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ACUTE APPENDICITIS IN PREGNANCY: AN INTEGRATIVE REVIEW OF DIAGNOSTIC STRATEGIES AND THERAPEUTIC APPROACHES

APENDICITE AGUDA NA GESTAÇÃO: UMA REVISÃO INTEGRATIVA DAS ABORDAGENS DIAGNÓSTICAS E CONDUTAS TERAPÊUTICAS ATUAIS

APENDICITIS AGUDA EN EL EMBARAZO: UNA REVISIÓN INTEGRADORA DE LOS ENFOQUES DIAGNÓSTICOS Y CONDUCTAS TERAPÉUTICAS ACTUALES

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ABSTRACT

Acute appendicitis in pregnancy represents a challenging clinical condition due to maternal anatomical and physiological changes that hinder early diagnosis. Evidence indicates that imaging methods, particularly ultrasound and magnetic resonance imaging, are essential for safe disease detection, whereas isolated clinical assessment shows limited accuracy. Surgical treatment remains the gold standard, with laparoscopy standing out as a safe and effective technique, especially when performed within a multidisciplinary context involving

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obstetricians, surgeons, and radiologists. Adequate pain management and the judicious use of antibiotics are indispensable to ensure maternal and fetal safety. Studies demonstrate that diagnostic delays and maternal comorbidities are associated with a higher risk of perforation and increased morbidity and mortality. In this scenario, integrated protocols combining laboratory evaluation, imaging modalities, and consistent therapeutic strategies may optimize clinical care and reduce complications. In conclusion, the management of acute appendicitis in pregnancy requires early diagnosis, timely surgical intervention, and multidisciplinary follow-up to achieve favorable maternal and neonatal outcomes.

Keywords: Acute Appendicitis. Pregnancy. Diagnosis. Laparoscopy. Maternal-Fetal Complications.

RESUMO

A apendicite aguda na gestação configura uma condição clínica desafiadora, em virtude das alterações anatômicas e fisiológicas maternas que dificultam o diagnóstico precoce. Evidências indicam que métodos de imagem, sobretudo ultrassonografia e ressonância magnética, são fundamentais para a detecção segura da doença, ao passo que a avaliação clínica isolada apresenta baixa acurácia. O tratamento cirúrgico permanece como padrão-ouro, com a laparoscopia destacando-se como técnica segura e eficaz, especialmente quando realizada em contexto multidisciplinar, envolvendo obstetras, cirurgiões e radiologistas. A analgesia adequada e o uso criterioso de antibióticos são medidas indispensáveis para assegurar a segurança materno-fetal. Estudos demonstram que atrasos diagnósticos e comorbidades estão associados a maior risco de perfuração e aumento da morbimortalidade. Nesse cenário, protocolos integrados que combinem avaliação laboratorial, exames de imagem e condutas terapêuticas consistentes podem otimizar o cuidado clínico e reduzir complicações. Conclui-se que o manejo da apendicite aguda na gestação requer diagnóstico precoce, intervenção cirúrgica oportuna e acompanhamento multidisciplinar para garantir melhores desfechos maternos e neonatais.

Palavras-chave: Apendicite Aguda. Gestação. Diagnóstico. Laparoscopia. Complicações Materno-Fetais.

RESUMEN

La apendicitis aguda durante el embarazo es una afección clínica compleja debido a los cambios anatómicos y fisiológicos maternos que dificultan el diagnóstico precoz. La evidencia indica que los métodos de imagen, en particular la ecografía y la resonancia magnética, son esenciales para la detección fiable de la enfermedad, mientras que la evaluación clínica por sí sola presenta baja precisión. El tratamiento quirúrgico sigue siendo el estándar de oro, destacando la laparoscopia como una técnica segura y eficaz, especialmente cuando se realiza en un entorno multidisciplinario con la participación de obstetras, cirujanos y radiólogos. Una analgesia adecuada y el uso prudente de antibióticos son medidas esenciales para garantizar la seguridad maternofetal. Los estudios demuestran que los retrasos en el diagnóstico y las comorbilidades se asocian con un mayor riesgo de perforación y una mayor morbilidad y mortalidad. En este contexto, los protocolos integrados que combinan la evaluación de laboratorio, las pruebas de imagen y los enfoques terapéuticos consistentes pueden optimizar la atención clínica y reducir las complicaciones. Se concluye que el manejo de la apendicitis aguda durante el embarazo requiere un diagnóstico precoz, una intervención quirúrgica oportuna y un seguimiento multidisciplinario para garantizar mejores resultados maternos y neonatales.

Palabras clave: Apendicitis Aguda. Embarazo. Diagnóstico. Laparoscopia. Complicaciones Materno-Fetales.

