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**Review Article**

# Acute Appendicitis in Pregnancy: Update on Management: Narrative Review Article

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**Abstract**: Acute appendicitis in pregnancy is a condition that is challanging to diagnose and treat.The common investigations like full blood count and C.reactive protein are not useful and imaging modalities are restricted to ultrasound and magnetic resonance imaging due to the risk of ionizing radiation exposure to the fetus.Early diagnosis and treatment is essential to prevent complications.The surgical treatment is by open or laparoscopic appendectomy.There is a trend towards laparoscopic appendectomy and so we have conducted this review article to look at the diagnosis and treatment of acute appendicitis in pregnancy.

**Keywords:** "Acute Appendicitis in Pregnancy,"Imaging in Acute Appendicitis in Pregnancy","Open Appendectomy in Pregnancy" and "Laparoscopic Appendectomy in Pregnancy".

## INTRODUCTION

Acute appendicitis in pregnancy is the most common non-obstetric acute abdominal condition that is encountered. It is seen in 1 in 1000 to 1 in 1,500 pregnancies. The incidence of acute appendicitis in pregnancy is 0.15 to 2.10 cases per 1,000 pregnancies. The clinical presentation is with pain over the right lower abdomen, and it may be associated with other symptoms like nausea and vomiting. Abdominal examination is difficult due to the presence of the gravid uterus, with its continued growth, pushing the abdominal organs laterally. This may account for the presentation of abdominal pain over the flank or loin.(Andersson & Lambe, 2001; Augustin & Majerovic, 2010; Rashid & Zainur Rashid Bin Zainuddin, 2014)

The anatomical and physiological changes that occur in pregnancy make the diagnosis of acute appendicitis in pregnancy difficult. The growth of the gravid uterus from the pelvis towards the umbilicus and epigastric region of the abdomen displaces the gastrointestinal organs laterally. This makes it difficult to elicit the classical signs like tenderness at McBurney's point and guarding over the right iliac fossa. The physiological changes that occur like the presence of leukocytosis, elevated serum alkaline phosphatase and C. Reactive protein make interpretation of the full blood count difficult to diagnose acute appendicitis in pregnancy.(Bouyou *et al*., 2015)

The diagnosis of acute appendicitis in pregnancy involves clinical examination, blood investigations and imaging. Due to the presence of the gravid uterus, ultrasound of the abdomen is the initial investigation of choice as it easy to use and does not the risk of radiation exposure to the fetus. Ultrasound has a sensitivity of 80% to 100% and a specificity of 83% to 96%. The factors that affect the diagnostic capacity of ultrasound include the size of the uterus, body mass index of the patient and the experience of the operator. Magnetic resonance imaging has slowly emerged as an alternative imaging modality to diagnose acute appendicitis in pregnancy with its sensitivity and specificity approaching 91% and 98% respectively. Its advantage is it does not use ionizing contrast, but it involves logistics and training to interpret the results. Computerized tomography is not used to diagnose acute appendicitis in pregnancy because it involves the use of ionizing contrast.(Bhandari *et al*., 2017; De Franca Neto *et al*., 2015)

The treatment of acute appendicitis in pregnancy is appendectomy and it should not be delayed as this can lead to complications like perforation, which in turn can lead to pre-term labor and fetal loss. Open appendectomy was the operation of choice for acute appendicitis in pregnancy, but the introduction of laparoscopic appendectomy has seen a shift towards this method of management. Laparoscopic appendectomy is safe, effected and associated with early recovery and reduced analgesia use. It has a slight increased risk of fetal loss when compared with open appendectomy.(Pastore *et al*., 2006)

The World Society of Emergency Surgeons (WSES) has recommended the use of laparoscopic appendectomy for acute appendicitis in pregnancy if the service and expertise is available. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) has recommended the use of laparoscopy for all the three trimesters of pregnancy, with precautions like reduced insufflation pressure, open trocar placement and fetal monitoring.(Di Saverio *et al*., 2020; Pearl *et al*., 2017)

As there is no current consensus on the management of acute appendicitis in pregnancy, there is no consensus on what is the ideal diagnostic agent that can be used, the treatment of acute appendicitis in pregnancy is not standardized with whether open or laparoscopic appendectomy should be used. We have conducted this review article looking for answers for all these factors in the management of acute cholecystitis in pregnancy. We conducted a literature review using PUBMED, the Cochrane database of systemic reviews, Google scholar and semantic scholar looking for randomized control trials, non-randomized trials, observational and cohort studies, clinical reviews, systemic reviews, case write ups, and meta-analysis from 1990 to 2023.The following keywords were used, “Acute appendicitis in pregnancy”, “Imaging in acute appendicitis in pregnancy”, “open appendectomy in pregnancy “and “Laparoscopic appendectomy in pregnancy “. 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 symptoms non-obstetric abdominal pain were included in this study.

# DISCUSSION

**Investigations in Acute Appendicitis in Pregnancy**

Blood investigations that are commonly used to aid in the diagnosis of acute appendicitis are not sensitive in pregnant patients. The presence of leukocytosis is not sensitive due to the physiological effects that occur in pregnancy. Others like the raised C-reactive protein levels are also not sensitive. Other investigations like the neutrophil to lymphocyte and platelet to lymphocyte ratio have shown encouraging results but its use is still not universal. Blood investigations should be used with clinical examination and imaging to help diagnose acute appendicitis in pregnancy. The use of urinalysis is also not sensitive due to the physiological presence of leukocytes in the urine.(Akbaş *et al*., 2020; Başkıran *et al*., 2018; Çınar *et al*., 2018; Yazar *et al*., 2015)

