

Ovarian Torsion at 8 weeks of Gestation in a Woman with Threatened Abortion After Frozen-Thawed Embryo Transfer: A Case Report

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Introduction: Ovarian torsion during pregnancy is a rare condition that requires prompt diagnosis and repositioning to preserve ovarian function.

Case Report: A 32-year-old woman underwent a successful pregnancy after FET, but was hospitalized for observation because of a threatened abortion. During the 8th week of pregnancy, a transvaginal ultrasound examination was performed due to sudden lower abdominal pain, which displayed an 8.3×5.2cm right ovary and a 4.3×3.6 cm enhanced echogenic mass over the right ovary with striated structures. Consequently, a preliminary diagnosis of ovarian torsion was made, and urgent laparoscopic exploration was conducted. Intraoperatively, the right fallopian tube and right ovary were rotated counterclockwise by 720 degrees. After rotate and reposition the right ovary and fallopian tube, a 3 cm diameter cyst was punctured. After 1 hour of observation, a 2×1×1cm segment of ovarian tissue was excised. Pregnancy was maintained with aggressive postoperative luteal support and anti-infective treatment.

Conclusion: The use of clomiphene citrate during endometrium preparation for frozen-thawed embryo transfer cycles may elevate the risk of ovarian torsion. Laparoscopic ovarian repositioning after ovarian torsion in pregnant women, even those with threatened abortion, is safe when combined with postoperative anti-infective treatment and intensive luteal support.

Keywords: ovarian torsion, frozen-thawed embryo transfer, pregnancy, laparoscopy

Introduction

As is well documented, ovarian torsion is one of the most prevalent gynecologic emergencies among women of childbearing age.¹ It is caused by complete or partial rotation of the adnexal structures, leading to ischemic changes in the ovary. Its incidence in the general population typically ranges from 0.01% to 0.05%.² However, its incidence during pregnancy is uncertain, estimated to be between 0.2% and 3%.³ Risk factors for ovarian torsion include ovarian masses, pregnancy, ovarian hyperstimulation syndrome (OHSS), polycystic ovarian syndrome, and multiple pregnancies.^{4,5} Considering the increased risk of ovarian torsion in the presence of large ovarian cysts, in vitro fertilization (IVF) and pregnancy puts adnexal torsion at increased risk. A retrospective cohort study showed that GnRH agonist trigger in combination with frozen-thawed embryo transfer (FET) significantly reduced the incidence of ovarian torsion and OHSS.⁶

In cases of suspected ovarian torsion, emergency laparoscopic surgery with ovarian repositioning or ovarian fixation and, if necessary, adnexectomy is reasonable.⁷ Unlike in non-pregnancy, guidelines for the management of ovarian torsion during pregnancy are scarce.^{8,9} Acute ovarian torsion with arterial obstruction, if left untreated, may result in ischemic necrosis of the ovary,¹⁰ thereby impacting ovarian function. During early pregnancy, ovarian secretion of

estrogen and progesterone is essential for the maintenance of pregnancy. This article presents the case of a patient hospitalized for threatened abortion after FET who developed ovarian torsion at 8 weeks of gestation and underwent laparoscopic exploratory surgery.

Case Description

This study was conducted in compliance with the Declaration of Helsinki and in the Department of Reproduction and Genetics of the Affiliated Hospital of Shandong University of Traditional Chinese Medicine, which was approved by the Medical Ethics Committee within the healthcare organization (no. 2024–05-003). The written consent was taken from the patient for this presentation. And the public disclosure of the case has been approved by the Affiliated Hospital of Shandong University of Traditional Chinese Medicine.

A 32-year-old woman with no previous history of pregnancy underwent laparoscopic aspiration of a right ovarian cyst in June 2020 at our fertility center, during which electrocautery was performed for a pelvic endometriotic lesion. Afterward, she underwent controlled ovarian hyperstimulation with a luteal phase gonadotropin-releasing hormone agonist (GnRH-A) protocol at our fertility center in September 2021. A total of 76 oocytes were retrieved, IVF was performed, and 8 embryos were obtained, all of which were frozen due to the occurrence of OHSS. Subsequently, she underwent endothelial preparation through an artificial cycle (oral estrogen and progesterone) in November 2021, followed by the transfer of two day-3 embryos, which did not result in pregnancy.