1 INTRODUCTION

Acute appendicitis is recognized as the most frequent non-obstetric abdominal emergency during pregnancy, configuring a relevant clinical challenge for obstetricians and surgeons. The diagnosis and management of the condition in pregnant women involve particularities that go beyond those observed in the general population, since physiological changes typical of pregnancy can mask classic signs and symptoms of the disease, delaying early recognition and compromising maternal and fetal outcomes (Zanuto et al., 2023). In this scenario, understanding the diagnostic and therapeutic nuances of appendicitis in the gestational period is essential to reduce complications such as perforation, diffuse peritonitis, premature birth, and even maternal-fetal mortality.

Appendicitis corresponds, in general terms, to inflammation of the vermiform appendix, whose anatomical location and morphological variations directly influence the clinical presentation and severity of the disease (Vieira et al., 2019). Studies show that the positioning of the appendix can vary considerably, especially in situations of increased abdominal volume, such as during pregnancy, which makes it difficult to clinically correlate pain and the location of the organ (Aguiar et al., 2019). This aspect becomes even more relevant in pregnant women, in whom the expanding uterus gradually displaces the viscera, altering classic clinical landmarks and reducing the applicability of semiological signs such as those of Blumberg and Rovsing (Restrepo-Castro et al., 2018).

From an epidemiological point of view, the prevalence of appendicitis is similar between pregnant and non-pregnant women; however, its clinical impact on the pregnancy-puerperal period is more complex. According to De Freitas et al. (2023), complications such as perforation, sepsis, and fetal distress occur more frequently in pregnant women due to delayed diagnosis and surgical intervention. The literature reinforces that the more advanced the gestational age, the greater the difficulties in identifying specific clinical signs and, consequently, the greater the risk of complications (Iamarino et al., 2017; Téoule et al., 2020).

Another diagnostic challenge is the overlapping of symptoms between appendicitis and manifestations typical of pregnancy. Nausea, vomiting, and nonspecific abdominal pain, common in the first trimester, can mimic appendicular inflammation, favoring underdiagnosis or misdiagnosis, with consequent delay in management (Zachariah et al., 2019). Thus, it is essential to make a differential diagnosis with other causes of non-traumatic acute abdomen, such as cholecystitis, pancreatitis, and gynecological-obstetric complications (Castro et al., 2022).

The use of complementary imaging and laboratory methods is fundamental in the diagnostic process. However, during pregnancy, techniques that are safe for the fetus should be prioritized, which limits some traditional options. Ultrasonography is the initial test of choice because it does not use ionizing radiation, although its sensitivity reduces as the uterus grows (Rocha et al., 2020). Magnetic resonance imaging appears as a non-invasive and highly accurate alternative, being indicated in inconclusive cases (Restrepo-Castro et al., 2018). In addition, new laboratory markers and inflammatory indices, such as the *Systemic Immune Inflammation Index*, have demonstrated relevant diagnostic value, although they still lack specific validation in pregnant women (Şener et al., 2023; Takesaki, 2018).

Early diagnosis is crucial to prevent complications such as appendicular rupture. Predictive models, including clinical scores applied in emergencies, have been shown to be useful in risk stratification and immediate surgical decision (Prachanukool et al., 2021). However, its applicability during pregnancy remains controversial, since most have been validated in non-pregnant populations.

As for treatment, appendectomy remains the gold standard for the management of acute appendicitis in pregnant women. The two main approaches are open surgery (laparotomy) and laparoscopic surgery. Laparotomy, for many years, was considered the technique of choice due to maternal-fetal safety and extensive accumulated experience (Barbosa et al., 2021). However, laparoscopy, already consolidated in non-pregnant women, has gained ground in pregnancy, supported by evidence demonstrating its safety and efficacy when conducted by experienced teams (Gok et al., 2018; Frountzas et al., 2019).

The debate between surgical techniques is ongoing. Recent systematic reviews and meta-analyses indicate that laparoscopy may be associated with lower rates of infectious complications, shorter hospital stays, and faster recovery (Locca et al., 2023). However, aspects such as abdominal insufflation with carbon dioxide and positioning of the pregnant woman still raise concerns about hemodynamic repercussions and the risk of preterm birth (Vujic et al., 2019). Thus, the choice of access route should consider gestational age, team experience, and clinical conditions of the patient.

In the therapeutic field, antibiotic therapy is mandatory, especially in complicated cases, but the choice of drug must respect fetal safety, avoiding agents with teratogenic potential (Guimarães et al., 2022; Aragon; Tobias, 2019). The same applies to pain management, in which non-steroidal anti-inflammatory drugs, widely used in adults, are restricted during pregnancy.

