemostasis showed varying effects on ovarian reserve, with implications for post-operative fertility.

Conclusions • The choice of the hemostasis method in laparoscopic cystectomy for ovarian endometriomas has a crucial influence on ovarian reserve function. Our findings emphasize the need to consider the potential consequences of thermal damage when selecting a hemostasis technique. Clinicians should weigh the benefits and risks of each method to protect ovarian reserve function effectively. This study offers valuable insights for guiding clinical practice, ensuring optimal outcomes for patients facing endometrioma-related fertility challenges. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Endometriosis is characterized by the presence of endometrial tissue, including glands and stroma, outside the uterus.[1] Ovarian endometriomas are a prevalent gynecological condition, affecting approximately 6.6% of women aged between 25 and 40 years.[2] When surgical intervention is necessary, laparoscopic cyst wall stripping is preferred.[3,4] However, surgical treatment carries the potential for adverse effects on ovarian reserve, which may result from the removal of healthy ovarian tissue or from thermal damage to normal follicles during the control of bleeding.[5]

Ovarian reserve refers to the quantity and quality of the remaining ovarian follicles at any given time.[6] It can be assessed using various methods, with serum Anti-Müllerian hormone (AMH) levels considered one of the most reliable endocrinological markers.[7] AMH, a glycoprotein produced by the granulosa cells within ovarian follicles, is a valuable predictor of the number of responsive follicles. Additionally, antral follicle count (AFC) is another method, although it has the limitation of being assessable only during specific phases of the menstrual cycle.[8]

The conventional hemostatic method for laparoscopic cystectomy is bipolar electrocoagulation. It offers simplicity and speed and does not necessitate advanced surgical skills. However, it risks inducing localized thermal damage, adversely affecting ovarian reserve.[9] In this context, laparoscopic suturing emerges as a promising alternative. Though, mastering this technique requires time and skill development. Another viable approach involves the use of topical hemostatic agents, promoting the formation of blood clots.[10]

Selecting an appropriate and effective hemostasis technique during surgery holds significant importance. Any decrease in the count of normally functioning follicles and the deterioration in follicle quality can substantially impact ovarian reserve function.[11] However, accurately quantifying the extent of this effect remains a challenge, as there is currently no definitive method for evaluating ovarian reserve function. Various methods and tests can be used to thoroughly evaluate ovarian reserve function and address this issue [12]. As preserving healthy ovarian tissue is a primary concern in laparoscopic cystectomy, assessing which hemostatic technique is less detrimental to the follicular reserve becomes imperative.

Therefore, this study analyzed the influence of various hemostatic methods employed during laparoscopic cystectomy on ovarian reserve. This study conducted a comprehensive analysis of clinical trials to evaluate the effects of various hemostatic methods during laparoscopic cystectomy on ovarian reserve. Serum Anti-Müllerian hormone levels and antral follicle counts were key indicators for assessing the impact on ovarian function. The study aims to provide valuable insight for optimizing patient outcomes and fertility preservation in gynecological surgery. The primary objective of this study was to compile pertinent literature, assess ovarian reserve function through AMH and AFC, and conduct a meta-analysis to derive appropriate findings to guide clinical practice.

METHODS

Search Strategy

We conducted database searches using a specific set of keywords and a predefined search strategy across 5 databases including PubMed, Cochrane Libarary, WanFang Data and CBM. Abstracts of articles were initially reviewed to eliminate duplicates, review studies, case studies, systematic evaluations, and animal tests, as these were not aligned with the objectives of this study. Subsequently, full texts were carefully examined to exclude articles not meeting the criteria for randomized controlled trials, appropriate hemostasis methods, and relevant assessment indicators.

The final selection of literature underwent a rigorous assessment for risk bias, and data analysis was carried out using Revman 5.3 software.[17] The English keywords employed included “ovarian endometriosis,” “laparoscopy,” “hemostasis method,” and “ovarian reserve function.” In Chinese, the keywords used were “ovarian endometriomas,” “hemostasis method,” “laparoscopic surgery,” and “ovarian reserve function.” A combination of these keywords and the respective free terms were applied in the database searches. As an illustration, the search strategy employed for the PubMed database is presented in Figure 1.

Figure 1. PubMed Search Strategy for Ovarian Endometriosis and Ovarian Reserve Studies

1.ovarian endometriosis
2.ovarian endometriosis cyst
3.endometri otic cyst
4.ovarian endometriotic cyst
5.ovarian endometriosis uterina
6.endometriosis of ovary
7.hocolate cyst of ovary
8.ovarian chocolate cyst
9.endometriotic cysts of ovary
10.OR/1-9
11.laparoscopy
12.peritoneoscope
13.laparoscopic surgery
14.laparoscopic cystectomy
15.TUES
16.OR/11-15
17.hemostasis method
18.hemostasis
19.hemostatic
20.OR/17-19
21.10 AND 16AND 20.

