

Acute Appendicitis in Pregnancy: An Update: Narrative Review Article

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Abstract: Acute appendicitis is the most common non-obstetric surgical emergency during pregnancy and remains a significant cause of maternal and fetal morbidity when diagnosis or treatment is delayed. The diagnosis of appendicitis in pregnant patients is particularly challenging because physiological, anatomical, and biochemical changes of pregnancy may obscure classical clinical manifestations. Delayed diagnosis increases the risk of appendiceal perforation, which is associated with preterm labor, fetal loss, maternal sepsis, and adverse neonatal outcomes. Imaging modalities, particularly ultrasonography and magnetic resonance imaging (MRI), have become essential components of the diagnostic pathway. Surgical intervention continues to represent the cornerstone of treatment. Recent evidence and international guidelines support laparoscopic appendectomy as the preferred surgical approach in most pregnant patients because of its favorable maternal outcomes, shorter hospital stay, and lower wound complication rates. Nevertheless, open appendectomy remains appropriate in selected clinical situations. Emerging literature on non-operative management using antibiotics has generated interest; however, current evidence suggests that surgery remains the standard of care due to concerns regarding treatment failure, recurrence, and maternal-fetal complications. Multidisciplinary collaboration among surgeons, obstetricians, anesthesiologists, radiologists, and neonatologists is crucial to optimizing outcomes. This review examines the diagnostic and current recommendations regarding the management of acute appendicitis in pregnancy.

Keywords: Acute Appendicitis, Pregnancy, Imaging, Open Appendectomy, Laparoscopic Appendectomy, Non-Operative Treatment.

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INTRODUCTION

Acute appendicitis in pregnancy is the most common non-obstetric cause of acute abdominal pain that occurs in pregnancy. It is seen in one in 500 to one in 800 pregnancies, and it is characterized by symptoms of lower abdominal pain. Classical presentation is rarely seen in these patients due to the presence of the gravid uterus, and it may be associated with symptoms of anorexia, nausea, and vomiting. On abdominal examination, the classical tenderness at McBurney's point is rarely present, as the gravid uterus pushes the cecum and appendix laterally; hence, this can lead to tenderness in the flank (De Franca Neto *et al.*, 2015; Yale *et al.*, 2022). The use of blood investigations, such as the presence of leukocytosis and elevated inflammatory markers like C.Reactive Protein (CRP) are not sensitive as they are naturally elevated during pregnancy. The presence of leukocytes in the urine is also normally present in the urine during pregnancy and is not sensitive

enough to diagnose acute appendicitis (Pastore *et al.*, 2006).

Imaging modalities are an important component of the diagnostic workup of pregnant patients with acute appendicitis. Ultrasound of the abdomen is the most common first-line imaging modality that is performed. Which is easily available and does not involve the use of radiation, but it has a low sensitivity and specificity. Magnetic resonance imaging (MRI) is the next most common imaging modality, and it has a high sensitivity and specificity for diagnosing acute appendicitis in pregnancy, but it is costly, time-consuming, and requires expertise to interpret it. Computerized tomography is rarely performed in pregnancy due to the use of ionizing radiation (Flexer *et al.*, 2014; Orbay *et al.*, 2019). The management of acute appendicitis in pregnancy is by performing an appendectomy, which can be done as an open or laparoscopic appendectomy, depending on the trimester of pregnancy. Non-operative treatment can be performed in selected patients, but the risk of

complications like perforation, and the maternal risk of pre-term labor and fetal loss are present (Weston & Moroz, 2015).

