Perioperative Anesthetic Care for Laparoscopic Appendectomy in a Pregnant Woman: A Case Report

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ABSTRACT

Introduction: Acute appendicitis is the most common non-obstetric surgical emergency during pregnancy and poses significant diagnostic and management challenges. Physiological and anatomical changes during gestation can obscure classical clinical signs, leading to delays in diagnosis and increased risk of maternal and fetal morbidity. Prompt surgical intervention is essential, and laparoscopy has become increasingly favored for its benefits in postoperative recovery and complication reduction. Anesthetic care in this population must account for altered maternal physiology, fetal safety, and perioperative risks.

Case Presentation: We report a case of a 31-year-old woman at 18 weeks of gestation who presented with right lower quadrant abdominal pain, nausea, and vomiting. Physical examination revealed localized tenderness and rebound pain, with a total Alvarado score of 8. Laboratory findings showed leukocytosis. Obstetric ultrasound confirmed a viable intrauterine pregnancy. Abdominal ultrasound demonstrated an enlarged non-compressible tubular structure suggestive of appendicitis. The patient underwent emergency laparoscopic appendectomy under general anesthesia using propofol, fentanyl, rocuronium, and sevoflurane, with intra-abdominal pressure maintained below 12 mmHg and left uterine displacement applied. Intraoperative fluid management included gelafusal, Ringer lactate, and normal saline. Multimodal analgesia was administered, and fetal heart tones remained reassuring throughout. Postoperative recovery was uneventful, and the patient was discharged on postoperative day four.

Discussion: This case illustrates the complexity of managing non-obstetric surgical emergencies during pregnancy. The choice of laparoscopic approach in the second trimester is supported by growing evidence indicating safety when physiologic parameters are maintained. Anesthetic management requires in-depth understanding of pregnancy physiology to avoid maternal hypoxemia, aspiration, and uteroplacental hypoperfusion. Fluid therapy must be balanced to support maternal hemodynamics while avoiding overload. Multimodal analgesia plays a critical role in minimizing opioid exposure and ensuring early recovery.

Conclusion: Emergency laparoscopic appendectomy in pregnancy can be performed safely with individualized anesthetic management and multidisciplinary coordination. The principles of maternal-fetal physiology

should guide perioperative decisions to optimize outcomes.

INTRODUCTION

Acute appendicitis is the most frequent non-obstetric surgical emergency encountered during pregnancy, with an incidence estimated between 0.04% and 0.2% of all pregnancies.[1] The condition most commonly presents during the second trimester and is associated with an increased risk of maternal and fetal morbidity if diagnosis and surgical intervention are delayed. Anatomical and physiological changes during pregnancy, particularly uterine enlargement and upward displacement of the appendix, may obscure classical clinical findings, leading to diagnostic uncertainty.[1] Furthermore, physiological leukocytosis in pregnancy and gestational changes in pain perception often complicate the interpretation of laboratory and clinical parameters. Consequently, atypical presentations are common, and the diagnosis of appendicitis in pregnant patients often depends on a high index of clinical suspicion supported by imaging.[2]

Ultrasonography (USG) is the first-line imaging modality for suspected appendicitis in pregnancy due to its wide availability, safety, and lack of ionizing radiation. Although its sensitivity is lower compared to MRI, especially in later trimesters due to limited acoustic windows, it remains a valuable and accessible tool in initial evaluation.[3] If the appendix is visualized as non-compressible and dilated with periappendiceal fluid or fat stranding, the diagnosis is considered highly suggestive. In resource-limited settings or emergent clinical scenarios, reliance on ultrasound and clinical scoring systems such as the Alvarado score remains essential.[4] Once the diagnosis is established, prompt surgical management is critical. Delay in intervention increases the risk of appendiceal rupture, which can lead to peritonitis, septic shock, miscarriage, preterm labor, or fetal demise. The rate of fetal loss in uncomplicated appendicitis is reported to be approximately 1.5%, but this can rise to over 35% in cases of perforation.[5] Thus, surgical exploration should not be deferred in a clinically suspicious case, particularly in the presence of localized peritonitis or imaging-confirmed appendiceal inflammation.

