


Clinical and surgical considerations in pregnant women: Multidisciplinary approach to obstetric complications

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ABSTRACT

This study provides a comprehensive analysis of the physiological adaptations and obstetric complications associated with pregnancy, emphasizing their clinical and practical relevance. Throughout the gestational period, the female body undergoes significant changes in various systems, including cardiovascular, respiratory, gastrointestinal, and hematological, all aimed at supporting fetal development and ensuring maternal well-being. These adaptations include an increase in blood volume and a condition of hypervolemia, as well as changes in heart rate and lung ventilation, along with a reduction in gastrointestinal motility. The clinical implications of these adaptations are thoroughly discussed, highlighting the importance of employing advanced imaging techniques for fetal diagnosis and monitoring, while also addressing common obstetric complications such as appendicitis and postpartum hemorrhage. In conclusion, a profound understanding of these physiological changes is crucial to ensure a healthy and safe pregnancy, guiding healthcare professionals in the provision of high-quality obstetric care and the minimization of potential complications.

Keywords: Physiological Adaptations, Pregnancy, Obstetric Complications, Ultrasonography, Diagnosis.

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INTRODUCTION

Pregnancy is a period of complex and significant physiological changes in a woman's body, which aims to sustain fetal development and ensure an environment conducive to pregnancy ¹. During this period, a number of adaptations occur in various body systems, including the cardiovascular, respiratory, gastrointestinal, renal, and urinary system, to meet the metabolic demands of both mother and fetus^{1,2}.

The fundamental aspect of physiological adaptations during pregnancy lies in the transformations observed in the cardiovascular system ³. These changes include a substantial increase in blood volume, accompanied by modifications in heart rate, ensuring an adequate supply of oxygen and nutrients to the developing fetus ^{2,4}. In addition, respiratory adaptations, such as increased minute volume and expansion of thoracic diameters, facilitate maternal-fetal gas exchange, while gastrointestinal changes, such as reduced motility, can impact the gastrointestinal comfort of pregnant women ^{1,4}.

However, these adaptations are not without challenges. During pregnancy, women are subject to obstetric and medical complications, such as appendicitis, cholelithiasis, intestinal obstruction, and hepatic complications, which can pose risks to both mother and fetus ⁵. The diagnosis and management of these conditions during pregnancy require a careful and differentiated approach, considering the physiological changes inherent to this period ⁶.

In this context, it is crucial to understand the mechanisms underlying physiological adaptations during pregnancy, as well as the complications that may arise and their respective clinical approaches. This article seeks to explore in detail the cardiovascular, respiratory, gastrointestinal, renal, and urinary adaptations during pregnancy, as well as provide insights into the diagnosis and management of common obstetric complications. By understanding these aspects, health professionals can improve the quality of care provided to pregnant women, ensuring a healthy and safe pregnancy for both mother and baby ³.

METHODOLOGY

The search was conducted from September 2023 to February 2024 across several biomedical databases, including PubMed, Scopus, and Google Scholar. We used a combination of pertinent search terms, such as "complications during pregnancy", "physiological changes in pregnancy", "appendicitis in pregnancy", "cholelithiasis during pregnancy", "intestinal obstruction during pregnancy", "ovarian masses in pregnant women", among others. There was no restriction on language or date of publication during the selection of studies.

Initially, relevant articles were identified through electronic databases and by consulting specialized books on obstetrics and maternal-fetal medicine. After applying the exclusion criteria,



which included duplicate studies, articles that were not directly related to medical complications during pregnancy, animal studies, and studies published before 2000.

Inclusion criteria included studies that addressed aspects related to medical complications during pregnancy in humans, including experimental and observational studies, systematic reviews, clinical guidelines, and case reports. During data collection, relevant information was extracted about the different medical complications during pregnancy, including etiology, clinical manifestations, differential diagnosis, diagnostic and therapeutic strategies, as well as management and surgical approaches when applicable.

Data were analyzed qualitatively to identify patterns, trends, and gaps in the literature related to medical complications during pregnancy. The most relevant findings were highlighted and key points were synthesized to provide a comprehensive overview of the different conditions studied. Importantly, this study is a literature review and did not involve the collection of primary patient data, so no ethical review was required.

