

Review

Adnexal Torsion during Pregnancy Diagnosis, Treatment, and Prognosis

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Abstract

Objective: Adnexal torsion, a rare gynecological emergency, occurs in 10–20% of adnexal cases during pregnancy, and the risk is fivefold greater for pregnant women than for their non-pregnant counterparts. Pathological variations include ovarian-tubal, solely ovarian, and solely tubal torsion. **Mechanism:** Ultrasound examination stands out as the accurate, safe, and readily available primary method for assessing adnexal torsion during pregnancy. Treatment approaches encompass both conservative and surgical interventions, with surgery being the mainstay for definitive diagnosis and management. The evolving trend toward minimally invasive techniques has led to elevated laparoscopic surgery being the preferred method for addressing surgical diseases during pregnancy. **Findings in Brief:** Laparoscopic surgery offers several advantages, such as minimal trauma, reduced bleeding, diminished postoperative pain, faster recovery, lower thromboembolic event incidence, and shorter hospital stays. Furthermore, laparoscopy provides superior exposure to the surgical field in pregnant women, minimizing uterine disturbance and subsequently lowering the risks of miscarriage, preterm labor, and premature rupture of membranes. **Conclusions:** A nuanced approach is needed for patients with adnexal torsion during pregnancy, where ultrasound serves as a crucial diagnostic tool and surgical intervention, especially through laparoscopy, emerges as a favorable therapeutic strategy. The benefits of laparoscopic surgery extend beyond effective treatment to encompass reduced maternal risk and improved postoperative outcomes, making it a preferred option for managing adnexal torsion during pregnancy.

Keywords: pregnancy; adnexal torsion; diagnosis; treatment; laparoscopic surgery; conservative operation

1. Introduction

Adnexal torsion refers to an anatomical displacement of the ovaries and/or fallopian tubes along the axis of the infundibulopelvic and ovarian proper ligaments. It is the fifth most common gynecological acute abdominal condition [1]. Adnexal torsion (AT) can occur in women of any age but is most common in those of childbearing age. Approximately 10–20% of adnexal torsions occur during pregnancy [2]. Hormonal changes during pregnancy, which cause ligament relaxation and enlargement of the ovaries as the uterus grows and enters the abdominal cavity, are the main reasons for adnexal torsion during pregnancy [3]. The probability of ovarian cyst torsion is several times greater in pregnant patients than in non-pregnant patients [4]. Some of the hormones that are involved in changes during pregnancy are estrogen, progesterone, relaxin, and human chorionic gonadotropin (hCG). Estrogen and progesterone stimulate the growth of the ovaries and the corpus luteum, which can increase the risk of torsion. Relaxin and hCG relax the smooth muscle of the pelvic organs and ligaments, which can reduce the support of the adnexa and allow them to twist more easily [5,6]. Most cases of adnexal torsion during pregnancy occur in the early-to-mid stage [7]. Diag-

nosing adnexal torsion during pregnancy is a significant challenge due to the non-specific nature of clinical presentations and the overlap of symptoms with other acute abdominal conditions. Moreover, laboratory tests, which include serum marker and inflammatory indicator data, lack the reliability and sensitivity needed to effectively distinguish adnexal torsion from alternative diagnoses. The presence of an enlarged uterus further complicates the diagnostic process, impeding thorough physical examinations and hindering the clarity of imaging modalities such as ultrasound. In contrast, pregnancy combined with adnexal torsion poses dual risks to mothers and fetuses, leading to insufficient adnexal blood supply and even necrosis of tissues in the ovaries and fallopian tubes. This can cause irreversible damage to reproductive endocrine functions and may lead to secondary complications, such as miscarriages, preterm births, infants with low birth weights, and even fetal death in utero. Therefore, identifying high-risk factors for adnexal torsion during pregnancy, conducting an early differential diagnosis, and implementing timely and effective interventions are necessary for improving pregnancy outcomes and ensuring the safety of mothers and children.



