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## Original Article

## Clinical characteristics and pregnancy outcomes of infertile patients with endometriosis and endometrial polyps: A retrospective cohort study

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## ABSTRACT

**Objective:** The aim of this study was to discuss the clinical characteristics and the prognosis of surgically diagnosed endometriosis complicated by endometrial polyps and investigate the association between pregnancy outcomes during subsequent pregnancies.**Materials and methods:** From January 2013 to December 2016, 1263 infertile patients were enrolled in the study. We identified 451 patients with endometriosis, and divided them into a polyp group ( $n = 204$ ) and a non-polyp group ( $n = 247$ ) based on whether or not they were associated with endometrial polyps. Postoperative clinical pregnant women ( $n = 82$ ) among the polyp group were then classified into a study group and a control group composed of those undergoing a singleton pregnancy ( $n = 164$ ) who delivered during the same time period. Clinical statuses and complications during pregnancy and delivery were collected from hospitals and by telephone interviews and surveys through the mail.**Results:** The prevalence rate of endometriosis infertile group was obviously higher than the non-endometriosis infertile group ([45.23%; 204/451] versus [17.12%; 139/812]). Women suffering from stage 1 to 4 endometriosis had a 42.44% (73/172), 40.69% (59/145), 55.89% (38/68) and 51.52% (34/66) occurrence rate of endometrial polyps, respectively. The frequency of endometrial polyps for stage 3 and 4 patients was obviously higher than that of stage 1 and 2 patients ([53.73%; 72/134] versus [41.64%; 132/317]). Moreover, the occurrence rate of deep infiltrating endometriosis (DIE) was 57.81% (37/64), which was obviously higher than that of ovarian endometriosis (42.42%; 98/231) and peritoneal endometriosis (44.23%; 69/156). Of the 204 women diagnosed with posterior endometrial polyps, 89 became pregnant, 7 pregnancies ended in a spontaneous abortion, and 82 successfully delivered a baby. The clinical pregnancy rate of patients in stages 1 and 2 was wholly higher than that of patients in stages 3 and 4 ([48.70%; 56/115] versus [37.71%; 26/82]). The postsurgical pregnancy status of patients suffering from peritoneal endometriosis was slightly better than those with ovarian or DIE, but differences were not statistically significant ( $P = 0.626$ ). We also found that the pregnancy rate was statistically elevated in patients whose EFI scores range from 7 to 10. When compared to the control group, women with endometriosis and endometrial polyps had a higher risk of their pregnancy being complicated by placenta previa (13.41%) and cesarean delivery (59.76%).**Conclusion:** Patients with endometriosis have a higher frequency of endometrial polyps. We found that a combined hysteroscopy and laparoscopy surgical procedure is an effective way to increase pregnancy rates. Different endometriosis stages and types in patients were associated with clinical pregnancy and spontaneous abortion rates. Women affected by both endometriosis and endometrial polyps have an independently elevated risk of placenta previa and cesarean delivery during pregnancy.© 2020 Taiwan Association of Obstetrics & Gynecology. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

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## Introduction

Endometriosis is a common gynecological disease for which endometrium-like tissue grows in areas outside the uterus, primarily in the pelvic cavity. Endometriosis occurs in 5%–10% of the general population, and up to 20%–50% of infertile women [1–3]. Clinically, notable symptoms include pelvic pain, menorrhagia, dysmenorrhea and infertility [4,5]. Similar to endometriosis, endometrial polyps are relatively common, occurring in 10%–40% of all women. They are detected in 1%–12% of asymptomatic patients during routine transvaginal sonography examinations [6]. Its prevalence ranges from 7.8% to 34.9% in routine clinical practice but is higher in infertile women [7]. Intrauterine structural abnormalities are thought to perturb implantation and cause infertility as well as early pregnancy loss [8,9].

The similar characteristics of endometriosis and endometrial polyps suggest that a potential association may exist between the two disorders. It is not totally understood whether endometrial polyps are a risk factor or an etiologic factor in endometrial-associated infertility. Several studies have revealed a higher frequency of endometrial polyps in patients with endometriosis compared to those without the disease [10–12]. Other studies have shown an increased presence of pelvic or peritoneal endometriosis in patients with suspected endometrial polyps through hysterosalpingography [13,14]. These studies indicate that the presence of endometriosis may be significantly associated with endometrial polyps.

