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Surgical Emergencies in Pregnancy
– A Retrospective Analysis of Six Surgical Departments and Review of Literature

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Rezumat

Urgențele chirurgicale în sarcină – o analiză retrospectivă în șase secții de chirurgie și o trecere în revistă a literaturii de specialitate

Context: Urgențele chirurgicale apărute în timpul sarcinii, deşi rare, reprezintă provocări critice pentru profesioniştii din domeniul medical, necesitând un echilibru atent între nevoile imediate ale mamei şi riscurile potențiale pentru făt.
Material şi metode: Acest studiu retrospectiv multicentric evaluează caracteristicile diagnostice şi strategiile de management pentru abdomenul acut non-obstetrical la femeile gravide internate în secțiile de chirurgie generală din şase clinici din România, în perioada 2017–2022.
Rezultate: Studiul a analizat 70 de cazuri, concentrându-se pe procesele de diagnostic, abordările de management şi rezultatele obținute. Rezultatele au evidențiat faptul că intervenția chirurgicală a fost predominantă, însă şi managementul conservator a avut o pondere semnificativă. Apendicita acută şi colecistita acută au fost cele mai frecvente urgențe identificate.
Concluzii: Studiul subliniază necesitatea unei abordări nuanțate în stabilirea diagnosticului şi a unui management anestezic adaptat pentru a asigura rezultate favorabile, evidențiind importanța intervenției prompte şi nevoia continuării cercetării pentru elaborarea unor ghiduri standardizate.

Cuvinte cheie: urgențe non-obstetricale, abdomen acut, sarcină, intervenție chirurgicală

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Abstract

Background: Surgical emergencies during pregnancy, although rare, present critical challenges for medical professionals, requiring a careful balance between the immediate needs of the mother and the potential risks to the fetus.

Material and Methods: This retrospective multicentric study evaluates the diagnostic characteristics and management strategies for non-obstetric acute abdomen in pregnant women admitted to general surgery departments across six clinics in Romania from 2017 to 2022.

Results: The study analyzed 70 cases, focusing on diagnostic processes, management approaches, and outcomes. Findings revealed that while surgical intervention was predominant, conservative management was also significant. Acute appendicitis and acute cholecystitis were the most common emergencies.

Conclusions: The study highlights the necessity of a nuanced approach in diagnosis and tailored anesthetic management to ensure favorable outcomes, emphasizing the importance of timely intervention and the need for further research to develop standardized guidelines.

Keywords: non-obstetric emergencies, acute abdomen, pregnancy, surgical intervention

Introduction

Surgical emergencies during pregnancy, while considered uncommon, pose critical decisions for medical professionals - balancing the immediate needs of the mother against the potential risks to her unborn child. These non-obstetric emergencies occur with a relative infrequency of 1 in every 500 to 700 pregnancies. Interestingly, only about 20% of these cases necessitate actual surgical intervention, presenting a complex dilemma in clinical decision-making. This delicate interplay often revolves around a crucial question: whether to proceed with prompt surgical action or to delay the intervention in hopes of minimizing risks to both the pregnant woman and the fetus. The implications of such decisions are profound, with severe repercussions looming over either choice. This article delves into the intricacies of managing surgical emergencies in pregnant patients, exploring the multifaceted approach required to navigate this challenging aspect of maternal healthcare (1).

During pregnancy, a woman's body undergoes significant anatomical and physiological changes to accommodate and support the growing fetus. These changes, affecting multiple organ systems, begin after conception and are continuous and dynamic. Normally, after an uncomplicated pregnancy, the body returns to its pre-pregnancy state with minimal residual effects. However, in certain cases, these changes can reveal or exacerbate pre-existing conditions or diseases. Normal physiological changes during pregnancy can sometimes be misinterpreted as disease or functional impairment. Therefore, understanding the normal physiological adjustments that occur during pregnancy is crucial to differentiate them from abnormal adaptation (2).

Diagnosing medical conditions during pregnancy presents unique challenges due to the overlap between common pregnancy-related symptoms and signs of pathological conditions. Symptoms such as nausea, vomiting, and abdominal pain, which are often associated with a normal pregnancy, can also be indicative of underlying surgical emergencies. The discernment between physiological and pathological conditions is critical yet complex, particularly when the usual diagnostic tools are limited by the pregnancy itself.

The utilization of diagnostic radiography, including X-rays and CT scans, is typically contraindicated in pregnancy due to the potential risk of fetal exposure to ionizing radiation. This limitation necessitates the reliance on alternative imaging modalities, which may not always provide the same level of detail, potentially delaying diagnosis and intervention. Moreover, a temperature over 37°C in the first trimester can be a normal finding but may also suggest an infectious or inflammatory process that warrants further investigation.