Laparoscopic appendectomy has emerged as the preferred operative approach for appendicitis in pregnancy due to its association with lower postoperative pain, reduced incidence of wound complications, shorter hospital stay, and faster recovery. Though initially controversial due to concerns regarding uterine insufflation and fetal exposure to carbon dioxide, multiple studies and consensus guidelines now support the safety of laparoscopy during all trimesters, provided intra-abdominal pressure is carefully regulated and maternal oxygenation and ventilation are closely monitored.[6–8] The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the American College of Obstetricians and Gynecologists (ACOG) both recommend laparoscopy as a safe option during pregnancy when performed with standard precautions.[6]

From the anesthesiologist's perspective, pregnancy introduces several challenges in perioperative care. Cardiopulmonary adaptations such as increased oxygen consumption, decreased functional residual capacity, and increased minute ventilation make pregnant patients more susceptible to rapid desaturation during apnea.[9] Gastroesophageal reflux is more prevalent due to increased intra-abdominal pressure and hormonal effects on the lower esophageal sphincter, increasing the risk of aspiration during induction. Uteroplacental perfusion is dependent on maternal cardiac output and mean arterial pressure, which may be compromised by hypovolemia, anesthetic agents, or aortocaval compression.[10] Additionally, the anesthetic

plan must account for the altered pharmacokinetics and decreased protein binding of various drugs in pregnancy, while also minimizing fetal exposure to agents with known teratogenic potential or depressant effects on the fetal central nervous system.

This case report presents the anesthetic management of a 31-year-old woman at 18 weeks of gestation undergoing laparoscopic appendectomy for acute appendicitis. The case highlights several anesthetic considerations specific to pregnancy, including airway assessment, aspiration prophylaxis, fluid management, selection of anesthetic drugs, uterine displacement, fetal monitoring, and postoperative analgesia. It also emphasizes the importance of a multidisciplinary approach to optimize both maternal and fetal outcomes in non-obstetric emergency surgery during pregnancy.

MATERIALS & METHODS

A 31-year-old female, gravida 2 para 1 (G2P1A0), was referred from a regional hospital with a 1-day history of epigastric and right lower quadrant abdominal pain, which had become progressively more severe. The pain was sharp, localized to the right lower quadrant, and was accompanied by nausea and two episodes of non-bilious vomiting. The patient denied fever, anorexia, constipation, diarrhea, or urinary complaints. She reported no vaginal bleeding, uterine contractions, or leakage of amniotic fluid. The patient was 18 weeks pregnant based on her last menstrual period and had been undergoing routine antenatal checkups without prior complications. Her obstetric history included one prior spontaneous vaginal delivery at term. There was no significant medical history of hypertension, diabetes mellitus, asthma, or prior abdominal surgery. She reported no allergies, smoking, or alcohol use.

On admission to our hospital, her vital signs were stable, and she was fully alert and oriented. The initial diagnosis of acute appendicitis in pregnancy was considered based on clinical and radiological findings.

Due to the progressive nature of the pain and radiological confirmation of appendiceal inflammation, she was scheduled for emergency laparoscopic appendectomy under general anesthesia. A multidisciplinary discussion was conducted with the obstetrics team to ensure maternal and fetal safety throughout the perioperative period.

Physical Examination and Preoperative Assessment

The patient was well-nourished, with a body weight of 82 kg and height of 163 cm (BMI 30.8 kg/m²). On physical examination, she appeared comfortable at rest. Her vital signs were as follows: blood pressure 120/76 mmHg, heart rate 82 bpm, respiratory rate 18 breaths/min, temperature 36.5°C, and oxygen saturation 98% on room air. Abdominal palpation revealed localized tenderness and rebound pain in the right lower quadrant without guarding or rigidity. The gravid uterus was palpable consistent with 18 weeks' gestation. There were no uterine contractions or vaginal bleeding.

Airway assessment revealed a Mallampati score of II, adequate mouth opening, and full neck mobility. There were no loose or missing teeth. The LEMON score was unremarkable: Look externally – no facial abnormalities; Evaluate – 3-3-2 rule fulfilled; Mallampati – II; Obstruction – none; Neck mobility – full. MOANS score was favorable: Mask seal – adequate; Obstruction – absent; Age – 31; No tooth issues; Stiff lungs – no respiratory pathology. The patient was assessed as having low risk for both difficult intubation and mask ventilation. Functional capacity was moderate, and the ASA Physical Status Classification was determined to be II (pregnancy without systemic disease).