Overall, maternal-fetal outcomes vary according to the precocity of diagnosis and the effectiveness of management. Multicenter studies, such as that of El Ghali et al. (2018), demonstrate that the delay in intervention is directly related to the increase in maternal-fetal morbidity and mortality. Likewise, the literature points out that the implementation of clinical protocols and timely access to appropriate diagnostic methods are determinants for better outcomes (Zanuto et al., 2023).

In this sense, acute appendicitis during pregnancy should be understood as part of a broader spectrum of acute non-obstetric abdomen, in which individualization of care is essential. The complexity of the interaction between gestational physiological changes, surgical risks, and maternal-fetal repercussions requires an interdisciplinary approach, involving obstetricians, surgeons, anesthesiologists, and radiologists (Zachariah et al., 2019). This integration is essential not only to reduce complications, but also to ensure safety and quality of care.

In view of this scenario, the present integrative review aims to gather and critically analyze the most current evidence on the diagnosis and therapeutic approaches of acute appendicitis in pregnant women. It seeks to understand the clinical challenges and recent advances in the field, focusing on the practical applicability of different diagnostic and surgical strategies, in order to contribute to the consolidation of more effective and safer care protocols for mother and fetus.

2 METHODOLOGY

The present research consists of an integrative review of the literature on acute appendicitis in pregnancy, focusing on the diagnostic approaches and therapeutic approaches currently described. The integrative review method was chosen because it enables a broad and systematic synthesis of the available evidence, including experimental and observational studies, case reports, and previous reviews. This characteristic promotes a comprehensive and critical understanding of the phenomenon investigated.

According to Zanuto et al. (2023), integrative reviews are relevant tools in the health area, as they allow the analysis of different types of evidence, favoring the identification of advances, knowledge gaps, and recommendations applicable to clinical practice. In this context, such an approach is especially appropriate for the study of acute appendicitis in pregnant women, a relatively rare condition with a high impact on maternal-fetal morbidity

and mortality, which still involves important diagnostic and therapeutic challenges discussed in the scientific literature.

2.1 SEARCH STRATEGY

The methodological process was conducted in interdependent and systematized stages, including: definition of the guiding question, establishment of inclusion and exclusion criteria, selection of databases, structured search, critical analysis of the studies and integrative synthesis of the results.

The guiding question was outlined based on the PICO (Population, Intervention, Comparison, and Outcome) model, widely used in literature reviews to guide the formulation of clinical questions. In this study, the population corresponded to pregnant women with suspected or confirmed diagnosis of acute appendicitis; the intervention included the available diagnostic and therapeutic strategies; the comparison considered the different methods of diagnostic imaging, laboratory tests, pharmacological and surgical approaches; and the outcome encompassed maternal and fetal outcomes, including complications, morbidity, and prognosis.

Thus, the guiding question was formulated in the following terms: *"What is the current evidence on the diagnosis and treatment of acute appendicitis in pregnant women, and what are the impacts of different approaches on maternal-fetal outcomes?"*element.

The searches were conducted in electronic databases of broad relevance in the health area, such as PubMed/MEDLINE, SciELO, LILACS, Web of Science and Scopus, complemented by consultations in institutional repositories of theses and dissertations. This diversity of sources was fundamental to contemplate both the international literature and the national scientific production, expanding the scope and representativeness of the analysis on the subject.

2.2 INCLUSION AND EXCLUSION CRITERIA

Original articles, case reports, systematic reviews, meta-analyses, dissertations, and retrospective studies that directly or indirectly addressed acute appendicitis in pregnant women were included. The time frame considered publications between 2017 and 2023, a period marked by relevant advances in both imaging methods and surgical techniques, especially in the use of laparoscopy during pregnancy (Frountzas et al., 2019; Gok et al., 2018).

The accepted languages were Portuguese, English and Spanish, in order to include publications from different geographical contexts. Duplicate studies, studies with insufficient data, narrative reviews without methodological rigor, and articles whose main focus was not appendicitis during pregnancy were excluded. For example, studies aimed exclusively at pediatric populations, although relevant for comparison, such as Takesaki (2018) and Téoule et al. (2020), were excluded.

2.3 SELECTION OF STUDIES

The selection of studies occurred in two sequential stages: initially, by reading titles and abstracts, followed by reading the pre-selected articles in full. Screening was conducted based on the presence of controlled and uncontrolled descriptors, including: *"acute appendicitis*", *"pregnancy", "pregnancy", "acute abdomen", "diagnostic imaging", "laparoscopy*", *"open surgery", "antibiotics in pregnancy"* and *"therapeutic approaches".*

At the end of the process, 22 studies were considered eligible to compose the analysis of this integrative review, including case reports (Barbosa et al., 2021; Restrepo-Castro et al., 2018), retrospective observational studies (El Ghali et al., 2018; Vujic et al., 2019; Castro et al., 2022), systematic reviews and meta-analyses (Frountzas et al., 2019; Locca et al., 2023; Zanuto et al., 2023), as well as academic dissertations (Takesaki, 2018).

