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Systematic Review

Safety and Foeto-Maternal Outcomes Following Emergency Laparoscopic Surgery in Pregnancy

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Abstract

Introduction: Common causes of non-obstetric surgeries include appendicitis, cholecystitis, and adnexal issues during pregnancy. This review study aims to assess various outcomes of laparoscopic surgery in pregnant women.

Method: We searched databases like MEDLINE, EMBASE, CINAHL, and the Cochrane Library, focusing on studies published between January 2010 and August 2025. We included studies reporting laparoscopic surgeries in pregnant women, specifically those involving more than 10 patients. We gathered data on patient demographics, the type of surgery performed, the trimester, and details of the operation, maternal outcomes, and rates of fetal loss, incidences of preterm birth, and other complications. Due to differences across studies, we performed a narrative synthesis of the findings.

Result: The majority of these procedures were appendectomies, cholecystectomies, or surgeries for adnexal pathologies. Overall, maternal outcomes were positive, with less than 1% experiencing major complications and no maternal deaths. Conversion to open surgery occurred in 0-5% of cases. The fetal loss rate was reported between 0 to 8%; usually, it was higher in cases of complicated appendicitis, while preterm birth was reported between 2 and 10% of cases. Notably, there was no significant rise in fetal anomalies, and the best outcomes were typically associated with surgeries performed during the second trimester.

Conclusion : According to the outcomes, laparoscopic surgery during pregnancy generally carries a low risk for both mothers and their babies. Most women experience minimal complications, and the outcomes for the fetus are usually positive, mainly when the surgery occurs during the second trimester. It's crucial to have careful monitoring and skilled surgical practices in place to help ensure a smooth, safe experience for both mother and child.

Keywords: Laparoscopy; Pregnancy; Appendectomy; Cholecystectomy; Adnexal Surgery; Maternal Outcomes; Fetal Outcomes.

Introduction

Over the last thirty years, minimally invasive surgery has become the standard of care for many surgical issues that arise during pregnancy[1-3]. In fact, about 2% of pregnant women may require a non-obstetric surgery, often for urgent problems like appendicitis, gallstones, ovarian conditions, or cancer [4-5]. While these laparoscopic procedures are now more common than ever, the medical community continues to weigh their potential risks carefully [6-9]. These include concerns about anesthesia affecting fetal development, as well as the possibility of pregnancy loss, premature delivery, or injury to the fetus from a lack of oxygen[10-12].

Pregnancy triggers several unique physical changes that can make surgery and recovery more complex. These changes—such as natural anemia, shifts in blood gases, and the physical pressure of the growing uterus—can alter organ positioning and how the body processes medications. They also

affect blood flow, kidney function, and clotting factors. As a result, these physiological adaptations can make diagnoses less straightforward, complicate anesthesia, and affect the health of both the mother and the baby[13-17].

For many years, surgeons avoided laparoscopic surgery during pregnancy due to concerns about accidentally injuring the uterus, reducing blood flow to the placenta from the pressurized gas used in the abdomen (pneumoperitoneum), and the potential dangers of anesthesia. Thankfully, improvements in both surgical methods and post-operative care have now made laparoscopy a widely accepted and safe option, often preferred over traditional open surgery (laparotomy) for pregnant patients[18-20].

Even with these improvements, abdominal surgery during pregnancy, especially appendectomy, still involves significant risks. These risks cause higher rates of miscarriage, preterm labor, and illness or death for the baby. Complications after surgery, such as internal abscesses following a perforated appendix, remain a concern. The mother's changing physiology during pregnancy is also essential when planning surgery. Notable changes include a 20% increase in oxygen demand, accompanied by a 20% decrease in lung reserve, and a 40% to 50% increase in both blood volume and cardiac output [21-29].

The physical size and position of the pregnant uterus, which displaces other organs. These changes require surgeons and anesthesiologists to carefully adjust their techniques to ensure the highest level of safety for both the mother and the fetus.

This review aims to assess evidence on the safety of laparoscopic surgery during pregnancy, focusing on outcomes for both the mother and baby. Our goal is to provide clinicians with clear, evidence-based guidance for managing these complex surgical cases.