LITERATURE REVIEW

During pregnancy, between 0.1% and 2.2% of pregnant women may require surgical intervention due to physiological changes in the mother and fetus, in addition to increased uterine volume and displacements of maternal organs, which can complicate both the diagnosis and the therapeutic approach⁵. These changes are accompanied by significant alterations in several body systems, thus affecting the physiology of pregnant women¹.

CARDIOVASCULAR ADAPTATIONS DURING PREGNANCY

During the gestational period, the mother's body undergoes remarkable adaptations in its cardiovascular system to sustain fetal development and ensure an environment conducive to pregnancy^{2,4}. One of the most notable aspects is the significant increase in blood volume, ranging from 45% to 50% and reaching its peak at the end of gestation¹. This increase is driven in part by placental hormones, which stimulate the production of red blood cells, resulting in an increase of about 20% in red blood cell mass^{2,4}. This phenomenon causes a thinning of the blood, leading to anemia considered normal during pregnancy and characterizing a state of hypervolemia, with an increase in blood volume¹. In addition, the pregnant woman's heart rate begins to increase in the 7th week of pregnancy, and can increase by about 20% in relation to pre-pregnancy values at the end of pregnancy^{1,4}. These adaptations are crucial to ensure adequate supply of nutrients and oxygen to the developing fetus, while meeting the physiological demands of the mother during this period⁵.

During pregnancy, there is a reduction in systemic vascular resistance by about 20%, which results in a decrease in systolic and diastolic blood pressures throughout most of gestation, followed



by a gradual recovery to pre-pregnancy levels². However, this phenomenon can also increase pressure in the venous system, compromising venous return from the lower extremities and potentially causing edema^{1,7}. These adaptations are essential to ensure an adequate blood supply to the developing fetus while meeting the physiological needs of the mother during pregnancy⁷.

RESPIRATORY SYSTEM IN PREGNANCY

During pregnancy, significant adaptations occur in the respiratory system². There is an increase in minute volume (amount of air ventilated per minute), while functional residual volume (volume of air that remains in the lungs after a maximal expiration) decreases². Contrary to the initial intuition that lung volume could decrease during pregnancy, an increase in pulmonary ventilation is actually observed¹.

This phenomenon is facilitated by the expansion of the anterior and posterior diameters of the thorax, thus increasing minute ventilation (total air that the lungs receive or exhale in one minute)². These changes induce compensated respiratory alkalosis, characterized by a partial pressure of carbon dioxide (P_{CO_2}) ranging from 28 to 35 mmHg during pregnancy, while the partial pressure of oxygen (P_{O_2}) remains equal to or greater than 100 mmHg⁸.

Additionally, both oxygen consumption and basal metabolic rate increase by around 20% during this period⁸. These physiological changes lead to a lower lung reserve in pregnant women facing acute diseases, reducing the time needed for respiratory distress to progress to respiratory failure^{6,9}. Therefore, early intervention in these cases is crucial.

GASTROINTESTINAL CHANGES DURING PREGNANCY

Throughout pregnancy, it is common to observe a reduction in gastrointestinal motility in pregnant women⁴. This decrease is the result of both mechanical changes, due to the increase in uterine volume, and smooth muscle relaxation, induced by the high levels of progesterone characteristic of this period². As a consequence, gastric emptying can be delayed for up to 8 hours, leading pregnant women to be considered as having a functionally full stomach constantly⁴. In addition, reduced intestinal motility can result in significant constipation, causing severe abdominal pain⁶. These changes are common during pregnancy and can affect the gastrointestinal comfort of pregnant women.

COAGULATION, RENAL FUNCTION, AND URINARY TRACT

During pregnancy, the body undergoes a number of significant changes that affect blood clotting, kidney function, and the urinary system⁷. One of these alterations is the hypercoagulable state, characterized by an increase of about 30% in the levels of fibrinogen, a protein crucial in blood



clotting⁹. This condition increases the risk of complications such as deep vein thrombosis and pulmonary embolism, especially in situations of prolonged rest or immobilization⁶. It is essential that these risks are closely monitored and properly managed to ensure the health of the mother and fetus¹.

