ORIGINAL RESEARCH ARTICLE

The efficacy of ultrasound-guided treatment of ovarian endometriosis cysts: A meta-analysis

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Abstract

The purpose of this meta-analysis was to systematically assess the efficacy of ultrasound-guided therapy of ovarian endometriosis cyst (OEC). Several databases were searched to gather published studies on the efficacy of ultrasound-guided treatment of OEC. The period of publication of the included studies was January 1, 2000 to December 31, 2020. Two researchers screened the literature and extracted data independently. The publication bias of the obtained studies was assessed. The obtain data was analyzed by a meta-analysis. Ten literatures ware included in this meta-analysis, including 2379 patients in the control group (laparoscopic cyst resection) as well as 1244 in the study group (ultrasound-guided interventional therapy). In contrast to the control group, the study group had higher treatment effectiveness rate, shorter operative duration, lower incidence of adverse reactions, higher luteinizing hormone level as well as lower follicle-stimulating hormone level. We conclude that ultrasound-guided treatment of OEC is conducive to improving the clinical treatment effect, reducing the effective rate of treatment, shortening the operative duration, decreasing the incidence of postoperative adverse reactions, increasing the luteinizing hormone level and decreasing the follicle-stimulating hormone level, which can effectively protect female's ovarian function, and is worthy of promotion and application. *(Afr J Reprod Health 2026; 30 7]: 115-123).*

Keywords: Ultrasound, Treatment, Ovarian Endometriosis Cyst, Clinical effect, Adverse reactions, Meta-analysis

Résumé

Cette méta-analyse visait à évaluer systématiquement l'efficacité du traitement échoguidé des kystes endométriaux ovariens (KEO). Plusieurs bases de données ont été consultées afin de recenser les études publiées sur l'efficacité de ce traitement. La période de publication des études incluses s'étendait du 1er janvier 2000 au 31 décembre 2020. Deux chercheurs ont examiné la littérature et extrait les données indépendamment. Le biais de publication des études obtenues a été évalué. Les données recueillies ont ensuite été analysées par méta-analyse. Dix études ont été incluses, portant sur 2 379 patientes dans le groupe contrôle (résection laparoscopique du kyste) et 1 244 dans le groupe d'étude (traitement interventionnel échoguidé). Comparativement au groupe contrôle, le groupe d'étude présentait un taux d'efficacité du traitement plus élevé, une durée opératoire plus courte, une incidence moindre d'effets indésirables, un taux d'hormone lutéinisante (LH) plus élevé et un taux d'hormone folliculo-stimulante (FSH) plus faible. Nous concluons que le traitement de l'OEC guidé par échographie est propice à l'amélioration de l'effet du traitement clinique, à la réduction du taux d'efficacité du traitement, à la diminution de la durée de l'intervention, à la réduction de l'incidence des réactions indésirables postopératoires, à l'augmentation du taux d'hormone lutéinisante et à la diminution du taux d'hormone folliculo-stimulante, ce qui peut protéger efficacement la fonction ovarienne féminine et mérite d'être promu et appliqué. *(Afr J Reprod Health 2026; 30 [7]: 115-123).*

Mots-clés: Échographie, Traitement, Kyste d'endométriose ovarienne, Effet clinique, Effets indésirables, Méta-analyse

Introduction

Ovarian endometriosis cyst (OEC) is a common gynecological disease, the main symptoms being abdominal pain and pelvic adhesion. Infertility can occur in severe cases, which impacts patients' quality of life.[1-3] Currently, the clinical pathogenesis of OEC is not clear, but a number of studies have pointed out that the disease is related to endometrial implantation, direct spread, tissue biochemistry, venous or lymphatic migration and other factors.[4] OEC has a high recurrence rate, often combined with pelvic adhesions, affect conception, and become a disease of many women who have not given birth.[5] The common treatment of OEC in clinical practice mainly contains drug treatment and surgical treatment. Surgical treatment, majorly hysterectomy, has good results, but it makes women

infertile.[6] Meanwhile, the side effects of drug treatment are relatively large, which is not conducive to the prognosis of patients, and the clinical efficacy needs to be further improved.[7]

As a new technology, ultrasound technology has high application value in many kinds of surgery.[8] In recent years, ultrasound-guided interventional therapy has been used to treat OEC,[9, 10] which has distinct advantages such as less trauma, low recurrence rate and fast recovery. However, up to now, there has been no systematic review or research project on ultrasound-guided interventional therapy for OEC. Therefore, this study was designed to analyze and evaluate the efficacy of ultrasound-guided treatment of OEC by systematic review of published studies and meta-analysis..