On February 16, 2023, she attended the center on the fourth day of her menstrual period for her second FET. This cycle involved an ovulation induction regimen for endometrium preparation with oral clomiphene citrate (MEDOCHEMIE LTD, Cyprus) 50mg/d for 5 days. On menstrual day 15, examination revealed a large follicle measuring 19 mm and another measuring 17.5 mm on her right ovary, with the remaining follicles not exceeding 10 mm. The endometrium layer was 12.2 mm thick, the serum estradiol level was 977.2 pg/mL, and the luteinizing hormone was 11.32 IU/L. She was subcutaneously administered 0.1 mg triptorelin acetate injection (Ferring GmbH, Germany) to promote follicle maturation and ovulation. Then, she was initiated on intramuscular injections of progesterone (XIANJU PHARMA, China) 20 mg/d starting one day after ovulation, as well as oral dydrogesterone tablets (AbbottBiologicalsB.V., The Netherlands) 20 mg/d on the day after ovulation. On March 6, she underwent FET of two day-3 embryos and continued to receive progesterone injection 20 mg/d intramuscularly and oral dextroprogesterone tablets 20 mg/d. Fourteen days later, her serum β -human Chorionic Gonadotropin (β -hCG) level was 725 IU/L. As of March 28 (22 days after FET), the patient experienced a small amount of vaginal bleeding due to exertion without abdominal pain. On April 3 (28 days after FET), an transvaginal ultrasound examination displayed a live fetus in the uterine cavity (consistent with 6w2d), a 1.37×0.28cm liquid-dark area outside the gestational sac, and 4.31×4.66cm liquid-dark and 2.04×1.98cm liquid-dark area in the right ovary. On April 6 (31 days after FET), the patient experienced increased vaginal bleeding and was admitted to our fertility center for treatment of threatened abortion. During hospitalization, the patient was advised to take bed rest as much as possible, and was given low-flow oxygen, vitamin B6, 5% glucose injection, and compounded vitamin fluids for nutritional supplementation. Progesterone injection and oral dextroprogesterone tablets were also administered for progesterone supplementation.

On April 16 (42 days after FET), the patient experienced sudden-onset severe pain in the right lower abdomen, accompanied by nausea and vomiting after a morning bath, as well as vaginal bleeding. An ultrasound examination (Figure 1) displayed a live fetus in the uterine cavity, a 1.66×0.67cm liquid-dark area outside the gestational sac, an 8.3×5.2cm right ovary, and 4.0×3.3cm liquid-dark and 2.0×1.8cm liquid-dark areas in the right ovary. While no blood flow signals were detected in the ovary, a few punctate blood flow signals were detectable in the periorbital cortex. Moreover, a 4.3×3.6 cm enhanced echogenic mass was identified above the right ovary with unclear borders and striated structures, which were not clearly demarcated from the right ovary. Consequently, a preliminary diagnosis of ovarian torsion was made, while the possibility of ovarian cyst rupture was not excluded. Thus, urgent laparoscopic exploration was conducted.

Laparoscopic examination revealed an enlarged uterus, consistent with a 2-month pregnancy with regular morphology. The left fallopian tube and ovary were normal in morphology and positioned on the left anterior side of the uterus. In contrast, the right fallopian tube and right ovary were rotated counterclockwise by 720 degrees and positioned on the