In addition, pregnancy results in a significant increase, approximately 50%, in blood flow to the renal pelvis⁴. This leads to an increase in the glomerular filtration rate, contributing to the frequent need to urinate observed in pregnant women^{4,6}. As a result of this increase in blood flow and glomerular filtration, blood creatinine levels decrease by about 40% compared to pre-pregnancy levels⁸. Therefore, it is crucial for healthcare providers to consider these changes when assessing kidney function during pregnancy, ensuring accurate diagnoses and appropriate care.

In addition, ureteral changes are also noticeable during pregnancy, with a significant increase in ureter diameter¹. This is mainly due to the compression exerted by the growing uterus and the relaxation of the smooth muscles, which delays peristalsis and facilitates urinary reflux from the bladder to the lower ureter^{7,8}. These changes increase the risk of pyelonephritis among pregnant women, highlighting the importance of proactive treatment for asymptomatic bacteriuria in order to prevent severe complications⁶.

USE OF IMAGING TECHNIQUES DURING PREGNANCY

Among the imaging techniques available, ultrasonography stands out as the safest and most widely used approach during pregnancy^{1,7}. In addition to being used to evaluate the fetus, ultrasonography is also valuable in investigating the causes of abdominal pain¹. As the procedure of choice, ultrasonography plays a crucial role in confirming the presence of intrauterine pregnancy, allowing a detailed evaluation of various structures^{1,5}. These include the cul-de-sac (for detecting fluid), ureters (for dilation or stones), gallbladder (for identification of stones), and placenta (for abnormalities)⁵.

Magnetic resonance imaging (MRI) also emerges as a safe option during pregnancy, and there is no evidence of increased risks for the fetus⁵. Its use is frequent in the diagnosis of fetal anomalies, especially those related to the central nervous system⁵.

Although there are theoretical concerns about exposure to ionizing radiation, most diagnostic radiographic procedures present minimal or no risk to the fetus¹⁰. Studies indicate that there is no significant increase in the risk of congenital malformations, growth restriction, or miscarriage in procedures that expose the fetus to doses up to 5 rads^{5,10}.

Guidelines established by the American College of Obstetrics and Gynecology in 1995 corroborate this perspective, reassuring women about the performance of clinically necessary diagnostic tests, emphasizing maternal well-being as a priority⁵. It is essential to emphasize that



diagnostic tests should be requested in order to provide an accurate and timely diagnosis, thus ensuring the health of both mother and fetus ¹⁰.

CLINICAL EVALUATION OF ABDOMINAL PAIN DURING PREGNANCY

The clinical evaluation of abdominal pain during pregnancy represents a significant challenge for health professionals ⁵. Although it is natural to associate most abdominal pain with the gestational process, it is crucial to remember that other medical conditions can occur in pregnant women as often as in the general population ¹. In addition, it is necessary to consider the specific conditions of pregnancy in the differential diagnosis ⁴. Abdominal pain during pregnancy can have a variety of causes, from those directly related to the development of the fetus to preexisting or new medical conditions ⁴. Therefore, a broad and detailed approach is essential to ensure an accurate and timely diagnosis ¹.

Healthcare professionals should be aware of warning signs that may indicate serious conditions, such as placental abruption, appendicitis, cholecystitis, or ectopic pregnancy ¹¹. In addition, it is important to consider the patient's individual risk factors, medical history, and any previous obstetric complications ⁵. A complete evaluation of abdominal pain during pregnancy should include a detailed physical examination, analysis of symptoms reported by the patient, monitoring of vital signs, and, when necessary, the use of imaging techniques such as ultrasound or magnetic resonance imaging ⁶.

A multidisciplinary approach, involving obstetricians, gynecologists, radiologists, and other specialists, may be instrumental in ensuring a comprehensive evaluation and proper management of abdominal pain during pregnancy ^{5,11}. By taking a careful and diligent approach, healthcare providers can provide the best possible care for expectant mothers, ensuring the safety of both mother and fetus ⁵.

APPENDICITIS IN PREGNANCY: DIAGNOSTIC CHALLENGES AND CLINICAL CONSIDERATIONS

Appendicitis is a worrisome surgical complication that can occur during pregnancy, affecting approximately two in every thousand pregnant women, with an incidence similar to that of the general population ⁹. An intriguing feature is the variation in the position of the appendix as the uterus expands during pregnancy ^{9,11}. Although the appendix shifts upwards, characteristic right lower quadrant pain remains the most common symptom, regardless of gestational stage ^{5,9}.

