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Appendicitis in Pregnancy; Diagnostic Challenges and Fetal and Maternal Outcomes

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1. Abstract

1.1. Introduction

Acute appendicitis is one of the most common causes of acute abdominal pain, affecting approximately 0.57% to 0.79% of pregnancies annually. It is the leading non-obstetric cause of acute abdomen in pregnant women. Diagnosing appendicitis during pregnancy presents significant challenges due to the overlapping symptoms with other pregnancy-related conditions, such as ovarian cysts, urinary tract infections, and labour pains. While appendicitis can occur at any stage of pregnancy, it is most commonly diagnosed in the second trimester, with an incidence ranging from 27% to 60%. Pregnancy-induced anatomical and physiological changes, such as uterine enlargement, can alter the position of the appendix, making clinical signs like rebound tenderness less reliable. Additionally, common symptoms of pregnancy, such as nausea, vomiting, fever, and elevated white blood cell count, further complicate the diagnosis. Although imaging techniques like ultrasound can assist in diagnosis, their effectiveness is limited by the physiological changes of pregnancy.Surgical intervention, typically via laparoscopy, is the standard treatment, with the second trimester being the safest time for both mother and fetus. Timely diagnosis and treatment are crucial to avoid complications such as perforation, preterm birth, and fetal mortality.Thus, there is a need for further research into the diagnostic and management challenges of appendicitis during pregnancy.

1.2. Aim

This study aims to investigate the incidence and accuracy of clinical, biochemical, and radiological methods for diagnosing acute appendicitis in pregnant women, using histopathology as the gold standard. It explores management challenges, delays, and maternal/fetal outcomes, including postoperative complications, and reviews diagnostic and treatment approaches in pregnancy.

1.3. Methods

A retrospective cross-sectional study was conducted at the Department of General Surgery, Dubai Hospital, from September 2017 to December 2023. The sample size is inclusive of all pregnant women who underwent appendectomy.

1.4. Results

A total of 14 pregnant women were included in the study. The mean age was 27.9 years, with a mean gestational age of 30 weeks at presentation. The mean WBC count was 11.8, CRP 141.2, and procalcitonin 7.67. Twelve patients had biopsy-proven appendicitis. Two patients had delayed diagnosis, and no maternal or fetal mortality occurred. Nine patients delivered vaginally, and five via C-section. There were no wound infections, and most patients underwent laparoscopic appendectomy. Statistically significant differences were found in WBC count and procalcitonin levels between

complicated and uncomplicated appendicitis.

1.5. Conclusion

In conclusion, appendectomy during pregnancy is generally safe with low maternal and fetal risks when performed promptly. Laparoscopic surgery is preferred, though its feasibility may be limited by gestational age. Conservative management may be considered but carries higher risks if surgery is delayed. Further research is needed to improve diagnostic and management strategies.

2. Introduction

Acute appendicitis is considered one of the leading causes of acute abdomen that affects the general population, however, management of appendicitis during pregnancy is quite a clinical conundrum. Thus, appendicitis with an incidence of approximately 0.57% to 0.79% cases per year of pregnancy is the most common non-obstetric cause of acute abdomen pain in pregnancy. The condition is a real diagnostic conundrum for clinicians as many of the symptoms of appendicitis resemble other complications that can occur during pregnancy such as cysts in the ovary, urinary tract infections or labor pains [1]. Thus, taking into consideration the above discussed adverse maternal and fetal consequences, future studies focusing on the diagnostic puzzle and management of appendicitis during pregnancy are needed [2].Literature has shown that appendicitis in pregnancy can occur at any stage of pregnancy, although certain trimesters are more predisposing than others. It is estimated that appendicitis affects women in their second trimester and some research findings show that it ranges from 27-60% [3]. This may be because many changes are associated with pregnancy and these changes may complicate effective diagnosis and treatment of the conditions. Despite a 19%-36% incidence, the first trimester can be particularly problematic, in part due to overlapping with other causes of abdominal pain and first- trimester pregnancy complications [4]. The third trimester despite having a slightly lower incidence of 15%-33% is still a challenge in terms of diagnosis due to changes in the size and position of the uterus on the other abdominal organs. Cohort studies reveal as high as 59% incidence of third-trimester appendicitis, so this must always be considered in any pregnant female presenting with acute abdominal pain[5].In this regard, diagnosis of appendicitis in pregnancy is very challenging usually because the presenting symptoms resemble any of the other mild pregnancy complications. Some symptoms like Nausea and vomiting, fever and abdominal pain are very common during pregnancy due to hormonal alterations, pressure from the growing uterus and Gastrointestinal complaints. This scenario of symptoms manifestation complicates appendicitis diagnosis from other diseases like ovarian torsion, pelvic inflammatory diseases and some gastrointestinal illnesses.Furthermore, the features that characterize clinical appendicitis like rebound tenderness and guarding may not be felt or may be masked by pregnancy alterations on the abdomen.