Note: The figure displays the search strategy used for the PubMed database to identify relevant articles for the study. The search strategy was designed to retrieve literature related to ovarian endometriosis, surgical interventions, and ovarian reserve function.

Inclusion and Exclusion Criteria for Literature Selection. Inclusion criteria were: (1) Publication year and article type: Articles included in this study were restricted to those published between January 2009 and September 2020. Only studies based on randomized controlled trial methodology were included. Language was not a restricting factor in our selection; (2): Study population: The study population consisted of women of childbearing age, specifically between 18 and 45 years old. Only those who exhibit normal preoperative ovarian function and carry a preoperative diagnosis of ovarian endometriomas, leading to surgical intervention, were selected. The post-operative diagnosis was aligned with the preoperative condition.

(3) Hemostasis methods: Articles were included if they discussed laparoscopic hemostasis using either sutures or bipolar electrocoagulation. Additionally, laparoscopic hemostasis using an ultrasonic scalpel was considered. Any combination of these three hemostasis modalities was eligible for inclusion; (4) Evaluation indicators: Articles were eligible for inclusion if they assessed AFC and AMH levels.

Exclusion criteria: (1) Articles that provided limited or incomplete access to data, such as reviews, abstracts, and case studies, were excluded from the study; (2) Articles containing identical information were also excluded; (3) Studies that did not align with the methods of hemostasis or assessment indices specified in this study were excluded.

Selection and Screening of Literature

Two investigators screened the selection of literature following the predefined inclusion and exclusion criteria. In cases of disagreement between them, a discussion was held to reach a consensus, or a third investigator made a decision. Throughout the screening process, information such as the source, authors, and country of origin of the literature was kept concealed to prevent any potential bias arising from the researchers’ subjective viewpoints. The screened literature was subsequently evaluated for quality by two reviewers using the Cochrane Quality Assessment Tool, which determined its final inclusion in the study.

Data Analysis

This study exclusively synthesized data derived from econometric models and randomized controlled trials. All observational metrics employed consistent units of measure, with reported deviations falling within statistically insignificant ranges. Data computations were conducted using Review Manager 5.3 software, distributed by the Cochrane Informatics and Knowledge Management Department. We calculated the mean difference (MD), standard deviation (SD), and 95% confidence interval (CI) corresponding to each outcome. For this analysis, a fixed-effects model was implemented.

Heterogeneity Assessment. Heterogeneity across the collected datasets was statistically assessed using I^2 values and *P* value tests. A fixed-effects model was considered appropriate when the I^2 value was less than 50%, and the corresponding *P*-value was greater than 0.1. In cases where the I^2 value was 50% or higher, or the *P* value was .1 or lower, indicating significant heterogeneity, further investigation was conducted to identify the sources of this variation through subgroup or sensitivity analysis. Only after the exclusion of substantial clinical heterogeneity were the data processed with a random-effects model.

RESULTS

Data Retrieval Results

A total of 1061 articles were initially retrieved from various databases. After eliminating duplicates, 427 articles remained. Subsequently, 370 articles were screened by reviewing abstracts to exclude case studies and studies related to methods and experimental design that did not align with the scope of this study. Among these, 57 articles emerged as randomized controlled trials, while 43 articles were excluded due to the incompatibility of their assessment indices with the present study and incomplete data.

Finally, 12 articles[18-29] were included in the study, encompassing a total of 1557 patients. These patients were distributed as follows: 523 in the electrocoagulation hemostasis group, 584 in the suture hemostasis group, and 450 in the ultrasonic scalpel hemostasis group. The literature screening process is presented in Figure 2.

Quality Assessment

The Cochrane Quality Assessment Tool was employed to evaluate the quality of all included studies and to extract essential information, including the results of the risk of bias assessment, as presented in Table 1.

Results of Group Comparisons

Statistical analysis revealed that the differences between groups were not statistically significant. It is worth noting that ovarian reserve function is significantly influenced by age. Figure 3 compares participant age between the suture and ultrasonic scalpel intervention groups. Similarly, Figure 4 illustrates the age comparison between the suture and

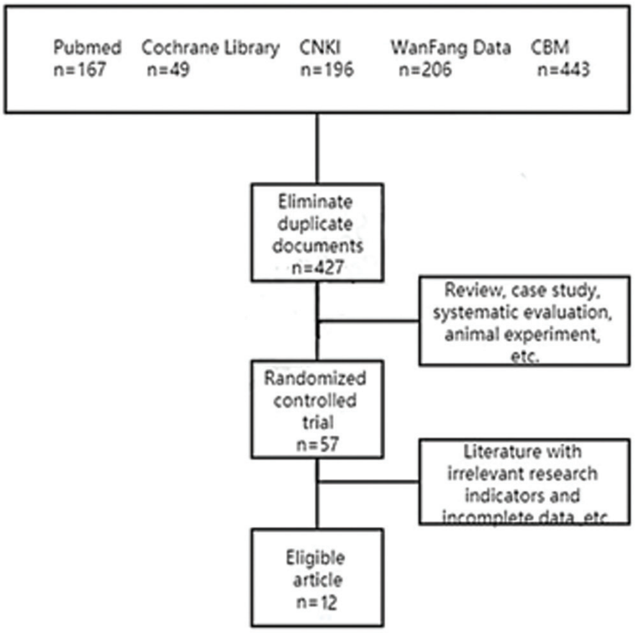
Table 1. Clinical Information and Bias Risk Assessment