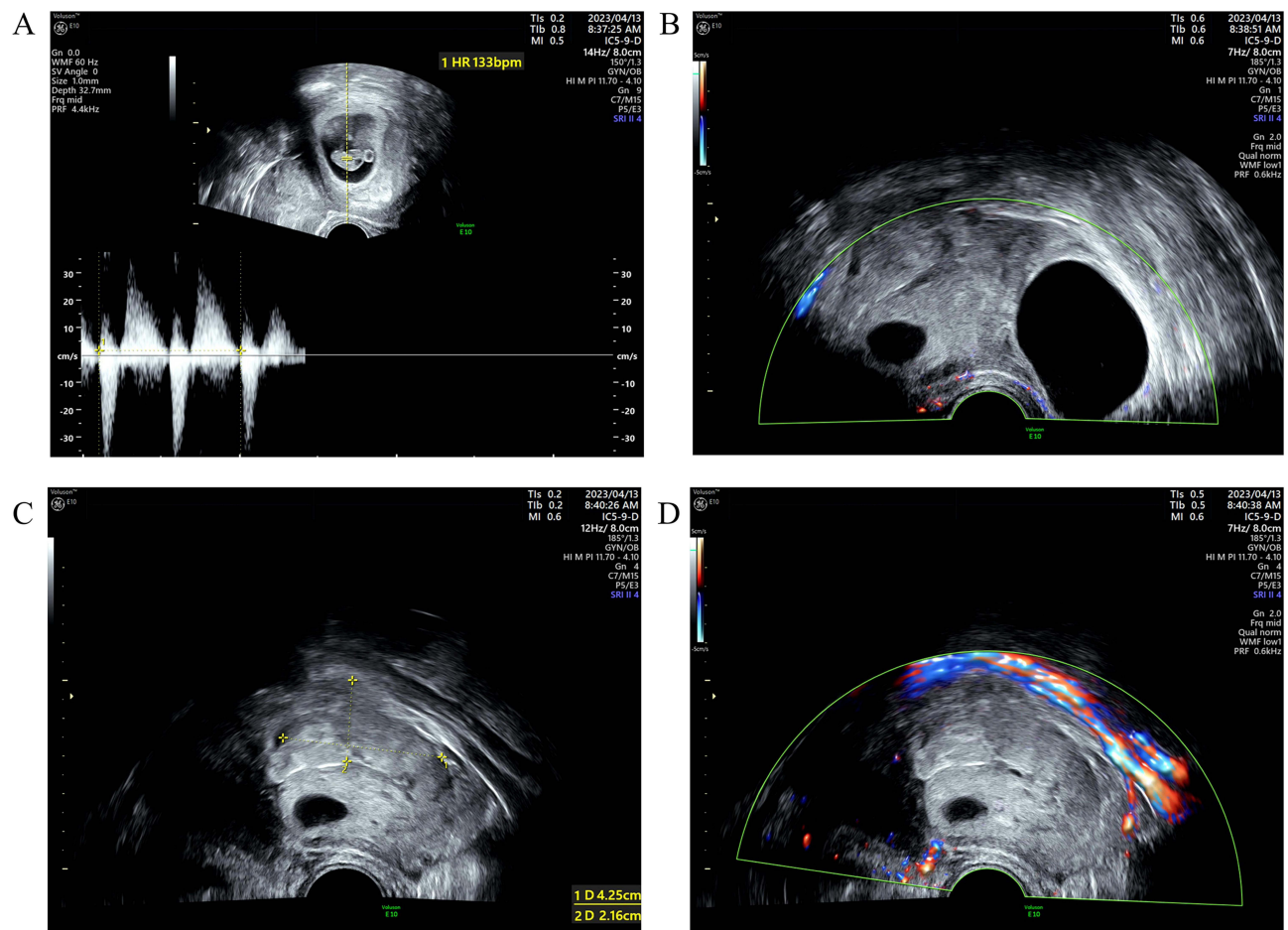


Figure 1 The ultrasound examination displayed suspicious ovarian torsion: (A) a live fetus in the uterine cavity; (B) an 8.3×5.2cm right ovary, and 4.0×3.3cm liquid-dark and 2.0×1.8cm liquid-dark areas in the right ovary; (C) a 4.3×3.6 cm enhanced echogenic mass above the right ovary with unclear borders and striated structures; (D) a few punctate blood flow signals could be detected in the peripheral cortex of the right ovary.

anterior side of the uterus (Figure 2A and B). The right ovary was enlarged, measured 8×5×4 cm, and had a purplish-blue color. Likewise, the peripheral vessels of the right fallopian tube were purplish-blue. The right ovary and fallopian tube were rotated and repositioned. After 15 minutes of observation, the right ovary became partially red, revealing a 3 cm diameter cyst. In order to reduce the risk of torsional recurrence and concomitantly relieve pain, pale yellow clear fluid was drained through the punctured cyst, and hemostasis was achieved via electrocoagulation. After a 30-minute monitoring period, approximately half of the right ovarian tissue regained its normal color. After 1 hour of observation, significant purplish-blue necrotic-like tissue was observed under the surface of the right ovary. Next, a wedge incision was performed on the right ovary, and a 2×1×1cm segment of ovarian tissue was excised (Figure 2C). Old blood clots were removed, fresh blood was drained from the trauma site, and absorbable sutures were used to control bleeding. Finally, the pelvis was thoroughly irrigated with saline, and no active bleeding or oozing of blood was detected. Despite the color of the right fallopian tube and peripheral blood vessels being normal, the color of the right ovary was marginally darker (Figure 2D). Finally, the incision was closed, concluding the operation. Afterward, the patient was transferred back to the ward for bed rest. Rehydration and infection preventive measures were implemented, along with progesterone injections and oral dextroprogesterone tablets, to support luteal function.