Toward the later phase of pregnancy, the gravid uterus pushes the appendix upwards and laterally due to the growth of the uterus[6]. Therefore, physical examination findings, including flinching RLQ tenderness, may not be as manifest, and other signs indicating peritoneal rebound tenderness may vary in their reliability[7]. Furthermore, pregnant women are also likely to present clinical symptoms similar to acute appendicitis, for instance, a high pulse rate, low blood pressure, and WBC counts that increase during pregnancy[8].Appendicitis can be suspected based on information about abdominal pain, other gastrointestinal symptoms such as nausea and vomiting, fever, and clinical findings indicating peritoneal inflammation in a non-pregnant population. Nevertheless, in pregnant women, these signs cannot be considered pathognomonic due to changes in the pregnant women's vascular base and displacement of the appendix[9]. Besides, there are many conditions related to pregnancy: cholecystitis, appendicitis, or constipation, which may also present similar clinical signs, so clinicians should be very careful when interpreting the patient's symptoms[10].In non-pregnant patients, biochemical markers are an important part of the evaluation of suspected appendicitis; however, this, too, is a problematic area in pregnancy. The WBC is usually elevated in pregnancy, and especially in appendicitis, may be normal or slightly raised and should not be relied upon to indicate the presence of the condition. A raised WBC count may point towards appendicitis, although elevated WBC count is not sufficient to diagnose appendicitis in pregnant women. Normally, pregnant women also have elevated WBC baseline levels which complicate the process of identifying a raised count as a definitive sign of appendicitis [11]. Other laboratory indices like CRP may be raised in appendicitis as well as other pregnancy conditions making it hard to distinguish between the two [12].Radiological imaging is very useful in confirming appendicitis, but its utility is greatly restricted in pregnancy because of the dangers it poses to the fetus. US is the most commonly used initial imaging study in pregnant patients with suspected appendicitis because it is noninvasive, not associated with ionizing radiation, and has been characterized to be superior to other imaging modalities in the diagnosis of appendicitis in pregnancy.However, the utilization of ultrasound for diagnosing appendicitis in pregnant women has proven to be limited by the pomological alterations of pregnancy, for instance, the rolling of the appendix by the growing uterus [13]. However, ultrasound is less specialized in detecting appendicitis among pregnant women than among nonpregnant women, especially in the later trimesters when the appendix migrates further downwards[14].For the diagnosis of appendicitis, a CT scan is preferred in the non-pregnant population because of its high specificity and sensitivity[15]. However, its use in pregnant women is discouraged since the fetus is sensitive to radiation that may harm it, particularly during the first trimester of pregnancy. Therefore, CT is often used when the diagnosis is suspected or inconclusive and the clinical condition of the patient