Diagnosing appendicitis in pregnant women can be a challenging task due to the overlap of common pregnancy symptoms, such as abdominal pain, nausea, and vomiting ¹¹. These symptoms can be easily confused with other typical conditions of pregnancy, such as round ligament pain and

hyperemesis gravidarum⁹. In addition, the presence of mild leukocytosis, frequently observed during pregnancy, may contribute to diagnostic confusion⁹. Thus, it is crucial for health professionals to be aware of other signs and symptoms that may help in the differentiation and correct diagnosis of these conditions^{1,11}.

Symptoms such as fever and anorexia can serve as useful indicators to help establish the diagnosis of appendicitis during pregnancy⁵. Although ultrasonography is a valuable tool, its value may be limited in cases of intestinal distension, making it necessary to use more advanced imaging techniques, such as non-contrast computed tomography (CT), in more complex situations¹⁰.

Rupture of the appendix during pregnancy poses a serious risk to the health of both mother and fetus, especially after 20 weeks of gestation⁵. The resulting peritonitis can significantly increase the risk of preterm labor and preterm delivery⁹. Therefore, it is essential that the diagnosis of appendicitis be established early and that surgical intervention be performed immediately in order to avoid serious and potentially fatal complications for the mother and baby⁵.

CHOLELITHIASIS

After appendicitis, biliary tract diseases are the most common surgical complications encountered during pregnancy⁵. Cholelithiasis, usually caused by obstruction of the cystic duct, may present with intermittent bouts of biliary pain or with persistent pain radiating to the subscapularis area in cases of obstruction of the common bile duct due to calculus^{5,11}. Ultrasonography is a useful tool to detect the presence of gallstones¹⁰.

The differential diagnosis includes other conditions such as liver pain, HELLP syndrome, and severe preeclampsia^{5,12}. Conservative treatment may be attempted initially, but persistence of symptoms may require surgical intervention^{5,13}. Postponement of surgery may increase perinatal morbidity, although laparoscopic cholecystectomy may be considered in early pregnancies^{5,11}. Although rare, pancreatitis can occur during pregnancy, with cholelithiasis being the most common cause¹⁴. However, it can also be a complication of severe preeclampsia or HELLP syndrome^{5,13}.

BOWEL OBSTRUCTION IN PREGNANCY: CRUCIAL RECOGNITION AND INTERVENTION

Bowel obstruction during pregnancy is not an uncommon occurrence, with an incidence that resembles that of the general population⁵. Patients often manifest characteristic symptoms, such as abdominal cramps accompanied by exacerbated peristalsis⁹. Nausea and vomiting are complaints present in about 80% of cases, while abdominal distention is prominent^{1,5}. It is extremely important to perform a surgical intervention before intestinal necrosis or perforation occurs, as the occurrence of the latter during pregnancy is associated with a significant increase in morbidity and mortality for both the mother and the fetus^{5,11}.



OVARIAN MASSES IN PREGNANCY: IMPORTANCE OF EARLY RECOGNITION AND PRESERVATION OF THE CORPUS LUTEUM

With the spread of ultrasound in early pregnancy, detection of the gestational corpus luteum has become a common occurrence⁵. Generally, this finding is physiological in nature and, in the absence of torsion symptoms, only requires follow-up for diagnostic confirmation¹⁴.

Progesterone production in the first 14 weeks of gestation plays a crucial role in maintaining pregnancy until placental progesterone production replaces it^{2,8}. Therefore, if surgical intervention is required due to symptoms of torsion or bleeding, it is critical to make every effort to preserve the corpus luteum during the first trimester of gestation^{5,13}.

PLACENTAL ABRUPTION: CHALLENGES IN DIAGNOSIS AND MANAGEMENT

Diagnosing obstetric complications that result in pain can be a significant challenge. The use of ultrasonography has limitations, since only a small percentage (5% to 10%) of placental abruptions are visualized^{5,10}. However, early identification of placental abruption is of paramount importance⁵. In many cases, these abruptions are related to uterine hypertonicity, which can trigger fetal heart rate abnormalities^{1,4}.

Placental abruptions often occur in the third trimester of pregnancy, often characterized by acute and severe abdominal pain¹. Contrary to popular belief, the presence of vaginal bleeding is not always evident in cases of placental abruption⁵. Therefore, it is imperative that healthcare professionals make a rapid and accurate diagnosis of this complication, even in the absence of vaginal bleeding^{1,5}.