Study	Sample	Age	Interventions	Outcomes and Assessment Metrics	Risk of Bias Assessment
Chamnan et al. (2014)[18]	25/25	18-45	Suture/EC	AMH	Low risk
Chun-Hua et al. (2016)[19]	69/69/69	18-45	Suture/EC / ultrasonic scalpel	AMH, AFC	Low risk
Zahra et al. (2015)[20]	47/45	18-42	Suture / EC	AMH	Low risk
Chang-Zhong et al. (2013)[21]	54/54/54	18-40	Suture/ EC / ultrasonic scalpel	AMH, AFC	Low risk
Fang et al. (2015)[22]	50/50/50	18-40	Suture/ EC / ultrasonic scalpel	AMH	Low risk
Chen et al. (2020)[23]	56/67/71	18-35	Suture/ EC / ultrasonic scalpel	AMH	Low risk
Rui et al. (2017)[24]	40/40/40	20-38	Suture/ EC / ultrasonic scalpel	AFC	Low risk
Jiang-Jing et al. (2016)[25]	70/70/60	18-36	Suture/ EC / ultrasonic scalpel	AFC	Low risk
Xiang-Ling et al. (2015)[26]	44/44	18-39	Suture/ EC	AMH, AFC	Low risk
Yuan-Yuan et al. (2015)[27]	40/40	20-35	Suture/Bipolar EC	AFC	Low risk
Jia-Ling et al. (2014)[28]	58/33/31	18-34	Suture/ EC / ultrasonic scalpel	AFC	Low risk
Hui-Shu et al. (2019)[29]	31/30/30	24-43	Suture/ EC / ultrasonic scalpel	AFC	Low risk

Note: The "risk of bias assessment" column indicates the level of risk associated with each study's bias assessment.

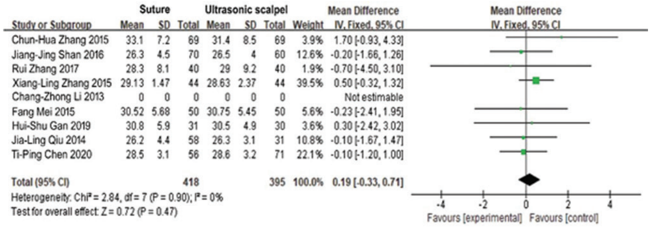
Abbreviations: AMH: Anti-Müllerian Hormone; AFC: Antral Follicle Count; Suture: Suture Hemostasis; EC: Electrocoagulation Hemostasis.

Figure 2. Flow Chart of Literature Screening for Inclusion



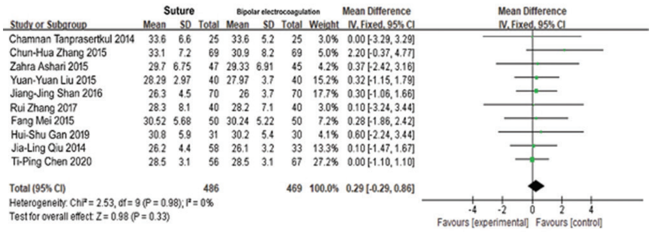
Note: This flow chart illustrates the process of literature selection and screening, including the number of articles obtained from initial database searches, removal of duplicates, assessment of relevance through reading abstracts, and the final number of articles included in the study.

Figure 3. Forest Plot Comparing Participant Age in Suture and Ultrasonic Scalpel Intervention Groups



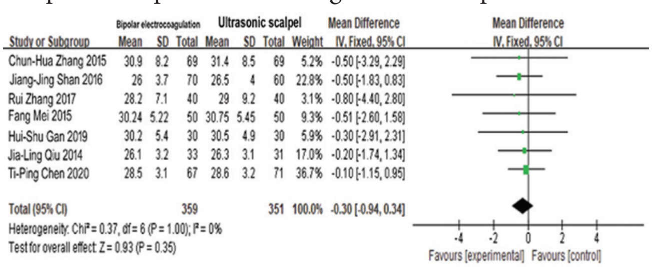
Note: This forest plot displays the comparison of participant age in the suture and ultrasonic scalpel intervention groups at various time points after surgery. The plot shows the distribution of age data from the included studies and provides insights into age-related differences between the two hemostatic methods.