A follow-up ultrasound examination on the first postoperative day displayed a live fetus detected in the uterine cavity. The right ovary measured 5.1×3.4 cm, and there was abundant blood flow signal in the ovary (Figure 3). The patient was hospitalized for observation until 12 weeks of pregnancy, and was discharged after ultrasonography showed that the

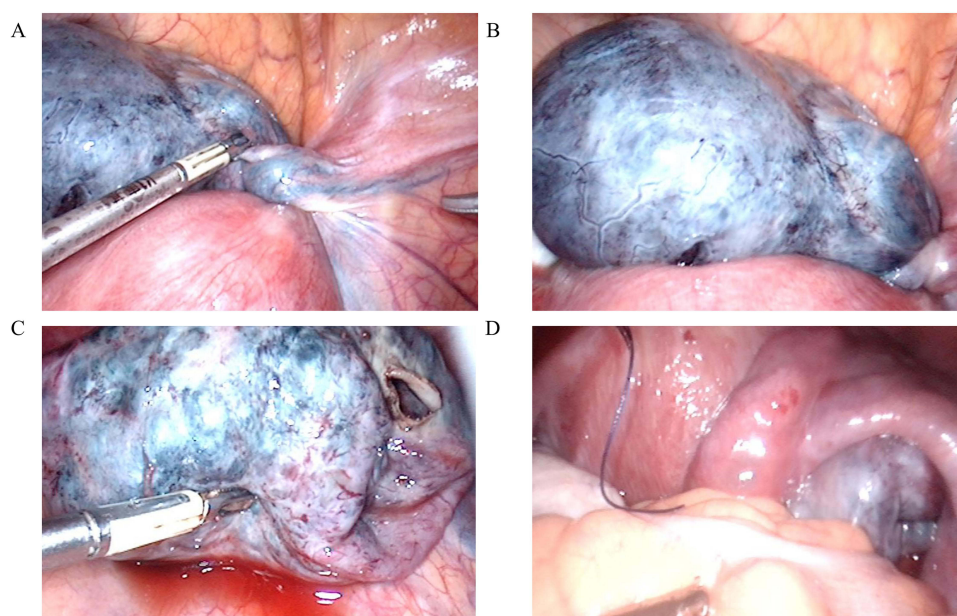


Figure 2 Diagnosis and treatment of ovarian torsion by laparoscopic surgery: **(A and B)** The right fallopian tube and right ovary were rotated counterclockwise by 720 degrees and positioned on the anterior side of the uterus. The right ovary was enlarged, measured 8×5×4 cm, and had a purplish-blue color. **(C)** A wedge incision was performed on the right ovary, and a 2×1×1 cm segment of ovarian tissue was excised. **(D)** At the end of the procedure, the right fallopian tube and peripheral vasculature were normal in color, and the right ovary was marginally darker.

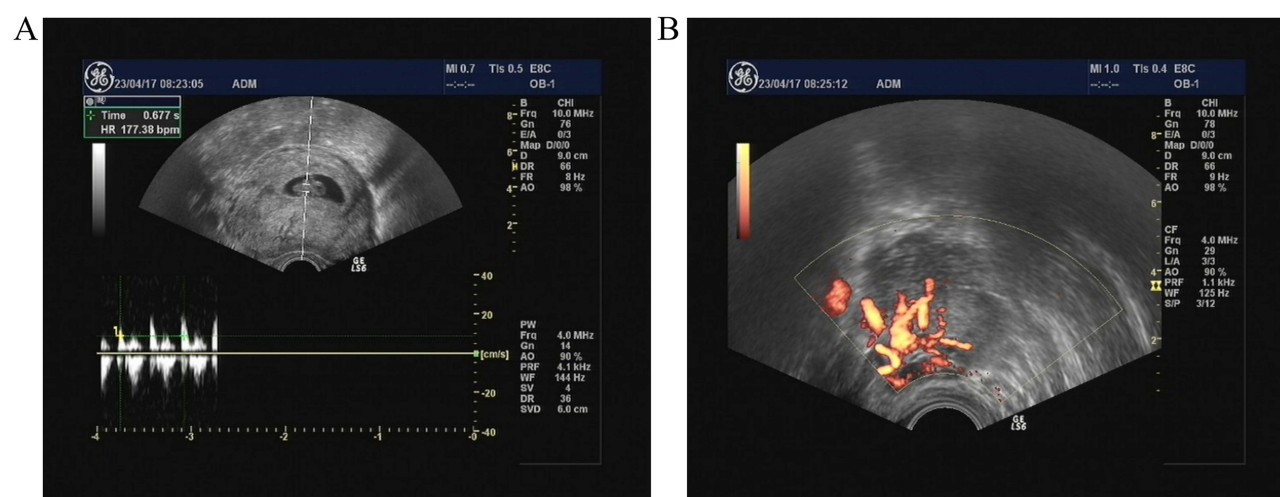


Figure 3 The ultrasound examination 1 day after laparoscopic surgery: **(A)** a live fetus in the uterine cavity; **(B)** the right ovary measured 5.1×3.4 cm with abundant internal blood flow signal.

thickness of the fetal nuchal translucency was 0.12 cm and the size of the ovary was normal. Afterwards, the patient underwent regular check ups in our hospital's obstetrics department for 20 weeks and everything was fine.