These disorders are currently causing high occurrence rates of infertility, which is due to various reasons. Both endometriosis and endometrial polyps can result in infertility. Endometriosis affects fertility in many aspects, including dissecting pelvic distortions and interfering with hormones and inflammation. Besides, speculating mechanisms of endometrial polyps leading to infertility include lesions that may interfere with sperm transport mechanically or occupy space to interfere with embryo implantation. As such, both two disorders affect the endometrium together. However, the exact mechanisms underlying this condition are still not completely known [15]. For infertile patients diagnosed with both endometriosis cysts and endometrial polyps, a combined laparoscopic and hysteroscopic surgical procedure is highly recommended. Mechanisms that interfere with fertility in women diagnosed with these two disorders could potentially experience adverse maternal and infant outcomes. The potential association between endometriosis and an adverse pregnancy outcome has been receiving increasing attention [16–22]. Nevertheless, to the best of our knowledge, only limited clinical data are available on pregnancy-related complications and perinatal outcomes of postsurgical patients diagnosed with these two disorders who subsequently become pregnant.

The objectives of this study were to investigate casual relationships between endometriosis and endometrial polyps in infertile patients and to discuss pregnancy outcomes following a combined and simultaneous laparoscopy and hysteroscopy surgical procedure. Our aim is to provide insight into the treatment of patients suffering from endometriosis complicated by endometrial polyps.

## Materials and methods

This study was approved by the Fujian Provincial Maternity and Children's Hospital. All patients were both fully aware of the research and signed consent letters prior to its commencement. From January 2013 to December 2016, 1263 infertile patients that fulfilled the inclusion criteria were enrolled in the study.

The infertility inclusion criteria for this study were as follows: 1) fertility intention and regular sexual intercourse with no

contraceptive measures for more than one year; 2) the causes of infertility may be endometriosis, endometrial polyps, tubal factors, or unknown reasons. The pre-operative diagnosis of endometriosis is based on clinical manifestations and imaging studies, such as dysmenorrhea, ultrasound or magnetic resonance imaging suggesting an adnexal mass, and elevated blood CA125. The diagnosis of endometrial polyps is based on ultrasound scanning; 3) no hormone therapy for three months prior to surgery; 4) normal ovarian reserve function; 5) regular menstruation; 6) normal sperm function of the patient's male partner; 7) active effort to become pregnant following surgery; 8) 24–36 months of participation in follow-up interviews. The exclusion criteria included polycystic ovarian syndrome, uterine fibroid, genitalia deformation, adenomyosis, hydrosalpinx, acute pelvic inflammatory disease, oligospermia and asthenospermia. Other medical comorbidity was also subject to the exclusion criteria, such as thyroid disorders, diabetes, hypertension, hyperprolactinemia and connective tissue diseases.

All patients underwent a combined laparoscopy and hysteroscopy surgical procedure 3–7 days following their menstruation cycle. General anesthesia was given to all patients. During the laparoscopic procedure, the oviduct, ovary, uterine and pelvic cavity were first fully probed to determine their condition. Ovarian cystectomy, ectopic focus removal and hydrotubation in both oviducts were performed. Ovarian endometriosis cysts were removed, and all wounds were stitched using a 3/0 absorbable suture. Electrocoagulation was applied to all major hemorrhagic spots to avoid large-scale electrocoagulation in the ovarian wound. Tubal reconstructive surgery was applied to remove all adhesions around the oviducts and to restore normal anatomy between the uterine, oviducts and ovary. Small foci on the pelvic peritoneum, uterosacral ligaments and uterine surface were excised or treated with bipolar electrocoagulation. Additionally, hysteroscopy was performed to detect and remove (excise) potential endometrial polyps. Normal saline was used as a distending medium. After the insertion of the hysteroscope, observations were made of the cervix, the uterine wall and its fundus as well as the opening of both oviducts. Direct observation was used to detect polyps, which were excised using forceps and/or curettage without damaging the endometrium. The hysteroscope was then reinserted to confirm the complete removal of polyps, marking the end of the procedure.

Both endometriosis cysts and endometrial polyp(s) were confirmed by pathologic examination, and the staging of endometriosis was performed according to the revised American Fertility Society (r-AFS) classification [23]. After surgery, all participants attempted to conceive naturally and were followed to evaluate their pregnancy status and outcome. Patients in advanced endometriosis stages (stage 3 and 4) were prescribed Triptorelin (Ipsen Pharma, France; 3.75 mg/28 days) three months following surgery and then were allowed to actively engaged in conception.