2.4 DATA EXTRACTION AND ANALYSIS

Data were extracted from a structured form that included: (1) study identification information (authors, year, journal, country of origin); (2) main objectives; (3) characteristics of the study population (gestational age, number of cases, type of study); (4) diagnostic methods employed; (5) therapeutic approaches used; (6) reported complications; and (7) maternal and fetal outcomes.

For critical analysis, the studies were organized into **thematic categories**, according to the emphasis of the content:

- **Anatomical and physiological aspects:** studies that address appendix variations and their diagnostic implications (Vieira et al., 2019; Aguiar et al., 2019).
- **Clinical and imaging diagnosis:** studies on clinical signs, laboratory tests, ultrasound, magnetic resonance imaging, and new markers (Rocha et al., 2020; Restrepo-Castro et al., 2018; Şener et al., 2023).

- **Surgical treatment:** comparisons between laparoscopy and laparotomy, maternal-fetal safety, and technical innovations (Gok et al., 2018; Frountzas et al., 2019; Locca et al., 2023).
- **Adjuvant pharmacological treatment:** use of antibiotics and analgesics in pregnant women (Guimarães et al., 2022; Aragon; Tobias, 2019).
- **Complications and prognosis:** risk factors for adverse outcomes and analysis of morbidity and mortality (De Freitas et al., 2023; Iamarino et al., 2017).

This categorization enabled the narrative synthesis of the evidence, highlighting convergences and divergences between the studies.

2.5 METHODOLOGICAL RIGOR AND RELIABILITY

Although integrative reviews do not follow protocols as strict as systematic reviews, we sought to ensure methodological rigor by using the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) guidelines as a reference for describing the selection and synthesis process of studies. In addition, a critical evaluation of relevance and methodological quality was carried out, considering criteria such as clarity of objectives, coherence between methods and results, validity of the evidence presented, and clinical applicability of the findings.

The inclusion of studies with different designs – case reports, retrospective studies, cohorts, systematic reviews and meta-analyses – was intentional, with the purpose of building a broad and comprehensive view of the theme. This diversity strengthens the review, allowing the integration of real clinical evidence (Barbosa et al., 2021), multicenter experiences (El Ghali et al., 2018), population analyses (Castro et al., 2022), and technological advances relevant to clinical practice (Locca et al., 2023).

2.6 JUSTIFICATION FOR THE METHODOLOGICAL CHOICE

The choice for an integrative review is justified by the scarcity of randomized clinical trials involving pregnant women with acute appendicitis, an understandable reality in the face of the ethical and practical barriers imposed by maternal-fetal risk. In this context, this type of review is particularly relevant because it enables the gathering of dispersed and heterogeneous information, favoring the construction of applicable clinical evidence.

As highlighted by Zachariah et al. (2019) and Zanuto et al. (2023), appendicitis in pregnancy should be analyzed from different diagnostic and therapeutic perspectives, given

its complexity and impact on maternal-fetal outcomes. Integrative review meets this need by allowing the integration of multiple perspectives on the same clinical phenomenon, promoting expanded understanding and providing subsidies for the development of more effective care protocols.

2.7 METHODOLOGICAL LIMITATIONS

Some inherent limitations of the method should be acknowledged. The first refers to the heterogeneity of the included studies, which presented different methodological designs, populations investigated, and health contexts, which makes it difficult to directly compare the findings. Secondly, the time constraint adopted (2017–2023) may have led to the exclusion of older publications that are still relevant, although the main intention was to prioritize recent evidence aligned with the most current diagnostic and therapeutic advances. Another factor to be considered is publication bias, since studies with positive results tend to be more frequently published, which can influence the availability and representativeness of data.

In addition, the absence of absolute consensus in the literature regarding the safety of laparoscopy during pregnancy is noteworthy, despite the growing number of favorable evidence (Frountzas et al., 2019; Gok et al., 2018). This aspect reinforces the need for caution in the interpretation and extrapolation of results, as well as the importance of new multicenter studies with greater methodological robustness to consolidate clinical recommendations.

2.8 SUMMARY OF THE METHODOLOGY

Thus, the methodology adopted in this integrative review sought to ensure a broad, judicious, and reasoned analysis of the available evidence. National and international databases were consulted, with the application of explicit inclusion and exclusion criteria, thematic categorization of findings, and the use of recognized guidelines for reviews. Thus, this study aims to contribute to the consolidation of knowledge about acute appendicitis in pregnancy, offering relevant subsidies for clinical practice and guidelines for future research.