Additionally, the physiological increase in intra-abdominal pressure as the pregnancy progresses can mask or mimic the signs of an acute abdomen, complicating the clinical assessment. This further accentuates the need for a high index of suspicion and a careful, nuanced approach to diagnosis during pregnancy, balancing the imperative to avoid unnecessary risks with the urgency to address potential emergencies.

The existing literature on non-obstetrical surgi-

cal emergencies during pregnancy is quite limited, with a relatively small number of published articles addressing this critical area. Moreover, there are no established guidelines that specifically tackle the unique challenges associated with managing these emergencies in pregnant patients. This significant gap in the literature underscores the necessity of conducting this study. By contributing valuable data and insights, this research aims to fill a crucial void in medical knowledge, potentially guiding future clinical practices and improving outcomes for both mothers and their unborn children. The absence of comprehensive guidelines and the scarcity of focused research in this area further highlight the importance of undertaking this study to provide much-needed evidence and guidance for healthcare professionals dealing with such complex and high-stakes situations.

The purpose of this study was to evaluate the diagnostic characteristics and management strategies of non-obstetrical acute abdomen in pregnant women admitted to a general surgery department. This involved a comprehensive analysis of the diagnostic processes, including the identification of specific challenges and limitations encountered in this patient demographic. Additionally, the study aimed to assess the effectiveness of various management approaches, focusing on their suitability for pregnant patients and the outcomes achieved. Through this investigation, we sought to contribute valuable insights to the existing body of knowledge on handling acute abdominal conditions in pregnant women within a general surgery context, potentially guiding future clinical practices and research in this specialized area.

Material and Method

This retrospective study was conducted by reviewing medical records from the period between 2017 and 2022. Data were collected from six general surgery clinics located across five major cities in Romania, enhancing the representativeness of the national clinical practice of the study. The cities included Bucharest, which had two participating clinics, and one clinic each from Iaşi, Craiova, Timişoara, and Târgu-Mureş.

The methodology was descriptive in nature, aiming to accurately characterize and summarize the features of non-obstetrical surgical emergencies among pregnant patients admitted to general surgery departments. The study focused on outlining the patterns, outcomes, and potential challenges encountered during the diagnostic and treatment processes.

The study included cases involving pregnant patients admitted to general surgery departments who, on discharge, received a diagnosis of a non-obstetric surgical emergency. It is important to note that inclusion in the study was not conditional on undergoing surgical intervention; both surgically managed and conservatively treated cases were included in the analysis.

The following parameters were quantified and categorized for analysis in the study:

- demographic parameters: age of the patient (years), gestational age (weeks);
- hospital clinical parameters: symptoms, surgical pathology category;
- biological parameters: white blood cell count (WBC), hemoglobin (HB), platelet count (PLT), lymphocyte count, neutrophil count, fibrinogen level;
- surgical parameters: type of anesthesia, management approach surgical operation performed, outcome parameters: postoperative complications, fetal condition, fetal status, status on discharge, duration of hospitalization (days).

These parameters were systematically collected and analyzed to assess their impact on the outcomes of the study.

A total of 70 cases met the eligibility criteria and were included in the study. The data extracted from these cases were subject to a thorough analysis, which sought to identify commonalities, trends, and notable exceptions in the presentation, management, and outcomes of these emergencies. Ethical approval for the study was obtained from the respective institutional review boards, with adherence to the ethical standards of the Helsinki Declaration.

The information derived from this study is expected to contribute to the broader understanding of how pregnancy modifies the presentation and management of surgical emergencies and to aid in the development of optimized protocols for the care of pregnant patients in general surgery settings.

Results

The analysis of non-obstetrical surgical emergencies in pregnant patients across the six general surgery clinics from 2017 to 2022 revealed a total of 70 cases.

The study sample comprised individuals with a mean age of 28.87 years [standard deviation (SD) ±

6.33 years, range 16-45 years and median 29 years]. The patients, on average, presented at a gestational age of 21.21 weeks (SD ± 9.34, range 5-37 weeks, median 21 weeks). The mean duration from the onset of symptoms to presentation was 35.51 hours (SD ± 25.51, range 4-96, median 24 hours).

Regarding biological parameters measured preoperatively, the mean white blood cell (WBC) count stood at 12.27 cells/μL (SD ± 4.11, range 5.45-24.45 cells/μL, median 11.33), indicating an inflammatory response that is consistent with an acute surgical condition. Postoperatively, the mean WBC count decreased to 10.69 cells/μL (SD ± 2.76, range 5.30-15.90 cells/μL, median 10.69), suggesting a possible normalization post-intervention. Hemoglobin (HB) levels were recorded with a mean value of 11.70 g/dL (SD ± 1.46, range 7.2-15 g/dL, median 11.8), and platelet (PLT) count averaged at 236.71 k/μL (SD ± 53.29, range 139-341 k/μL, median 217.5), both within normal ranges but reflecting the physiological stress of surgery. Fibrinogen levels, an acute-phase reactant, showed a mean of 472.40 mg/dL (SD ± 111.79, range 309-624 mg/dL, median 474), which can be indicative of the body's coagulation response to surgical trauma or inflammation. These laboratory values reflect the typical acute phase response and recovery in the context of surgical intervention.