Methods

Inclusion and exclusion criteria

Inclusion criteria: Case-control study; The study objects were patients with OEC; The content of the study was the therapeutic efficacy of ultrasound-guided treatment of OEC; Periodical literature.Exclusion criteria: Conference papers, review papers, research reports; Non-case-control studies; Repeated published studies; The abstract information is incomplete.

Literature search strategy

We conducted an information search on The Cochrane Library (https://www.cochranelibrary.com/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), EMbase (https://www.embase.com/), Web of Science (https://www.webofscience.com/wos/), China national knowledge infrastructure (CNKI, https://www.cnki.net/) as well as other databases to collect relevant studies on the efficacy of ultrasound-guided treatment of OEC.

The deadline was January 1, 2000 to December 31, 2020. The English keywords were ultrasound-guided interventional therapy, ovarian endometriotic cysts, and laparoscopic cyst resection.

Literature screening and data extraction

Two researchers screened literature and extracted data independently, and consulted a third person to make a judgment on the selection of literatures with objections from both parties. Literature selection was carried out following the inclusion and exclusion criteria. First, by reading the title and abstract, some irrelevant literatures were eliminated, and then by further reading the full text, the literature was finally decided whether to choose. Next, data were extracted from the included literature, containing researchers, publication year, study type, sample size, and measurement data.

Publication bias of literature

The publication bias was evaluated with the aid of the Newcastle-Ottawa Scale (NOS),[11] and studies with a score ≥6 were identified to be of high quality.

Literature screening results

Through electronic searching of several databases, 625 relevant literatures were collected. Following the inclusion and exclusion criteria, 10 literatures were finally obtained,[12-21] among which 1244 patients in the study group (SG) as well as 2379 patients in the control group (CG). The SG received ultrasound-guided interventional therapy, while the CG received laparoscopic cyst resection. Figure 1 displayed the literature screening process.

Basic features and quality evaluation of the obtained literatures

Table 1 revealed the basic features of the obtained studies. NOS was adopted to assess the publication bias of the obtained studies. The scores were all higher than 7 points, indicating that all the included literatures were of high quality, which was conducive to the formation of subsequent meta-analysis results. Effective rate of treatment; Operative duration; Estradiol (E2) level; Incidence of adverse reactions; Luteinizing hormone (LH) level; Follicle-stimulating hormone (FSH) level.