3 RESULTS

Acute appendicitis is one of the most prevalent surgical emergencies during pregnancy, with an estimated incidence between 0.04% and 0.2% of pregnancies, and is considered the main cause of acute non-obstetric surgical abdomen in this period (El Ghali

et al., 2018; Barbosa et al., 2021). Its pathophysiology is related to obstruction of the appendicular lumen, usually caused by fecalites, lymphoid hyperplasia, or, less frequently, by foreign bodies. This blockage triggers a progressive inflammatory process, marked by edema, ischemia, and, in advanced stages, perforation (Iamarino et al., 2017; Téoule et al., 2020). In the gestational context, the diagnosis is more complex due to the anatomical and physiological changes typical of pregnancy, such as the displacement of the cecum and appendix by uterine growth, the increase in circulating blood volume, and hormonal and immunological changes (Aguiar et al., 2019; Vieira et al., 2019).

3.1 ANATOMICAL ALTERATIONS AND DIAGNOSTIC REPERCUSSIONS

During pregnancy, the position of the appendix undergoes significant anatomical changes. As the uterus increases in volume, especially from the second trimester onwards, the appendix can be displaced superiorly, towards the right upper quadrant, or laterally, modifying the usual abdominal topography. This change has a direct impact on the clinical presentation, since the classic location of pain can be altered, making diagnosis difficult (Aguiar et al., 2019; Vieira et al., 2019). The most evident clinical implication is in the evaluation of sensitivity at McBurney's point, which loses reliability in advanced pregnancies. In addition, abdominal pain can be confused with common discomforts of pregnancy, which contributes to the delay in diagnosis and increases the risk of maternal and fetal complications (De Freitas et al., 2023; Restrepo-Castro et al., 2018).

3.2 CLINICAL PRESENTATION AND COMPLICATIONS

The clinical presentation of acute appendicitis in pregnant women tends to be atypical, characterized by less specific symptoms and often of lower intensity, such as diffuse abdominal pain, nausea, vomiting, and fever (Barbosa et al., 2021; Takesaki, 2018). The most serious and feared complication is appendix perforation, which is directly associated with increased maternal and fetal morbidity and mortality. Evidence indicates that delayed diagnosis correlates with higher rates of perforation, peritoneal infection, and the occurrence of preterm birth (El Ghali et al., 2018; Iamarino et al., 2017; De Freitas et al., 2023). Among the main risk factors for complications are delays in seeking medical care, diagnostic difficulty resulting from gestational alterations, advanced maternal age, and the presence of comorbidities (Prachanukool et al., 2021).

3.3 DIAGNOSTIC APPROACH

The diagnosis of acute appendicitis during pregnancy requires a careful approach, which combines detailed anamnesis, physical examination, laboratory evaluation, and imaging tests (Zachariah et al., 2019; Rocha et al., 2020). Among the laboratory tests, the leukogram, the measurement of C-reactive protein and, more recently, systemic inflammatory indices, such as the *Systemic Immune Inflammation Index* (SII), which has shown promise in the detection of relevant inflammatory processes (Şener et al., 2023). However, these parameters, when analyzed in isolation, have limitations, due to the physiological changes in the inflammatory response during pregnancy.

With regard to imaging methods, abdominal ultrasound is considered the first choice, as it is safe, non-invasive, and capable of evaluating the appendix, in addition to identifying free fluid or abscessed collections (Rocha et al., 2020; Zachariah et al., 2019). When inconclusive, abdominal magnetic resonance imaging appears as a complementary method, offering high sensitivity and specificity, without risks of ionizing radiation to the fetus (Restrepo-Castro et al., 2018). Computed tomography, on the other hand, should be reserved only for situations in which MRI is not available, due to maternal-fetal exposure to radiation (Rocha et al., 2020).

3.4 THERAPEUTIC CONDUCTS

The treatment of acute appendicitis during pregnancy is predominantly surgical, with the main objective of preventing maternal and fetal complications (Zachariah et al., 2019; EL Ghali et al., 2018). Appendectomy can be performed openly (*open appendectomy*) or laparoscopic. Recent evidence demonstrates that the laparoscopic approach is safe in pregnant women, providing less postoperative pain, faster recovery, and lower risk of surgical wound infection (Frountzas et al., 2019; Gok et al., 2018; Locca et al., 2023). However, the choice of technique should consider the gestational age, the experience of the surgical team, the maternal conditions, and the extent of the inflammatory process (Vujic et al., 2019; Zachariah et al., 2019).

In specific situations, especially in the early stages of the disease or in the face of diagnostic uncertainty, antibiotic therapy can be used as a conservative measure, as long as it is associated with close monitoring. However, surgical intervention remains the gold standard (Guimarães et al., 2022). Pain management is an essential aspect of treatment and should respect the pharmacological restrictions imposed by pregnancy, prioritizing safe

analgesics, such as paracetamol, and reserving the use of opioids for selected cases and in a judicious manner (Aragão; Tobias, 2019).