The World Society of Emergency Surgeons (WSES), in its guidelines for the diagnosis and management of acute appendicitis of 2020, has recommended laparoscopic appendectomy for the management of acute appendicitis in pregnancy if the expertise is available, and it has not recommended non-operative treatment for acute appendicitis in pregnancy (Di Saverio *et al.*, 2020). The European Association of Emergency Surgeons (AES), in their guidelines for the management of acute appendicitis in pregnancy, has recommended non-operative treatment for uncomplicated appendicitis in pregnancy, and laparoscopic appendectomy is recommended until the 20th week of gestation or if the fundus of the uterus is below the level of the umbilicus. Laparoscopic appendectomy is recommended for both complicated and uncomplicated appendicitis in pregnancy (Adamina, 2022).

As there is no consensus on the diagnosis and management of acute appendicitis in pregnancy, we have conducted this review article to look at the role of ultrasound and magnetic resonance imaging in the diagnosis of acute appendicitis in pregnancy. We will also investigate the role of laparoscopic and open appendectomy for acute appendicitis in pregnancy. The role of non-operative treatment for acute appendicitis in pregnancy will also be investigated. We conducted a literature review using PUBMED, the Cochrane database of systematic reviews, Google Scholar, and Semantic Scholar, looking for randomized controlled trials, non-randomized trials, observational and cohort studies, clinical reviews, systematic reviews, case write-ups, and meta-analyses from 1990 to 2026. The following keywords were used: "Acute appendicitis," "Pregnancy," "Imaging," "Open appendectomy," "Non-operative treatment," and "Laparoscopic appendectomy". All articles were in English, and all articles were assessed by manual cross-referencing of the literature. Commentaries and editorials were excluded from this review. Only Pregnant patients with non-obstetric abdominal pain were included in this study.

DISCUSSION

Diagnosis of Acute Appendicitis in Pregnancy

Imaging is essential when diagnosing acute appendicitis in pregnancy, with an ultrasound of the abdomen and magnetic resonance imaging being the most common imaging modalities that are used. Ultrasonography has the advantages of its availability and absence of radiation; however, it is operator-dependent and has low sensitivity and specificity. Magnetic resonance imaging (MRI) is often used when ultrasonography findings are indeterminate, and it has a better sensitivity and specificity (Katz *et al.*, 2012; Khandelwal *et al.*, 2013). The diagnostic performance of

ultrasonography for the diagnosis of acute appendicitis in pregnancy was assessed by a case-control study by Segev *et al.*, A total of 67 pregnant patients were included in this study, and ultrasonography had a positive predictive value of 0.94 (Segev *et al.*, 2016). Kazemini *et al.*, conducted a prospective study on the accuracy of ultrasonography in diagnosing acute appendicitis in pregnancy. A total of 58 pregnant patients with acute appendicitis were included in this study, and the sensitivity, specificity, positive predictive value, and negative predictive value were 80%, 75%, 91.4%, and 52.9%, respectively (Kazemini *et al.*, 2017).

A systematic review and meta-analysis on the diagnostic performance of ultrasonography in acute appendicitis in pregnancy was conducted by Wang *et al.*, A total of 4 studies with 239 patients were included in this study, and ultrasonography had a sensitivity of 56% and a specificity of 88%, a positive likelihood ratio of 4.65 (95%CI, 1.42-15.23), and a negative likelihood ratio of 0.50 (95%CI, 0.41-0.62) (Wang *et al.*, 2023). Another systematic review and meta-analysis on the diagnostic accuracy of ultrasonography in diagnosing acute appendicitis in pregnancy was conducted by Moghadam *et al.*, A total of 8 studies with 1593 patients were included in this study, and the overall sensitivity and specificity were 77.6% and 75.3%, respectively. The sensitivity of ultrasonography during the first, second, and third trimesters were 69%, 63%, and 51%, respectively, while the specificity of ultrasonography during the first, second, and third trimesters was 85%, 85%, and 65%, respectively (Maryam Nakhaie Moghadam, 2022).