Discussion

Ovarian torsion is highly likely to compromise the blood supply to the ovaries and occurs as an adverse event during pregnancy. The occurrence of ovarian torsion during pregnancy is uncommon. Our case is the first report of ovarian torsion in a patient with threatened abortion during a successful FET pregnancy after IVF.

Ovarian torsion generally manifests as a sudden onset of lower abdominal pain, tender mass in the adnexal region, and signs of peritoneal irritation, accompanied by nausea and vomiting, low-grade fever, and leukocytosis. Accurate

diagnosis of ovarian torsion during pregnancy is often challenging, as its symptoms and signs often lack specificity. Almost all patients are admitted to the emergency department due to acute or subacute lower abdominal pain.¹¹ Ovarian torsion may be misdiagnosed as a disease causing lower abdominal pain due to general surgical reasons (such as appendicitis, renal colic, intestinal obstruction, intestinal perforation, peritonitis), gynecological diseases (such as hemorrhagic ovarian cysts, ovarian cyst rupture, leiomyoma torsion or degeneration), and obstetric diseases (ectopic pregnancy, placental rupture, or uterine rupture).¹² Of note, abnormality detected via color Doppler ultrasonography has a positive predictive value of up to 90% for the diagnosis of ovarian torsion.¹³ When color Doppler ultrasonography shows ovarian masses, reduced blood flow signals, and vortex like pedicle, high vigilance is required for ovarian torsion.¹⁴ Shur's team believe that magnetic resonance imaging (MRI) can be used for preliminary assessment of acute abdominal pain during pregnancy to clarify the diagnosis when appendicitis cannot be ruled out and no mass is detected by ultrasound.¹⁵ In addition, ovarian torsion is often accompanied by tubal torsion, and isolated tubal torsion is even rarer. However, acute isolated tubular torsion during pregnancy has also been reported before.^{16,17} The appearance of acute isolated tubular torsion is similar to ovarian torsion, but color Doppler ultrasonography often shows normal ovarian and pelvic masses.¹⁷ In summary, color Doppler ultrasonography examination is an essential method for emergency department evaluation of acute abdominal pain during pregnancy, which helps distinguish ovarian torsion from other diseases.

Although the probability of ovarian torsion during pregnancy is extremely low, there has been an increase in reports in recent years. The use of exogenous gonadotropins to promote ovulation in IVF-embryo transfer (ET) allows for the retrieval of multiple oocytes. However, it is worthwhile emphasizing that hCG-mediated ovarian hypersensitivity and enlargement increase the risk of OHSS and adnexal torsion.¹⁸ Meyer's team reported 140 patients with ovarian torsion over a period of 9 years at a medical center, of whom 76 (54.3%) received assisted reproductive technology treatment.¹⁹ Wang's team reported 82 cases of ovarian torsion during pregnancy in a medical center over a 10-year period, with 11 cases occurring after IVF-ET.⁹ In 2021, Yuet al's team reported a case of pregnancy complicated with adnexal torsion after IVF and conducted a systematic literature review.²⁰ After reviewing 38 case reports, Yu's team suggested that detorsion and preservation of ovarian function are the main treatment methods.²⁰

FET cycles thaw and transfer one or more embryos (frozen in the previous treatment cycle) to the uterus. Freezing embryos after IVF allows for natural recovery of enlarged ovaries, and selective FET is a strategic choice. As a result of previous retrospective cohort studies, the probability of ovarian torsion occurring during FET cycles is very low,⁶ and there are currently few clinical reports. Recently, Sibai's team reported a case of transient ovarian torsion in a 7-week pregnant patient after FET. The patient received 5 mg of aromatase inhibitor (Femara) for endometrium preparation. The patient presented with pain in the right lower back and ultrasound examination showed temporary or incomplete ovarian torsion. After conservative treatment, the patient had a good prognosis.⁸ Our case is similar to the one reported by Sibai's team, both using ovulation inducing drugs for endometrium preparation. Ovulation inducing drugs can promote follicle development while increasing estrogen levels, causing functional endometrium to grow in response to the increase in estrogen levels. After ovulation, progesterone completes the preparation of the endometrium after sufficient estrogen priming.²¹ The previous system review indicated that letrozole or clomiphene citrate may improve clinical pregnancy rate (CPR) in FET cycles, but no adverse reactions related to attachment torsion were reported.²² In 2012, Shiao's team reported a case of unilateral adnexal torsion caused by OHSS after induction of ovulation with clomiphene.²³ There are also two reports of women receiving clomiphene citrate experiencing massive ovarian edema, one of which occurred at 13 weeks of pregnancy.^{24,25} Currently, only we and Sibai's team have reported a possible association between letrozole or clomiphene citrate and ovarian torsion in FET cycles, but it is unclear whether letrozole or clomiphene citrate poses a risk of ovarian torsion. This may be ascribed to ovarian enlargement and luteinizing cysts caused by letrozole or clomiphene citrate ovulation, formation of corpus luteum, and endogenous hCG secretion, which promotes ovarian enlargement over a longer period of time, thereby increasing the risk of ovarian torsion. Gynecologists must be aware of the risks associated with using clomiphene citrate to treat infertility. Although ovarian torsion during FET cycles is extremely rare, patients should be informed of this potential risk.