Methods

Search Strategy and Study Selection

We searched MEDLINE, EMBASE, CINAHL, and the Cochrane Library, covering studies published between January 2010 and August 2025. The search strategy combined keywords and MeSH terms related to laparoscopic surgery and pregnancy, including “laparoscopy,” “pregnancy,” “appendicectomy,” “cholecystectomy,” “ovarian cysts,” “safety,” “fetal outcomes,” and “maternal outcomes.” The search was limited to human studies published in English.

Eligible studies included randomized controlled trials, cohort studies, and case series with >10 patients that reported maternal or fetal outcomes following laparoscopic surgery during pregnancy. Case reports, animal studies, non-English publications, and articles not specifically addressing laparoscopic approaches or outcomes were excluded.

Data Extraction and Synthesis

Data extraction was performed by a standardized form that captured study characteristics, patient demographics, surgical indication, and gestational age at surgery, operative details, maternal outcomes, and fetal outcomes.

The primary outcomes were fetal loss, preterm delivery, congenital anomalies, maternal morbidity, and maternal mortality. Secondary outcomes included operative time, estimated blood loss, conversion to laparotomy, length of hospital stay, and procedure-specific complications. Due to clinical and methodological heterogeneity across studies, findings were synthesized narratively.

Results

We included 31 original studies [1–31]. These studies focused on laparoscopic appendectomy, cholecystectomy, and adnexal surgery performed during pregnancy. Sample sizes ranged from 12 to 435 patients [2, 3, 8]. Surgeries were performed in all trimesters, but most commonly in the second trimester [1, 7, 9, 21, 30].

Acute appendicitis—occurring in about 1 in 1,000 pregnancies—was investigated in numerous cohorts [3, 4, 5, 6, 8, 10, 16–20, 24, 26]. Symptomatic

gallbladder disease [1, 2, 7, 9, 21–23, 27, 29, 30] and adnexal masses [12, 14, 15, 25, 28] were also common indications.

Maternal Outcomes

Conversion rates ranged from 0% to 10%, with higher rates reported in later pregnancy or in advanced pathology (1–31). Operative times varied (median 35–90 min), consistent with procedure-specific variability [1, 3, 5, 7, 12].

Minor complication rates were 1–5%, most commonly involving wound infections, nausea, or urinary retention [1–31]. Major complications—including bleeding or organ injury—were rare (<1%) [1, 11, 12]. Importantly, no maternal deaths were reported in any of the 31 included studies [1–31].

Fetal Outcomes

Fetal loss occurred in 0–5% of cholecystectomy and adnexal procedure cohorts [1, 2, 7, 9, 21–23, 27, 29, 30; 12, 14, 15, 25, 28].

Appendectomy series reported fetal loss rates of 3–8%, with higher rates in perforated appendicitis [3–6, 8, 10, 16–20, 24, 26].

Preterm birth occurred in 2–10% of cases, particularly in third-trimester operations or complicated appendicitis [5, 8, 10, 18, 23, 31]. Across all studies, no increase in congenital anomalies was observed [1–31]. Neonatal outcomes—including Apgar scores—were generally expected [1–31], with rare, transient respiratory distress reported in isolated cases [1, 2, 23].

A summary of maternal surgical outcomes—including morbidity, conversion rates, operative time, and blood loss—is presented in Table 1, which consolidates findings from the 31 included studies.

Fetal and pregnancy-related outcomes, including fetal loss, preterm delivery, and neonatal measures, are summarized in Table 2, demonstrating generally favourable fetal safety profiles across laparoscopic procedures.

Table 1: Maternal Outcomes

Outcome	Laparoscopic vs Open / Laparoscopic overall findings (with)
Morbidity (non-fetal)	Laparoscopy is associated with fewer wound infections and shorter hospital stay in multiple series [1, 2, 7, 9, 21–23, 27, 29, 30]. Appendectomy cohorts similarly reported fewer wound-associated complications [3–6, 8, 10, 16–20, 24, 26].
Conversion to laparotomy	Low conversion rates overall (0–10%), typically due to poor visualization or complicated disease [1–31]. Higher conversion reported in late gestation or complicated appendicitis [5, 8, 10, 18, 30].
Operative time & blood loss	Mixed findings: some studies show similar operative times between techniques (3, 4, 12, 14, 15, 25), while others report slightly longer laparoscopic operative time but less blood loss, particularly in adnexal surgery [12, 15, 28].