- age: 28.87 ± 6.33 (16-45) years;
- gestational age: 21.21 ± 9.34 (5-37) weeks;
- onset of symptoms: 35.51 ± 25.51 (4-96) (hours);
- biological parameters;
- WBC (preop): 12.27 ± 4.11 (5.45-24.45) (cells/μL);
- WBC (postop): 10.69 ± 2.76 (5.30-15.90) (cells/μL);
- HB: 11.70 ± 1.46 (7.2-15) (g/dL);
- PLT: 236.71 ± 53.29 (139-341) (k/μL);
- Fibrinogen: 472.40 ± 111.79 (309-624) (mg/dL).

**Normal values: WBC 5-10 (cells/μL), HB 12-14.5 (g/dL), PLT 150-450 (k/μL), Fibrinogen 200-400 (mg/dL).*

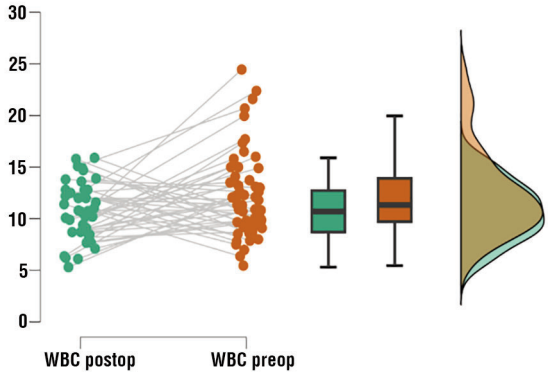

Figure 1. Comparison of preoperative and postoperative white blood cell (WBC) counts

The analysis of white blood cell (WBC) counts in patients pre- and post-operatively reveals a noticeable trend towards elevated WBC counts before surgery. This pattern, illustrated in the connected dot plot, demonstrates the majority of patients experiencing a decrease in WBC post-operatively (*Fig. 1*).

Fig. 2 presents the distribution of imaging modalities employed for diagnostic purposes. Abdominal ultrasound (US) was the most frequently utilized method, accounting for 48 cases, reflecting its widespread adoption due to accessibility, cost-effectiveness, and efficiency in clinical practice. Computed tomography (CT) was the second most used modality, with 5 cases, followed by abdominal X-ray (Rx) with 4 cases. Magnetic resonance imaging (MRI) was the least utilized, being employed in only 2 cases.

The conditions necessitating intervention were categorized as either requiring conservative management or surgical treatment. Acute appendicitis and acute cholecystitis were the most common emergencies, each with 19 cases. Acute appendicitis prompted surgical intervention in 18 of the 19 cases, underscoring its severity and the necessity for operative management. Acute cholecystitis, on the other hand, was predominantly managed conservatively, with 16 cases not

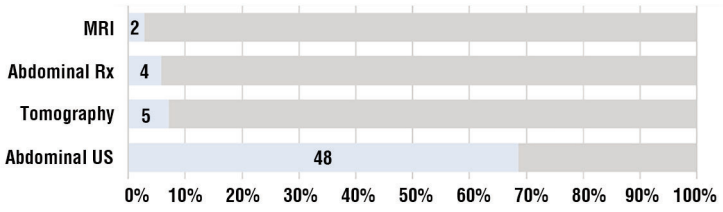

Figure 2. Distribution of imaging methods used for diagnosis

proceeding to surgery. Ano-rectal conditions, although less frequent with 8 cases, exclusively required surgical management. Acute pancreatitis and gynecological emergencies also presented a notable division between management strategies with acute pancreatitis being primarily managed conservatively (5 out of 7 cases) and gynecological emergencies predominantly requiring surgical intervention (4 out of 5 cases) (*Table 1*). For 2 cases we did not have accurate data regarding the management.

In our study, gynecological emergencies included right ovarian torsion, pelvic inflammatory disease, ovarian tumors, and hemoperitoneum due to ruptured ovarian cysts.

The data further revealed that trauma accounted for two cases, with an equal split between conservative and surgical management. Occlusive syndrome was noted in three cases, predominantly managed surgically (two cases). Hernia cases, though only two, were exclusively treated with surgical intervention. Renal emergencies were managed surgically in both recorded cases. A single case of retroperitoneal abscess also required surgical intervention. Overall, surgical management was the predominant approach, with 43 out of 68 cases undergoing operative treatment. This underscores the tendency toward surgical intervention in managing non-obstetrical emergencies during pregnancy in the studied clinics.