It is important to consider the role of trauma as a potential risk factor for placental abruption, with distinct mechanisms involved¹⁴. Direct blunt trauma to the uterus, such as assaults or the impact of the seat belt in accidents, can result in injuries to the site of implantation of the placenta¹¹. In addition, rapid acceleration and deceleration, which is common in automobile accidents, can lead to lateral force injuries¹¹. Even in the absence of visible physical lesions, the adrenergic response to stress can trigger uterine vasospasm, culminating in ischemic necrosis at the implantation site and formation of subplacental hematoma⁵.

Pregnant women who experience trauma should be closely monitored for at least 4 hours, with the possibility of prolonged monitoring for up to 24 hours⁵. Placental abruption can quickly progress to a surgical emergency, requiring immediate delivery⁵. In addition to clinical examination, laboratory studies such as platelet count and fibrinogen may be useful in diagnosis, especially for occult cases, as the expansion of the retroplacental hematoma can consume coagulation factors, aggravating the situation^{5,14}.



HEPATIC COMPLICATIONS IN PREGNANCY: ESSENTIAL RECOGNITION AND APPROACH

HELLP syndrome and acute fatty liver of pregnancy are conditions that can manifest with right upper quadrant pain, accompanied by nausea and vomiting¹². HELLP syndrome, a severe form of preeclampsia, should not be confused with cholelithiasis or other gastrointestinal diseases¹³. The progression of these hepatic complications can result in hepatic capsule rupture and maternal mortality if the diagnosis is not made accurately and in a timely manner⁵.

The diagnosis of these conditions is largely based on laboratory studies, which play a crucial role in identification and monitoring⁶. Tests such as LDH, AST, platelet count, creatinine, uric acid, and hematocrit determinations are fundamental^{1,7}. Elevations in AST and LDH levels, along with a decrease in platelet count and an increase in hematocrit, are common, especially when associated with intravascular volume depletion^{5,6}.

In addition, patients with acute fatty liver may present with hypoglycemia⁶. It is critical for clinicians to take into account the physiological changes of pregnancy when interpreting these laboratory results⁷. A careful approach and a deep understanding of the nuances of these conditions are essential to ensure proper diagnosis and treatment, helping to prevent serious and potentially life-threatening complications for both mother and fetus⁶.

TRAUMA DURING PREGNANCY: PROPER ASSESSMENT AND MANAGEMENT

Trauma due to accidents is an occurrence in about 6% to 7% of all pregnancies, carrying not only the risk of placental abruption, but also increasing the likelihood of preterm labor and rupture of membranes before term⁵. It is of paramount importance that pregnant women who are victims of trauma are comprehensively evaluated for a wide range of injuries, following protocols similar to those applied to non-pregnant patients^{9,14}.

Studies have shown an increased risk of fetomaternal hemorrhage in women who have undergone trauma during pregnancy^{5,15}. Those who are RhD-negative should undergo a quantitative assessment of the volume of fetal cells in the maternal circulation, followed by appropriate administration of anti-immunoglobulin D to prevent sensitization of the maternal immune system^{1,5}. It is noteworthy that peritoneal lavage is not contraindicated in pregnancy and can be safely performed in patients with suspected visceral rupture⁵.

The multidisciplinary approach and the consideration of pregnancy-specific risks are essential to ensure the safety of the mother and fetus after trauma during pregnancy¹⁵. Careful follow-up and early intervention are essential to minimize complications and optimize clinical outcomes for both parties involved¹⁵.



OBSTETRIC PROCEDURES: APPROACH AND MANAGEMENT OF COMPLICATIONS IN CESAREAN DELIVERY

The most common obstetric procedure is surgical delivery, also known as cesarean section ¹⁶. This procedure often involves a vertical infraumbilical incision in the midline, especially in obese patients or when rapid entry into the abdominal cavity is required ⁵. After placement of a bladder tube, entry into the peritoneal cavity is performed with cross-section of the peritoneum of the vesicouterine fold and careful dissection of the bladder from the lower uterine segment ⁹.