3.5 MATERNAL AND FETAL PROGNOSIS

The literature demonstrates that appendicular perforation or delay in surgical intervention are strongly associated with adverse outcomes, such as sepsis, preterm birth, and fetal death (El Ghali et al., 2018; De Freitas et al., 2023). Evidence from case series reinforces that the early approach, ideally before the occurrence of perforation, is related to better maternal and neonatal outcomes, achieving fetal survival rates greater than 95% when surgery is conducted properly (Barbosa et al., 2021; Restrepo-Castro et al., 2018).

3.6 SPECIAL ASPECTS AND RECENT DEVELOPMENTS

The COVID-19 pandemic period imposed additional challenges to the diagnosis of acute abdomen, including appendicitis, due to the reduction in the demand for emergency services and the modification of the clinical-pathological profile observed in these patients (Castro et al., 2022). At the same time, technological advances in laparoscopic surgery have provided greater precision and safety, contributing to the reduction of morbidity and mortality, especially with the implementation of improved fetal monitoring and perioperative care protocols (Locca et al., 2023; Zachariah et al., 2019). In this context, the integration of clinical scores, laboratory parameters, and imaging methods represents a consolidated strategy to minimize diagnostic delays and reduce complications (Prachanukool et al., 2021; Şener et al., 2023).

In summary, acute appendicitis during pregnancy is a unique diagnostic and therapeutic challenge. The anatomical variability of the appendix, the physiological changes typical of pregnancy, and the often atypical clinical presentation compromise the reliability of the evaluation based only on signs and symptoms. The diagnosis should, therefore, be based on laboratory tests, inflammatory indices and safe imaging methods, especially ultrasonography and magnetic resonance imaging. Early surgical treatment, preferably laparoscopically, is associated with better maternal and fetal outcomes, while antibiotic therapy alone remains reserved for specific and selected situations. Finally, multidisciplinary management involving obstetricians, surgeons, and anesthesiologists is essential to reduce morbidity and mortality and optimize maternal and neonatal outcomes.

4 DISCUSSION

Acute appendicitis in pregnancy represents a significant clinical challenge due to the anatomical, physiological, and immunological changes typical of pregnancy, which hinder both the diagnosis and the definition of the appropriate therapeutic approach (Barbosa et al., 2021; Zachariah et al., 2019). Diagnostic delay is frequent and is associated with maternal and neonatal complications, including appendix perforation, peritonitis, and preterm birth (De Freitas et al., 2023; El Ghali et al., 2018). Thus, early detection is essential to reduce morbidity and mortality, requiring an in-depth understanding of the clinical manifestations, laboratory tests, and available imaging methods.

From an anatomical point of view, the position of the appendix can vary significantly during pregnancy due to uterine growth, moving cranially and laterally, which modifies the classic presentation of pain in the right iliac fossa (Aguiar et al., 2019; Vieira et al., 2019). These changes may mask the typical signs of peritoneal irritation, making isolated clinical evaluation unreliable. Pain can migrate to the right upper quadrant, being confused with cholestasis, cholecystitis, or obstetric complications, which reinforces the need for further investigation (Restrepo-Castro et al., 2018; Rocha et al., 2020).

Laboratory markers have an auxiliary role in the diagnosis, but they have limitations. The physiological increase in leukocytosis in the second and third trimesters compromises the specificity of the white blood cell count (Şener et al., 2023). In this context, combined inflammatory indices, such as the *Systemic Immune Inflammation Index* (SII), are promising because they offer greater diagnostic accuracy and help stratify the risk of complications (Şener et al., 2023; Iamarino et al., 2017). Even so, there is a consensus that laboratory tests should always be interpreted in conjunction with clinical and imaging findings.

Among the imaging methods, ultrasonography is the initial modality recommended for its safety and absence of ionizing radiation (Rocha et al., 2020). However, its accuracy may be reduced in advanced pregnancies, due to the displacement of the appendix (Barbosa et al., 2021). Magnetic resonance imaging (MRI) is an effective alternative, with high sensitivity and specificity, allowing the identification of abscesses and perforation without fetal risks (Zachariah et al., 2019; Vujic et al., 2019). Computed tomography (CT) should be reserved for cases in which the previous methods do not provide a conclusive diagnosis, carefully considering the risk-benefit ratio (Rocha et al., 2020).

Surgical treatment is considered the gold standard, and delay in intervention is associated with a higher risk of morbidity and mortality (De Freitas et al., 2023; El Ghali et

al., 2018). Laparoscopy has been consolidated as the preferred technique in pregnant women, with advantages such as less surgical trauma, accelerated recovery, and lower risk of surgical wound infection, and is considered safe in all trimesters when conducted by an experienced team (Frountzas et al., 2019; Gok et al., 2018; Locca et al., 2023). Specific care includes monitoring intra-abdominal pressure and proper positioning of the patient to prevent aortocaval compression and fetal hemodynamic impairments (Zachariah et al., 2019). Open appendectomy is also indicated in cases of contraindication to laparoscopy or extensive perforation.

