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ACUTE APPENDICITIS IN PREGNANCY – DIAGNOSTIC AND THERAPEUTIC CHALLENGES

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ABSTRACT

Background: Acute appendicitis during pregnancy is one of the most common non-obstetric surgical conditions in pregnant women. However, due to the ambiguous symptoms that may be presented, an accurate diagnosis can be delayed or misinterpreted as a result of pregnancy-related changes.
Aim: The aim of this article is to highlight the challenges involved in diagnosing and treating acute appendicitis in pregnant women.
Methods: A review of scientific articles published on Google Scholar and PubMed from 2015 to 2025.
Results: Acute appendicitis in pregnancy presents with identical symptoms or mimics several other diseases, not only obstetric conditions. Surgical treatment is recommended, but there are no clear guidelines favoring either laparoscopic or open methods. Magnetic resonance imaging (MRI) is the most accurate imaging modality for diagnosing acute appendicitis. Laboratory diagnostics do not provide definitive evidence for appendicitis in pregnancy.
Conclusion: It is essential to be aware of the numerous ways acute appendicitis can present in pregnancy and to remain critical of an initially proposed diagnosis. The choice of surgical treatment largely depends on the experience and skill of the physician. Therefore, continuous education is necessary to understand the challenges associated with this condition.

KEYWORDS

Appendicitis, Pregnancy, Diagnosis, Treatment

CITATION

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1. Introduction

Acute appendicitis (AA) is one of the most common causes of so-called acute abdomen. It refers to an obstruction of the appendiceal lumen. This may be caused by lymphoid tissue hypertrophy in the course of infection, fecalith impaction, or intraluminal tumor mass. As a result, intraluminal pressure increases, damaging the epithelium and fostering inflammation. Rising pressure may lead to necrosis of the appendiceal wall and perforation, potentially resulting in diffuse peritonitis. (1)

The most common symptoms of AA are summarized in Table 1. (2)

Table 1. Symptoms of acute appendicitis

Symptoms reported by patient	Abnormalities on examination
Pain at McBurney's point (1/3 of the distance from the right anterior superior iliac spine to the navel)	Fever
Pain at Lanz's point (1/3 of the distance from the right to the left anterior superior iliac spine)	Blumberg’s sign
Migration of pain from the epigastrium to the right iliac fossa	Rovsing’s sign
Loss of appetite	Psoas sign
Nausea	Muscle guarding
Vomiting	Leukocytosis
Weakness	Neutrophilia
	Elevated C- Reactive Protein (CRP)

Acute appendicitis is the most frequent non-obstetric cause of surgery in pregnant women. Surgical treatment—appendectomy—is most commonly performed during the first trimester, and its frequency decreases as pregnancy progresses. (3)

The etiology of AA in pregnant women does not differ significantly from that in other adults. (4) It is most frequently diagnosed in the first and second trimesters—7.4 and 7.3 cases per 10, 000 person-years, respectively—while in the third trimester the incidence drops to 4.6 per 10, 000 person-years. The overall incidence during pregnancy ranges from 1.8 to 41 cases per 10, 000 pregnancies. (5)

2. Aim

This paper aims to present diagnostic and treatment methods for acute appendicitis in pregnant women, and to highlight the challenges encountered during the diagnostic-therapeutic process.

3. Methodology

A review of scientific articles, society guidelines, and textbooks published between 2015 and 2025. Searches were conducted on Google Scholar and PubMed using the terms:”pregnancy appendicitis", ”acute appendicitis during pregnancy", ”inflammation of appendix in pregnant women", ”appendicitis", ”pregnancy surgery". Meta-analyses, professional guidelines, and case reports were preferred.

4. Results

4.1. Acute Appendicitis in Pregnancy – Diagnosis

The Alvarado score is sometimes used during diagnosis (Figure 1).

Basic diagnostics include laboratory and imaging studies. Laboratory tests assess complete blood count and inflammatory markers. Some researchers suggest specific ratios—such as neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios—as useful diagnostic aids in pregnant women. (6, 7)

Imaging studies commonly include abdominal ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI).