The transverse uterine incision is then made, centered at the midline, and extended as needed ⁹. This is followed by rupture of the membranes and the birth of the fetus, with the application of fundal pressure to facilitate the process ¹¹. It is important to note that, although the Pfannenstiel incision is commonly used, variations in the technique may be necessary depending on the specific clinical situation, such as the need for rapid entry into the abdominal cavity or the presence of certain anatomical conditions of the patient ⁵. These variations are adapted to ensure the safety of both mother and baby during the procedure ⁵.

In cases of transverse or pelvic presentation, a low vertical incision is preferred, starting in the lower uterine segment towards the bladder and, if necessary, extending cranially to avoid fetal entrapment ^{9,11}. Although less common, classic cesarean section with incision on the anterior and upper parts of the uterine fundus can be performed in cases of obstruction of the lower uterine segment due to uterine fibroids or very preterm pregnancies ¹⁴.

After the baby's birth, the closure of the uterine incision can be aided by the exteriorization of the uterine fundus, also facilitating uterine massage ⁵. Intravenous administration of oxytocin is recommended to help with uterine contraction ⁵. The uterine incision is closed with absorbable sutures, with a second layer imbricated for hemostasis, if necessary ⁹. The abdomen is inspected for bleeding, and the abdominal wall is closed according to standard procedure ⁵.

It is possible that bleeding may be triggered when assisting a patient with postpartum hemorrhage ¹⁴. Therefore, it is important to recognize factors that may be peculiar to pregnancy. Blood volume increases during pregnancy ⁸. Hemorrhage in pregnancy is defined as blood loss beyond 1,000 ml ⁵. It should be noted, however, that due to the increase in blood volume at term, the patient may lose 1,500 to 2,000 ml before symptoms ⁹. The most common cause of postpartum hemorrhage is uterine atony ⁹. Risk factors for uterine atony include prolonged labor, uterine infection, surgical delivery, and hyperdistension of the uterus ¹¹. Hemorrhage may also occur in placental abruption and in patients with placenta previa, either before or after delivery. It is recommended that therapy be initiated after loss of 600 ml ¹¹.

The first step is to screen for vaginal, cervical, or uterine lacerations ⁵. If the test is negative and the mechanism is compression of the uterus, an external uterine massage should be performed

and 10 units of oxytocin should be administered in a 1-liter bag of intravenous fluid ^{5, 11}. Oxytocin should be administered slowly, at a rate not exceeding 200 ml/h ^{6, 11}. If there is no response to oxytocin, administration of an alternative uterotonic agent such as methylergonovin or carboprostaglandin ⁵ should be considered. In addition, an internal uterine massage can be performed by placing the hand inside the uterus and compressing it against the spine ¹⁶. If these measures fail, consideration should be given to exploring the uterus manually to remove clots or retain placental fragments ⁹. If hemorrhage persists, uterine arterial embolization or ligation of the hypogastric arteries may be necessary ⁹.

The epidural spine can be a valuable tool in the treatment of postpartum hemorrhage, as it can provide an effective sympathetic blockade ⁵. If all conservative measures fail, it may be necessary to perform an emergency hysterectomy to control the hemorrhage and save the patient's life ⁹. It is important that the medical team is prepared for these eventualities and has the necessary resources available to intervene quickly and ensure the best possible outcome for both mother and baby ¹⁴.

The first step is to screen for vaginal, cervical, or uterine lacerations ⁵. If the test is negative and the mechanism is uterine atony, manual exploration of the uterus should be initiated to ensure complete removal of the placenta and aggressive uterine massage should be initiated ⁹. If this is unsuccessful, administration of an oxytocin solution, 20 units per liter of saline, at a rate of 200 ml/h, may assist with uterine ^{contractility}_{6,11}. A rate of up to 500 ml can be administered in 10 minutes without significant cardiovascular complications; however, maternal hypotension may occur with an intravenous bolus injection as low as 5 units ^{5, 6}.

When oxytocin does not produce an adequate response, synthetic prostaglandin 15-methyl-F2 α (Carboprost) should be administered intramuscularly or into the uterine wall ^{5, 6}. In addition, methylergonovine, 0.2 mg, can be administered intramuscularly ⁵. Methylergonovine is contraindicated in patients with hypertension ⁵. Prostaglandin F2 α is contraindicated in patients with asthma ⁵. Misoprostol (Cytotec) also has uterotonic properties and can be used at a dose of 1,000 μ g rectally ¹¹.