In this article, we reviewed the occurrence, clinical manifestations, diagnosis, and treatment of adnexal torsion during pregnancy. A literature review was conducted by searching PubMed for articles using the keywords “adnexal torsion”, “ovarian torsion”, and “pregnancy”. Additional articles were identified by searching for combinations of the aforementioned keywords with “ultrasound”, “MRI”, “surgery”, and “conservative operation”. Original research articles addressing the occurrence, clinical manifestations, diagnosis, and treatment of adnexal torsion during pregnancy were reviewed and focused on the timing, route, and mode of operation.

2. Risk Factors for Adnexal Torsion During Pregnancy

Adnexal torsion during pregnancy is a gynecological acute abdominal condition. The factors leading to its occurrence are diverse and are not agreed upon. Its known risk factors are as follows:

2.1 Ovulation Induction and Ovarian Hyperstimulation Syndrome

Sun *et al.* [8] and others have shown that the use of assisted reproductive technologies can increase the incidence of adnexal torsion during pregnancy. A study has shown that the incidence of ovarian torsion is 0.025–0.2% following external stimulation of the ovaries [9], and this proportion can reach 16% in patients with ovarian hyperstimulation syndrome [10]. This might occur because excessive stimulation increases the size and weight of the ovaries, leading to elongation of the fallopian tubes and an increase in their mobility, which becomes a key cause of adnexal torsion during pregnancy. Additionally, the presence of abdominal fluid further increases ovarian mobility. The administration of downregulating drugs during pregnancy, which can prolong luteal support, can lead to continued ovarian enlargement. Therefore, the probability of ovarian torsion increases significantly [11].

2.2 Persistent Adnexal Mass

This is also a common cause of torsion. Ovarian dermoid cysts and cystadenomas are the most common adnexal tumors in non-pregnant women, and the most common pathological type is corpus luteum cysts [5]. When the diameter of the adnexal tumor exceeds 5 cm, the risk of torsion increases. Larger tumors are more likely to twist at approximately weeks 10 to 17 of pregnancy because the growing uterus pushes the adnexal tumor out of the pelvis, providing more space for movement [5].

2.3 Pregnancy

Asfour *et al.* [12] comprehensively investigated the high-risk factors for adnexal torsion and reported that the average odds ratio (OR) for the occurrence of adnexal torsion during pregnancy was 18:1, suggesting that pregnancy is an independent risk factor for adnexal torsion.

2.4 Ligament Length

A study has shown that torsion is associated with the length of the ovarian proper ligament and is thus an independent risk factor for ovarian torsion [13]. During pregnancy, the enlarged uterus stretches the utero-ovarian ligament, lengthening it and pulling the ovary out of the pelvis, thus increasing the chance of torsion.

2.5 Week of Gestation

In their 2019 study, Daykan *et al.* [14] investigated adnexal torsion (AT) during pregnancy and compared the outcomes of these patients with those of non-torsion patients. Among the 48 patients (24 AT, 24 cysts), AT, primarily in the first trimester, exhibited increased symptom rates. Laparoscopic surgery (87.5%) yielded a 79.2% rate of ovarian preservation. No significant differences in adverse outcomes emerged between the groups. This study advocates for laparoscopic management, affirming its safety and efficacy in ensuring positive maternal and fetal outcomes during pregnancy [14].

2.6 Adnexal Mass Size in Pregnancy

In their retrospective study spanning from 2000 to 2009, the authors examined 80 pregnant women who underwent surgery for adnexal masses, categorizing them by size (<6 cm, 6–15 cm, >15 cm). Notably, there was a higher incidence of adnexal torsion in the <6 cm group (40%), which significantly differed from that in the >15 cm group (0%). Malignancy rates were greater in the >15 cm group (40%) than in the <6 cm group (3.3%) and the 6–15 cm group (9.1%). The predominant histopathological diagnoses were mature cystic teratoma (46.3%), serous cystadenoma (17.5%), and mucinous cystadenoma (11.3%). Despite these variations, surgical intervention did not cause maternal or fetal complications. The authors advocate considering surgery for adnexal masses >6 cm in length during pregnancy, emphasizing the nuanced risks associated with size categories [15].

