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Original article

Effect of ovarian dermoid cyst excision on ovarian reserve and response: Insights from *in vitro* fertilization

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ABSTRACT

Study objective: To investigate the impact of an ovarian dermoid cyst or dermoid cyst surgery on ovarian reserve in patients undergoing *in vitro* fertilization/intracytoplasmic sperm injection (IVF/ICSI).
Design: We performed a retrospective cohort study by using the records of patients with a history of ovarian dermoid cyst who underwent IVF/ICSI between 2009 and 2013. The antral follicle count (AFC) obtained by transvaginal ultrasound during controlled ovarian hyperstimulation of IVF/ICSI, total number of basal follicles [i.e., basal antral follicle count (B-AFC)], and dominant follicles greater than 1.4 cm [i.e., dominant antral follicle count (D-AFC)] were calculated between the different groups.
Patients: We included 260 patients with a history of dermoid cyst excision and 23 patients with a dermoid cyst who underwent IVF/ICSI. Two hundred and eighty-three matched patients without a dermoid cyst and ovarian surgery history were included.
Intervention: None.
Measurements and main results: The B-AFC was significantly smaller in the dermoid cyst group than in the matched control group ($p = 0.030$). The B-AFC and D-AFC were both significantly smaller for the previously operated ovary than for the contralateral nonoperated ovary ($p = < 0.001$), and both were smaller in the ovary with a teratoma than in the other teratoma-free ovary with a mean reduction of 40.5% and 38.8%, respectively ($p = 0.018$ and $p = 0.004$, respectively). The B-AFC and D-AFC were significantly fewer in ovaries treated by open surgery than in ovaries treated laparoscopically ($p = 0.031$ and $p = 0.028$, respectively). There was no significant difference in the main IVF outcomes between the two groups or the subgroups.
Conclusion: Our results suggest that ovarian dermoid cyst excision could significantly reduce ovarian reserve to a similar extent as the cyst itself. The presence or resection of dermoid cysts will not affect the main IVF outcomes.

Background/Introduction

A mature ovarian cystic teratoma, also called a dermoid cyst, is the most common ovarian tumor in women of reproductive age and constitutes up to 20% of all ovarian tumors.[1] Despite its high prevalence, studies are scarce concerning its effect on ovarian reserve and its treatment strategy in infertile patients, although one previous study showed an increased prevalence of infertility among women with mature cystic teratomas.[2]

Conflicts of interest: The authors have no conflicts of interest to declare relevant to this article.

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The management of ovarian dermoid cysts in infertile women raises the following questions: (1) does surgical treatment of a dermoid cyst impact the ovarian reserve? (2) does a dermoid cyst and its resection impair the prognosis of assisted reproductive technologies (ARTs)? and (3) does the cyst damage the surrounding ovarian tissue? Until recently, definitive data have rarely been available to clarify these issues. Few studies have specifically investigated residual ovarian function after laparoscopic excision of dermoid cysts, especially in association with infertility. Kim et al[3] reported no difference in the serum levels of anti-Müllerian hormone (AMH) between women with mature cystic teratomas and age-matched and body mass index (BMI)-matched controls. They speculated that mature cystic teratomas do not significantly affect ovarian reserve, whereas stage IV endometriomas may be closely associated with decreased ovarian reserve. The effects of surgical treatment are often more harmful to the ovarian reserve, compared to the cyst itself. Surgical treatment of the dermoid cyst seems to affect the antral follicle count (AFC). Urman et al[4] reported that the AFC decreased more than 10% 6 months after cystectomy for endometriomas, compared to the preoperative count. Somigliana et al[5] declared that the laparoscopic excision of nonendometrioid benign ovarian cysts, which included only seven cases of dermoid cyst, was associated with significant injury to the ovarian reserve.

Purpose/Aim

The aim of the present study was to evaluate the impact of excising an ovarian dermoid cyst on ovarian reserve and the response to ovarian stimulation.