In this case, the patient exhibited typical signs, and laparoscopic exploration was immediately performed owing to its high safety profile and minimal adverse fetal consequences.^{26,27} However, it is worth noting that non-obstetric procedures

performed during pregnancy have been reported to increase the risk of early miscarriage or intrauterine growth retardation.²⁸ The current consensus on ovarian torsion is that early salvage of ovarian tissue is effective. Earlier studies have reported that about 73% of torsioned ovaries have a likelihood of recovery and preservation of function.²⁹ Even if the torn appears blue-black color intraoperatively, normal follicular development is detected on ultrasound in 90% of cases after restoration surgery, with blood flow signals and ovarian acoustic images being restored to normal within 6 weeks.³⁰ Although our patient manifested symptoms of threatened abortion and considering the detrimental effects of ovarian tissue damage induced by ovarian torsion, laparoscopic ovarian torsion restoration was urgently performed to rescue the ovary. Previously, ovarian restoration was hypothesized to increase the risk of thrombus dislodgement, and therefore, adnexectomy remains the preferred choice. However, a study comparing over 1,000 cases of ovarian torsion restoration versus resection documented that the incidence of postoperative pulmonary embolism was merely 0.2% and was comparable between the restoration and resection groups.³¹ Consequently, the color of the ovary and the surrounding blood vessels was closely monitored after ovarian restoration. Interestingly, a large amount of purple-blue tissue was observed under the surface of the right ovary at 1 hour postoperatively. Finally, part of the purple-blue tissue was resected. In IVF-ET patients with a strong desire for fertility and in those who are diagnosed early and highly suspected of having an ovarian torsion, early laparoscopic exploration and restoration are pivotal for the preservation of ovarian function and the continuation of the pregnancy.

In addition, a paracentesis of the ovarian cyst was performed during the procedure. Common complications of ovarian cysts in pregnancy include cyst torsion, rupture, infection, malignancy, and cyst impaction.³² The need for treatment of ovarian cysts is generally determined based on clinical symptoms, as well as cyst type and size.^{33,34} Asymptomatic simple cysts measuring less than 5 cm in diameter are likely to resolve spontaneously. On the other hand, surgical excision may be considered for persistent masses larger than 5 cm or those with malignant potential.³⁵ Thus, the clinician must carefully consider and make a deliberate decision when to proceed with surgical intervention. Early intervention may increase the risk of miscarriage and loss of luteal function, while late intervention increases the risk of complications.³⁶ Notably, an earlier study reported that for functional ovarian cysts in pregnancy, cyst aspiration and drainage during laparoscopic adnexal torsion reversal reduced the risk of recurrent torsion compared to reversal alone.³⁷ Herein, after laparoscopic rotational repositioning of the right ovary and right fallopian tube, a 3 cm diameter cyst was identified on the right ovary. We immediately performed paracentesis and routinely administered preoperative and postoperative medications to inhibit contractions and prevent infection in order to minimize the risk of miscarriage. Our patient's pregnancy was successfully maintained following surgery, luteal support, and anti-infective treatment.

This report has certain limitations. Due to the low incidence, we only reported one case of ovarian torsion in a woman with threatened miscarriage after FET surgery. Individual or few cases cannot fully represent their clinical characteristics and outcomes, which affects the generalizability of the conclusions. In addition, the patients in this case were only followed up to 20 weeks, and the lack of long-term follow-up data and offspring outcomes is another limitation.

Conclusion

Use of clomiphene citrate during endometrium preparation for frozen-thawed embryo transfer cycles may be a risk factor for ovarian torsion during pregnancy. Although ovarian torsion after FET surgery is very rare, timely color Doppler ultrasound examination can help differentiate and diagnose other diseases for lower abdominal pain during pregnancy. Laparoscopic ovarian restoration after ovarian torsion in pregnant women with threatened abortion is safe with postoperative anti-infective therapy and intensive luteal support.

Abbreviations

IVF, in vitro fertilization; ET, embryo transfer; GnRH-A, gonadotropin-releasing hormone agonist; FET, frozen-thawed embryo transfer; OHSS, Ovarian Hyperstimulation Syndrome; hCG, human Chorionic Gonadotropin.