Antibiotic therapy has an adjuvant role in the perioperative period, aiming to reduce infectious complications and improve maternal-fetal outcomes. The choice should prioritize drugs that are safe during pregnancy, such as first- or second-generation cephalosporins, avoiding agents with teratogenic risk (Guimarães et al., 2022; Aragon; Tobias, 2019). Pain management should be individualized, favoring safe analgesics, such as paracetamol, and reserving opioids for selected situations (Aragon; Tobias, 2019).

Maternal and neonatal outcomes are directly related to the time between symptom onset and surgical intervention. Appendicular perforation significantly increases the rate of preterm birth and neonatal complications, while early intervention reduces adverse events and achieves fetal survival rates greater than 95% (El Ghali et al., 2018; De Freitas et al., 2023; Barbosa et al., 2021; Restrepo-Castro et al., 2018). Factors such as advanced maternal age, comorbidities, and delay in care are determinants of a worse prognosis and should guide intensive surveillance protocols (Iamarino et al., 2017; Prachanukool et al., 2021).

The adoption of multidisciplinary protocols involving obstetricians, surgeons, and anesthesiologists is essential for assertive decisions about surgical timing, access route, and anesthetic management, contributing to the reduction of maternal-fetal risks (Zachariah et al., 2019; Vujic et al., 2019). In addition, the standardization of clinical flows and the continuing education of teams are recommended strategies to standardize conducts and improve results (Castro et al., 2022).

Recent literature also highlights the potential of emerging technologies, such as predictive algorithms and artificial intelligence applied to image analysis, which can improve diagnostic accuracy and reduce therapeutic delays (Prachanukool et al., 2021; Téoule et al., 2020). Although in the validation phase, such tools represent promising prospects for high complexity centers.

Despite the advances, important gaps remain, especially in the management of pregnant women in the first trimester, when the accuracy of ultrasonography is lower and fetal risks are more critical. Future research should prioritize the development of non-invasive early diagnosis strategies, optimized antibiotic therapy protocols, and comparative studies between surgical approaches at different gestational stages (Barbosa et al., 2021; Frountzas et al., 2019; Locca et al., 2023).

In summary, acute appendicitis during pregnancy requires an integrated approach, which includes maternal anatomical and physiological changes, careful interpretation of laboratory tests, rational use of imaging methods, and individualized surgical conduct. Laparoscopy, when indicated, stands out as the preferred technique, associated with better outcomes. Antibiotic therapy and pain management must respect fetal safety, while multidisciplinary action, evidence-based protocols, and technological innovation are fundamental pillars to optimize maternal and neonatal prognosis (Zachariah et al., 2019; Vujic et al., 2019; De Freitas et al., 2023).

5 CONCLUSION

Acute appendicitis during pregnancy is a relevant clinical challenge, due to the anatomical and physiological changes of pregnancy that hinder diagnosis and require a balance between maternal and fetal safety. Imaging methods, especially ultrasound and MRI, remain critical for early identification, while atypical clinical presentation can delay detection and increase the risk of serious complications.

Surgical treatment remains the gold standard, and laparoscopy is considered safe and effective when performed by experienced teams and in accordance with obstetric protocols. Antibiotic therapy alone should be reserved for very specific cases, given the scarcity of robust evidence. Adequate analgesia, on the other hand, with drugs compatible with pregnancy, is essential for maternal comfort and fetal safety.

The early identification of risk factors, associated with the use of integrated clinical protocols and multidisciplinary strategies, is decisive for reducing morbidity and mortality. In this scenario, technological advances, such as combined inflammatory indices and artificial intelligence applied to diagnostic imaging, have promising potential, although they still lack validation.

In summary, the management of appendicitis in pregnant women should be based on early diagnosis, timely surgical intervention, and a multidisciplinary approach, ensuring better

maternal and neonatal outcomes. Future studies should prioritize the standardization of protocols, the long-term evaluation of outcomes, and the clear definition of criteria for conservative conduct, consolidating a practice based on robust evidence.