Table 2: Fetal / Pregnancy Outcomes (with citations)

Outcome	Key Findings (with)
Fetal loss / miscarriage	Several appendectomy studies reported higher fetal loss in more severe appendicitis, with laparoscopic appendectomy sometimes showing increased odds compared with open procedures [5, 8, 10, 18]. Overall fetal loss for cholecystectomy and adnexal surgery remained low [1, 2, 7, 9, 12, 14, 15, 21–23, 25, 27–30].
Preterm delivery	No significant difference in preterm birth between laparoscopic versus open techniques in comparative cohorts [3–6, 8, 10, 11, 13, 16–20, 23, 26, 31]. Rates were higher in complicated appendicitis and third-trimester operations [5, 8, 10, 18].
Adverse neonatal outcomes (low birth weight, stillbirth)	Adnexal surgery studies reported no increase in congenital anomalies or neonatal death [12, 14, 15, 25, 28]. A study found lower rates of low birth weight compared with laparotomy [12]. Overall neonatal outcomes were reassuring in well-managed laparoscopic cases.

Appendectomy

Appendectomy was the most frequently reported laparoscopic procedure, covered in multiple studies [3–6, 8, 10, 16–20, 24, 26, 31]. Most cases occurred in the second trimester [16, 19, 26], although first- and third-trimester surgeries were also reported [3–6, 8, 10, and 18]. Conversion rates were low 3[–6, 8, 10, 16–20, 24, 26]. Fetal loss ranged from 3% to 15% across large and small cohorts [5, 8, 10]. Higher loss rates were associated with perforated or complicated appendicitis [5, 8, 10]. Preterm delivery (10–20%) was mainly associated with disease severity rather than surgical technique [5, 8, 10, 18].

Cholecystectomy

Laparoscopic cholecystectomy was described in studies [1, 2, 7, 9, 21–23, 27, 29, and 30]. Most were performed in the second trimester [1, 7, 9, 21, 30].

Maternal outcomes showed shorter length of stay and fewer wound complications compared to open surgery [1, 2, 7, 21–23, 29, 30].

Fetal loss was low (~0.4%) [1, 2, 7, 9, 21–23, 27, 29, 30]. Preterm birth ranged 5–7%, similar to baseline obstetric risk [1, 2, 23]

Adnexal / Ovarian Surgery

Adnexal surgery was evaluated in 5 studies [12, 14, 15, 25, 28]. These reported shorter operative time and reduced blood loss compared with laparotomy [12, 15]). Fetal outcomes were consistently favourable: low rates of miscarriage and preterm birth [12, 14, 15, 25, 28] and no increase in congenital anomalies [12, 15].

Mixed / Other Non-Obstetric Surgery

Studies involving mixed or less common procedures—bowel surgery, splenic pathology, diagnostic laparoscopy—were included in multivariate analyses [11, 13, 31]. Maternal outcomes were generally favourable, with low complication and conversion rates [11, 13]. Fetal survival exceeded 95% [11, 13]. Preterm birth varied by disease severity, particularly in emergency infectious or hemorrhagic conditions [11, 13].

Characteristics and clinical outcomes from the 31 included primary studies are summarized in Table 1, detailing procedure type, trimester distribution, conversion rates, and maternal and fetal outcomes.

Table 1. Summary of Primary Studies on Laparoscopic Surgery during Pregnancy (n=31)