is severe. In these situations, the risk of molecular diagnosis may supersede the danger of radiation exposure, still, the decision must not be made hastily and it should involve consideration of gestational age among other factors [5].When appendicitis is suspected, the treatment plan depends on the gestational stage, the severity of appendicitis, and the health status of both mother and baby. Management for patients with appendicitis is surgical, and it is done by means of an appendectomy, most preferably done via laparoscopy today v. Laparoscopic appendectomy is done rather than the open surgery method, as the laparoscopic method has fewer adverse effects, a shorter postoperative stay and better aesthetic result iv. Surgical intervention is easy technically in the first trimester because of the small size of the uterus but the risk for the fetus is higher in the first trimester especially if the fetus is in the period of organogenesis[16].The second trimester is considered safe for both the fetus and the mother. However, Surgical treatment in the third trimester is possible but more complicated due to the size of the uterus which might obscure the appendix, and there is a risk of preterm labor in addition to other risks [3]. In addition, there are chances that injuries lead to perforation of peritonitis leading to increased maternal morbidity, fetal demises, or preterm delivery. Such risks require early identification and prevention strategies to be applied if they are to be effectively managed. Procrastination is hazardous because it raises both maternal and fetal complications and mortality. Perforated appendicitis during pregnancy is linked with increased fetal mortality, preterm birth, and neonatal complications [2]. The purpose of this study is to review the literature on diagnostic difficulties and treatment approaches regarding acute appendicitis in pregnancy. This study aims to look at clinical, biochemical and radiological barriers to prompt diagnosis of appendicitis, the effects ofappendicitis on maternal/fetal complication rate, and the efficacy of existing diagnostic tools and plans of management.

3. Objectives and Aims

3.1. Objectives

The purpose of this study is to retrospectively review all the cases of acute appendicitis in pregnant women done in our hospital during the study period to look for

1. The accuracy of clinical, biochemical and radiological investigations used in the diagnosis of acute appendicitis in pregnant women keeping histopathology being the gold standard for diagnosis of acute appendicitis.

2. To find out any delays associated with diagnosis and what were the factors associated with delays.

3. To analyze the fetal and maternal outcome post-operatively in terms of wound infection, prolonged hospital stay, intrabdominal sepsis, re-operation, loss of fetus, premature birth and fetal anomalies

4. Methodology

Setting: Department of general surgery Dubai hospital, Dubai Health.

Sampling technique: continuous sampling.

Population and Study Sample: All pregnant patients who underwent appendectomy from Sep 2017 till Dec 2023 in Dubai hospital.Patients were followed till 12 month post-delivery to look for fetal outcomes and milestones achieved by baby.

Study design: Retrospective cross-sectional.

5. Sample Size and Selection

All patients who were pregnant women who underwent appendectomy from Sep 2017 till DEC 2023 were included. It's a retrospective study.

Sources of Data: Electronic Medical Record System (SALAMA SYSTEM)

5.1. Data Collection

After getting approval from the ethical committee the principal investigator and co- investigator will go through the medical records of pregnant women who underwent appendectomies from Sep 2017 till Dec 2023 using the electronic medical record system (SALAMA SYSTEM). All data will be collected using an Excel sheath filling in all the required details as mentioned in the sample Excel sheath at the end.

6. Data Management

6.1. Data Analysis Strategies

All analysis was conducted using the Statistical Package for Social Sciences (SPSS) version24. Records of all pregnant women who underwent appendectomy from Sep 2017 till Dec 2023 were reviewed.Mean values ± standard deviation was computed for all quantitative variables, including patient age, gestational age (GA), white cell count, CRP, and procalcitonin. Presenting symptoms of abdominal pain, fever, clinical tenderness in the lower abdomen, fatal and maternal outcome (categorical variable) were calculated as percentages (wound infection, hematoma, re-surgery, pre-term labor, miscarriage, fetal death, fetal anomalies)

7. Results

The study period consisted of 19 pregnant women who underwent appendectomy. Of the 19 females, the study included 14 patients who underwent appendectomy during pregnancy.as 5 patients were excluded from the analysis due to lack of follow-up data after the surgery.This prevented the extraction of information regarding the progression of pregnancy and fetal and maternal outcomes.The mean age of the pregnant patients at presentation was 27.9 years. The average gestational age at the time of presentation was 30 weeks. The mean pulse rate was 98 beats per minute.The average temperature was 37.2°C, with one patient exhibiting a temperature of 38.8°C and an appendicular mass formation. This