Ethics Approval and Informed Consent

The Ethics Committee for Reproductive Medicine of the Affiliated Hospital of Shandong University of Traditional Chinese Medicine reviewed and gave ethical approval (File No. 2024-05-003).

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This study was funded by the National Natural Science Foundation of China (82174429, 82104914) and 2024 Shenzhen Luohu District Soft Science Research Program (LX202402023).

Disclosure

The authors report no conflicts of interest in this work.

References

1. Amirbekian S, Hooley RJ. Ultrasound evaluation of pelvic pain. *Radiol Clin North Am.* 2014;52(6):1215–1235. doi:10.1016/j.rcl.2014.07.008
2. Damigos E, Johns J, Ross J. An update on the diagnosis and management of ovarian torsion. *Obstet Gynaecol.* 2012;14(4):229–236. doi:10.1111/j.1744-4667.2012.00131.x
3. Huchon C, Fauconnier A. Adnexal torsion: a literature review. *Eur J Obstet Gynecol Reprod Biol.* 2010;150(1):8–12. doi:10.1016/j.ejogrb.2010.02.006
4. Acharya K, Poudel D, Dahal S, Kuikel S, Adhikari A. A case of huge ovarian cyst in second trimester: a rare case report. *Ann Med Surg.* 2022;82:104765. doi:10.1016/j.amsu.2022.104765
5. Houry D, Abbott JT. Ovarian torsion: a fifteen-year review. *Ann Emerg Med.* 2001;38(2):156–159. doi:10.1067/mem.2001.114303
6. Berkanoglu M, Coetzee K, Bulut H, Ozgur K. Risk of ovarian torsion is reduced in GnRH agonist triggered freeze-all cycles: a retrospective cohort study. *J Inst Obstet Gynaecol.* 2019;39(2):212–217. doi:10.1080/01443615.2018.1479381
7. Psilopatis I, Damaskos C, Garmpis N, et al. Ovarian torsion in polycystic ovary syndrome: a potential threat? *Biomedicines.* 2023;11(9):2503. doi:10.3390/biomedicines11092503
8. Sibai H, Heraiz AI, Madkour NM. Transient ovarian torsion in a pregnant woman after vitrified-warmed embryo transfer: a case report. *JBRA Assist Reprod.* 2024;28(1):209–210. doi:10.5935/1518-0557.20230056
9. Wang Y-X, Deng S. Clinical characteristics, treatment and outcomes of adnexal torsion in pregnant women: a retrospective study. *BMC Pregnancy Childbirth.* 2020;20(1):483. doi:10.1186/s12884-020-03173-7
10. Robson S, Kerin JF. Acute adnexal torsion before oocyte retrieval in an in vitro fertilization cycle. *Fertil Steril.* 2000;73(3):650–651. doi:10.1016/S0015-0282(99)00579-8
11. Bassi A, Czuzoj-Shulman N, Abenhaim HA. Effect of pregnancy on the management and outcomes of ovarian torsion: a population-based matched cohort study. *J Minim Invasive Gynecol.* 2018;25(7):1260–1265. doi:10.1016/j.jmig.2018.03.022
12. Chang S-D, Yen C-F, Lo L-M, Lee C-L, Liang -C-C. Surgical intervention for maternal ovarian torsion in pregnancy. *Taiwan J Obstet Gynecol.* 2011;50(4):458–462. doi:10.1016/j.tjog.2011.10.010
13. Bridwell RE, Koefman A, Long B. High risk and low prevalence diseases: ovarian torsion. *Am J Emerg Med.* 2022;56:145–150. doi:10.1016/j.ajem.2022.03.046
14. Moro F, Bolomini G, Sibal M, et al. Imaging in gynecological disease (20): clinical and ultrasound characteristics of adnexal torsion. *Ultrasound Obstet Gynecol.* 2020;56(6):934–943. doi:10.1002/uog.21981
15. Shur J, Bottomley C, Walton K, Patel JH. Imaging of acute abdominal pain in the third trimester of pregnancy. *BMJ.* 2018;361:k2511. doi:10.1136/bmj.k2511
16. Origoni M, Cavoretto P, Ferrari A. Acute isolated tubal torsion in pregnancy due to twisted Morgagni hydatid. *Minerva Ginecol.* 2008;60(1):95–96.
17. Origoni M, Cavoretto P, Conti E, Ferrari A. Isolated tubal torsion in pregnancy. *Eur J Obstet Gynecol Reprod Biol.* 2009;146(2):116–120. doi:10.1016/j.ejogrb.2009.05.002
18. Humaidan P, Quartarolo J, Papanikolaou EG. Preventing ovarian hyperstimulation syndrome: guidance for the clinician. *Fertil Steril.* 2010;94(2):389–400. doi:10.1016/j.fertnstert.2010.03.028
19. Meyer R, Meller N, Amitai Komem D, et al. Pregnancy-associated ovarian torsion - a single-center case-control study. *Reprod Sci Thousand Oaks Calif.* 2023;30(6):1998–2002. doi:10.1007/s43032-022-01138-z