Materials and methods

We performed a retrospective cohort study that involved the collection of data from the electronic records of women who underwent *in vitro* fertilization/intracytoplasmic sperm injection (IVF/ICSI) between January 2009 and December 2013 in the Center for Reproductive Medicine at Shandong Provincial Hospital Affiliated to Shandong University (Jinan, China). Patients were monitored and managed in accordance with standardized clinical protocols used at the hospital. We initially included 304 patients who were previously diagnosed with a dermoid cyst by postoperative pathologic examination or by transvaginal ultrasound scan (TVS). Twenty-one patients were excluded because they met the following exclusion criteria: (1) dermoid cyst recurrence after surgery, (2) history of adnexectomy, or (3) previous ovarian surgery. If an included patient underwent several oocyte retrieval cycles, only the first cycle was included. Two hundred and sixty patients who had a history of dermoid cyst resection and 23 patients who had a dermoid cyst but no resection were finally included in Group 1. The control group (Group 2), which comprised women without fibroids, was matched to the study group by the following criteria: (1) age (± 1 year), (2) number of cycles, (3) type of infertility (i.e., primary or secondary), (4) presence of tubal disease (as diagnosed by a history of ectopic pregnancy or tubal obstruction) or history of tubal surgery, (5) history of surgery for endometrial polyps, (6) presence of male factors (oligospermia, asthenospermia, azoospermia), (7) presence of polycystic ovary syndrome,(8) type of protocol used for controlled ovarian hyperstimulation (COH), and (9) presence of endometriosis or adenomyosis. We required exact matching for criteria 1–3. For criteria 4–9, we attempted to match individuals as closely as possible. For most individuals, we were able to match at least three of these criteria. Researchers performing the matching were blinded to the IVF/ICSI outcomes. If multiple patients matched the criteria, one patient was chosen at random. All patients underwent routine COH. Day 3 AFCs before starting ovarian stimulation (i.e., the B-AFC) and the number of dominate follicles (D-AFC) that were greater than 1.4 cm at the time of human chorionic gonadotropin (hCG) administration were calculated. Detailed TVS monitoring before and during IVF/ICSI cycles was systematically applied and recorded; it had comparability with ultrasound assessment.

To avoid a large difference in number when comparing women who had surgery and women who did not have surgery (260 women vs. 23 women), we only included patients who had laparoscopic cystectomy into Group 1.1 and included patients who had no surgical management on the ovary into Group 1.2. This comparison was more acceptable because the ratio of the case numbers was lowered to 108:23, and the evaluation of open surgery for just the removal of an ovarian cyst was less meaningful. In both subgroups, the total number of B-AFC and D-AFC in each ovary was compared. The pregnancy outcomes such as cancellation, clinical miscarriage, clinical pregnancy rate (CPR), and delivery rate (DR) were compared.

Moreover, in the unilateral surgery subgroup, the difference in the AFC numbers between women who underwent an open surgery approach and laparoscopic approach was also measured. In our paper, $\triangle 1$ = (AFC on the nonsurgery side of the ovary) − (AFC on the surgery side of the ovary). $\triangle 2$ = (AFC on the teratoma-free side of the ovary) − (AFC on the teratoma side of the ovary). To clarify whether the impact is related to the surgical procedure and/or to a prior cyst, we compared the values between $\triangle 1$ and $\triangle 2$. A schematic diagram of our study is shown in Figure S1.

Statistical analysis was performed using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) while taking into consideration the match between each case woman and her control. Normally distributed data were presented as the mean and standard deviation. Abnormal distribution data were presented as the median (interquartile range). For continuous variables, the difference between the mean of the patients and the mean of the controls was computed and tested using a *t* test for paired comparisons. For proportions, the Chi-square test or Fisher's exact test were applied. The Kruskal–Wallis nonparametric test, followed by the Mann–Whitney *U* test, was applied for non-normal distributive data. A two-tailed $p < 0.05$ was considered significant.

This study was approved by the Institutional Review Board of Shandong University (Jinan, China). Written informed consent was obtained from the participants at the time of their presentation for IVF/ICSI treatment.

Results

Two hundred eighty-three patients fulfilled the inclusion criteria and were paired with 283 matched controls (Figure 1). The characteristics of the patients and the ovarian stimulation outcomes are shown in Table 1. Group 1 comprised patients who had undergone ovarian dermoid cyst resection unilaterally ($n = 203$) or bilaterally ($n = 57$) and 23 patients who still had a dermoid cyst during IVF/ICSI. Group 2 included 283 matched controls without a dermoid cyst or cystectomy. The oocyte retrieval procedure was successful without complications. There was no report of teratoma torsion or peritonitis during or after oocyte retrieval. No torsion was reported during the pregnancies. Table 1 shows no significant differences in most of the items compared. However, the mean B-AFC (in the left and right ovaries) was significantly smaller in Group 1 than in Group 2 (13.9 ± 7.1 vs. 15.9 ± 8.1; $p = 0.030$). The median number of good quality embryos transferred was significantly higher in Group 2 than in Group 1 (2 embryos vs. 1 embryo; $p = 0.029$). There were no differences between the two groups in the main IVF outcomes such as the CPR and DR (Table 2). The clinical miscarriage rate was slightly higher in Group 1 than in

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