patient was initially managed conseratively for 48 hours but did not improve, necessitating laparoscopic appendectomy.The white blood cell count ranged from 9 to 24, with a mean of 11.8. The C-reactive protein levels were between 5.8 and 302.8, with a mean of 141.2. Procalcitonin levels were in the range of 0-48, with a mean of 7.67.The time from diagnosis to presentation varied from 1 to 10 days, with a mean of 2.4 days. The duration of the surgical procedure ranged from 30 to 140 minutes, with a mean of 78.7 minutes.The gestational age at delivery ranged from 38 to 40 weeks, with a mean of 39.21 weeks. The mean duration of stay for the baby post-delivery was 2.43 days with a range from 2-7 days it was mainly associated with the mother's stay in the hospital and none of the babies had any specific reasons for prolonged stay.The most common presenting symptoms among the pregnant patients were right iliac fossa pain, epigastric pain radiating to the right iliac fossa, and right iliac fossa pain accompanied by fever. Additionally, one patient presented with a palpable mass, and another had suprapubic pain. Of the 14 patients, 12 were confirmed to have appendicitis based on histopathological examination, while 2 did not have appendicitis. The mean duration of hospital stay was 3 days.2 patients had a delay in diagnosis one of them was operated on after 5 days of admission and was found to have a perforated appendix with pus in the pelvic cavity , although this patient had normal us as well as CT scan with minimally raised septic markers because of which diagnosis was delayed and the patient was finally taken for operative intervention on 5th post-admission day based on pain out of proportion to clinical findings. However, otherthan a prolonged hospital stay patient, and fetus did not have any further complications, the baby was delivered at 39 weeks of gestation by normal vaginal delivery. baby achieved normal milestones when followed till 12 months post-delivery.When post-op complications were studied 11 patients did not have any post-op complications however one patient had intraabdominal collection requiring radiological drainage and one patient had post-op ileus resulting in delayed discharge. One patient had a pleural effusion managed conservatively.

We did not observe any maternal and fetal mortality. Moreover, there was no delay in achieving milestones when patients were followed till the baby was one year old.Furthermore, none of the patients had pre-term labor or threatened with abortion.9 patients were delivered by spontaneous vaginal delivery and 5 by c-section, the decision to proceed with the cesarian section was purely on obstetric grounds.One patient had pre-op fetal tachycardia on preoperative CTG findings reaching up to 140 b/min which settled postoperatively.13 patients underwent laparoscopic appendectomy and only one had open appendectomy as she had appendicitis during 37 weeks of gestation and laparoscopy was technically not feasible. No wound infection was observed, need of re-surgery nor neonatal complication were observed post-delivery.All patients had ultrasound abdomen for diagnosing appendicitis and ultrasound was able to pick up the diagnosis in 4 out of 14 patients.Rest patients were ultrasound negative but were taken for surgery either on clinical grounds or because pain was not settling.

One patient had ct scan and it was reported as normal , based of ct scan findings surgery was delayed but patient did not settle and was taken for diagnostic laparoscopy and was found to have perforated appendix with four quadrant peritonitis.MRI pelvis was not done in any patient weather it was the availability or any other reason is not clear on retrospective review.Further sub analysis showed an increase in pulse rate and CRP when compared with diseaseseverity has no statistical significance. However, WBC count and procalcitonin values are statistically significant and patients whohad complicated appendicitis in terms of having perforation, pelvic abscess, mass formation had significant increase in WBC count and procalcitonin as compared to patients who had simple appendicitis. Table 22: Descriptive Parameters Based on Severity of Appendicitis in Pregnancy (Perforated and Non-Perforated) Gestational age for complicated appendicitis in weeks at presentation was on average 19.2

(SD 11.441) weeks. Gestational for simple appendicitis in weeks at presentation was at 16.94 (SD 10.7) weeks on average WBC count for complicated appendicitis was 15.5 (SD5.6), whereas WBC count for simple

appendicitis was 9.138 (SD 1.57).