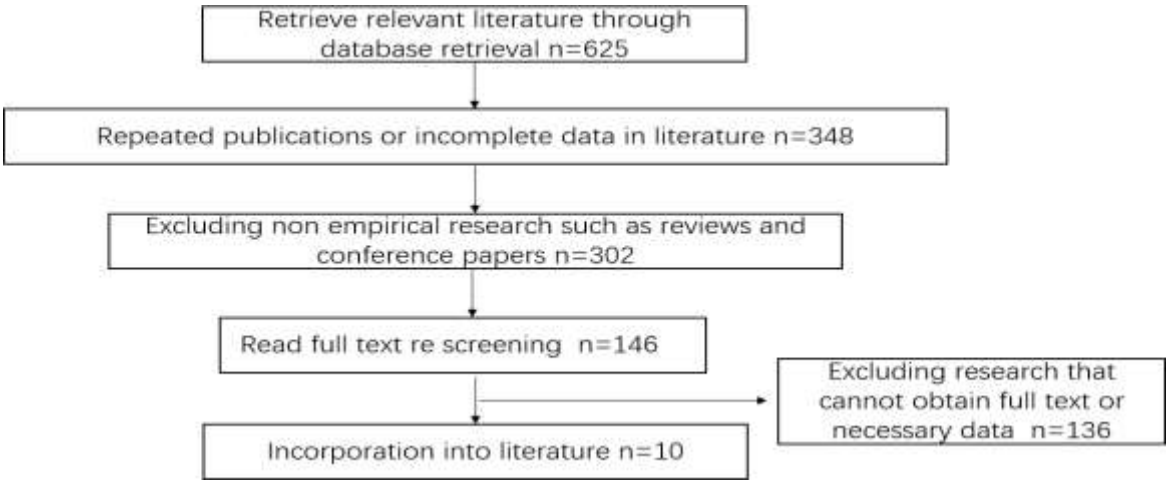

Figure 1: Flow chart of literature screening

Table 1: Basic features of included studies

Included studies	Year of publication	Number of cases SG	CG	Study type	NOS score /point	Research index
Zhang[12]	2019	40	40	Control study	7	①②④⑤⑥
Gong[13]	2018	72	71	Control study	8	①
Wang[14]	2020	30	30	Control study	9	①③⑤
Wei[15]	2020	95	72	Control study	9	①④
Holsbeke[16]	2010	713	1847	Control study	8	①④
Koike[17]	2002	45	65	Control study	8	①④⑤⑥
Wang[18]	2011	68	68	Control study	8	①
Wu[19]	2014	34	34	Control study	9	①④
Dan[20]	2018	110	110	Control study	7	⑥
Cai[21]	2016	37	42	Control study	8	①②③⑤⑥

① Effective rate of treatment; ② Operative duration; ③ Estradiol (E2) level; ④ Incidence of adverse reactions; ⑤ Luteinizing hormone (LH) level; ⑥ Follicle-stimulating hormone (FSH) level.

Statistical analysis

Meta-analysis was implemented utilizing RevMan 5.3 software. Odds ratio (OR) was adopted to be the effect index of categorical variables, and point estimates and 95% confidence intervals (CI) were given for each effect size. χ^2 test (α=0.1) was adopted to analyze the heterogeneity among the obtained studies, and I^2 was adopted to quantify the degree of heterogeneity. When conducting a meta-analysis, the fixed effect model was employed in scenarios where no statistical heterogeneity was detected among the study results. Conversely, if statistical heterogeneity was observed, a more in-depth analysis was carried out to identify its source. Once the influence of any apparent clinical heterogeneity had been eliminated, the random effects model was then utilized for the meta-analysis. P<0.05 meant the difference was significant.

Results

Effective rate of treatment

Nine literatures were included,[12-19, 21] including 1134 patients in SG and 2269 patients in CG. Heterogeneity test results displayed that I^2=80%, P<0.00001, reflecting that the results of the two groups have certain heterogeneity. Hence, a meta-analysis was implemented using the random effects model. In contrast to the CG, the SG had higher treatment effective rate [OR=4.00, 95% CI (1.64, 9.77)] (P=0.002, Figure 2).

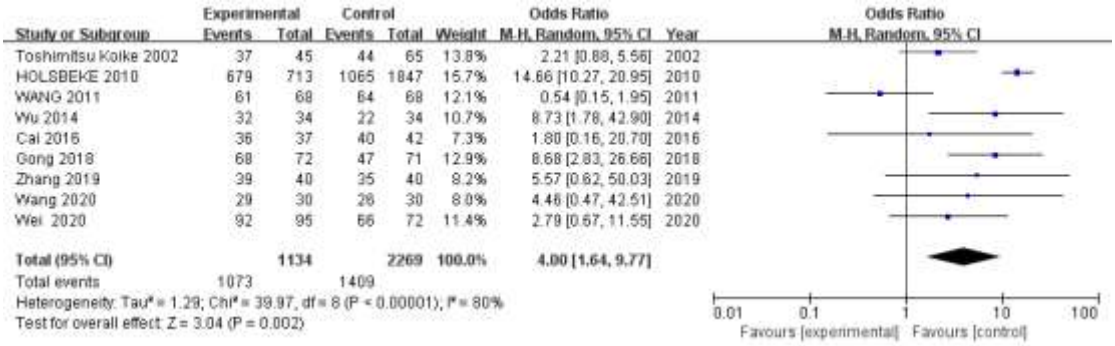

Figure 2: Meta-analysis results of effective rate of treatment in the two groups.

Operative duration

Two literatures were included,[12, 21] containing 77 patients in SG and 82 patients in CG. Heterogeneity test results displayed that I^2=84%, P=0.01, reflecting that the results of the two groups have certain heterogeneity. Hence, a meta-analysis was implemented utilizing the random effects model. In contrast to the CG, the SG had shorter operative duration [MD=-20.26, 95% CI (-24.80, -15.73)] (P<0.00001, Figure 3).