To determine the prevalence of endometrial polyps in the endometriosis, we compared the hysteroscopic findings in the endometriosis group (451 cases) with the non-endometriosis group (812 cases). Based on the criteria cited above, we selected 451 patients with endometriosis, and they were then classified into either a polyp group ( $n = 204$ ) or a non-polyp group ( $n = 247$ ) for our subsequent cohort study.

Following surgery, patient files were reviewed and telephone inquiries were made on a regular basis to keep track of their pregnancy status and outcome. The duration of the entire survey was between 24 and 36 months. The clinical pregnancy rate and the spontaneous abortion rate were used as indicators of clinical pregnancy outcomes following surgery. Clinical pregnancy was defined as the presence of an intrauterine gestational sac with fetal cardiac activity determined by ultrasonography [24]. Spontaneous abortion was confirmed when ultrasonography showed either

abnormality, no embryonic heartbeat or death of the gestational sac. Postsurgical patients who subsequently became pregnant were selected for the study group (82 cases). Certain variables, such as age, body mass index (BMI), whether participants smoke tobacco, gravidity, parity, education exposure and economic income, were correlated according to the method of one-to-two pairing. Moreover, 164 women undergoing a normal pregnancy were enrolled as the control group. Analysis was performed by comparing groups respective of their course of pregnancy and perinatal outcome as well as any pregnancy-related complication and the health status of the infant.

### Statistical analysis

SPSS version 16.0 (IBM, Armonk, NY, USA) was used to analyze the data. Measurement data displaying normal distribution are shown as mean  $\pm$  standard deviation (SD). All data were analyzed using a *t*-test to compare between the two groups or variance between multiple groups. Non-normal distribution data were analyzed using the chi-square test, the Fisher's exact test or the rank sum test.  $P < 0.05$  was considered statistically significant.

### Results

Out of the 451 women suffering from endometriosis and infertility, 204 also suffered from endometrial polyps, therefore the prevalence rate was obviously higher than the non-endometriosis infertile group ([45.23%; 204/451] versus [17.12%; 139/812]). No statistical significance was found between the profiles of the two groups, indicating that the two data sets were generally well balanced (Table 1). Because 15 patients in the endometriosis group (i.e., 7 patients in the polyp group and 8 patients in the non-polyp group) were forfeited due to not following up, a total of 436 participants (i.e., 197 in the polyp group and 239 in the non-polyp group) remained from which to analyze pregnancy outcomes.

Women suffering from stage 1–4 endometriosis had a 42.44% (73/172), 40.69% (59/145), 55.89% (38/68) and 51.52% (34/66) occurrence rate of endometrial polyps, respectively. The frequency of endometrial polyps for stage 3 and 4 patients was obviously higher than that of stage 1 and 2 patients ([53.73%; 72/134] versus [41.64%; 132/317]). However, a pairwise comparison of the two groups revealed no significant differences. Moreover, the occurrence rate of deep infiltrating endometriosis (DIE) was 57.81% (37/64), which was obviously higher than that of ovarian endometriosis (42.42%; 98/231) and peritoneal endometriosis (44.23%; 69/156). We found no significant difference between the latter two polyp types ( $P = 0.093$ ). In addition, comparison of the pregnancy status between polyp and non-polyp groups in women suffering from endometriosis was shown in Table 2.

The clinical pregnancy rate of patients in stages 1 and 2 was wholly higher than that of patients in stages 3 and 4 ([48.70%; 56/115] versus [37.71%; 26/82]). A pairwise comparison between the two groups revealed no significant difference ( $P = 0.813$  &

$P = 0.415$ ). Spontaneous abortion rates did not differ significantly with respect to the specific endometriosis stage ( $P = 0.352$ ). The postsurgical pregnancy status of patients suffering from peritoneal endometriosis was slightly better than those with ovarian or DIE, but differences were not statistically significant ( $P = 0.626$ ). The cumulative clinical pregnancy rate was significantly higher in groups with endometriosis fertility index (EFI) scores of 7–8 and 9–10 than in groups with EFI scores of less than 7. However, a comparison between the two subgroups (i.e., the 7–8 and 9–10 subgroups) showed no significant differences ( $P = 0.729$ ). Furthermore, no significant differences ( $P = 0.138$ ) were observed between the three subgroups (i.e., the 5–6, 3–4 and 0–2 subgroups) (Table 3).