The retrospective multicentric study also analyzed the type of anesthesia administered during the surgical management of non-obstetrical emergencies in pregnant patients. Out of the 44 surgical cases, the majority underwent general anesthesia (29 cases), highlighting its predominance as the anesthetic of choice in these scenarios. This was particularly noticeable in cases of acute appendicitis, where all 15 surgeries performed employed general anesthesia. In the context of ano-rectal emergencies, spinal anesthesia was favored in 4 out of 8 cases, with only a single case requiring general anesthesia, suggesting a preference for regional anesthesia in this subset of conditions (*Table 2*).

Local anesthesia was used in a minimal number of cases, totaling 4 across all conditions. Notably, it was chosen exclusively for ano-rectal conditions, which may reflect the localized nature of these surgical interventions. In contrast, spinal anesthesia was utilized in 11 cases, distributed across various conditions including acute appendicitis (3 cases) and gynecological surgeries (1 case), indicating its use in a select range of surgeries where it was deemed safe and effective. The data illustrates a tailored approach to anesthetic management, with the choice of anesthesia being contingent upon the nature of the surgical emergency and the clinical condition of the pregnant patient.

Table 1. Distribution of cases by diagnosis and management approach

Condition	Conservative	Surgical	TOTAL
Acute appendicitis	1	18	19
Acute colecystitis	16	3	19
Ano-rectal	0	8	8
Acute pancreatitis	5	2	7
Gynecological	1	4	5
Occlusive syndrome	1	2	3
Hernia	0	2	2
Trauma	1	1	2
Renal	0	2	2
Retroperitoneal abcess	0	1	1
Total	25	43	68

The clinical outcomes post-surgical interventions for non-obstetrical emergencies in pregnant patients were categorized into three types: healed, enhanced, and deceased. The study recorded a high success rate with 50 out of 70 cases resulting in complete healing. In addition, all cases of acute pancreatitis resolved favorably, emphasizing the effectiveness of the medical interventions for these conditions within the studied cohort (*Table 3*).

The term 'enhanced' denotes cases that showed improvement but did not completely resolve, encompassing 19 cases. Acute cholecystitis constituted the majority of these with 8 cases, followed by acute appendicitis with 3. This indicates that while most patients showed a significant recovery, a subset experienced a

Table 2. Distribution of surgical cases by type of anesthesia

Condition	Local	Spinal	General	Total
Acute appendicitis	0	3	15	18
Acute colecystitis	0	0	3	3
Ano-recta	3	4	1	8
Acute pancreatitis	0	1	1	2
Gynecological	0	1	3	4
Occlusive syndrome	0	0	2	2
Hernia	0	0	2	2
TraumaR	0	0	1	1
Renal	1	0	1	2
Retroperitoneal abcess	0	0	1	1
Total	4	11	29	43

Table 3. Clinical outcomes by diagnosis and evolution status

Condition	Healed	Enhanced	Deceased	Total
Acute appendicitis	16	3	0	19
Acute colecystitis	12	7	0	19
Ano-rectal	6	2	0	8
Acute pancreatitis	7	0	0	7
Gynecological	4	0	1	5
Occlusive syndrome	3	0	0	3
Hernia	0	2	0	2
Trauma	1	1	0	2
Renal	2	0	0	2
Retroperitoneal abces	1	0	0	1
Total	52	15	1	68

protracted recuperation process. Notably, there was only a single mortality recorded in the cohort, within the gynecological category, marking a mortality rate of approximately 1.4%. This low mortality rate underscores the critical importance of timely diagnosis and intervention in the management of surgical emergencies in pregnancy, contributing to favorable maternal outcomes.

The patient who unfortunately deceased presented with an acute surgical abdomen, but her diagnosis was significantly complicated by the fact that she sought medical attention over five days after the onset of symptoms, resulting in a delayed presentation. The postoperative diagnosis was pelvic inflammatory disease. During surgery, a significant amount of purulent fluid was observed throughout the entire peritoneal cavity. A lavage and toileting of the peritoneal cavity were performed, and the fetus was delivered via cesarean section. Despite the best efforts of both the anesthesia and surgical teams, the patient's condition deteriorated, leading to her death on the fifth postoperative day. It is important to note that, despite the mother's demise, the fetus survived and The duration of hospitalization for patients with non-obstetrical surgical emergencies during pregnancy was analyzed based on the type of management: surgical or conservative. The shortest hospital stay for surgically managed patients was 1 day, the longest being 21 days. The mean hospitalization duration for surgical interventions was 4.74 days, with a standard deviation of 3.51 days, indicating variability in recovery time and complexity of cases. The median stay for surgical cases was 4 days, reflecting a central tendency for patients to be discharged within this timeframe (*Table 4*).