E2 level

Two literatures were included,[14, 21] including 67 patients in SG and 72 patients in CG. Heterogeneity test results displayed that I^2=96%, P<0.00001, reflecting a certain heterogeneity between the two groups. Thus, a meta-analysis was implemented utilizing the random effects model. No difference was seen in E2 level between the two groups [MD=12.30, 95% CI (-12.69, 37.29)] (P=0.33, Figure 4).

Incidence of adverse reactions

A total of 5 literatures were included,[12, 15-17, 19] including 927 patients in the SG and 2058 patients CG. Heterogeneity test results displayed that I^2=39%, P=0.16, reflecting no certain heterogeneity between the two groups, so a meta-analysis was conducted utilizing the fixed effect model.

In contrast to the CG, the SG had lower incidence of adverse reactions [OR=0.41, 95% CI (0.29, 0.57)] (P<0.00001, Figure 5).

LH level

A total of 4 literatures were included,[12, 14, 17, 21] including 152 patients in SG and 177 patients in CG. Heterogeneity test results displayed that I^2=92%, P<0.00001, indicating that the results of the two groups have certain heterogeneity, so a meta-analysis was implemented utilizing the random effects model. In contrast to the CG, the SG had higher LH level [MD=1.05, 95% CI (0.79, 1.31)] (P<0.00001, Figure 6).

FSH level

Four literatures were included,[12, 17, 20, 21] including 232 patients in SG and 257 patients in CG. Heterogeneity test results showed that I^2=95%, P<0.00001, indicating that there was a certain degree of heterogeneity in the results between the two groups. Therefore, a meta-analysis using the random effect model was conducted. In contrast to the CG, the SG had lower FSH level [MD=-1.58, 95% CI (-2.99, -0.16)] (P=0.03, Figure 7).

Publication bias

The uneven distribution of circles in the funnel plot indicates that there may be publication bias in the literature, as shown in Figure 8.

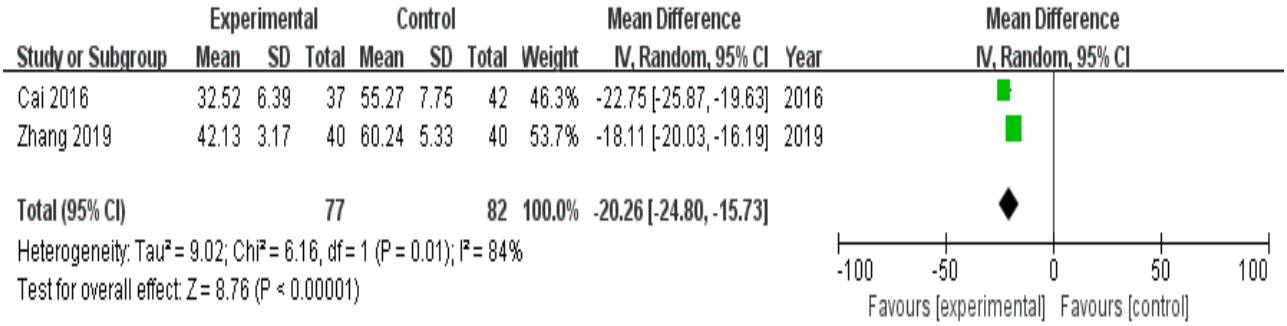

Figure 3: Results of meta-analysis of operative duration in two groups.