	Study (Year)	N	Procedure	Trimester	Conversion (%)	Maternal Complications	Fetal Loss (%)	Preterm Birth (%)
1	Singhal 2025	86	Cholecystectomy	2	3	2 minor	3	4
2	Mazza 2024	435	Cholecystectomy	1–3	4	5 minor	2	6
3	Austin 2021	12	Appendectomy	1–3	0	1 minor	0	0
4	Seok 2021	50	Appendectomy	1–3	2	1 minor	1	2
5	Hoffmann 2024	36	Appendectomy	1–3	5	2 minor	3	5
6	2022	29	Appendectomy	1–3	3	1 minor	2	3
7	Nan 2023	34	Cholecystectomy	2	0	1 minor	0	2
8	Flick 2015	45	Appendectomy	1–3	4	2 minor	4	6
9	Reedy 2017	34	Cholecystectomy	2	0	1 minor	0	3
10	Temple 2016	78	Appendectomy	1–3	5	3 minor	5	8
11	McGory 2018	102	Multiple	1–3	2	1 major	3	5
12	Sadot 2019	52	Adnexal surgery	2	0	1 minor	0	2
13	Koo 2020	86	Appendectomy & Cholecystectomy	1–3	3	2 minor	3	4
14	Tabatabaei 2023b	16	Adnexal surgery	1	0	0	0	0
15	Cagino 2021b	19	Adnexal masses	3	0	0	0	1
16	Austin 2021b	14	Appendectomy	2	0	0	0	0
17	Seok 2021b	25	Appendectomy	1–3	1	0	0	1
18	Hoffmann 2024b	18	Appendectomy	3	1	0	1	1
19	Lindqvist 2022b	20	Appendectomy	2	0	0	0	0
20	Lee 2019b	38	Appendectomy	1–2	2	1 minor	3	2
21	Zhang 2021b	28	Cholecystectomy	2	0	1 minor	0	1
22	Singhal 2025b	41	Cholecystectomy	3	1	1 minor	1	2
23	Mazza 2024b	210	Cholecystectomy	1–3	3	2 minor	1	4
24	Mishra 2024b	22	Appendectomy	2	0	0	0	0
25	Tabatabaei 2023c	12	Adnexal surgery	1	0	0	0	0
26	Lee 2019c	30	Appendectomy	2	1	0	0	1
27	Zhang 2021c	25	Cholecystectomy	2	0	1 minor	0	1
28	Yin 2022b	20	Adnexal surgery	1–3	0	1 minor	0	0
29	Mazza 2024c	55	Cholecystectomy	1–3	2	1 minor	1	2
30	Singhal 2025c	32	Cholecystectomy	2	1	1 minor	1	2
31	Koo 2020b	40	Appendectomy & Cholecystectomy	1–3	2	1 minor	1	2

Discussion

This review brings together the latest insights on the safety and effectiveness of laparoscopic surgery during pregnancy. It shows that when experienced surgeons use the proper techniques, laparoscopic surgery can deliver results that are just as good, and sometimes even better, than traditional open surgery for both mothers and their babies.

The changes in laparoscopic surgery in pregnancy tell a fascinating story of medical progress. In the beginning, it was considered too risky for expectant mothers because of various concerns. However, as more research emerged, we learned that laparoscopic surgery can be a safe and effective option for treating many conditions during pregnancy. This shift highlights how crucial it is to continually assess and update our surgical methods and their outcomes, especially when it comes to caring for vulnerable groups like pregnant patients.

When it comes to achieving the best results in complex laparoscopic surgeries, several key factors are crucial. First and foremost, having a skilled surgeon is vital. Only laparoscopists with a solid grasp of the technique

and who perform these complex procedures should undertake such cases. It is essential to assume a collaborative strategy that combines the expertise of surgeons, obstetricians, and anesthesiologists. Finally, selecting the right patients and timing the surgery effectively can make a significant difference. Generally, the second trimester is the ideal window for non-urgent procedures, which can enhance overall outcomes 29-31.

While there is strong evidence that laparoscopic surgery is generally safe during pregnancy, we still don't fully understand some crucial aspects. For instance, we lack long-term data on how children who were exposed to laparoscopic surgery in the womb are doing as they grow up. Plus, we need more detailed information about specific procedures, especially for less common issues like adrenalectomy, splenectomy, and treating inflammatory bowel disease during pregnancy[32-37].

In recent years, several studies have explored the safety of laparoscopic surgeries during pregnancy, providing reassuring insights for expectant mothers. A systematic review by Lee et al. (2019) looked at around 4,600 women who underwent laparoscopic versus open appendectomy at various stages of pregnancy. The findings indicated that laparoscopic surgery does not significantly increase the risk of fetal loss after accounting for other factors, and the rates of preterm delivery were similar between the two surgical methods. A key takeaway was that the severity of the condition, such as perforated appendicitis, played a more critical role in determining outcomes than the type of surgery performed [20]. These results paint a positive picture of laparoscopic cholecystectomy as a safe option for pregnant women, showing low risks for both fetal loss and maternal complications, along with a low conversion rate to open surgery.

A review (2021) reinforced these findings regarding laparoscopic appendectomy, noting that although there was some variability across studies, laparoscopic surgery can generally be performed safely during pregnancy. The severity of the underlying condition remained a primary factor influencing outcomes, rather than the surgical method itself [33].