Conversely, the conservative management approach resulted in a minimum hospital stay of 2 days and a maximum of 8 days. The average length of stay for conservatively treated patients was 4.00 days, with a notably lower standard deviation of 1.73 days, suggesting a more homogenous duration of hospitalization among these cases. The median duration of 3 days for conservative management indicates that most patients were discharged slightly earlier than those undergoing surgery. Overall, the average length of hospital stay for all patients was 4.54 days with a median of 4 days, denoting a small discrepancy between the two treatment approaches in terms of hospitalization duration.

Of the 70 patients included in the study, six underwent cesarean delivery during the same hospitalization. Among these cases, one fetus was declared deceased shortly after birth and the rest were discharged in good condition. The neonate of the patient who died following delivery survived and was subsequently discharged in good general condition.

Discussions

The uterus, originally a pelvic organ, enlarges and becomes intra-abdominal around the 12th week of gestation. By the end of this period, it can be palpated as a firm globe above the pubic symphysis (3). By the 20th week, the uterus reaches the level of the umbilicus, after which intrinsic growth nearly ceases. Additional enlargement is due to the distension and mechanical stretching of the muscular fibers. At 36 weeks, the uterus rises to the level of the xiphoid process, potentially impeding maternal respiration. In primiparous women, around week 38, approximately two weeks before delivery, the fetal head descends into the pelvis, and the uterine height regresses to its 36-week size (4).

During pregnancy, the growing uterus exerts pressure on surrounding organs, causing significant anatomical and physiological changes. The intestines are displaced laterally, the diaphragm and

Table 4. Hospitalization Duration by Management Type (Surgical vs. Conservative)

Hospitalization (days)	Surgery	Conservative	Overall
Minimum	1	2	1
Maximum	21	8	21
Mean	4.74	4.00	4.54
Std. Deviation	3.51	1.73	3.13
Median	4	3	4

liver are elevated, the stomach is compressed, and the urinary bladder is under increased pressure, leading to a reorganization of abdominal contents. The lower esophageal sphincter tone decreases by 30-50%, particularly in the third trimester, contributing to gastrointestinal symptoms (5). Additionally, progesterone reduces gallbladder tone and motility, resulting in increased volume, decreased emptying rates, and a higher risk of gallstone formation, particularly in the second and third trimesters. The liver adapts by increasing protein synthesis and nutrient provision while maintaining stable hepatic blood flow to accommodate the metabolic demands of pregnancy (6).

The kidneys undergo notable changes, including displacement by the uterus and an increase in length and volume, which return to pre-pregnancy states postpartum. Kidney volume increases by approximately 30%, and renal plasma flow and glomerular filtration rate (GFR) rise by 60-80% mid-pregnancy before slightly decreasing toward term. Compression of the left ureter by the sigmoid colon in the last trimester intensifies ureterohydronephrosis, with dilation and reduced peristalsis mediated by prostaglandin E2. These renal changes are critical for managing the increased metabolic waste and fluid demands of pregnancy (7).

The cardiovascular system undergoes profound adaptations to support the growing fetus. Cardiac output increases by 30-50%, peaking between 28-32 weeks, while blood volume rises by 45% (8). These changes, mediated by hormonal influences such as estrogen, progesterone, and the renin-angiotensin-aldosterone system, ensure adequate uteroplacental circulation. Blood pressure decreases during early pregnancy due to vasodilation, reaching its lowest point between 24-32 weeks before returning to pre-pregnancy levels postpartum. The heart may enlarge and shift position due to the elevated diaphragm, supporting enhanced cardiac activity to meet maternal and fetal metabolic demands (9).

Pulmonary function also adapts significantly during pregnancy. Tidal volume increases by 30-50%, while expiratory reserve volume, residual volume, and functional residual capacity decrease by 15-30% (10). Resting minute ventilation rises by 30-50%, starting in the first trimester and peaking at term, while airway resistance and lung compliance remain unchanged. Vital capacity and inspiratory reserve volume are maintained, and total lung capacity remains stable despite these changes. These respiratory adaptations optimize oxygen exchange to meet the increased metabolic demands of both the mother and fetus (11).

Elevated levels of progesterone during pregnancy lead to a body temperature exceeding 37°C in the first trimester. It returns to normal in the last two trimesters, with a tendency toward hypothermia in the final weeks of pregnancy (12).

During pregnancy, significant metabolic and hematologic changes occur to support the increased demands of the maternal and fetal systems. Basal metabolic rate rises, accompanied by augmented oxygen consumption and a 30% increase in carbon dioxide production due to heightened metabolism (13). These changes lead to compensated respiratory alkalosis, characterized by elevated arterial oxygen levels and reduced carbon dioxide levels, facilitating efficient gas exchange between the mother and fetus. Renal compensation through increased bicarbonate excretion reduces buffering capacity while maintaining pH balance (14).