Magnetic resonance imaging is the second most common imaging modality that is used to diagnose acute appendicitis in pregnancy. Pedrosa *et al.*, conducted a retrospective study on the efficacy of magnetic resonance imaging in acute appendicitis in pregnancy. A total of 51 patients were included in this study, and the sensitivity, specificity, positive predictive value, and negative predictive value were 100%, 96.3%, 1.4%, and 100%, respectively (Pedrosa *et al.*, 2006). A five-year multicenter study on magnetic resonance imaging of acute appendicitis in pregnancy was conducted by Burke *et al.*, A total of 709 patients were included in this study; 66 patients had findings of acute appendicitis on magnetic resonance imaging. The sensitivity, specificity, positive predictive value, and negative predictive value were 96.8%, 99.2%, 92.4%, and 99.7%, respectively (Burke *et al.*, 2015). Burns *et al.*, also conducted a retrospective study on the use of magnetic resonance imaging to diagnose acute appendicitis in pregnancy, and the sensitivity and specificity was 75% and 100%, respectively (Burns *et al.*, 2017).

A systematic review and meta-analysis on the diagnostic performance of magnetic resonance imaging for the diagnosis of acute appendicitis in pregnancy was conducted by Motavaselian *et al.*, A total of 26 studies

were included in this study, and the sensitivity was 0.92(95%CI,0.88-0.95), the specificity was 0.98(95%CI,0.97-0.98), and the positive likelihood ratio was 29.52(95%CI,21.90-39.81), and the negative likelihood ratio was 0.10(95%CI,0.04-0.25) respectively (Motavaselian *et al.*, 2022). Another systematic review and meta-analysis on the clinical use of magnetic

resonance imaging in the diagnosis of acute appendicitis in pregnancy was conducted by Kave *et al.*, Nineteen studies with 2400 patients were included in this study, and the sensitivity was 91.8%(95%CI,87.7-94.9%), specificity was 97.9%(95%CI,97.2-100%), respectively(Kave *et al.*, 2019).

Table I

Study	Study type	Imaging Modality	Sensitivity (%)	Specificity (%)
Kave <i>et al.</i> ,	Systematic review & Meta-analysis	Magnetic resonance Imaging (MRI)	91.8	97.9
Motavaselian <i>et al.</i> ,	Systematic review & Meta-analysis	Magnetic resonance Imaging (MRI)	92	98
Moghadam <i>et al.</i> ,	Systematic review & Meta-analysis	Ultrasonography	77.6	75.3
Wang <i>et al.</i> ,	Systematic review & Meta-analysis	Ultrasonography	56%	88%

Table showing the sensitivity and specificity of ultrasonography and magnetic resonance imaging in diagnosing acute appendicitis in pregnancy.

Management of Acute Appendicitis in Pregnancy

The treatment of acute appendicitis in pregnancy is by performing an appendectomy, which can be performed as an open or laparoscopic approach. The surgical approach would depend on the gestational age, whether the appendicitis is complicated or not, and whether there are presence of co-morbidities or previous surgeries. The laparoscopic approach should also factor in the risk of injury to the uterus during trocar placement and the tolerance of the fetus to carbon dioxide during pneumoperitoneum(Kirshtein *et al.*, 2009; Miloudi *et al.*, 2012). Aggenbach *et al.*, conducted a retrospective study on the impact of acute appendicitis in pregnancy, and accurate diagnosis and prompt treatment should be performed to prevent complications to the mother and reduce the risk of fetal loss(Aggenbach *et al.*, 2015). Yang *et al.*, looked at the outcomes of the treatment options for acute appendicitis in pregnancy. A total of 10,271 patients were included in this study, and 57.2% underwent laparoscopic appendectomy, 13.7% underwent open appendectomy, and 29.2% underwent non-operative treatment. Laparoscopic appendectomy was associated with a lower risk of pre-term labor(Yang *et al.*, 2021).