- **Ultrasound** is widely available and fast, but subjective and operator-dependent. In pregnancy, ultrasound sensitivity ranges from 56% to 77.6%, and specificity from 75.3% to 88%, compared to about 90% and 95% in the general adult population. Sensitivity decreases across trimesters (69%, 63%, 51%, respectively), as does specificity (85%, 85%, 65%, respectively). Particularly in the third trimester, reliance on ultrasound alone is discouraged. (8-10)
- **Computed Tomography** is more precise and objective; however, it is costlier, often requires intravenous contrast, and exposes to ionizing radiation—making it generally unsuitable for pregnant patients.
- **Magnetic Resonance Imaging** appears to be the best imaging modality for pregnant women, offering high sensitivity (91.8–95.0%) and specificity (97.9–99.9%) according to meta-analyses, but it is often not readily available in emergency settings. (2, 11-13)

4.2. Acute Appendicitis in Pregnancy – Treatment

Treatment options include conservative antibiotic therapy intravenous and oral or surgical intervention.

- Antibiotic management is associated with a lower risk of preterm labor compared to surgery, while rates of miscarriage and maternal death are similar in both groups. However, conservatively treated patients may experience higher rates of complications like sepsis, peritonitis, or venous thrombosis. (14)
- Appendectomy may be performed via open or laparoscopic methods. Meta-analyses suggest laparoscopy yields lower infection rates and shorter hospital stays, whereas open surgery may present a lower fetal loss risk. Some studies report decreased preterm birth with laparoscopy, and prolonged gestational age in term births for open surgery. However, other studies find no increased fetal mortality with laparoscopy. (15-20)

Multidisciplinary collaboration among specialists is crucial. (21)

- The European Association of Endoscopic Surgery (EAES) guidelines strongly recommend surgery for complicated AA or when a fecalith is present, and weakly recommend it for uncomplicated cases. Laparoscopy is advised before 20 weeks gestation; afterwards, the choice depends on surgeon experience. (22)
- Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) similarly favors surgical over conservative treatment. (23)

In low-resource settings, antibiotic therapy may be primary. Notably, cases from Greenland and a 19-year-old pregnant woman show successful non-surgical management. (24, 25)

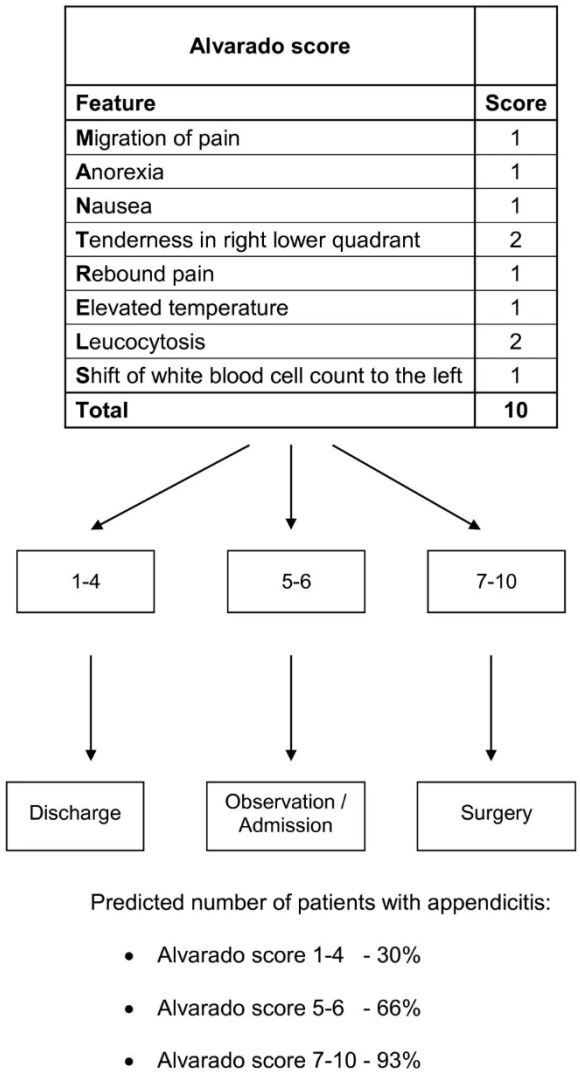

Fig. 1 *Alvarado score. Source: Ohle, R., O'Reilly, F., O'Brien, K.K. et al. The Alvarado score for predicting acute appendicitis: a systematic review. BMC Med* ***9****, 139 (2011). https://doi.org/10.1186/1741-7015-9-139*