Hematologically, red blood cell mass increases by 15-20%, or up to 30% with iron supplementation, driven by elevated erythropoietin levels, although the relative plasma volume expansion causes physiological anemia. Leukocyte levels rise, with notable neutrophilia and a mild increase in lymphocyte and monocyte counts, while eosinophil and basophil levels remain unchanged (15).

Pregnancy is also marked by significant adaptations in coagulation and platelet dynamics. Platelet activity increases, but platelet counts may decrease slightly due to increased turnover and clearance, resulting in gestational thrombocytopenia in some cases, which is typically mild and asymptomatic (16). Coagulation factors such as fibrinogen and factors V and IX increase, while factors XI and XIII decrease. This hypercoagulable state, mediated by elevated estrogen, helps reduce postpartum hemorrhage risk but raises susceptibility to venous thromboembolism. Additionally, D-dimers and erythrocyte sedimentation rate (ESR) levels increase markedly, though their clinical significance is limited by broad normal ranges in pregnancy (17).

Abdominal pain is common in pregnant women, resulting from physiological changes and potentially life-threatening conditions. The incidence of acute abdomen during pregnancy stands globally at 1 in 500-600 pregnancies (18). Risk factors include:

- Personal medical history: previous surgeries, chronic diseases, and pre-existing medical conditions.
- Age: certain conditions are more prevalent in specific age groups, with appendicitis commonly affecting younger adults.

- Infections: particularly those affecting abdominal viscera such as cholecystitis or appendicitis.
- Gallstones: increased risk of cholecystitis or acute pancreatitis.
- Medication: some drugs, like anticoagulants, heighten the risk of intra-abdominal hemorrhages.
- Abdominal trauma: can lead to organ rupture or perforation necessitating emergency surgery.
- Congenital conditions: conditions like Meckel's diverticulum can escalate the risk of acute surgical abdomen.
- Lifestyle: smoking and excessive alcohol consumption, both before and during pregnancy, increase the risk of abdominal conditions.

Non-obstetrical causes are typically managed conservatively during the first and third trimesters to avoid spontaneous abortion or preterm labor. However, in emergencies, surgery is performed to prevent fatality (19). Around 0.5% to 2.0% of pregnant women with this type of acute abdomen will require surgical intervention (20). Non-obstetric causes include:

- To manage non-obstetrical causes, surgical intervention is generally avoided in the first and third trimesters to prevent miscarriage and preterm labor respectively. However, in emergencies, surgery is performed to prevent fatalities (21).

Acute non-obstetric abdominal conditions requiring surgical intervention occur in about 0.5% to 2.0% of all pregnant women (22). These conditions include:

- Acute appendicitis: this is the most common cause of surgical acute abdomen during pregnancy, with an incidence of 1 in 500-2000 pregnancies (23). It can occur in any trimester, with a higher incidence in the second trimester, though appendicular perforation is more common in the third trimester. The presentation may be non-specific, typically starting as peri-umbilical pain that migrates to the right iliac fossa, but these signs can be altered, especially in advanced pregnancy. Fever, nausea, vomiting, and anorexia are common, and leukocytosis may not always indicate inflammation due to physiological changes during pregnancy. Retrocecal or pelvic position of the appendix can lead to atypical symptoms, and the gravid uterus may displace the appendix, causing pain to be felt in the right upper quadrant. Perforation can lead to generalized peritonitis (24).
- Acute cholecystitis: this is the second most common non-obstetrical cause of acute abdomen. Pregnancy predisposes to gallstone formation due to biliary stasis and cholesterol-rich biliary secretion, influenced by increased estrogen and decreased soluble bile acids due to progesterone. Symptoms are similar to non-pregnant women and include postprandial nausea, vomiting, anorexia, and pain in the epigastrium or right upper quadrant, potentially radiating to the back. Murphy's sign is suggestive for acute cholecystitis. Physiological leukocytosis and increased alkaline phosphatase levels during pregnancy limit their diagnostic utility (25,26).
- Acute pancreatitis: with an incidence of approximately 0.3-1 per 1000 pregnancies, gallstones are the primary etiology during pregnancy, causing 67-100% of cases. Hypertriglyceridemia accounts for 4-6% of cases. Diagnosis is challenging as symptoms, including severe epigastric pain, postprandial nausea, and vomiting, may mimic serious obstetrical complications warranting an emergency cesarean section. Elevated lipase levels support the diagnosis (27,28).
- Intestinal obstruction: rare in pregnancy, with an incidence of 1/3000 pregnancies, this condition has a high fetal loss rate (17%) and maternal mortality (2%) . It occurs mostly in advanced pregnancies, with peaks at 16-20 weeks and 36 weeks to 6 weeks postpartum. Common causes are adhesions, volvulus, intussusception, and hernias, with adhesions accounting for 60-70% of cases in pregnant women, particularly with a history of previous abdominal surgery or peritonitis. Symptoms include nausea, vomiting, abdominal pain, distension, and cessation of passage of feces and gas (29).
- Perforated ulcer: a rare occurrence in pregnancy, presenting suddenly with severe retrosternal or epigastric pain. Clinical examination may not reveal any abdominal signs. Intraperitoneal perforation can rapidly lead to peritonitis due to leakage of gastric contents into the peritoneum (30).
- Ruptured splenic artery aneurysm: pregnancy, particularly in the third trimester or during labor, is a major risk factor for rupture. Hormonal changes during pregnancy are

theorized to alter arterial wall properties. Elective treatment for asymptomatic splenic artery aneurysms in women of childbearing age is recommended and includes splenectomy, artery resection, aneurysm exclusion, or embolization (31).