Figure 4. Forest Plot Comparing Participant Age in Suture and Bipolar Electrocoagulation Groups



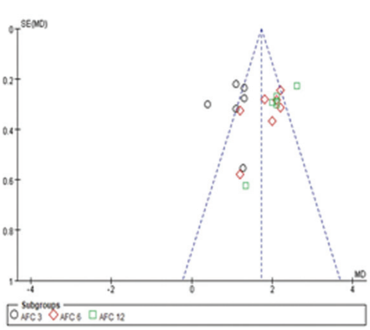
Note: This forest plot illustrates the comparison of participant age between the suture and bipolar electrocoagulation groups at different time points following surgery. The plot depicts the data from the included studies, offering insights into age-related differences between these two hemostatic methods. Components of the figure include individual study data points, the combined effect estimate, and confidence intervals.

Figure 5. Forest Plot Comparing Age between Ultrasonic Scalpel and Bipolar Electrocoagulation Groups.



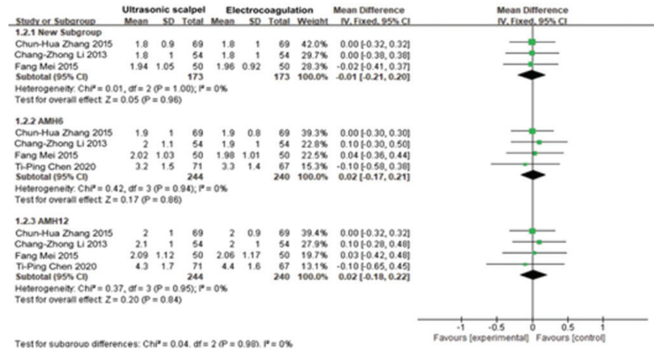
Note: This forest plot displays a comparison of participant age between the ultrasonic scalpel and bipolar electrocoagulation groups across different time points post-surgery. The components of the figure include individual study data points, the combined effect estimate, and corresponding confidence intervals.

Figure 6. Funnel Plot Analysis Comparing Electrocoagulation Hemostasis and Suture Hemostasis



Note: This funnel plot provides a graphical representation of publication bias in studies comparing the effects of electrocoagulation hemostasis and suture hemostasis on ovarian reserve function. The plot displays individual study results on the y-axis against their precision (or sample size) on the x-axis. In this dataset, study results are not evenly distributed within the funnel, asymmetry may indicate potential publication bias or other sources of heterogeneity.

Figure 7. Comparison of Post-operative AMH Value between Ultrasonic Scalpel Hemostasis and Electrocoagulation Hemostasis



Note: This figure presents a forest plot comparing the post-operative AMH (Anti-Müllerian Hormone) levels between patients who underwent ultrasonic scalpel hemostasis and those who received electrocoagulation hemostasis. Each square on the plot represents an individual study, with the size of the square indicating the study's weight in the analysis. The horizontal lines extending from each square represent the 95% confidence interval for each study, and the diamond at the bottom provides the overall summary estimate of the effect.

bipolar electrocoagulation groups, while Figure 5 presents the comparison by age between the bipolar electrocoagulation and ultrasonic scalpel groups.

Assessment of Publication Bias

A funnel plot was plotted to examine the presence of publication bias within the compiled studies. However, due to the limited number of included studies, determining the plot's symmetry proved challenging. A larger collection of studies was needed to enhance the interpretational robustness of the funnel plot. This research identified the largest subset of studies within an individual group, encompassing 7 studies that compared various study indicators with different hemostasis methods. Therefore, the analysis for publication bias was restricted to this specific group. The corresponding funnel plot is presented in Figure 6. The results revealed that the dispersion of studies around the central line does not exhibit perfect symmetry, indicating the possibility of publication bias.

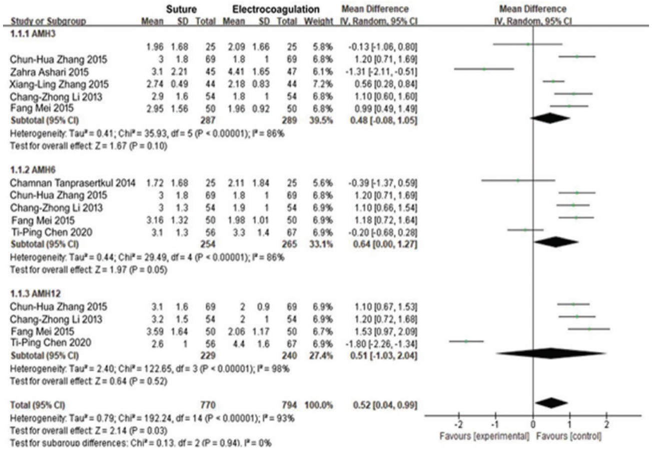
Comparison of Hemostasis Methods: Electrocoagulation vs. Ultrasonic Scalpel

In this analysis, four distinct studies[19,21-23] were identified for evaluating and comparing two hemostasis methods: electrocoagulation and ultrasonic scalpel. These studies collectively assessed AMH levels at various time points after surgery, totaling 484 cases. This pool comprised 240 cases utilizing electrocoagulation and 244 cases employing ultrasonic surgery. Remarkably, the analysis revealed an I^2 value of 0%, signifying low heterogeneity among the studies. The post-operative AMH level data unequivocally demonstrated no significant difference in AMH levels between the electrocoagulation hemostasis and ultrasonic scalpel hemostasis methods, as depicted in Figure 7.