Table 4 provides the main results of the association between endometriosis and adverse pregnancy outcomes. Compared to women undergoing normal pregnancy, the study group was associated with a higher risk of placenta previa and cesarean delivery. Furthermore, we found no correlation between preeclampsia, postpartum hemorrhaging, premature fetal membrane rupture, infants with low birth weights, stillbirths, perinatal mortality and fetal distress (Table 4).

### Discussion

Endometriosis and endometrial polyps are both common gynecological diseases, but their causes and pathogeny have yet to be clearly understood. Both diseases have a high occurrence rate among infertile women, and both are estrogen-dependent disorders; but whether the two are correlated remains unclear. We found that patients with endometriosis who suffer from infertility have a 45.23% rate (204/451) of contracting endometrial polyps, which is significantly higher than non-endometriosis patients who receive hysteroscopic and laparoscopic surgical procedures for infertility at the hospital (17.12%) (139/812). Although it is possible that our findings may be due to chance alone, they are consistent with results from Kim et al. [10]. Furthermore, such a high occurrence rate of endometrial polyps among patients with endometriosis infertility was also reported by Park et al. [12] who also found that the growth of the Ki-67 and Bcl-2 proliferation marker genes that suppress cell apoptosis in endometrial tissues of patients results in increased cell proliferation and decreased apoptosis, increasing the likelihood that patients with endometriosis contract endometrial polyps. In addition, an endometrial polyp is a space-occupying lesion, which may in itself be the cause of infertility. However, the cause and pathogeny of both diseases remain unclear, necessitating further research.

So far opinions have been divided on the influence of r-AFS classification on the occurrence rate of endometrial polyps [12]. In this study, we found that participants with advanced stages (stages 3 and 4) of endometriosis had a higher rate of contracting endometrial polyps compared to participants in the earlier stages (stages 1 and 2). This indicates that patients with severe endometriosis may have a higher concomitant rate of endometrial polyps

**Table 1**  
Baseline characteristics of women with and without endometriosis.

Characteristics	Total (N = 1263)	Endometriosis (N = 451)		Non-endometriosis (N = 812)
		Polyps (N = 204)	Non-polyps (N = 247)	
Mean age (y)	27.7 $\pm$ 4.9	28.6 $\pm$ 5.3	27.4 $\pm$ 5.1	27.5 $\pm$ 4.6
Body mass index (kg/m <sup>2</sup> )	20.6 $\pm$ 2.8	20.3 $\pm$ 3.1	20.7 $\pm$ 2.4	21.1 $\pm$ 2.5
Infertility duration (y)	3.1 $\pm$ 2.8	3.6 $\pm$ 2.5	3.2 $\pm$ 2.3	3.2 $\pm$ 3.7
Primary infertility (n, %)	719 (56.93%)	113 (55.39%)	142 (57.49%)	464 (57.14%)
Secondary infertility (n, %)	544 (43.07%)	91 (44.61%)	105 (42.51%)	348 (42.86%)

The probability of all values was above 0.05.

**Table 2**

Comparison of the pregnancy status between polyp and non-polyp groups in women suffering from endometriosis.

Items	Number of cases (n)	Clinical pregnancy (n, %)	Spontaneous abortion (n, %)
Polyp group	197	82 (41.62%)	7 (4.06%)
Non-polyp group	239	79 (33.05%)	8 (3.34%)
P value		0.002	0.273

**Table 3**

Gestational comparison among the stages, types and endometriosis fertility index (EFI) scores of patients with endometriosis.

Items	No. of cases	Cumulative pregnancy	Spontaneous abortion
<b>Endometriosis stages</b>	197	82 (41.62%)	8 (4.06%)
Stage 1	64	29 (45.31%)	1 (1.56%)
Stage 2	51	27 (52.94%)	2 (3.92%)
Stage 3	43	15 (34.89%)	3 (6.98%)
Stage 4	39	11 (28.21%)	2 (5.13%)
<b>Endometriosis types</b>			
Ovarian EM	77	32 (41.56%)	3 (3.89%)
Peritoneal EM	81	35 (43.21%)	3 (3.70%)
DIE	39	15 (38.46%)	2 (5.13%)
<b>EFI</b>			
9–10	23	16 (69.57%) <sup>a</sup>	1 (4.35%)
7–8	89	46 (51.69%) <sup>a</sup>	4 (4.49%)
5–6	58	15 (25.86%)	2 (3.45%)
3–4	21	4 (19.05%)	1 (4.76%)
0–2	6	1 (16.67%)	0 (0.00%)

Note: Data are shown as n (%) unless stated otherwise. EFI = endometriosis fertility index.