- Ovarian torsion: the incidence is increased during pregnancy, complicating 1 in 800 pregnancies, likely due to the increased incidence of adnexal masses. It typically occurs between 6 and 14 weeks of gestation and presents with abdominal hypersensitivity followed by nausea, vomiting, diarrhea, constipation, mild fever, tachycardia, severe pain, shock, and urinary discomfort (32).
- Abdominal trauma: occurs in 6-7% of pregnancies, mainly due to vehicular accidents, physical assaults, and falls. Trauma is the most common cause of non-obstetrical maternal death, though only 0.3% of injuries require surgical intervention (33).

Clinical and Imaging Evaluation of Acute Abdomen in Pregnancy

Acute abdomen investigation during pregnancy poses a unique set of challenges. Clinical evaluation can be complex due to the overlap between symptoms experienced as part of the normal state of pregnancy (like nausea and vomiting) and those resulting from underlying pathological processes, some requiring urgent surgical intervention. An enlarged uterus can grow up to 5 liters, distorting normal anatomy and complicating the localization of pathology during clinical examination. Physiological changes associated with pregnancy, such as nonspecific leukocytosis, physiological anemia, and an elevated baseline heart rate may mimic acute conditions (34).

The symptoms of acute abdomen often resemble pregnancy-related digestive issues, necessitating detailed history taking and careful clinical examination for prompt diagnosis. The clinical examination involves inspection, palpation, percussion, and auscultation of the abdomen to identify signs of tenderness, inflammation, and abdominal rigidity. A key symptom of acute abdomen is abdominal pain. Initially, the causative disease must be determined based on the location and characteristics of the pain. Sudden, severe pain is characteristic of a perforated ulcer or intestinal loop. Acute appendicitis begins with pain and discomfort in the upper abdomen, which then localizes in the right iliac fossa. Acute cholecystitis and pancreatitis often occur after the consumption of fatty foods. Diagnosis can be more difficult during pregnancy due to anatomical changes from the gravid uterus displacing abdominal viscera and the relaxation and stretching of the abdominal wall. The position of the appendix is known to move upward and to the right as gestation progresses, complicating the differentiation of appendicitis from acute cholecystitis and duodenal ulcer perforation (35,36).

Therefore, any localized area of tenderness must be interpreted within the correct clinical context, considering the possible visceral location. Information on the onset timing of abdominal pain and associated symptoms, descriptions of bowel movements, vomiting, and the patient's medical history are also beneficial for diagnosis. If there is a history of recent surgical intervention and severe vomiting, ileus may be suspected. In addition to acute abdominal pain, the absence of bowel sounds during auscultation is a significant finding that may indicate an intestinal occlusion. Inflammation spreading into the pelvis may be suspected if rectal examination reveals tenderness at the Douglas pouch.

Abdominal findings, particularly those obtained through palpation, are indispensable for both diagnosing the causative disease and determining appropriate treatment. Decisions to perform emergency surgery or opt for conservative treatment with patient observation must be based on symptoms like signs of peritoneal irritation. Blumberg's sign and muscular guarding are significant indicators that can determine the cause of the acute abdomen, the severity, and the extent of peritonitis.

During the clinical examination, the physician must also consider:

- Fetal heart rate (to look for any evidence of fetal compromise, which could indicate the need to expedite birth);
- The size, tone of the gravid uterus, and the frequency of uterine contractions;
- The patency of fetal membranes;
- Dilation, effacement, and shortening of the cervical canal (37).

Imaging in Pregnancy

Medical imaging during pregnancy primarily relies on ultrasound due to its non-invasive nature and safety for both the mother and fetus. Ultrasound is the first-line modality for diagnosing acute abdomen and assessing fetal well-being, offering high sensitivity and specificity. However, its

effectiveness may decline after the 32nd week of gestation due to the mechanical effects of the enlarging uterus, potentially necessitating alternative imaging methods. While concerns about ionizing radiation persist, evidence suggests that the teratogenic risk to the fetus is often overestimated. Radiation doses below 50 mGy are considered safe, with significant risks only arising at doses above 150 mGy (38,39).