Imaging is important to help in the diagnosis of acute appendicitis in pregnancy. The imaging modalities that are commonly used are ultrasonography and magnetic resonance imaging. Ultrasonography of the abdomen is cheap, cost effective and easy to perform and it does not require the use of ionized contrast agents. Its sensitivity and specificity approach 90% and 85% respectively but the major drawback is the size of the uterus, the experience of the person performing the ultrasound and the size of the abdomen. Otherwise, ultrasonography is often the first imaging modality that is done for acute appendicitis in pregnancy.(Aggenbach *et al*., 2015; Baruch *et al*., 2020; Segev *et al*., 2016)

Magnetic resonance imaging which has good soft tissue penetration, is a safe, effective and non-ionizing imaging modality that can be used to diagnose acute appendicitis in pregnancy. There have been several retrospective studies that have looked at the sensitivity and specificity of magnetic resonance imaging are 95%-100% and 99% -100%.(Burke *et al*., 2015; Burns *et al*., 2017; Pedrosa *et al*., 2006)

A systemic review and meta-analysis on the clinical use of magnetic resonance imaging in the diagnosis of acute appendicitis in pregnancy by Kave *et al*., The study included 2400 patients from 19 studies and this study concluded that the sensitivity and specificity of magnetic resonance imaging in diagnosing acute appendicitis in pregnancy was 91.8% and 97.9% respectively. A similar systemic review on the diagnostic accuracy of magnetic resonance imaging for acute appendicitis in pregnancy by Cho *et al*., also came with the same conclusion.(Cho & Oh, 2021; Kave *et al*., 2019)

Another systemic review and meta-analysis on the diagnostic performance of magnetic resonance imaging in detecting acute appendicitis in pregnancy was conducted by Motavaselian *et al*., A total of 709 patients from 26 studies were included in this study, the sensitivity and specificity of magnetic resonance imaging were 92% and 98% respectively.(Motavaselian *et al*., 2022)

**Management of Acute Appendicitis in Pregnancy**

The management of acute appendicitis in pregnancy is by performing an appendectomy. The appendectomy can be performed as an open appendectomy or a laparoscopic appendectomy. Once the diagnosis has been established an appendectomy should be performed without any delay. With the introduction of laparoscopic appendectomy, there has been an increase in its use in the management of acute appendicitis in pregnancy.(Brown *et al*., 2009; Eryilmaz *et al*., 2002; Kapan *et al*., 2013)

Laparoscopic appendectomy was introduced for the treatment of acute appendicitis in pregnancy, as it was safe, associated with reduced complication and reduced analgesia but initial studies showed a higher risk of fetal loss when compared with open appendectomy. With better experience with laparoscopy, this risk has come down and should be done for patients with acute appendicitis in pregnancy.(Cai *et al*., 2020; Kirshtein *et al*., 2009; Lemieux *et al*., 2009; Yang *et al*., 2021)

There have been several systemic reviews and meta-analyses that have compared laparoscopic appendectomy versus open appendectomy in the treatment of acute appendicitis in pregnancy. All these studies showed that there was no significant difference with regards to the wound infection rate, length of hospital stay, post operative use of analgesia and ambulation. There was a slight increase in risk of fetal loss in the group that underwent laparoscopic appendectomy. This can be explained by the fact that all the cases in these studies had undergone surgery in the first and second trimester and there was significant heterogenicity in the studies. Despite these finding laparoscopic appendectomy is still recommended for the surgical treatment of acute appendicitis in pregnancy.(Lee *et al*., 2019; Walker *et al*., 2014; Walsh *et al*., 2008; Wilasrusmee *et al*., 2012; Zhang *et al*., 2021)

Conservative treatment for acute appendicitis in pregnancy is not recommended due to the high risk of complications like perforation and abscess formation. This can ultimately lead to higher risk of pre-term labor and fetal loss.(Mourad *et al*., 2000; Nakashima *et al*., 2021)

The negative appendectomy rate in acute appendicitis in pregnancy varies from 11% to 50%, and a higher rate is expected in pregnancy due to the effort to establish a diagnosis and prevent complication like perforation which can lead to pre-term labor and fetal loss. The goal of establishing the diagnosis of acute appendicitis in pregnancy as early as possible may lead to an increase negative appendectomy rate.(Ito *et al*., 2012; McGory *et al*., 2007)

**Table I:**

| Study | Year | N=numbers | Negative Appendectomy Rate (%) |
|---|---|---|---|
| McGory *et al*., | 2007 | 3133 | 23% |
| Kirshtein *et al*., | 2009 | 42 | 12% |
| Sadot *et al*., | 2010 | 57 | 24% |

Table showing the negative appendectomy rate in acute appendicitis in pregnancy

## CONCLUSION

The diagnosis of acute appendicitis in pregnancy is challenging due to its clinical presentation and the limitations of blood investigation and imaging modalities. The diagnosis may be delayed due to the effort to establish a diagnosis before operating. Delay in diagnosis can be detrimental to the patient and may lead to fetal loss. Imaging modalities are always done but the diagnosis can be a challenge, so ultimately it is the treating surgeon who will have to decide if an appendectomy needs to be performed.

Magnetic resonance imaging is slowly becoming an important imaging modality that can be used to diagnose acute appendicitis in pregnancy as it is safe to use in pregnancy. It is hoped that magnetic resonance imaging will become a common investigation tool to establish a diagnosis and rule acute complications in acute appendicitis in pregnancy.

Laparoscopic appendectomy is slowly becoming the gold standard in the management of acute appendicitis in pregnancy. Experience in laparoscopy is important as the presence of the gravid uterus makes position of the ports and performing the appendectomy difficult. With better training surgeons will be able to perform this operation with ease.

**Conflict of Interest**: There is no conflict of interest.

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