The probability of most values was above 0.05.

<sup>a</sup> The probability was below 0.05.**Table 4**

Association between endometriosis and maternal and infant outcomes.

Variables	EM and EP (n = 82)	Control (n = 164)	RR (95% CI)	P value
<b>Maternal outcomes</b>				
Placenta previa	11 (13.41%) <sup>a</sup>	7 (4.27%)	3.14 (1.78, 5.24)	<0.001
Placental abruption	6 (7.32%)	13 (7.93%)	0.92 (0.71, 1.28)	0.248
Gestational hypertension and preeclampsia	2 (2.44%)	3 (1.83%)	1.33 (0.85, 1.89)	0.392
Preterm premature rupture of membranes	13 (15.85%)	27 (16.46%)	0.96 (0.69, 1.62)	0.124
Cesarean delivery	49 (59.76%) <sup>a</sup>	63 (38.41%)	1.56 (1.38, 2.24)	<0.001
Postpartum hemorrhaging	7 (8.54%)	12 (14.63%)	1.16 (0.82, 1.41)	0.305
<b>Infant outcomes</b>				
Preterm birth	9 (10.98%)	17 (10.18%)	1.06 (0.76, 1.25)	0.137
Perinatal asphyxia	2 (2.44%)	5 (3.05%)	0.80 (0.58, 1.37)	0.488
Perinatal death	0 (0%)	1 (0.61%)	0.00	0.931
Low birth weight	7 (8.54%)	12 (14.63%)	1.17 (0.61, 1.43)	0.129
Small for gestational age	5 (6.10%)	9 (5.49%)	1.11 (0.83, 1.59)	0.298
NICU admission	2 (2.44%)	4 (2.44%)	1.00 (0.56, 1.41)	0.171

Note: Data are shown as n (%) unless stated otherwise. CI = confidence interval; NICU = neonatal intensive care unit; RR = relative risk.

The probability of most values was above 0.05.

<sup>a</sup> The probability was below 0.05.

compared to their less severe counterparts. Furthermore, we also found that patients with DIE were more likely to contract endometrial polyps than patients with peritoneal endometriosis. This indicates that endometrial polyps and endometriosis are closely correlated in terms of clinicopathological features. Moreover, DIE may be more closely correlated to endometrial polyps, severely affecting the eutopic endometrium. Nevertheless, further research is needed to determine whether the existence of endometrial polyps increases the invasive ability of the endometrium given that its tissues, which enter the abdominal cavity, can easily grow into ectopic foci.

Laparoscopic surgery is an ideal choice in treating endometriosis due to its small incision, minimal trauma, quick recovery and relatively few complications. This procedure can be used to both confirm and to determine the stage of endometriosis. The procedure allows for the clearance of all foci and the removal of all harmful

cytokines and antibodies in peritoneal fluids. It is also useful in separating adhesion and pelvic recovery. These advantages are all conducive in promoting pregnancy rates following surgery. Hysteroscopy, combined with pathological examinations, is ideal for patients diagnosed with endometrial polyps since it allows for the direct observation of the uterine cavity, the complete removal of the endometrium anomaly and the preservation of healthy tissues surrounding the anomaly. Previous studies have reported that a combined hysteroscopy and laparoscopy surgical procedure can improve pregnancy rates of patients suffering from endometriosis or endometrial polyps [25,26]. Our previous study also found that 106 infertile women suffering from stage 3 and 4 endometriosis achieved a pregnancy rate of 57.5% following surgery [27]. As shown in this study, the clinical pregnancy rate of patients with endometriosis who suffer from infertility is 36.93% following surgery, which is consistent with the findings cited above. A combined



hysteroscopy and laparoscopy surgical procedure is therefore an effective way to increase pregnancy rates.