Not Mentioned in the Tables:

Gestational age for complicated appendicitis in weeks at delivery

Gestational age for simle appendicitis in weeks at time of delivery

Crp for perforated appendicitis

crp for simple appendicitis

Procalcitonin for complicated appendicitis

Procalcitonin for simple appendicitis

8. Discussion

Acute appendicitis is a common surgical emergency during pregnancy occurring during approximately 1 in 700-1500 pregnancies[17]. The management is composed of unique challenges due to physiological changes of pregnancy, diagnostic difficulties and concerns over maternal and fetal outcomes. Pregnancy reduces the overall risk of appendicitis compared to non-pregnant women[xviii]. Studies indicate that pregnant women are prioritized for surgery resulting in shorter time to surgery compared to nonpregnant women[21]. Diagnosing appendicitis during pregnancy is complicated as the symptoms of pregnancy overlap with the symptoms of appendicitis. Imaging modalities such as ultrasound and MRI are preferred during pregnancy due to their safety. US is used in 86-97% of the cases while MRI is employed selectively (5-21%) for inconclusive cases[20]. The gold standard for safe

management of appendicitis during pregnancy across all trimesters is a surgical intervention where laparoscopic appendectomy is favored due toshorter operative time, reduced hospital stays, and lower complication rates compared to open surgery[21]. However, open surgery may still be required in advanced gestational age due to technical limitations[22]. Conservative management with antibiotics was explored as an alternative for uncomplicated cases however there is a risk of recurrence and complications such as perforation. Studies report a fetal loss rate of 4% with conservative management and 5% with surgical intervention[23]. Delayed surgery after failed conservative treatment significantly increases the risk of preterm labor and fetal loss[27]. In terms of maternal outcomes, immediate surgery for complicated appendicitis reduces maternal infectious complications such as sepsis compared to delayed or failed conservative management[17]. Fetal loss rates vary by treatment modalities, the lowest being in open surgery (2%) and highest in laparoscopic procedures (14%). However, it is important to note that these differences may be due to selection bias or a small sample size[20]. Moreover, preterm delivery rates do not significantly differ between pregnant women who have had an appendectomy during their current pregnancy and those who had not have anappendectomy during their pregnancy, 4.5% and 5.6% respectively[21].Nonetheless, negative appendectomy rates (removal of a normal appendix), remain a concern, particularly with a large gestational age when diagnostic accuracy decreases. Rates

are higher in the second half of pregnancy (36%) compared to earlier stages (15%)[22]. Despite this, early surgical intervention minimizes risk of perforation and adverse outcomes. Assessing appendicitis in pregnant women is challenging due to physiological changes that may confound the interpretation of inflammatory markers and vital signs. Research has shown that white blood cell counts, C-reactive protein, and other clinical parameters are

utilized in evaluating appendicitis, but their diagnostic value is hindered by pregnancy-related alterations.

Research on cases of appendectomy performed during pregnancy has demonstrated that white blood cell counts were elevated in many patients. However, this marker alone was not sufficient for diagnosing appendicitis due to the physiological leukocytosis that occurs naturally during pregnancy, particularly in the third trimester. Similarly, levels of C-reactive protein, which rise in response to systemic inflammation, were frequently elevated in these

patients. Yet, analogous to WBC counts, CRP lacked specificity for appendicitis in pregnancy, as other inflammatory or infectious conditions could also cause elevated CRP levels. A study analyzing 56 pregnant women who underwent appendectomy found that neither WBC nor CRP were reliable as standalone diagnostic indicators for acute appendicitis during pregnancy[22,23]. Procalcitonin, another inflammatory marker, has been investigated for its potential to differentiate between uncomplicated and complicated cases of appendicitis. While PCT levels are typically low unless there is a significant bacterial infection or sepsis, its utility in pregnant women remains limited due to the lack of data specific to this population undergoing appendectomy. However, existing research has suggested that elevated PCTlevels may be associated with more serious manifestations of appendicitis[16].Vital signs such as fever and tachycardia are frequently employed as clinical indicators of appendicitis. However, their reliability is diminished during pregnancy due to the overlapping physiological changes associated with this condition. For example, an elevated heart rate is a normal adaptive response in pregnancy, rendering tachycardia less specific for underlying infection or inflammation. Similarly, pregnant women with appendicitis may not consistently present with fever, which is more commonly observed in cases involving perforation or abscess formation[25,26]. The results of our study show that only WBC count and procalcitonin are statistically significant and are elevated with appendicitis in pregnancy and values are directly related to the severity of the disease, our patient who had perforated appendix, pelvic abscess or mass formation had elevated levels of WBC count reaching up to 22 and CRP of up to 48 as compared to patients who had simple mild appendicitis who had either normal or mildly elevated values. Pulse rate, temperature and gestational age are not associated with disease severity as per our results. Also, our results did not show the superiority of any imaging modality over the other while we did not do an MRI in any patients, was done in almost all patients and was able to detect the disease in almost half of the patients. CT scan on the other hand was done in 2 patients and did not pick up the finding although one of the patients who underwent CT scan showed a perforated appendix with abscess formation and surgery was delayed because of negative CT scan findings.Given the limitations of laboratory markers, clinicians often rely on imaging modalities to aid in the diagnosis of appendicitis in pregnancy. Diagnostic imaging techniques are essential in identifying appendicitis during pregnancy, as clinical assessment alone is often inadequate due to the similarities between appendicitis symptoms and normal physiological changes