Comparative Analysis of AMH Level: Electrocoagulation Hemostasis vs. Suture Hemostasis

In this analysis, a total of six studies[18-23] were identified for the evaluation and comparison of two hemostasis methods: electrocoagulation and suture hemostasis. These studies involved measuring AMH levels at various time intervals following surgery, encompassing 576 cases. Among these cases, 287 utilized suture hemostasis, while 289 employed electrocoagulation hemostasis.

Figure 8. Comparison of Post-operative AMH Value between Suture Hemostasis and Electrocoagulation Hemostasis



Note: This figure displays a forest plot comparing post-operative AMH (Anti-Müllerian Hormone) levels between patients who underwent suture hemostasis and those who had electrocoagulation hemostasis. Each square in the plot represents an individual study, with the square's size reflecting the study's weight in the analysis. The horizontal lines extending from each square represent the 95% confidence interval for each study, and the diamond at the bottom provides the overall summary estimate of the effect. The plot allows for the evaluation of the impact of these two hemostatic methods on post-operative AMH levels.

The results indicate that the average AMH values in the suture group were higher than those in the electrocoagulation group at the 3rd and 6th months post-surgery. However, no significant difference was observed in the 12th month, as illustrated in Figure 8. Notably, the heterogeneity test revealed an overall I^2 value of 93%, suggesting substantial heterogeneity. Therefore, a subgroup analysis was conducted.

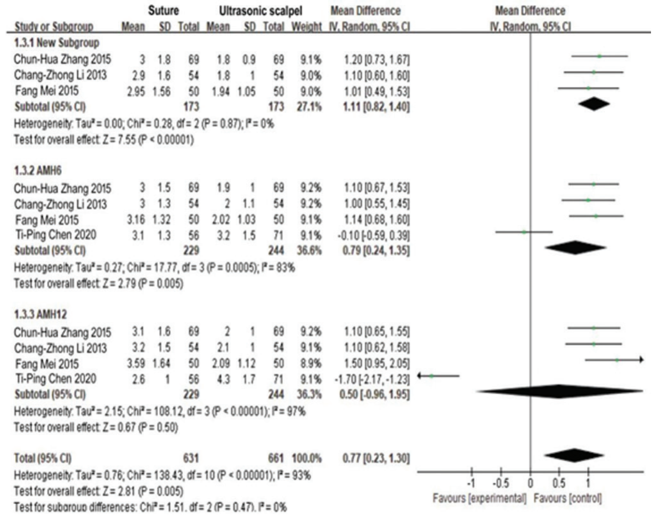
The heterogeneity test was further divided into subgroups based on the post-operative follow-up time, which revealed I^2 values of 86% at 3 months after surgery, 86% at 6 months post-surgery, and 98% at 12 months postoperatively. The increased heterogeneity within this dataset is likely attributed to the age of the subjects and the severity of the disease. It is evident that further research involving a significant number of RCTs is warranted to address this complexity.

Comparing AMH between Suture Hemostasis and Ultrasonic Scalpel Hemostasis

In this analysis, a total of four studies[19, 21-23] were analyzed to evaluate and compare the efficacy of suture hemostasis and ultrasonic scalpel hemostasis. These studies encompassed a comprehensive assessment of AMH levels at three distinct time points: the 3rd, 6th, and 12th months post-surgery, involving a total of 473 cases. Among these cases, 229 utilized suture hemostasis, while 244 employed ultrasonic scalpel hemostasis.

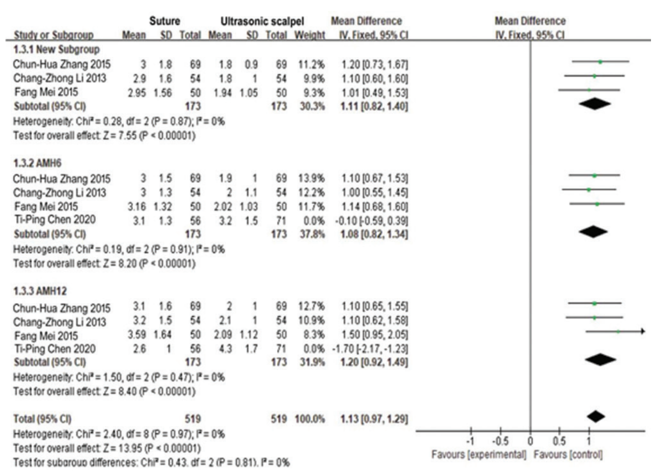
The findings revealed that the AMH value within the suture group was significantly higher than that within the ultrasonic scalpel hemostasis group at the 3rd and 6th months post-surgery. However, no statistically significant difference was observed at the 12th month post-surgery, as presented in Figure 9. Notably, when the article by Chen et al.[23] was excluded from the analysis, the forest plot's heterogeneity significantly decreased. In each subgroup, the I^2 value was reduced to 0, suggesting that this particular