According to the literature, the pregnancy rate of patients with endometriosis who suffer from infertility is 41.62% following surgery, which was obviously higher than the non-polyp group. It was also found that patients with stage 1 and 2 endometriosis had a higher pregnancy rate than stage 3 and 4. Moreover, the spontaneous abortion rate and the clinical pregnancy rate in the polyp group were statistically higher than the non-polyp group. This indicates that the pregnancy rate of patients with a less severe form of endometriosis was higher compared to those with severe endometriosis. Moreover, infertile patients with peritoneal endometriosis have a better chance of natural conception than their ovarian or DIE counterparts, but the difference is not statistically significant. This means that the pregnancy rate of patients is not obviously correlated to the endometriosis type. In addition, this study found that the fertility prognosis of women with high EFI scores was excellent. We also found that the pregnancy rate was statistically elevated in patients whose EFI scores range from 7 to 10. This indicated that the EFI scoring system could explicitly predict natural pregnancy following surgery, which is consistent with previous studies [25,28,29]. However, this observation still requires confirmation through further studies.

Underlying potential mechanisms associated with pregnancy complications in women with endometriosis and endometrial polyps remain largely unknown. However, women with endometriosis and endometrial polyps should experience similar perinatal outcomes as their healthy counterparts given that this combined surgical procedure is capable of removing the foci in their endometrium, restoring normal anatomy, improving the microenvironment of the pelvic cavity, removing endometrial polyps and repairing the incision in the uterine cavity. However, to the best of our knowledge, previous studies have mainly focused on pregnancy outcomes under endometriosis alone; in other words, there has been few studies published on pregnancy complications and perinatal outcomes in patients with endometriosis complicated by endometrial polyps. As indicated in our study, we found a higher risk of placenta previa in the study group, which is to some extent consistent with results reported in previous studies [30–35].

Other mechanisms could nevertheless be associated with the correlation between endometriosis and endometrial polyps. Namely, other conceivable reasons for abnormal placentation could include endometrial inflammation, anomalous blastocyst implantation due to uterine dysperistalsis and impaired free radical metabolism, inadequate uterine contractility and an alteration in the uterine junctional zone [36]. However, our study was limited by a relatively small sample size. Therefore, more prospective studies are needed to clarify the relationship between endometriosis and placenta previa. Furthermore, we also observed a higher risk of cesarean delivery, corroborating findings by Stephansson et al. [16]. The cause of this difference was that patients who suffer from chronic infertility yearn to be pregnant and are therefore eager to accept cesarean delivery. In addition, with the intent to guarantee the safety of patients during delivery, part of the job of the obstetrician could also be to provide the patients the choice of cesarean delivery due to the stressful medical environment in China. Thus, a cesarean delivery on maternal request may offer at least a partial explanation for the elevated risk in elective cesarean delivery among women with endometriosis complicated by endometrial polyps [37]. However, pregnant women should not be encouraged to choose cesarean section as the default delivery option unless the safety of the mother or infant is at stake. Furthermore, in this study we did not find any difference in the rates of placental abruption, premature rupture of fetal membrane, preeclampsia, postpartum hemorrhage and infant outcomes.

The merits of this study are as follows: First, the case data derived from a medical center, and the surgery was performed by the same doctors. The source of case data was reliable and the diagnosis was clear, thus avoiding bias in case selection. Second, all women affected by endometriosis and endometrial polyps were confirmed by surgical and pathological diagnosis, thereby substantially reducing the risk of misclassification. Third, detailed clinical information, such as the stage, type and EFI of endometriosis, was wholly available for analysis. Fourth, the follow-up time was adequate, namely, from 24 to 36 months, and the number of forfeited follow-up cases was less than 5%. Finally, we employed various means to control potential confounding factors; namely, two qualified professionals verified the data used to ensure correctness and reliability. The limitation of our study is that it was observational in nature, and although we adopted various approaches to control confounding factors, residual confounding factors could still exist. In addition, the sample size was relatively small. To this end, we plan to conduct complementary multi-center, large-sample and prospective cohort studies in the future.

In summary, we confirmed results supporting the hypothesis that patients suffering from endometriosis have a higher frequency of endometrial polyps, although further research concerning the underlying mechanisms is needed. We found that the combined hysteroscopy and laparoscopy surgical procedure is an effective way to increase pregnancy rates. However, women affected by endometriosis and endometrial polyps have an independently elevated risk of placenta previa and cesarean delivery during pregnancy. Thus, our results strongly suggest that infertile patients with endometriosis should receive the combined hysteroscopy and laparoscopy surgical procedure to increase their chance of pregnancy. In addition, to reduce the chance of cesarean delivery and avoid delivery-related complications, a more rigorous monitoring system must be adopted for these patients.

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## Declaration of competing interest

All authors of this study declare no conflicts of interest.

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