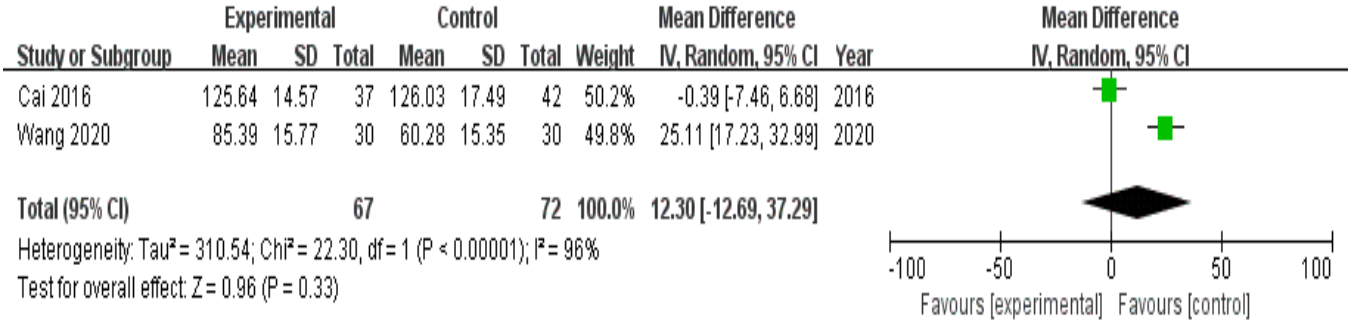

Figure 4: The results of meta-analysis of E2 level in two groups.

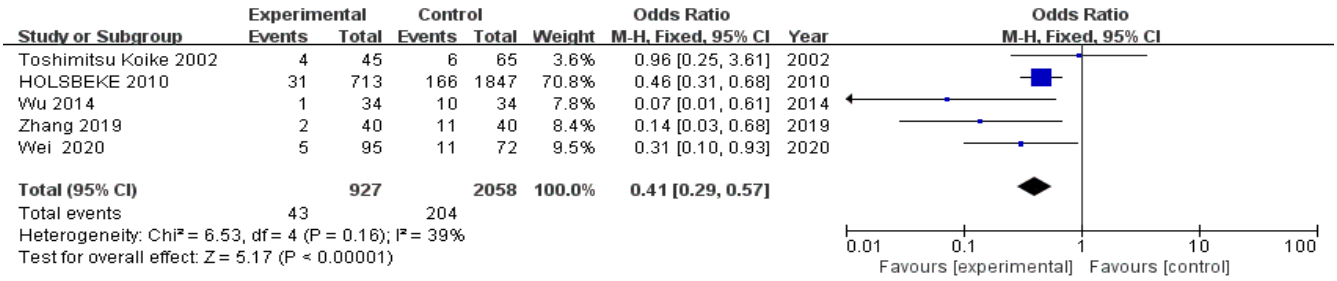

Figure 5: Results of meta-analysis of the incidence of adverse reactions in two groups.