When pharmacological measures fail to control hemorrhage, surgical measures should be adopted ⁹. If the hemorrhage is secondary to uterine atony, ligation of the uterine vessels may be successful ⁵. The first step in the ligation of the uterine arteries is at the level of the anastomosis of the uterine and ovarian arteries in a high position at the bottom, immediately below the utero-ovarian ligament ^{9, 14}. A suture can be made with an atraumatic needle from the uterus, surrounding the vessel, which will be tied ⁹.

If bilateral ligation of utero-ovarian vessels does not stop bleeding, temporary atraumatic occlusion of the ovarian arteries in the infundibulopelvic ligaments can be attempted ⁵. Due to a decrease in perfusion pressure, thrombosis in the vascular bed can produce hemostasis ¹⁴. If

conservative measures are unsuccessful, a hysterectomy may have to be performed before sequelae of coagulopathy and hemorrhagic shock occur⁵. In the case of postpartum hemorrhage, supracervical hysterectomy is the procedure of choice⁹.

As in the gynecological hysterectomy already described, the upper fixations of the uterus are isolated, but after ligation of the uterine arteries, the fundus of the uterus is amputated from the cervix, which is closed with eight-shaped stitches^{5,9}. This procedure also maintains the integrity of the uterosacral ligaments⁵. It is difficult to remove the cervix, especially after vaginal delivery secondary to dilation of the lower uterine segment⁹. Only surgeons skilled in this procedure should proceed without a request for consultation⁹.

REPAIR OF EPISIOTOMIES AND COMPLICATIONS: SURGICAL APPROACHES AND STRATEGIES TO PREVENT RECTOVAGINAL FISTULAS

In exceptional circumstances, it may be necessary for a surgeon to intervene to repair an episiotomy and its possible complications⁹. Episiotomy is an incision in the perineal body performed during childbirth, usually in the midline, from the posterior commissure of the vulva towards the rectum, in order to facilitate the birth process^{5,9}. Although these incisions provide greater comfort to the patient, in some cases, they may extend beyond what is expected, reaching the anal sphincter (third degree) or even the rectal wall (fourth degree)¹⁴. An inadequate repair can result in the development of a rectovaginal fistula, which shares similar symptoms to rectal fistulas associated with Crohn's disease, but is usually simpler to repair and has a lower recurrence rate^{5,9}.

The repair process of an episiotomy involves the reapproximation of the vaginal and perineal tissues⁵. In case of anal sphincter involvement, it is necessary to identify and reapproach the fascial capsule, which commonly retracts posteriorly¹¹. If the rectal wall is compromised, a multi-layered closure using 2-0 or 3-0 absorbable suture for the mucosa, muscles, rectovaginal fascia, and anal sphincter, in addition to the vaginal and vaginal mucosa muscles, will provide a better chance of preventing the development of a fistula^{9,11}. Due to the increase in vascularity associated with pregnancy, adequate closure without inducing tissue necrosis through the stitches should not present any problems⁵.

RESULTS AND DISCUSSION

The present study investigated the physiological adaptations and complications associated with the cardiovascular, respiratory, gastrointestinal, renal, urinary and hepatic systems during pregnancy, as well as the relevant diagnostic and therapeutic approaches. The results provided important insights into the complexities of these processes and the need for a multifaceted approach to ensure maternal and fetal well-being^{5,11,15}. The cardiovascular adaptations observed, including a

significant increase in blood volume and heart rate, corroborate previous findings in the literature^{2,8}. Hypervolemia and elevated heart rate are essential to ensure an adequate supply of nutrients and oxygen to the fetus, highlighting the importance of these changes in the maintenance of pregnancy¹.

Changes in the respiratory system, such as increased minute volume and reduced functional residual volume, are crucial to meet the increased metabolic demands during pregnancy^{1,2,8}. Understanding these adaptations is critical for the effective management of potential respiratory complications and for ensuring adequate oxygenation for both mother and fetus^{1,4}. Reduced gastrointestinal motility and delayed gastric emptying are common phenomena during pregnancy, often associated with abdominal discomfort^{1,4,6}. Early identification of these changes and the implementation of appropriate management strategies are essential to improve gastrointestinal comfort and avoid further complications^{5,15}.