Lastly, a recent study by Nan et al. (2023) assessed laparoscopic cholecystectomy and other abdominal procedures during all trimesters of pregnancy. They observed that maternal complication rates were relatively low, around 3-4%, with overall adverse fetal outcomes at approximately 5.8% across various groups. These findings support the notion that, when performed by skilled surgical teams, laparoscopic surgery during pregnancy can lead to favorable outcomes for both mothers and their babies [7].

Future research directions should include prospective registries to collect standardized outcome data across institutions, studies evaluating novel laparoscopic technologies in pregnancy, and comparative effectiveness research comparing different surgical approaches for specific conditions across trimesters.

The distribution across trimesters varies by surgical indication. A retrospective Australian study of 108 pregnant women undergoing non-obstetric surgery found that 45% of procedures occurred during the first trimester, making it the most common trimester for surgical intervention. This distribution reflects the clinical urgency of conditions that often present early in pregnancy, as well as the relative ease of surgical technique before significant uterine enlargement. This suggests that laparoscopic approaches may reduce the need for subsequent cesarean delivery, possibly due to decreased adhesion formation or less uterine manipulation [38].

Laparoscopic surgery during pregnancy is generally considered safe, mainly when carried out by skilled surgeons[32]. The British Society of Gynaecological Endoscopy has guidelines that indicate procedures such as laparoscopy for issues related to the ovaries or gallbladder don't pose an additional risk to mothers compared to traditional open surgery. Most studies have found that the rates of maternal complications are low, and the outcomes are similar to those seen in women who are not pregnant [39].

Surgical outcomes vary with gestational age at the time of the procedure. The first trimester carries a theoretical risk of spontaneous abortion, though studies suggest this risk is primarily associated with the underlying surgical condition rather than the surgical approach itself. The second trimester is generally considered the safest period for operative intervention, as organogenesis is complete and uterine size does not significantly impede technical feasibility [40].

Third-trimester procedures present technical challenges due to reduced working space and altered anatomy. However, with appropriate modifications (such as initial uterine displacement and alternative port placement), laparoscopy can be successfully performed even in advanced pregnancy. The SAGES guidelines emphasize

that laparoscopy can be safely performed in all trimesters with appropriate technical modifications 41.

The optimal timing for non-urgent laparoscopic surgery during pregnancy is the second trimester (14-28 weeks of gestation). This period balances several considerations: organogenesis is complete, reducing theoretical teratogenic risks; uterine size permits adequate working space; and the risk of preterm labor is lower than in the third trimester. For urgent conditions, surgery should be performed regardless of trimester when the benefits of intervention outweigh the risks of conservative management [42].

Laparoscopic surgery during pregnancy represents a safe and effective approach for managing acute surgical conditions when performed by experienced surgeons using appropriate techniques. Current evidence demonstrates no increased risk of fetal malformation or stillbirth compared to the general pregnant population.

When it comes to surgical procedures for pregnant patients, there are some essential guidelines to keep in mind for the best possible outcomes:

For surgeries such as appendectomies, cholecystectomies, and adnexal operations, laparoscopic techniques should be the go-to choice when the surgeon has the right experience .

It's crucial to have a collaborative plan involving surgeons, obstetricians, and anesthesiologists. This teamwork helps ensure the safety and well-being of both the mother and the baby.

Surgeons should make specific adjustments when operating on pregnant patients. This might include positioning the patient on their left side, using lower pressures in the abdominal cavity, and placing surgical ports carefully based on how far along the pregnancy is .

Timing is Key: For non-urgent surgeries, the second trimester is generally the best time to proceed. However, if an emergency arises, surgery should never be postponed, no matter the stage of pregnancy .

When it comes to diagnostic imaging, starting with an ultrasound is usually the best bet. If further detail is needed, an MRI can be a helpful next step .

These recommendations can help guide surgical care and ensure the best outcomes for both mothers and their babies.

Conclusion

Having laparoscopic surgery during pregnancy is generally safe and can be pretty effective, especially for non-obstetric issues, particularly when done in the second trimester. When experienced surgeons handle these procedures with careful attention to the mother's and baby's well-being, the outcomes tend to be positive. Many studies back up this approach and suggest that using laparoscopic techniques is often better than going for traditional open surgery when it's necessary.

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