2.7 History of Adnexal Torsion

In certain instances, torsion may occur multiple times during a single pregnancy, carrying a high recurrence risk of 15.1% [16]. A study has proposed that individuals with pelvic inflammatory disease, endometriosis, or ovarian malignancy are less likely to experience torsion due to adhesions between the ovaries and surrounding tissues [17]. Conversely, factors such as polycystic ovary syndrome (PCOS) and previous tubal ligation surgery have been identified as potential contributors to an increased risk of torsion [18,19]. PCOS, characterized by a hormonal disorder leading to enlarged ovaries with multiple cysts, may affect ovarian blood supply and mobility. On the other hand, tubal ligation surgery, a permanent contraception method involving the cutting or blocking of fallopian tubes, could result in adhesions, inflammation, or changes in tubal anatomy.

These factors may predispose women with PCOS or a history of tubal ligation to develop torsion, particularly when combined with other risk factors such as ovarian tumors, pregnancy, or pelvic infection [18,20].

3. Early Methods of Diagnosis

3.1 Clinical Presentation

The clinical manifestations and signs of adnexal torsion in pregnant women are non-specific and similar to those in non-pregnant patients. Acute or subacute lower abdominal pain is the most common symptom of adnexal torsion in pregnant women. The patient initially experiences sudden, unilateral (localized) pain in the lower abdomen or pelvis. The nature of the pain can be sudden, persistent, severe, intermittent, or gradually worsening [21]. Patients often adopt a passive position and have difficulty standing and walking, with symptom relief possible in the lateral position on the affected side. Individuals may experience pain after vigorous activity, impact, or other trauma. In cases of incomplete torsion, the twisted adnexa may spontaneously untwist, leading to fluctuating pain. The sudden pain gradually subsides or persists as atypical chronic abdominal pain that worsens with retorsion. Adnexal torsion (AT)-related abdominal pain may also be accompanied by acute nausea and vomiting, and patients with ischemic necrosis may experience fever [2]. On examination, adnexal masses and tenderness may be detected. In early pregnancy, a distinct mass often larger than 5 cm may be palpated, with localized tenderness at the mass and the connecting area between the mass and the uterus. However, atypical symptoms might occur in mid-to-late pregnancy, and abdominal pain can be easily mistaken for uterine contractions. However, gynecological examinations may lack specificity due to uterine enlargement, leading to misdiagnosis. Timely and accurate preoperative diagnosis of AT is a major challenge and needs to be improved.

3.2 Differential Diagnosis

The non-specific nature of the symptoms and signs of adnexal torsion during pregnancy results in frequent misdiagnosis. Differentiating between adnexal torsion and common acute abdominal conditions during pregnancy is necessary [22]. Conditions such as appendicitis, threatened miscarriage, preterm labor, degeneration of uterine fibroids, placental abruption, and uterine rupture need to be considered. The clinical symptoms of adnexal torsion may be confused with those of preterm labor or impending delivery, affecting clinical diagnosis and treatment. Early diagnosis, i.e., determining whether abdominal pain is caused by obstetric, gynecological, urological, or general surgical conditions, is difficult. Experienced sonographers can play a crucial role in diagnosis. If no stones are found in the urinary system and if the amniotic fluid volume, placenta, or fetal heart rate are normal, common obstetric emergencies, such as placental abruption, impending uterine rupture, or

placenta previa, can be excluded based on careful analysis of the clinical presentation and signs.

3.3 Laboratory Tests

No specific laboratory tests are available for diagnosing AT. A slight increase in the white blood cell count and C-reactive protein concentration should encourage doctors to test for this condition [23]. A study has shown that a white blood cell count greater than 11,000/mL may indicate a greater likelihood of torsion in pregnant women. However, white blood cell counts are generally slightly greater in pregnant women than in non-pregnant women; thus, the diagnostic value of this parameter is still unclear [4].