REFERENCES

Aguiar, A. A., & et al. (2019). Avaliação das posições e situações anatômicas do apêndice em pacientes pediátricos com apendicite aguda. Revista de Medicina, 98(1), 1-7. https://doi.org/10.11606/issn.1679-9836.v98i1p1-7

Aragão, F. F. D., & Tobias, A. F. (2019). Tratamento farmacológico da dor na gestante. BrJP, 2, 374-380. https://doi.org/10.5935/2595-0118.20190067

Barbosa, G. F., & et al. (2021). Apendicite aguda em paciente gestante: Relato de caso. Archives of Health Investigation, 10(1), 129-133. https://doi.org/10.21270/archi.v10i1.5810

Castro, G. R. A., & et al. (2022). Alterações clínico-epidemiológicas em pacientes com abdome agudo não traumático durante a pandemia da COVID-19: Um estudo retrospectivo. Revista do Colégio Brasileiro de Cirurgiões, 49, 1-8. https://doi.org/10.1590/0100-6991e-20223322

de Freitas, M. H. B., & et al. (2023). Complicações clínicas da apendicite no período gravídico-puerperal. Revista Eletrônica Acervo Saúde, 23(8), e13371. https://doi.org/10.25248/reas.e13371.2023

El Ghali, M. A., & et al. (2018). Acute appendicitis complicating pregnancy: A 33 cases series, diagnosis and management, features, maternal and neonatal outcomes. Pan African Medical Journal, 30(1), 1-9. https://doi.org/10.11604/pamj.2018.30.212.14076

Frountzas, M., & et al. (2019). Is the laparoscopic approach a safe choice for the management of acute appendicitis in pregnant women? A meta-analysis of observational studies. The Annals of The Royal College of Surgeons of England, 101(4), 235-248. https://doi.org/10.1308/rcsann.2019.0006

Gok, A. F. K., & et al. (2018). Laparoscopic versus open appendectomy in pregnancy: A single center experience. Ulus Travma Acil Cerrahi Derg, 24, 552-556. https://doi.org/10.5505/tjtes.2018.76236

Guimarães, F. S., & et al. (2022). Uso de antibacterianos em gestantes antes e após regulamentação no Brasil: Coortes de nascimentos de Pelotas, Rio Grande do Sul, de 2004 e 2015. Cadernos de Saúde Pública, 38, 1-15. https://doi.org/10.1590/0102-311X00253621

Iamarino, A. P., & et al. (2017). Fatores de risco associados às complicações de apendicite aguda. Revista do Colégio Brasileiro de Cirurgiões, 44, 560-566. https://doi.org/10.1590/0100-69912017006012

Locca, D. C., & et al. (2023). Avanços na técnica de cirurgia laparoscópica: Uma revisão sistemática das últimas décadas. Brazilian Journal of Health Review, 6(3), 13776-13783. https://doi.org/10.34119/bjhrv6n3-209

Prachanukool, T., & et al. (2021). Clinical prediction score for ruptured appendicitis in ED. Emergency Medicine International, 2021, 1-5. https://doi.org/10.1155/2021/9946160

Restrepo-Castro, O. I., & et al. (2018). Diagnosis of appendicitis in the third trimester of gestation: Case report and review of the literature. Revista Colombiana de Obstetricia y Ginecología, 69(2), 124-131. https://doi.org/10.18597/rcog.3101

Rocha, A. P. C., & et al. (2020). Avaliação por imagem de condições não obstétricas na gestação: O que todo radiologista deve saber. Radiologia Brasileira, 53(3), 185-194. https://doi.org/10.1590/0100-3984.2019.0127

Şener, K., & et al. (2023). Diagnostic value of systemic immune inflammation index in acute appendicitis. Revista da Associação Médica Brasileira, 69, 291-296. https://doi.org/10.1590/1806-9282.20221328

Takesaki, N. A. (2018). Apendicite aguda em pediatria: Estudo clínico-epidemiológico e avaliação de marcadores laboratoriais de risco para gravidade [Dissertação de Mestrado, Universidade Estadual de Campinas]. Repositório da Unicamp. http://repositorio.unicamp.br/jspui/handle/REPOSIP/332575

Téoule, P., & et al. (2020). Acute appendicitis in childhood and adulthood: An everyday clinical challenge. Deutsches Ärzteblatt International, 117(45), 764-774. https://doi.org/10.3238/arztebl.2020.0764

Vieira, E. P. L., & et al. (2019). Congenital abnormalities and anatomical variations of the vermiform appendix and mesoappendix. Journal of Coloproctology, 39, 279-287. https://doi.org/10.1016/j.jcol.2019.02.003

Vujic, J., & et al. (2019). Non-obstetric surgery during pregnancy: An eleven-year retrospective analysis. BMC Pregnancy and Childbirth, 19, 1-5. https://doi.org/10.1186/s12884-019-2191-5

Zachariah, S. K., & et al. (2019). Management of acute abdomen in pregnancy: Current perspectives. International Journal of Women's Health, 11, 119-134. https://doi.org/10.2147/IJWH.S162219

Zanuto, T. S., & et al. (2023). Apendicite aguda na gravidez: Uma revisão integrativa. Research, Society and Development, 12(3), e25012340716. https://doi.org/10.33448/rsd-v12i3.40716