The Alvarado score was calculated as 8, suggesting probable appendicitis: migration of pain (1), anorexia (0), nausea/vomiting (1), tenderness in RIF (2), rebound tenderness (1), fever (0), leukocytosis (2), neutrophilia (1).

Supporting Investigations

Initial laboratory results showed leukocytosis with a WBC count of 13,200/μL, indicating an active inflammatory process. Neutrophils were elevated at 78%. Hemoglobin was 11.2 g/dL, hematocrit 34.5%, and platelet count 310,000/μL. Electrolytes, renal function (urea and creatinine), and liver enzymes (AST/ALT) were within normal limits. Coagulation parameters (PT, aPTT, INR) were also normal.

The USG was limited by bowel gas and the gravid uterus but showed a dilated, non-compressible tubular structure in the right lower quadrant measuring more than 6 mm in diameter, with wall thickening and increased echogenicity of the surrounding fat, consistent with acute appendicitis. Obstetric ultrasound confirmed a viable intrauterine pregnancy with a fetal heart rate of 146 bpm and appropriate fetal growth for gestational age. There were no signs of uterine bleeding or abruption.

Chest X-ray was not performed due to pregnancy. Electrocardiogram (ECG) showed normal sinus rhythm without abnormalities.

Anesthesia Management

The patient underwent thorough preoperative preparation with a multidisciplinary team involving anesthesiology, general surgery, and obstetrics to ensure maternal and fetal safety during emergency laparoscopic appendectomy. Informed consent was obtained after comprehensive counseling regarding the risks of surgery and anesthesia in pregnancy, including the risks of fetal exposure to anesthetic agents and potential for preterm labor.

On the day of surgery, the patient was fasted for more than 8 hours and premedicated with intravenous ranitidine 50 mg and metoclopramide 10 mg to reduce gastric acidity and volume, thus minimizing the risk of aspiration. In the operating room, the patient was positioned with a 15° left lateral tilt using a wedge under the right hip to prevent aortocaval compression by the gravid uterus, optimizing uteroplacental perfusion. Standard ASA monitoring was applied, including ECG, non-invasive blood pressure, pulse oximetry, capnography, and temperature monitoring.

Anesthesia was induced using Propofol 2 mg/kg intravenously, selected for its rapid onset and favorable profile in obstetric patients due to its ability to maintain hemodynamic stability and lower intracranial pressure. Fentanyl 2 mcg/kg IV was given for analgesia during laryngoscopy and surgical incision, while also providing attenuation of the sympathetic response during intubation.

To secure the airway, Rocuronium 1.2 mg/kg IV was used to provide neuromuscular relaxation, enabling a smooth rapid sequence intubation (RSI). Cricoid pressure was applied to prevent regurgitation. Intubation was performed with a cuffed endotracheal tube (size 7.0 mm), and correct placement was verified with bilateral chest auscultation and continuous capnography. The airway was secured uneventfully on the first attempt.

Maintenance of anesthesia was achieved using sevoflurane at 1.5–2.0 MAC in an oxygen-air mixture (FiO$_2$ 0.5), chosen for its low blood-gas partition coefficient, rapid titratability, and excellent uterine relaxation properties. Ventilation was provided in pressure-controlled mode with tidal volumes of 6 mL/kg ideal body weight, maintaining normocapnia (etCO$_2$ 32–36 mmHg). PEEP of 5 cm H$_2$O was applied to prevent atelectasis and maintain adequate alveolar recruitment. Intra-abdominal pressure during laparoscopy was carefully maintained at ≤12 mmHg to minimize effects on venous return and fetal perfusion.

Intraoperative fluid therapy was carefully selected to support intravascular volume without causing fluid overload. A total of 500 mL of gelafusal was administered early in the procedure to support colloid oncotic pressure and anticipate potential intraoperative blood loss, especially considering the increased vascularity of the

gravid pelvis and the risk of uterine venous engorgement during pneumoperitoneum. Ringer Lactate 500 mL was given as the primary crystalloid to replace insensible and third-space losses, and to maintain acid-base homeostasis. Additionally, 250 mL of NaCl 0.9% was used to deliver intravenous medications including antipyretics and opioids, and to supplement fluid maintenance. Hemodynamic parameters remained within target range throughout the procedure, with no evidence of hypotension or uterine hypoperfusion. Estimated intraoperative blood loss was approximately 30 mL, and total urine output was 150 mL.