3.4 Imaging Studies

For diagnosing adnexal cyst torsion during pregnancy, ultrasound examination is the preferred imaging method [24]. Ultrasound can reveal an adnexal mass or cystic enlargement of the ovary. Doppler flow analysis may reveal abnormal changes in blood flow to the affected adnexa; thus, this approach can increase diagnostic accuracy. The ultrasound characteristics of adnexal torsion during pregnancy include a twisted pedicle sign, ovarian edema, a reduction or disappearance of ovarian blood supply, free fluid in the abdomen/pelvis, and a whirlpool sign [3,25]. In one study, the percentage of patients with a twisted pedicle on ultrasound was found to be very high (84%) [3]. Although ultrasound is valuable in the early stages of pregnancy for diagnosing adnexal torsion, it has limitations in cases of incomplete, intermittent, or early torsion [26]. In late pregnancy, the enlarged uterus and differences in the skill level of ultrasound operators may hinder the observation of these typical features in some patients.

Magnetic resonance imaging (MRI) has high sensitivity and specificity for diagnosing adnexal torsion in pregnant women [6]. This mass prominently displays an adnexal mass, does not require radiation, and is suitable for diagnosing suspected adnexal torsion during pregnancy. Typical MRI findings in adnexal torsion include asymmetric enlargement of the ovary, eccentric thickening of the cyst wall, a twisted pedicle showing a beak sign, nodules, or a whirlpool sign [6]. In patients experiencing adnexal torsion accompanied by hemorrhagic infarction, magnetic resonance imaging (MRI) reveals high signal intensity on spectral preservation with inversion recovery T1 weighted imaging (SPIR T1WI), mixed high signal or isointensity on diffusion weighted imaging (DWI), and nodular high signal intensity [27]. Additionally, patients with infarction exhibit a significantly lower signal intensity on the apparent diffusion coefficient (ADC) than patients without infarction [28]. However, due to its inability to assess ovarian blood perfusion and its relatively high cost, MRI is not recommended as the initial imaging modality for suspected adnexal torsion during pregnancy.

4. Choice of Surgical Approach

After adnexal torsion is identified during pregnancy, it needs to be treated earliest. The available treatment options include manual detorsion and surgical intervention. Surgery is the gold standard and the most effective method for treating adnexal torsion. Surgical options for treating adnexal torsion include conservative surgical treatment and traditional radical surgery. Surgical approaches include laparoscopy and open surgery. The appropriate treatment method and surgical technique should be selected based on individual patient differences to improve the quality of life of patients and achieve favorable maternal and fetal outcomes.

The surgical approaches for adnexal torsion (AT) include conservative surgery, such as detorsion, cyst aspiration, excision of adnexal masses, and ovarian fixation, and radical surgery, such as adnexectomy. These options offer different levels of intervention depending on the severity and specifics of the case. The choice between conservative and radical surgery depends on factors such as the extent of torsion, the viability of the ovarian tissue, and the patient's reproductive desires and overall health.

With growing awareness of the importance of preserving ovarian function, conservative surgical treatment strategies have received increased amounts of attention. While treating pregnant women with adnexal torsion, efforts should be made to preserve the ovaries. Although previous researchers speculated that detorsion of the twisted adnexa might increase the risk of thrombosis and embolism, no correlation was found between detorsion and the occurrence of thromboembolic events [2,29]. Didar *et al.* [7] reviewed 163 studies addressing the treatment of adnexal torsion in pregnant women. Laparoscopic surgery (56.88%) was found to be more common than open surgery (11%) or expectant management (2.99%). The most common surgical methods were cystectomy and detorsion (29.06%), followed by salpingo-oophorectomy (27.32%) and singular detorsion (18.31%). Salpingectomy, oophorectomy, cystectomy, ovarian fixation, and combined treatments (such as detorsion with ligament plication and cystectomy with ovarian fixation) were uncommon. Thromboembolic events did not occur in any patient, and only six recurrences were reported. Melcer *et al.* [16] reported 71 cases of pregnancy-related adnexal torsion due to functional ovarian cysts, all of which were treated conservatively. Among them, 28 patients underwent detorsion, and 41 patients had ovarian cyst aspiration or fenestration. The recurrence rates for these two procedures in the same pregnancy were 14.3% and 0%, respectively. Tsafirir *et al.* [30] reported that among patients diagnosed with adnexal torsion, 68 underwent detorsion, 82 underwent combined detorsion with cystectomy or fenestration, and 43 underwent partial or total adnexectomy. Adnexal fixation was performed in 21 patients. Compared to detorsion alone, cyst drainage or cystectomy significantly decreased the recurrence rate by 50%