Figure 9. Comparison of Post-operative AMH Value between Suture Hemostasis and Ultrasonic Scalpel Hemostasis



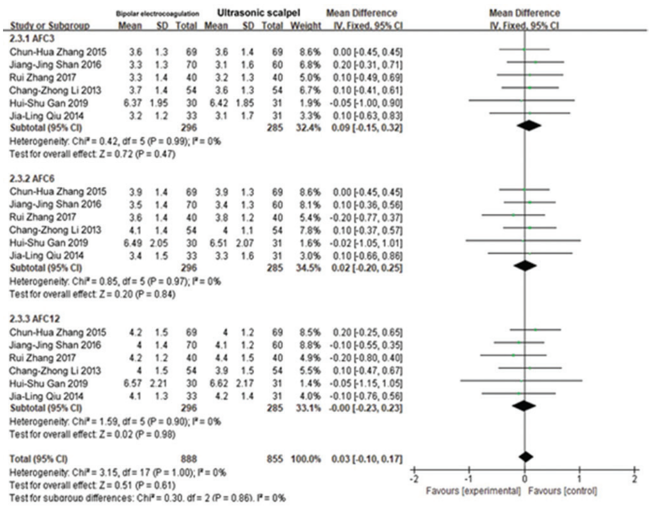
Note: This figure presents a forest plot comparing post-operative AMH (Anti-Müllerian Hormone) levels between patients who underwent suture hemostasis and those who received ultrasonic scalpel hemostasis. Each square in the plot represents an individual study, and the size of the square corresponds to the study's weight in the analysis. The horizontal lines extending from each square indicate the 95% confidence interval for each study, and the diamond at the bottom represents the overall summary estimate of the effect.

Figure 10. Comparison of Post-operative AMH Value between Suture Hemostasis and Ultrasonic Scalpel Hemostasis (After Removing Heterogeneity)



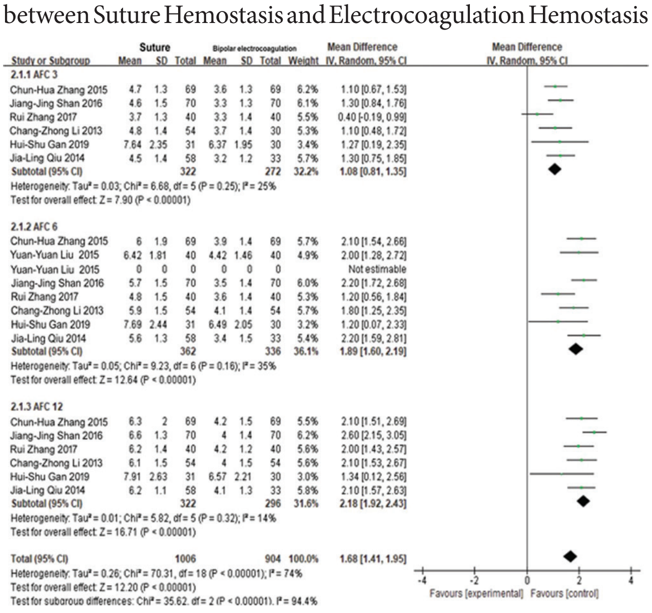
Note: This figure displays a forest plot comparing post-operative AMH (Anti-Müllerian Hormone) levels between patients who underwent suture hemostasis and those who received ultrasonic scalpel hemostasis after the exclusion of the source of high heterogeneity. Each square in the plot represents an individual study, and the size of the square corresponds to the study's weight in the analysis. The horizontal lines extending from each square indicate the 95% confidence interval for each study, and the diamond at the bottom represents the overall summary estimate of the effect.

Figure 11. Comparison of AFC (Antral Follicle Count) Value between Electrocoagulation Hemostasis and Ultrasonic Scalpel Hemostasis



Note: This figure presents a forest plot comparing the AFC (Antral Follicle Count) values between patients who underwent electrocoagulation hemostasis and those who received ultrasonic scalpel hemostasis after laparoscopic cystectomy for ovarian endometriomas. Each square in the plot represents an individual study, and the size of the square reflects the study's weight in the analysis. The horizontal lines extending from each square represent the 95% confidence interval for each study, while the diamond at the bottom represents the overall summary estimate of the effect. This plot illustrates the comparative impact of these two hemostatic methods on post-operative AFC values, providing valuable insights into their effects on ovarian reserve function.

Figure 12. Comparison of AFC (Antral Follicle Count) Value between Suture Hemostasis and Electrocoagulation Hemostasis



Note: This forest plot depicts the comparison of AFC (Antral Follicle Count) values between patients who underwent suture hemostasis and those who underwent electrocoagulation hemostasis following laparoscopic cystectomy for ovarian endometriomas. Each square on the plot represents an individual study, with the size of the square indicating the study's weight in the analysis. The horizontal lines extending from each square represent the 95% confidence interval for each study's findings. The diamond at the bottom of the plot represents the overall summary estimate of the effect. This figure provides a visual representation of the impact of these two hemostatic methods on post-operative AFC values, aiding in the assessment of their influence on ovarian reserve function.

study was a major source of high heterogeneity, as illustrated in Figure 10.