No additional neuromuscular relaxant doses were required intraoperatively. The surgery lasted approximately 45 minutes with an estimated blood loss of 50 mL and urine output of 150 mL. Hemodynamic parameters remained stable throughout, with blood pressure ranging from 110–125/70–85 mmHg and heart rate between 78–90 bpm. Fetal status was intermittently assessed via Doppler, and no signs of fetal distress were observed.

At the conclusion of the procedure, inhalational agents were discontinued, and the patient was allowed to regain spontaneous ventilation. Neuromuscular blockade was reversed with Neostigmine 2.5 mg and Atropine 1 mg IV. Extubation was performed uneventfully once the patient was fully awake, with intact airway reflexes and adequate respiratory effort. She was then transferred to the PACU for close observation with an initial Aldrete score of 9/10.

Postoperative Evaluation

In the post-anesthesia care unit, the patient remained stable and pain-free. Pain was managed with a fentanyl PCA (350 mcg fentanyl diluted in 50 mL NaCl 0.9%) at a rate of 2.5 mL/h and Paracetamol 1 g IV every 8 hours. Rescue analgesia with tramadol was available if needed, but not required. There were no episodes of nausea or vomiting.

The patient was transferred to the obstetric ward for continued monitoring. Fetal heart tones remained stable, and there were no uterine contractions or signs of preterm labor. She was mobilized on the first postoperative day and resumed oral intake. Bowel movements returned on postoperative day two. Surgical wounds remained clean and dry with no signs of infection.

The patient was discharged on postoperative day four in good condition, with instructions to follow up with both surgery and obstetrics clinics. Continuation of routine antenatal care was advised. No postoperative complications were noted.

DISCUSSION

Managing acute appendicitis during pregnancy requires careful integration of surgical urgency, obstetric physiology, and anesthetic safety. Acute appendicitis remains the most common non-obstetric surgical emergency during pregnancy, with a second-trimester peak, when the growing uterus begins to alter intra-abdominal anatomy. Prospective data highlight that perforation rates can reach 30–40% when diagnosis is delayed, contributing to poor maternal–fetal outcomes.[1] The classic signs—right lower quadrant pain, rebound tenderness, and leukocytosis—are often masked or modified by physiological changes in pregnancy. Leukocytosis, for example, may be physiological in pregnancy, reaching up to 16,000/µL even in the absence of infection.[2] Similarly, pain localization becomes less reliable as the appendix is displaced cephalad by the enlarging uterus. Thus, clinical diagnosis often requires reliance on pattern recognition and symptom evolution rather than textbook presentation.

In this case, ultrasonography was used as the primary imaging modality. While it is the recommended first-line approach due to fetal safety, its sensitivity and specificity for appendicitis drop significantly with gestational progression—down to 36% in the third trimester. Nevertheless,

ultrasonography remains a rational first step because its positive predictive value is high when the appendix is visualized. When imaging is equivocal, some advocate the use of MRI as a secondary modality; its diagnostic accuracy approaches 100% and it is considered safe for the fetus. However, in low-resource or emergency contexts, such as this case, a high Alvarado score and compatible clinical signs may justify expedited surgical intervention without MRI, in line with recommendations to avoid delays that increase fetal morbidity.[3]

Laparoscopic appendectomy, chosen in this case, has been shown to be safe across all trimesters, contradicting earlier concerns regarding pneumoperitoneum and fetal acidosis.[11] The theoretical concern is that increased intra-abdominal pressure could reduce uteroplacental perfusion via compression of the inferior vena cava and aorta. However, studies have demonstrated that when insufflation pressure is kept ≤12 mmHg and the patient is positioned with left uterine displacement, these effects are negligible.[8] Moreover, laparoscopy offers advantages such as reduced postoperative pain, earlier return of bowel function, and lower wound complication rates—benefits that are particularly valuable in pregnancy where maternal immobility increases the risk of thromboembolism. An open approach, while still acceptable, carries a higher risk of incisional hernia and longer recovery, and is typically reserved for advanced gestation or surgical inexperience.[7]