and 75%, respectively. The recurrence rate for cyst detorsion alone was 20.6%, and adnexal fixation after detorsion did not reduce the recurrence rate compared to fenestration detorsion or cystectomy. Although cyst removal may eliminate the risk factors for recurrence, post-torsion edema and the fragile nature of the mass can make cyst removal challenging. Since most cases are benign, large cysts can be safely detoured and drained through a puncture in these situations.

To preserve the ovary in patients with adnexal torsion (AT), the viability of the ovary needs to be assessed. No effective clinical predictive indicators are available for evaluating ovarian viability. Clinicians consider ovaries in adnexal torsion patients who appear “dark purple” to be necrotic, potentially forming thrombi and posing a risk of thrombus dislodgement upon detorsion. The nature of cysts in such ovaries is challenging to determine, and the tissue is fragile, posing risks of tumor dissemination and residual disease. The characterization of “dark purple” ovaries as necrotic has been a conventional viewpoint in past studies. A study has demonstrated that even patients with ovaries displaying purple or black coloration can retain ovarian function after detorsion [31]. According to a retrospective chart review of 60 confirmed ovarian torsion patients, the likelihood of ovarian preservation was highest when the surgery occurred within 4 hours of initial presentation in the emergency department (83% preservation *vs.* 56% after 4 hours, $p = 0.39$). The presence of Doppler flow on sonographic examination significantly increased the odds of preservation (60% *vs.* 27%, $p = 0.02$). Preservation was less likely to be associated with intraoperative concern for necrosis (20% *vs.* 84%, $p < 0.01$); however, detorsion attempts in 64% of patients resulted in the preservation of 35% of necrotic-appearing ovaries [32]. In another study of 18 patients who underwent detorsion for twisted black-bluish ischemic adnexa, 89% had normal ovarian function at follow-up (6–36 months), while 11% exhibited ovarian atrophy [33]. An ultrasound follow-up study has indicated high rates of follicular development (up to 80% or more) post-detorsion surgery [34]. Despite these observations, potential limitations and challenges in accurately assessing ovarian viability based on visual cues alone should be acknowledged. The subjective nature of color interpretation and the variability in individual responses to ischemia underscore the complexity of decisions regarding surgical intervention, emphasizing the need for a comprehensive approach that considers both clinical and imaging findings. Consequently, many patients undergo adnexectomy [35,36]. Several studies [37,38] have shown that, regardless of the appearance of the ovaries, efforts should be made to preserve the ovaries. Post-detection, the appearance of the adnexa and follicle development can be assessed via ultrasound; more than 90% of patients who undergo detorsion have normal ovarian function. Adnexectomy may be performed in patients with complete ovarian necrosis, severe

infection, suspected malignant tumors, or postmenopausal status. Therefore, some researchers recommend preserving the ovary regardless of its appearance or signs of reperfusion [39]. Balasubramaniam *et al.* [40] reported 45 cases of ischemic adnexa, which were preserved following conservative surgery after detorsion. The time from symptom onset to surgery varied from 1 day to 120 days, and after one year of follow-up post-surgery, the ovarian blood supply and follicular development were found to be normal, with no postoperative complications. Additionally, several studies have shown that almost all ovaries deemed necrotic at the time of detorsion during surgery exhibit normal development after postoperative follow-up [35,41]. Preserving the adnexa, which was previously considered to be a high risk factor for embolism, does not increase the likelihood of pulmonary embolism. The occurrence rate of pulmonary embolism is 0.2% in patients with adnexal torsion, and detorsion does not contribute to an increase in this rate [21,42]. Therefore, during surgery, effort should be made to preserve ovarian function, and the decision to remove an ovary should not be based solely on its color.