associated with pregnancy. The three main imaging modalities employed are ultrasonography, magnetic resonance imaging, and computed tomography, each offering unique advantages and limitations. Ultrasonography has been widely utilized, as it is readily available, radiation-free, and canvisualize the appendix in many cases. Ultrasonography is commonly the primary imaging technique utilized for pregnant individuals with suspected appendicitis due to its safety and ease of access. Graded compression ultrasound can detect an inflamed appendix, especially in early gestation, and offer supplementary information on obstetric etiologies of abdominal discomfort, such as placental abruption. However, its diagnostic accuracy is limited by anatomical changes associated with

the gravid uterus, including enlargement and displacement of the appendix. Research has demonstrated that ultrasound visualizes the appendix in only a small proportion of cases during pregnancy, with sensitivity as low as 2236% in later trimesters[26,27].Magnetic Resonance Imaging has emerged as the preferred secondary imaging technique when ultrasonographic findings are inconclusive. This modality avoids the use of ionizing

radiation, rendering it safe for both the pregnant patient and the fetus, and has demonstrated high diagnostic accuracy. Research indicates that MRI exhibits a sensitivity of 96.8% and a specificity of 99.2% in the diagnosis of appendicitis during pregnancy [30]. Additionally, MRI can identify alternative causes of abdominal pain, such as ovarian torsion or bowel obstruction. The typical imaging protocol involves the use of T1- and T2-weighted

sequences to visualize the appendix and any associated peri appendiceal inflammation. Despite these advantages, the utilization of MRI may be limited by factors such as cost and availability, particularly in emergency settings[36,37]. Computed Tomography (CT) is highly accurate for diagnosing appendicitis, with sensitivity exceeding 95%xxi. However, its use in pregnant patients is typically limited to cases where both ultrasound and MRI findings are inconclusive, due to concerns about fetal exposure to ionizing radiation. While modern CT protocols have reduced radiation exposure to levels below thresholds associated with adverse fetal outcomes, its application in this population remains constrained by these potential risks[28,32]. Fetal outcomes following appendectomy during pregnancy have revealed that several factors, including the timing of surgery, the severity of appendicitis, and the surgical approach, can influence the risk of complications. These studies provide valuable insights into the incidence of preterm birth, cesarean delivery, neonatal intensive care unit admission, and fetal mortality. A retrospective analysis of 50 pregnant women undergoing appendectomy reported an 8% rate of preterm birth, with no maternal deaths observed. Preterm births occurred in both the second and third trimesters, with two neonatal fatalities in the second trimester attributed to a case involving multiple congenital anomalies. The study emphasized that delayed diagnosis and surgical intervention significantly increased the risk of perinatal mortality, particularly in cases of perforated appendicitis, where perinatal mortality reached 37% compared to only 1.5% in uncomplicated cases[33]. Three of our patients had post op maternal complications in terms of intra-abdominal

collection, pleural effusion and ileus and that was directly related to the severity of the disease. No pre-term labour or threatened abortion was noted. Moreover, all patients were delivered after 38 weeks of gestation. No fetal complications were noted, and babies were followed till one year of age with normal milestone developments.