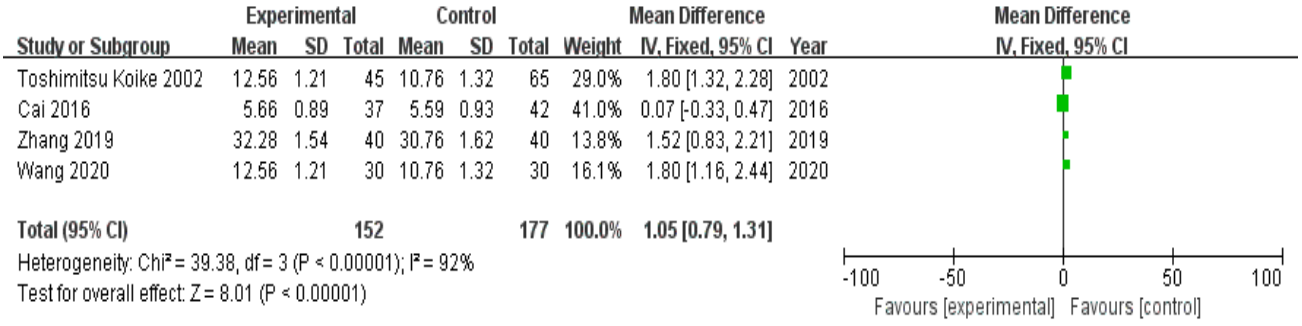

Figure 6: The results of meta-analysis of LH level

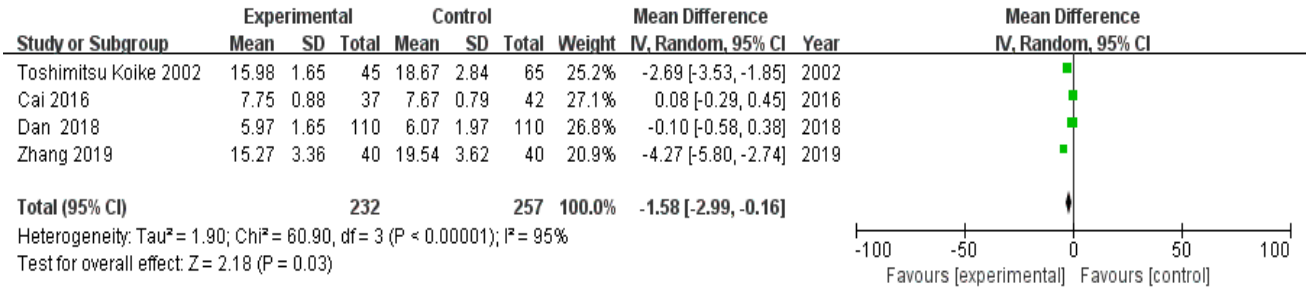

Figure 7: The results of meta-analysis of FSH level in two groups.

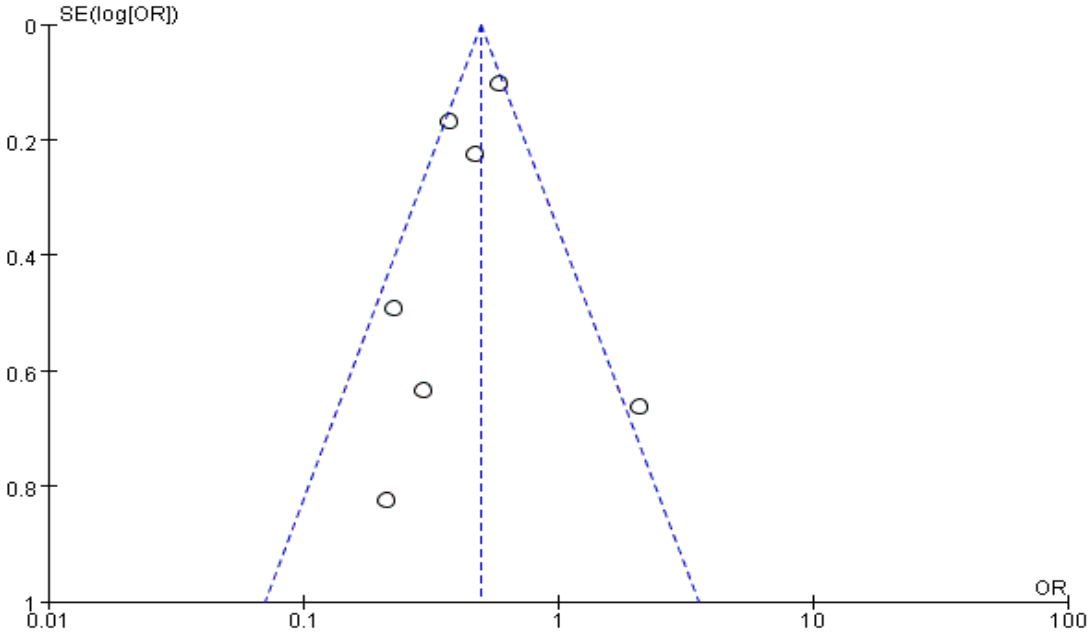

Figure 8: Publication bias

Discussion

Nowadays, OEC is a type of the common gynecological diseases in female, mainly affecting women of childbearing age between 20 and 45 years old. The common symptoms are pain and infertility. This disease has a certain degree of infiltration, which may cause uterine adhesion, and is very easy to relapse.[22] OEC is one of the clinical cases of endometriosis cyst, the drug treatment effect is relatively slow, the side effect is relatively large, and the patient needs to take medicine for a long period, the surgical treatment effect is also poor, which is prone to cause greater trauma to the patients, and even damage to other organs, and the recurrence rate is still relatively high.[23] Therefore, ultrasound-guided interventional therapy has been mentioned, and has achieved good therapeutic effect, without the need for laparotomy, simple operation, avoiding the impact on the uterus and leading to infertility, and accordingly it is widely used.[15-18]In our study, the patients in the SG received ultrasound-guided interventional therapy. This technique, leveraging the real-time imaging advantages of ultrasound, can clearly display the location, shape and relationship of the lesion with surrounding tissues, providing precise navigation for the treatment operation. In contrast, the patients in the CG received the laparoscopic cyst resection, which required the establishment of an intra-abdominal pneumoperitoneum under general anesthesia and the completion of cyst resection using laparoscopic

instruments.The results displayed that in contrast to the CG, the SG had higher treatment efficiency and shorter operative duration. This difference mainly stems from the fact that ultrasound-guided interventional therapy does not require the establishment of an abdominal cavity, does not involve extensive tissue dissection, has a more direct operation path, and can monitor the treatment process in real time, allowing for timely adjustment of the operation strategy. This efficiency not only shortens the surgical time for patients but also brings the advantage of rapid effect manifestation, which was basically similar to previous study.[24]