4.1 Surgical Approach

Laparoscopic surgery during pregnancy was contraindicated due to fears of uterine injury during the placement of trocars and a decrease in fetal perfusion caused by the pneumoperitoneum. However, with the widespread adoption of minimally invasive techniques, laparoscopic surgery has become the preferred method for treating many surgical conditions during pregnancy. Compared to traditional open surgery, laparoscopic surgery has several advantages, including minimal trauma, less bleeding, less postoperative pain, faster recovery, a lower incidence of thromboembolic events, and shorter hospital stays. Laparoscopic surgery during pregnancy provides better access to the surgical field and reduces disturbances in the uterus, thus decreasing the risk of miscarriage, preterm labor, and premature rupture of membranes.

4.2 Choosing Laparoscopic Surgery during Pregnancy

The safety of laparoscopic surgery during pregnancy is assessed primarily based on postoperative miscarriage rates, preterm birth rates, and the effect of carbon dioxide (CO₂) pneumoperitoneum on the mother and fetus. Ekici *et al.*'s [43] retrospective study on adnexal torsion during pregnancy emphasized the safety and efficacy of surgical management. Laparoscopic surgery was the preferred approach in 88.9% of patients, and it demonstrated advantages such as shorter operation times, reduced blood loss, lower analgesic requirements, and a greater rate of adnexal preservation (94.4%) than laparotomy (66.7%). These findings support the recommendation that laparoscopic surgery be the preferred technique for managing adnexal torsion during pregnancy whenever feasible. This preference aligns with the broader trend toward minimally invasive proce-

dures, showcasing its potential to optimize outcomes for both mothers and fetuses in this specific clinical scenario [43].

4.3 Effect of Pneumoperitoneum Pressure and Hypercapnia on the Mother and Fetus

During pregnancy, an increase in oxygen consumption and physiological ventilation, along with an elevated diaphragm causing an increase in mechanical ventilation resistance and a reduction in oxygen reserve, limit the degree of Trendelenburg positioning. This reduces the tolerance of pregnant women to pneumoperitoneum. Additionally, the supine position may decrease cardiac output and uterine arterial blood flow, potentially increasing the risk of fetal hypoxia [44]. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) [45] recommended maintaining pneumoperitoneum pressure at 10–15 mmHg (1 mmHg = 0.133 kPa) and adjusting the pressure according to the physiological state of the pregnant woman. Meyer *et al.* [46] compared miscarriage and stillbirth rates, gestational age at delivery, delivery characteristics, and neonatal outcomes between women who underwent diagnostic laparoscopy for suspected adnexal torsion during pregnancy and those who did not undergo laparoscopy; they found no difference between the groups ($p \geq 0.05$). Daykan *et al.* [14] retrospectively analyzed patients who underwent surgery for suspected adnexal torsion during pregnancy for more than 12 years; among 85 patients in the study group, 78 underwent laparoscopic surgery, and seven underwent open surgery. Compared to a control group of women who had uneventful pregnancies, no significant differences were found in gestational age at delivery, rates of preterm birth, Apgar scores, pH of the umbilical cord, or birth weights between the groups ($p \geq 0.05$). In a joint study by 17 Israeli hospitals, 389 surgical procedures were analyzed during pregnancy, including 192 laparoscopic surgeries (141 in early pregnancy, 46 in mid-pregnancy, and five in late pregnancy) and 197 open surgeries (63 in early pregnancy, 110 in mid-pregnancy, and 24 in late pregnancy); the results did not reveal an increase in fetal loss following laparoscopic surgery. Zou *et al.* [47] investigated the safety of laparoscopic surgery during different stages of pregnancy; 78 and 48 women underwent laparoscopic surgery during early and mid-to-late pregnancy, respectively. They found no differences in surgical complications or pregnancy outcomes between the groups ($p \geq 0.05$). Weiner *et al.* [48] conducted a similar study investigating the feasibility and safety of laparoscopic surgery in late pregnancy without adverse effects on pregnancy outcomes. The American Society of Gastrointestinal and Endoscopic Surgeons (SAGES) guidelines support the safe and effective use of laparoscopic surgery for managing acute abdominal conditions at all stages of pregnancy [49]. These guidelines specifically recommend laparoscopy for both the diagnosis and treatment of adnexal torsion. It is essential to recognize