Comparative Analysis of AFC Level between Electrocoagulation Hemostasis and. Ultrasonic Scalpel Hemostasis

In this analysis, a total of six studies[19,21,24,25,28,29] were examined to evaluate and compare the effectiveness of two hemostasis methods: electrocoagulation hemostasis and ultrasonic scalpel hemostasis. These studies encompassed the assessment of AFC levels at three distinct time points: the 3rd, 6th, and 12th months post-surgery. In total, 581 cases were analyzed, with 296 cases employing electrocoagulation hemostasis and 285 cases using ultrasonic scalpel hemostasis. The results indicate that, regardless of the post-operative time frame, AFC levels remained consistent, with no significant difference observed between the use of electrocoagulation hemostasis and ultrasonic scalpel hemostasis, as depicted in Figure 11.

Comparison of Antral Follicle Count (AFC) Between Electrocoagulation and Suture Hemostasis Groups

In this analysis, seven relevant studies[19,21,24,25,27,28] were compiled for the purpose of comparing two distinct hemostasis methods: electrocoagulation hemostasis and suture hemostasis. The assessment of post-operative Ankle-Brachial Index (ABI) values was conducted at different time points, involving a total of 698 cases. Out of this pool, 336 cases implemented electrocoagulation hemostasis, while 362 cases opted for suture hemostasis.

The inclusive analysis revealed that across the entire follow-up period, the total effect size indicated an MD of 1.68, with a 95% CI ranging from 1.41 to 1.95 and a statistically significant $P < .0001$. These results underscore that the post-operative ABI value in the suture hemostasis group was notably higher than that in the electrocoagulation hemostasis group, as demonstrated in Figure 12. The calculated I^2 value of 74% denotes substantial heterogeneity.

However, through subgroup analysis based on the post-operative follow-up time, the heterogeneity test results within each subgroup yielded values of 25% for the 3 months post-surgery, 35% for the 6 months post-surgery, and 14% for the 12 months post-surgery. These findings suggest that the primary source of heterogeneity in this study is closely related to the duration of post-operative follow-up, refer to Figure 12.

Comparing AFC Between Suture Hemostasis and Ultrasonic Scalpel Hemostasis Groups

In this analysis, seven studies[19,21,24-26,28] were included that analyzed and compared the efficacy of suture hemostasis in contrast to ultrasonic scalpel hemostasis. These investigations involved the assessment of AFC values at various post-operative time points. In total, 695 cases were included, encompassing 366 cases implementing suture hemostasis and 329 cases opting for ultrasonic scalpel hemostasis.

The overall analysis demonstrated a substantial effect, with an MD of 1.60 and a 95% CI from 1.28 to 1.93. The $P < .00001$, signifying statistical significance. These findings indicate that the post-operative AFC value within the suture hemostasis group was notably higher than that within the ultrasonic scalpel hemostasis group, as illustrated in Figure 13. Notably, the I^2 value of 83% underscores substantial heterogeneity.

Subgroup analyses were conducted based on the follow-up time after surgery, with corresponding results for the heterogeneity test within each subgroup as follows: I^2 = 64% at 3 months post-operation, I^2 = 67% at 6 months post-operation, and I^2 = 19% at 12 months post-surgery. The sources of heterogeneity in this study are likely associated with the subjects› age, disease severity, measurement time, and post-operative follow-up time. However, additional research with a considerable number of RCTs is warranted.

DISCUSSION

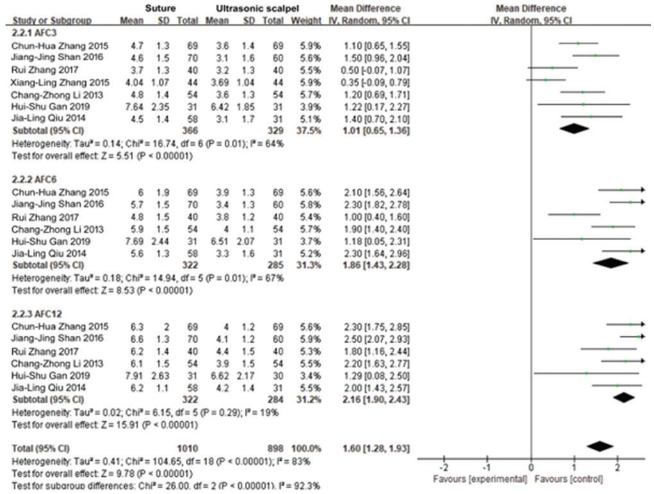
Ovarian endometriosis occurs in 15-40% of cases of pelvic endometriosis.[13] Surgery becomes an option when conservative treatments are ineffective or infertility persists due to this condition. Assessing ovarian reserve function lacks standardized indicators, but the most commonly employed indicators include AMH, AFC, basal hormone levels, and inhibin B, along with measurements of ovarian volume. In clinical practice, AMH and AFC are preferred due to their ease of acquisition.[8-9]

This study excludes basal hormone levels due to their instability, influenced by factors like ovarian-related diseases, menstrual cycles, and medications. Inhibin B is not considered due to its high cost and unclear predictive function regarding ovarian reserve capacity. Ovarian volume measurements are omitted due to their susceptibility to ovarian cysts, ovulation frequency, and operator-dependent variability.[8-13] Therefore, in this study, AMH and AFC serve as primary indicators for assessing ovarian reserve function.