A systematic review on the role of laparoscopic appendectomy for acute appendicitis in pregnancy was conducted by Walker *et al.*, This study concluded that laparoscopic appendectomy was usually performed before 24 weeks of gestation. There was also an avoidance of performing a laparoscopic appendectomy in the third trimester of pregnancy(Walker *et al.*, 2014). A systematic review on laparoscopic versus open appendectomy in pregnancy was conducted by Walsh *et al.*, A total of 28 studies with 637 cases were included in this study, and laparoscopic appendectomy was

associated with a 6% risk of fetal loss, and the negative appendectomy rate was at 27%(Walsh *et al.*, 2008). A meta-analysis of observational studies on the safety of laparoscopic appendectomy for acute appendicitis in pregnancy was conducted by Fountzas *et al.*, A total of 21 studies with 6276 patients were included in this study, with 1963 patients undergoing laparoscopic appendectomy and 4313 undergoing open appendectomy. Laparoscopic appendectomy was associated with a higher risk of fetal loss, but the postoperative complications were similar between the groups(Fountzas *et al.*, 2019).

A systematic review and meta-analysis on the safety of laparoscopic appendectomy versus open appendectomy for acute appendicitis in pregnancy was conducted by Wilasrusmee *et al.*, Eleven studies with 3415 patients were included in this study, with 599 undergoing laparoscopic appendectomy and 2816 undergoing open appendectomy. Laparoscopic appendectomy was associated with a higher risk of fetal loss (RR 1.91,95%CI,1.31-2.77), but there were no differences regarding postoperative complications and length of hospital stay between the procedures(Wilasrusmee *et al.*, 2012). A systematic review and updated meta-analysis comparing laparoscopic versus open appendectomy for acute appendicitis in pregnancy was conducted by Lee *et al.*, A total of 22 studies with 4694 patients (905 laparoscopic and 3789 open) were included in this study. Laparoscopic appendectomy was associated with a higher risk of fetal loss (OR- 1.72,95%CI,1.22-2.42), but there were no differences regarding pre-term delivery (OR-0.76,95%CI,0.51-1.15). Laparoscopic appendectomy was associated with a shorter length of hospital stay and reduced wound infection rates when compared to open appendectomy(Lee *et al.*, 2019).

A systematic review and meta-analysis comparing laparoscopic versus open appendectomy was

conducted by Zhang *et al.*, Twenty studies with 7248 patients were included in this study, and laparoscopic appendectomy was associated with a higher fetal loss (OR,1.93,95%CI,1.39-2.69), lower wound infection rate (OR,0.34,95%CI,0.18-0.62), and the pre-term delivery rates were similar between the groups (OR,0.80,95%CI,0.48-1.04). The length of hospital stay was shorter in the laparoscopic appendectomy group (Zhang *et al.*, 2021). A systematic review and meta-analysis on the safety of laparoscopic

appendectomy in acute appendicitis during pregnancy was conducted by Chakraborty *et al.*, A total of 17 studies with 1886 patients undergoing laparoscopic appendectomy and 4261 undergoing open appendectomy. The fetal loss rate was higher in the laparoscopic appendectomy group (5.96% vs 3.73%), with an Odds Ratio of 1.84(95%CI,1.31-2.58). The pre-term labor rate was higher in the open appendectomy group (8.99%vs 2.84%), and the Odds Ratio was 0.39(95%CI,0.27-0.55)(Chakraborty *et al.*, 2019).