Another prospective cohort study reported no statistically significant differences in preterm delivery rates (4.5% vs. 5.6%), small-for-gestational-age births (2.3% vs. 6.2%), or Csection rates (18.2% vs. 20.4%) between pregnant women who underwent appendectomy and those who did not. This suggests that appendectomy itself does not inherently increase adverse obstetric outcomes when performed promptly. However, delayed intervention, especially in perforated cases, has been associated with higher risks of preterm delivery and fetal complications[33]. In terms of surgical approaches, studies have shown that laparoscopic appendectomy has been linked to slightly higher fetal loss rates compared to open surgery (14% vs. 2% respectively), though this may potentially be secondary to selection bias or variation in disease severity among patients undergoing different procedures[34]. Despite this, laparoscopic surgery is generally characterized by shorter operative times, reduced hospital stays, and comparable obstetric outcomes when performed by experienced surgeons[26] All our cases were done laparoscopically except for one that presented at 35 weeks of gestation and ended up having an open appendectomy because of technical reasons.Existing research on appendectomy during pregnancy has emphasized the significance of fetal monitoring, particularly through the use of cardiotocography (CTG), to assess fetal well-being throughout and following the surgical procedure. A study on laparoscopic appendectomy reported that fetal heart rate was continuously monitored immediately before and after the operation to evaluate any potential effects of the procedure on fetal health[32]. Continuous fetal monitoring, including cardiotocography, is crucial during appendectomy in pregnant patients. This practice is essential as surgical interventions, such as the creation of pneumoperitoneum during laparoscopy, could theoretically impact uteroplacental blood flow or induce uterine irritability. Another study emphasized the importance of closely monitoring maternal and fetalhemodynamics throughout the perioperative period, with CTG serving as a valuable tool to assess fetal heart rate patterns and detect early signs of distress[35]. This is particularly important in cases where uterine contractility or other complications arise during surgery. For example, in some cases of uterine irritability, tocolytics such as indomethacin were administered to prevent preterm labour[35]. One patient had tachycardia on preop CTG and all patients had normal post operative CTG.Our retrospective study of 14 cases provides valuable insights into maternal and fetal outcomes following appendectomy during pregnancy, including data on inflammatory markers, symptoms, vital signs, delivery mode, and neonatal outcomes. We have included detailed clinical parameters such as preoperative inflammatory markers and fetal monitoring, enabling comprehensive evaluation of diagnostic and perioperative management strategies. Additionally, we focused on obstetric outcomes, including preterm labor, delivery mode, and neonatal intensive care admissions.

9. Limitations of Our Study

The primary limitation of our study is the small sample size, which restricts the generalizability of findings and statistical power to

detect significant differences in outcomes. The lack of a control group of pregnant women without appendectomy or those managed conservatively makes it challenging to isolate the impact of surgery from the underlying condition.

10. Areas for Future Research

Future research should address these limitations by incorporating larger multicenter samples to improve statistical power and generalizability. Additionally, further research is needed to evaluate the role of CTG in predicting neonatal outcomes and guiding obstetric management during appendectomy, including the impact of abnormal findings on immediate interventions like cesarean delivery or anesthesia adjustments. Long-term follow-up studies examining maternal morbidity and neonatal development after appendectomy during pregnancy would

also provide valuable insights into its safety profile.

11. Conclusion

In conclusion, Appendectomy during pregnancy generally has low maternal and fetal risks when performed promptly and is generally safe. Laparoscopic surgery is preferred due to better outcomes but may have limitations based on gestational age. Conservative management may be an option for some cases but carries higher risks if delayed surgery is required. Further research is needed to improve diagnostic tools and optimize management

strategies for this patient population. Comprehensive fetal monitoring, including continuous cardiotocography, is crucial during appendectomy in pregnant patients to promptly identify and manage any complications, such as fetal distress or uterine contractions, thereby minimizing risks to both the mother and fetus. Objective laboratory markers, including white blood cell count, C-reactive protein, and potentially procalcitonin, can provide valuable

diagnostic information when evaluating appendicitis in pregnancy but must be interpreted in conjunction with clinical findings and imaging studies. While maternal vital signs may offer additional clues, they are less specific due to the physiological adaptations associated with gestation. Employing these diagnostic tools as part of a comprehensive, stepwise approach is essential to optimize maternal and fetal outcomes. Ultrasonography is the preferred initial imaging modality for suspected appendicitis during pregnancy due to its safety and availability.