Several factors contribute to the decline in ovarian reserve capacity, including surgical technique and the nature of the disease itself. While there have been suggestions of a connection between the method of hemostasis during surgery and ovarian reserve capacity,[14] this relationship remains inconclusive. Post-operative cyst debridement trauma often results in oozing or active bleeding.[15,16] Laparoscopic electrocoagulation and ultrasonic scalpel hemostasis are preferred for their convenience and effectiveness compared to suture hemostasis, making them widely adopted in clinical practice.

However, electrocoagulation used for hemostasis also inflicts thermal damage on normal ovarian tissue, whereas suture ligation hemostasis operates on the principle of compression, allowing for potential recovery of normal ovarian tissue post-procedure. This study carefully compared three hemostasis techniques: electrocoagulation, suture, and ultrasonic scalpel hemostasis. The analysis focused on post-operative indicators of ovarian reserve, including AFC and AMH levels.

Figure 13. Comparison of AFC (Antral Follicle Count) Value between Suture Hemostasis and Ultrasonic Scalpel Hemostasis



Note: This forest plot illustrates the comparison of AFC (Antral Follicle Count) values between patients who underwent suture hemostasis and those who underwent ultrasonic scalpel hemostasis following laparoscopic cystectomy for ovarian endometriomas. Each square on the plot represents a specific study, and the size of the square corresponds to the study's weight in the analysis. The horizontal lines extending from each square indicate the 95% confidence interval for the study's findings. The diamond at the bottom of the plot represents the overall summary estimate of the effect. This figure provides a visual summary of the impact of these two hemostatic methods on post-operative AFC values, contributing to the evaluation of their influence on ovarian reserve function.

Our findings emphasize the significance of the chosen hemostatic method in maintaining ovarian function. Notably, suture hemostasis consistently exhibited a positive impact on AFC, demonstrating significantly higher values compared to electrocoagulation and ultrasonic scalpel hemostasis. This difference is particularly evident at 3- and 6-months post-surgery.

In contrast, no substantial difference emerged when comparing AMH levels between these methods. While this observation suggests that AMH may not be the most sensitive marker for assessing hemostasis-related changes, the variance in AFC offers an alternative perspective. The higher AFC values in the suture hemostasis group indicate better preservation of the antral follicles, which is critical for maintaining reproductive potential. However, heterogeneity was evident, with factors such as age, disease severity, and post-operative follow-up time contributing to the observed differences. These findings serve as a foundation for informed decision-making regarding hemostasis techniques in ovarian endometriosis surgeries. It emphasizes the importance of tailored surgical approaches, particularly for women desiring future fertility.

Study Limitations

We acknowledge a few limitations in this study. Firstly, the predominance of included studies from a single geographic region, predominantly China. This geographic restriction raises concerns about the applicability of the findings to broader international populations. Secondly, variations in surgical techniques, equipment, and clinical practices across different regions may limit the generalizability of the results. Moreover, potential biases related to patient demographics, healthcare procedures, and research methodologies within this specific geographical context may introduce confounding factors that could affect result accuracy. To mitigate this limitation, future research should encompass a more diverse selection of studies from various countries and regions or consider collaborative, multi-center investigations RCTs to enhance the robustness and external validity of the study's conclusions.

CONCLUSION

In this study, a comprehensive analysis of existing literature and a meta-analysis were conducted to investigate the impact of various hemostatic methods on ovarian reserve function in the context of laparoscopic cystectomy for ovarian endometriomas. The evaluation utilized Anti-Müllerian hormone and antral follicle count as key assessment parameters. The results provide essential guidance for clinical practice in selecting the most appropriate hemostatic techniques to safeguard ovarian reserve function. Notably, suture hemostasis emerged as the method least disruptive to ovarian reserve function during laparoscopic cystectomy for ovarian endometriomas. In contrast, there was no significant disparity between electrocoagulation hemostasis and ultrasonic scalpel hemostasis regarding their impact on ovarian reserve function. These findings offer valuable insights for clinicians and surgeons when making informed decisions about hemostatic methods for patients undergoing this procedure.

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CONFLICT OF INTERESTS
The authors report no conflict of interest.

AVAILABILITY OF DATA AND MATERIALS
The data supporting the findings of this study are available from the corresponding author upon request, subject to reasonable conditions.

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