that these guidelines are tailored to address surgical issues during pregnancy rather than offering general recommendations.

With the advancement of minimally invasive surgical techniques, a study has reported that single-incision laparoscopic surgery (SILS) is a more viable and safer option during pregnancy than multi-port laparoscopy. It is a superior surgical method for treating pregnant patients. SILS allows for the temporary closure of the pneumoperitoneum to reduce the adverse effects of CO₂ on the mother and fetus while managing or extracting specimens externally [50]. During SILS, adnexal masses reach the umbilical port protector, allowing external puncture and aspiration of cystic fluid, which reduces the risk of specimen bag tear and cystic fluid leakage, thus minimizing incisional and intraperitoneal contamination, adhesion, and the risk of tumor implantation [51]. SILS facilitates the easy transition between external and internal manipulation during cystectomy and helps overcome the limitations of traditional laparoscopy in treating large ovarian cysts. Several studies have reported successful SILS procedures for large adnexal masses (10–20 cm) in the mid-pregnancy period [52,53]. Jiang *et al.* [54] conducted a multicenter study on SILS for adnexal masses in pregnant women. Among the 38 patients, one underwent SILS right salpingectomy for a combined intrauterine and ectopic pregnancy, and the remaining 37 underwent SILS cystectomy. Postoperatively, there were two miscarriages (one with placenta previa and fetal death in utero and one with missed abortion) and one stillbirth induction, but the remaining had favorable maternal and neonatal outcomes. A follow-up of 4.7–56 months showed no marginal developmental delays or intellectual disabilities in the children. Studies on the effect of SILS during pregnancy on maternal and child outcomes are limited to pregnancy continuation and delivery; thus, information on long-term fetal effects is lacking. Given that the number of cases in published studies is small, large-scale, multicenter, prospective, high-quality research is needed to validate the application value of the SILS during pregnancy.

5. Conclusion

To summarize, adnexal torsion is an acute abdominal condition in pregnant women where delayed treatment seriously threatens maternal and fetal health, necessitating early detection, diagnosis, and treatment. Acute or subacute lower abdominal pain in pregnant women should encourage doctors to test for adnexal torsion. Adnexal torsion in pregnant women occurs mainly in early pregnancy, and due to its non-specific clinical and laboratory manifestations, it can be easily confused with emergencies in the digestive, urological, and gynecological systems, making preoperative diagnosis challenging. Ultrasound examinations can be performed for the preliminary diagnosis of adnexal torsion in early pregnancy, whereas MRI is the most effective adjunctive examination in mid-to-late pregnancy. Surgery

is the most definitive diagnostic and therapeutic approach. Conservative surgical treatment is the preferred method for treating adnexal torsion during pregnancy; however, clinical decisions should be made based on the extent and duration of torsion, age, gestational age, nature of the tumor, and fetal intrauterine condition. The most appropriate surgical technique should be selected to minimize maternal and fetal complications and preserve fertility.

Author Contributions

RX and HZ designed the research study. RX and ZY performed the research. ZY analyzed the data. RX, HZ and ZY wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

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Conflict of Interest

The authors declare no conflict of interest.

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