Our study also indicated that in contrast to the CG, the SG had lower incidence of adverse reactions, indicating that prognosis of patients was better after ultrasound-guided treatment. This is because laparoscopic surgery requires the creation of an intra-abdominal pneumoperitoneum and the operating space is relatively small, which may cause mechanical traction or thermal damage to the surrounding tissues; while ultrasound-guided interventional therapy precisely locates the treatment site, minimizing interference with normal tissues, thereby reducing the risks of postoperative bleeding, infection, organ damage, and other adverse reactions. Consistently, Zhao et al. suggested that ultrasound-guided ablation may reduce adverse events in patients with abdominal wall endometriosis.[25]

To better understand the effects of ultrasound guidance on ovarian function, the LH and FSH levels in SG and CG were further analyzed. The results showed that in contrast to the CG, the SG had better improvements of LH level and FSH level, implying that the number of follicles of the patients increased after ultrasound-guided treatment, indicating that the ovarian function of the patients would not be destroyed, and ultrasound-guided treatment even increased ovulation, increased the chances of conception, with less damage to the ovary and no impact on fertility. This may be attributed to the minimally invasive protection of ovarian tissue provided by ultrasound-guided interventional therapy: Compared with the potential ovarian cortical damage caused by laparoscopic surgery, the precise operation under ultrasound guidance can maximize the preservation of ovarian reserve function and promote normal follicular development. The optimization of hormone levels is directly reflected in an increase in the number of follicles and an improvement in ovulation rate, thereby creating favorable conditions for conception. Consistent with our findings, Koike et al. suggested that ultrasound-guided transvaginal ethanol sclerotherapy did not adversely impact reproductive performance in low-fertility women with OEC.[26] Wang and his colleague suggested that ultrasound-guided ablation was safe and effective for treating abdominal wall endometriosis.[27].

Strengths and limitations

The main advantages of this study are reflected in three aspects: Firstly, through strict screening of included literature, a comprehensive analysis framework covering multiple centers and large sample sizes was established; Secondly, it systematically explored the correlations between different ultrasound parameter combinations and clinical outcomes for the first time; Thirdly, the subgroup analysis method was employed to reveal the potential impact of histological types on treatment responses.

The main research limitations can be summarized as follows: First, affected by the quality of included studies, the uneven quality of obtained studies may lead to the deviation of results. Some studies may have methodological defects or low sample sizes that affect the reliability and stability of the studies. Second, the diversity of ultrasound parameters. In the ultrasound-guided treatment of OEC, different researchers may use different ultrasound parameters and thresholds, which may lead to differences in results. In addition, the correlation between ultrasound parameters and histologic type also needs to be further explored. For this reason, subsequent studies can increase the sample size accordingly and limit the quality of obtained studies to obtain more realistic findings.

In addition, these findings offer dual implications for clinical practice and policy-making: At the practical level, it is recommended to establish a standardized operation protocol for ultrasound-guided OEC treatment, clearly recommend parameter combinations, and require adjustments of treatment strategies based on tissue types; At the policy level, it is urgently necessary to formulate quality control standards for ultrasound treatment equipment, incorporate the parameter monitoring

module into the medical insurance reimbursement review system, and promote the establishment of multidisciplinary collaborative OEC diagnosis and treatment centers.

Conclusion

Ultrasound-guided treatment of OEC is conducive to improving the clinical treatment effect, reducing the effective rate of treatment, shortening the operative duration, decreasing the incidence of postoperative adverse reactions, increasing the LH level and decreasing the FSH level, which can effectively protect female's ovarian function, and is worthy of promotion and application.

Contribution of authors

Qian Zhang and Jing Zhao: conception and design. Wei Feng and Fangfei Su: analysis and interpretation of data. Xianquan Shi and Lina Zhang: drafting the article or revising it critically for important intellectual content. All authors: final approval of the version to be published.

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