Table II

Study	Study Type	N=numbers	Main findings on Fetal loss	Main findings on pre-term delivery	Maternal/Surgical outcomes	Conclusion
Walsh <i>et al.</i> , 2008	Systematic review	637 Laparoscopic Appendectomy (LA) cases	Fetal loss after Laparoscopic Appendectomy =6%, higher than that of Open Appendectomy (OA)	Preterm delivery appeared lower after Laparoscopic Appendectomy than Open Appendectomy	OA appeared safer because of the lower fetal loss risk	Open appendectomy was safer because of lower fetal loss risk
Wilasrusme <i>et al.</i> , 2012	Systematic review and meta-analysis	3,415 women	LA associated with significantly increased fetal loss (RR 1.91, 95% CI 1.31-2.77)	No significant difference (RR 1.44, 95% CI 0.68-3.06)	No significant difference in wound infection, birth weight, operative time, Apgar score, or hospital stay	LA may increase the risk of fetal loss
Walker <i>et al.</i> , 2014	Systematic review	N/A	Increased fetal loss associated with LA compared with OA	Similar pre-term delivery rates between groups	LA is associated with minimally invasive benefits	Caution is advised when selecting LA during pregnancy
Fountzas <i>et al.</i> , 2019	Meta-analysis	6,276 women	Increased fetal loss risk with LA	No significant difference between techniques	Lower neonatal 5-min Apgar scores were reported after OA; otherwise, outcomes were similar	LA is considered relatively safe when performed by experienced surgeons
Lee <i>et al.</i> , 2019	Systematic review and updated meta-analysis	4,694 women	Initial analysis suggested higher fetal loss with LA (OR 1.72), but significance disappeared after sensitivity analysis (OR 1.16, p=0.581)	No significant difference (OR 0.76)	LA had a shorter hospital stay and a lower wound infection risk	Evidence insufficient to conclude that LA increases fetal loss

Table showing the comparison of laparoscopic and open appendectomy for acute appendicitis in pregnancy regarding fetal loss.

Non-Operative Treatment for Acute Appendicitis in Pregnancy

Non-operative treatment for acute appendicitis in pregnancy is used for the treatment of pregnant patients with uncomplicated appendicitis, but due to the

risk of recurrence and the risk of developing complicated appendicitis, it should be used with caution. These risks should be explained to the patients as they are associated with maternal complications and fetal loss (Smolkin *et al.*, 2023). A retrospective study was conducted by Ceresoli *et al.*, on operative and non-operative treatment of acute appendicitis in pregnancy. There were 349 patients with acute appendicitis in pregnancy, and non-operative treatment was conducted in 38.46% of the

patients. There were no differences regarding the perinatal outcomes between operative and non-operative treatment for acute appendicitis in pregnancy (Ceresoli *et al.*, 2025).

A systematic review and meta-analysis comparing antibiotic therapy and appendectomy for acute appendicitis in pregnancy was conducted by Candrawinata *et al.*, A total of 5 studies with 3562 patients were included in this study. Antibiotic therapy was associated with a lower risk of pre-term labor (OR-0.63,95%CI,0.43-0.92), but there was a higher risk of complications (OR-1.79,95%CI,1.19-2.69). This study concluded that antibiotic therapy should be used with caution when treating acute appendicitis in pregnancy (Candrawinata *et al.*, 2023).

CONCLUSION

Acute appendicitis remains the most common non-obstetric surgical emergency encountered during pregnancy and represents a significant diagnostic and therapeutic challenge. Physiological and anatomical alterations associated with pregnancy frequently obscure classic symptoms, increasing the risk of delayed diagnosis and appendiceal perforation. Early recognition is therefore essential because disease progression substantially increases maternal and fetal morbidity.

Surgical intervention remains the cornerstone of management, with appendectomy providing definitive treatment and preventing complications associated with perforation. Contemporary evidence strongly supports laparoscopic appendectomy as the preferred operative technique in most pregnant patients because of its favorable maternal outcomes, shorter recovery period, and comparable fetal safety profile. Although interest in non-operative management continues to grow, current evidence remains insufficient to support routine antibiotic-only therapy during pregnancy. Successful treatment requires a multidisciplinary approach involving surgeons, obstetricians, anesthesiologists, radiologists, and neonatal specialists. Ultimately, prompt diagnosis, timely surgical intervention, and coordinated multidisciplinary care remain the most effective strategies for optimizing maternal and fetal outcomes in the management of acute appendicitis during pregnancy.

Conflict of Interest: There is no conflict of interest.

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