Computed tomography (CT) is recommended in specific scenarios, such as major trauma or suspected pulmonary embolism, as it provides critical diagnostic information with negligible fetal radiation exposure when the fetus is not directly in the field of view. Modern CT scanners with automatic exposure control can further reduce radiation doses. Iodinated contrast media used in CT imaging have not demonstrated teratogenic effects and can be safely administered if essential diagnostic information cannot be obtained otherwise (40-42).

Magnetic Resonance Imaging (MRI) is preferred for advanced imaging during pregnancy due to its lack of ionizing radiation and superior soft tissue resolution. MRI at 1.5 T or less is proven safe in all trimesters, while the safety of higher field strengths, such as 3 T, remains inconclusive. Rapid sequence MRI is favored over conventional techniques, and the acoustic noise exposure should not exceed 90 dB to prevent potential fetal ear damage. Intravenous gadolinium, although capable of crossing the placenta, is avoided during pregnancy due to its potential risks, despite the lack of definitive evidence of harm in humans (43,44).

In cases where life-threatening conditions necessitate imaging with ionizing radiation, the benefits of timely and accurate diagnosis outweigh the risks to the fetus. With careful adherence to safety guidelines, medical imaging remains a vital tool for ensuring maternal and fetal health during pregnancy.

The management of non-obstetric surgical emergencies during pregnancy presents unique challenges, necessitating a balance between maternal and fetal health. Our study analyzing such emergencies across six general surgery clinics from 2017 to 2022 reported a number of 70 pregnant women with surgical pathology.

These findings align with existing literature. A recent study notes that up to 2% of pregnancies require emergency non-obstetric surgery, with acute appendicitis and cholecystitis being common indications (45). Similarly, a study of 2019 reported a predominance of acute appendicitis in pregnant patients undergoing non-obstetric abdominal surgery (46). Regarding anesthesia, general anesthesia is commonly used in non-obstetric surgeries during pregnancy, consistent with the findings of the study (47).

However, the single mortality case underscores the importance of timely diagnosis and intervention, as delays can lead to adverse outcomes. This is corroborated by the literature, which emphasizes that early suspicion and serial examination are crucial in managing non-obstetric surgical emergencies during pregnancy (48). In summary, the results of the study are consistent with existing literature, highlighting the importance of prompt diagnosis and appropriate management of non-obstetric surgical emergencies during pregnancy to ensure favorable maternal and fetal outcomes.

The current study is subject to several limitations that must be taken into account when interpreting its findings. Firstly, the analysis conducted was purely descriptive due to the heterogeneous nature of the data. This heterogeneity arises from the varied presentations, management approaches, and outcomes of the non-obstetrical surgical emergencies encountered, which precludes a more detailed statistical analysis that could potentially identify underlying patterns and associations with greater precision.

Secondly, the scope of the data is limited by the small number of cases available for review. With only 70 cases included in the study period, the ability to draw broad conclusions that are representative of the entire population of pregnant women experiencing surgical emergencies is constrained. This small sample size may also reduce the statistical power of the study, thereby limiting the detection of significant differences or trends within the data.

Another significant limitation is the absence of a national registry for non-obstetrical surgical emergencies in pregnant patients. A comprehensive registry would provide a larger dataset, which could lead to more robust statistical analysis and a more nuanced understanding of these clinical scenarios. The lack of such a registry hinders the accumulation of a large-scale data pool that could enable more definitive conclusions and the development of evidence-based guidelines for managing these complex cases.

Lastly, the retrospective nature of the study introduces potential biases related to data collection and record-keeping inconsistencies. Such biases could affect the accuracy and completeness of the data, thus impacting the study's findings.

These limitations underscore the need for further research, including prospective studies and the establishment of a national registry to facilitate the collection of comprehensive data on this subject.

Conclusions

The present study highlights the critical nature of acute abdominal conditions in pregnant patients and underscores the importance of prompt diagnosis and intervention. Surgical management was predominant (43/68 cases), with general anesthesia most frequently used. Laboratory data confirmed an acute inflammatory response, with postoperative improvements indicating effective management. Most patients recovered fully (73.5%), with a low mortality rate (1.4%), emphasizing the importance of early diagnosis. Hospital stays averaged 4.74 days for surgical cases and 4.00 days for conservative management. Our findings demonstrate that timely recognition and management of acute abdomen can significantly reduce mortality rates, underscoring the necessity for swift medical action. The study also emphasizes the complexity of anesthetic management in this patient population, where each case requires a customized approach based on the patient's clinical status and the specific surgical emergency. The variability of cases in our study reinforces the need for personalized anesthetic strategies to optimize outcomes. Although this study provides valuable insights, it also points to the need for further research. Larger, prospective studies are essential to deepen our understanding of non-obstetrical surgical emergencies during pregnancy and to aid in the development of standardized care protocols.

Conflicts of Interests

The authors declared no potential conflicts of interest.

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