The hypercoagulable changes observed during pregnancy increase the risk of thromboembolic complications, highlighting the importance of surveillance and appropriate management of these hemostatic disorders^{5,6}. In addition, renal and urinary adaptations are essential to maintain the fluid and electrolyte balance of the mother and fetus, emphasizing the need for regular monitoring of renal function^{2,7,8}. Ultrasonography has emerged as a crucial tool for the evaluation of the fetus and for the diagnosis of obstetric complications¹⁰.

Magnetic resonance imaging has also been shown to be a safe option in certain cases, providing additional information on fetal anomalies^{5,6}. Understanding the risks and benefits of these imaging modalities is essential to guide appropriate clinical decisions during pregnancy¹⁰. The assessment of abdominal pain during pregnancy presents unique challenges due to the overlap of common pregnancy symptoms and preexisting medical conditions^{1,4}. Early identification of warning signs and consideration of specific characteristics of pregnancy are essential for accurate differential diagnosis and effective management of abdominal pain^{1,5}.

The diagnosis of appendicitis during pregnancy can be complex due to the overlap of common pregnancy symptoms^{5,11}. Awareness of atypical presentation patterns and the implementation of early diagnosis strategies are crucial to avoid serious complications⁵. Biliary tract diseases, such as cholelithiasis, represent frequent complications during pregnancy, requiring a careful approach and individualized management strategies^{5,9}. Early recognition and appropriate treatment of hepatic complications are essential to prevent maternal and fetal morbidity⁵.

Bowel obstruction during pregnancy poses significant risks to the mother and fetus, requiring early surgical intervention to avoid serious complications⁵. Early recognition of symptoms and prompt intervention are essential to ensure better clinical outcomes⁹. Early recognition and proper management of ovarian masses during pregnancy are essential to ensure maternal and fetal health⁹.



Preservation of the corpus luteum during the first trimester of pregnancy is essential to maintain pregnancy until placental progesterone production is established ⁵.

Trauma during pregnancy poses significant risks to the mother and fetus, requiring comprehensive assessment and appropriate management strategies ⁹. Early recognition and aggressive treatment of associated complications are essential to minimize maternal and fetal morbidity and mortality ^{5,9}. Surgical delivery, such as cesarean section, is a common intervention during pregnancy, requiring a careful approach and an appropriate surgical technique to ensure better maternal and neonatal outcomes ^{9, 11, 16}.

Recognition and proper management of complications, such as postpartum hemorrhage, are crucial to avoid further morbidity and mortality ⁵. Taken together, the results of this study highlight the importance of comprehensively understanding the physiological adaptations and complications associated with pregnancy, as well as implementing effective diagnostic and management strategies to ensure maternal and fetal well-being. This information is critical to guide clinical practice and improve obstetric outcomes in pregnant women.

CONCLUSION

The present study offered a comprehensive analysis of the physiological adaptations and complications associated with pregnancy, highlighting the importance of regular monitoring and a multidisciplinary approach to ensure maternal and fetal well-being.

By reviewing cardiovascular, respiratory, gastrointestinal, renal, urinary, hepatic, and other adaptations, we were able to elucidate the complexity of these processes and their clinical relevance. Cardiovascular adaptations, including hypervolemia and increased heart rate, are essential for adequate supply of nutrients and oxygen to the fetus, while respiratory changes aim to meet increased metabolic demands.

Gastrointestinal and urinary changes also play key roles in maintaining fluid and electrolyte balance during pregnancy. However, pregnancy can also be accompanied by medical complications such as appendicitis, cholelithiasis, bowel obstruction, and trauma, requiring a careful approach and specific management strategies to ensure better clinical outcomes.

In addition, obstetric procedures, such as cesarean sections, require appropriate surgical technique and prompt recognition of potential complications. The use of imaging techniques, such as ultrasound and MRI, plays a crucial role in the early diagnosis of fetal anomalies and obstetric complications, allowing for timely interventions and improved maternal and neonatal outcomes.

Thus, this study underscores the importance of continuing medical education and the development of up-to-date clinical guidelines for the effective management of the complexities associated with pregnancy. By better understanding physiological adaptations and potential



complications, healthcare providers can provide safer and more effective care to pregnant women, ensuring a positive experience during pregnancy and childbirth.



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