The anesthetic plan in this case reflected a well-structured response to pregnancy-induced physiological changes. Pregnancy leads to increased oxygen consumption by up to 30% and reduces functional residual capacity (FRC) by 20% by the second trimester.[12,13] These changes shorten the apnea time to desaturation, making preoxygenation and rapid airway control essential. Moreover, increased progesterone levels lower the tone of the lower esophageal sphincter and delay gastric emptying, especially in the presence of

stress or opioids, raising the aspiration risk. Hence, rapid sequence induction with cricoid pressure is considered the gold standard, even in the absence of overt gastric distention.[14,15]

Rocuronium was appropriately selected to facilitate rapid onset of neuromuscular blockade. In pregnant patients, the volume of distribution of hydrophilic drugs is increased, potentially requiring dose adjustments to achieve desired effects.[10] Rocuronium remains a preferred agent in RSI for pregnancy due to its predictable onset and lack of histamine release compared to succinylcholine, which also carries risks of hyperkalemia, especially in the setting of delayed surgery or tissue injury. Although sugammadex offers the potential for rapid and complete reversal, especially in emergent fetal distress situations, it remains off-label for use in pregnancy due to concerns about potential interaction with progesterone and unproven fetal safety in large-scale studies. Neostigmine with atropine, as used here, remains a standard and safe reversal regimen.[9]

Volatile anesthetics such as sevoflurane are commonly used for maintenance due to their rapid titratability and uterine relaxation properties. However, they do decrease uterine tone in a dose-dependent fashion and can reduce uteroplacental blood flow if hypotension ensues.[16] Thus, maintaining a MAP >65 mmHg and using minimal effective concentrations (1–1.5 MAC) are critical. Some authors suggest TIVA with propofol may reduce uterine relaxation and fetal exposure, but data on neonatal outcomes remain limited, and intraoperative awareness risk may be higher if BIS monitoring is unavailable.[17] In this patient, sevoflurane was appropriately used at moderate concentrations with continuous monitoring.

Fluid management was conservative and balanced. Pregnant patients experience a 40–50% increase in plasma volume by mid-pregnancy, but also increased capillary permeability, which raises the risk of

pulmonary edema with over-resuscitation.[18] Colloids such as Gelafusal were used in small volumes to support intravascular oncotic pressure and maintain preload during pneumoperitoneum, which can otherwise reduce venous return. Some studies caution against liberal colloid use due to concerns about interstitial leakage and coagulopathy, but when used judiciously, they are effective in maintaining hemodynamic stability.[17] Ringer Lactate is preferred over isotonic saline due to its buffer content and reduced risk of hyperchloremic acidosis, particularly important during laparoscopy where CO_2 absorption can already promote acidosis. NaCl 0.9% was appropriately used in small volume primarily as a vehicle for medication dilution.[19]

Postoperative analgesia in pregnancy requires a nuanced approach to minimize neonatal exposure while ensuring maternal comfort, as untreated pain itself may induce uterine irritability through catecholamine release.[20] Multimodal analgesia with paracetamol, tramadol, and ketorolac was appropriate in this case. Ketorolac, though contraindicated in late third trimester due to risk of premature ductus arteriosus closure, is safe in the second trimester when used in single doses.[20,21] Opioid-sparing strategies are favored, and in future cases, regional blocks such as the transversus abdominis plane (TAP) block could be considered to further minimize systemic drug use.[20]

Fetal monitoring during non-obstetric surgery varies by gestational age. Continuous monitoring is standard after fetal viability (typically >24 weeks), while in earlier gestation intermittent Doppler confirmation of heart rate is considered adequate. In this case, fetal well-being was confirmed pre- and postoperatively, and there were no signs of uterine irritability or contractions. The decision to avoid tocolytics was appropriate, as routine prophylactic use is not supported by evidence and may introduce unnecessary risks such as pulmonary edema and tachycardia.[22]

CONCLUSION

Laparoscopic appendectomy during pregnancy, though complex, can be performed safely with multidisciplinary coordination and careful anesthetic planning. This case highlights the importance of timely surgical intervention in suspected appendicitis during the second trimester to prevent maternal and fetal complications. The anesthetic approach must be tailored to the physiological changes of pregnancy, incorporating strategies such as rapid sequence induction, uterine displacement, judicious fluid management, and opioid-sparing analgesia to ensure maternal stability and fetal well-being. While several anesthetic and surgical options exist, decisions should be guided by pathophysiological principles, current evidence, and resource availability. Ultimately, individualized, theory-informed perioperative care remains critical to achieving favorable outcomes in pregnant patients requiring emergency non-obstetric surgery.

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