20. Yu M, Liu Y, Jia D, Tian T, Xi Q. Adnexal torsion in pregnancy after in vitro fertilization: case report and literature review. *Medicine*. 2021;100(3):e24009. doi:10.1097/MD.00000000000024009
21. Steiner AZ, Paulson RJ. Oocyte donation. *Clin Obstet Gynecol*. 2006;49(1):44–54. doi:10.1097/01.grf.0000197518.76553.c1
22. Glujovsky D, Pesce R, Sueldo C, et al. Endometrial preparation for women undergoing embryo transfer with frozen embryos or embryos derived from donor oocytes. *Cochrane Database Syst Rev*. 2020;10(10):CD006359. doi:10.1002/14651858.CD006359.pub3
23. Shiao C-S, Huang Y-H, Chang M-Y, et al. Adnexal torsion in a woman undergoing ovarian hyperstimulation with clomiphene citrate therapy: a case report and review of the literature. *Arch Gynecol Obstet*. 2012;285(1):271–273. doi:10.1007/s00404-011-2033-4
24. Kawaguchi R, Ueda S, Tsuji Y, et al. Massive ovarian edema in pregnancy after ovulation induction using clomiphene citrate. *Arch Gynecol Obstet*. 2008;277(4):375–378. doi:10.1007/s00404-007-0474-6
25. Patty JR, Galle PC, McRae MA. Massive ovarian edema in a woman receiving clomiphene citrate. A case report. *J Reprod Med*. 1993;38(6):475–479.
26. Chen L, Ding J, Hua K. Comparative analysis of laparoscopy versus laparotomy in the management of ovarian cyst during pregnancy. *J Obstet Gynaecol Res*. 2014;40(3):763–769. doi:10.1111/jog.12228
27. Fatum M, Rojansky N. Laparoscopic surgery during pregnancy. *Obstet Gynecol Surv*. 2001;56(1):50–59. doi:10.1097/00006254-200101000-00025
28. Cagino K, Li X, Thomas C, et al. Surgical management of adnexal masses in pregnancy: a systematic review and meta-analysis. *J Minim Invasive Gynecol*. 2021;28(6):1171–1182.e2. doi:10.1016/j.jmig.2021.01.020
29. Spitzer D, Wirleitner B, Steiner H, Zech NH. Adnexal torsion in pregnancy after assisted reproduction - case study and review of the literature. *Geburtshilfe Frauenheilkd*. 2012;72(08):716–720. doi:10.1055/s-0032-1315186
30. Parelkar SV, Mundada D, Sanghvi BV, et al. Should the ovary always be conserved in torsion? A tertiary care institute experience. *J Pediatr Surg*. 2014;49(3):465–468. doi:10.1016/j.jpedsurg.2013.11.055
31. Oelsner G, Shashar D. Adnexal torsion. *Clin Obstet Gynecol*. 2006;49(3):459–463. doi:10.1097/00003081-200609000-00006
32. Kolluru V, Gurumurthy R, Vellanki V, Gururaj D. Torsion of ovarian cyst during pregnancy: a case report. *Cases J*. 2009;2(1):9405. doi:10.1186/1757-1626-2-9405
33. Mukhopadhyay A, Shinde A, Naik R. Ovarian cysts and cancer in pregnancy. *Best Pract Res Clin Obstet Gynaecol*. 2016;33:58–72. doi:10.1016/j.bpobgyn.2015.10.015
34. Cathcart AM, Nezhat FR, Emerson J, Pejovic T, Nezhat CH, Nezhat CR, et al. Adnexal masses during pregnancy: diagnosis, treatment, and prognosis. *Am J Obstet Gynecol*. 2023;228(6):601–612. doi:10.1016/j.ajog.2022.11.1291
35. Patacchiola F, Collevicchio N, Di Ferdinando A, et al. Management of ovarian cysts in pregnancy: a case report. *Eur J Gynaecol Oncol*. 2005;26(6):651–653.
36. Galatis D, Kiriakopoulos N, Komiotis I, et al. Paracentesis of an ovarian cyst during second-trimester pregnancy. *Cureus*. 2021;13(11):e19610. doi:10.7759/cureus.19610
37. Melcer Y, Dvash S, Maymon Ret al. Torsion of functional adnexal cysts in pregnancy: aspiration and drainage are important in preventing recurrence. *Isr Med Assoc J IMAJ*. 2021;23:48–51.

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