4.3. Diagnostic- therapeutic challenges

The anatomy of a pregnant woman undergoes significant changes due to the displacement of internal organs caused by the enlarging uterus. As a result, the same pathological conditions may present with a different clinical picture, both in terms of symptom characteristics and their anatomical location, posing a substantial diagnostic challenge in the pregnant population.(26)

Kyhl et al. described a case of a pregnant woman post-term, who, despite reporting progressively worsening abdominal pain, was sent home twice. It was only during a cesarean section performed due to fetal hypoxia that acute appendicitis with perforation was discovered. The only symptoms of this patient were abdominal pain and leukocyturia. (27)

Yuna Kim and Inchul Hwang describe the case of a woman in the second trimester of pregnancy who presented to the Emergency Department with epigastric pain, without other complaints, and with normal laboratory results, except for elevated white blood cell count. After administration of pain medications, the patient was discharged and antibiotic therapy was prescribed, suspecting a urinary tract infection. Three days later, the patient returned due to the migration of the pain from the suprapubic area to the right lower quadrant of the abdomen. Imaging studies including US and MRI did not confirm acute appendicitis. The patient continued to be treated with antibiotics, suspecting inflammatory bowel disease. Due to lack of clinical

improvement, a laparoscopic appendectomy was performed, resulting in an improvement in the patient's clinical status, and histopathological examination led to the diagnosis of acute appendicitis.(28)

In the case described by Dao et al., the woman presented with gradually increasing intermittent pain in the lower abdomen, which migrated to the right iliac fossa. On physical examination, there was tenderness at McBurney's point, while Rovsing's sign was negative. With elevated inflammatory markers, the clinical picture corresponded with acute appendicitis, however pregnancy was diagnosed through the detection of beta hCG and a urine pregnancy test. Ultrasonography revealed an intrauterine pregnancy. A diagnostic laparoscopy was performed considering that both acute appendicitis and ectopic pregnancy could cause mentioned symptoms in the patient. During the procedure, a heterotopic pregnancy was identified, with an ectopic pregnancy located in the right fallopian tube. The fallopian tube and appendix were removed. Histopathological examination confirmed the presence of a heterotopic pregnancy and ruled out acute appendicitis.(29)

Mamah et al. describe the case of a woman in whom a spontaneous intraperitoneal hematoma mimicked acute appendicitis. This is a rare condition that may be caused by bleeding from damaged blood vessels or, increasingly, is associated with endometriosis. The patient was a 30-year-old primigravida at 32 weeks of pregnancy, presenting with a dull pain mostly localized in the right lower quadrant of the abdomen. On abdominal ultrasound, the appendix was not visible. Obstetric causes of the symptoms were excluded, and acute appendicitis was diagnosed, leading to the initiation of antibiotic therapy and intravenous fluid therapy. An MRI excluded acute appendicitis, and treatment was discontinued. The examination revealed a lesion resembling a hemorrhagic ovarian cyst. Deteriorating red blood cell parameters suggested bleeding. The patient's clinical condition suddenly worsened, with signs of shock and increased pain. After excluding gynecological causes and worsening fetal well-being, intraperitoneal bleeding was diagnosed. A surgical procedure was performed, during which a 2.5-liter hemoperitoneum with active bleeding from the ovarian-tubal complex was discovered. A cesarean section was performed. Due to the inability to stop the bleeding, a subtotal hysterectomy was carried out. Given the loss of approximately 4.7 liters of blood, the patient received red blood cell concentrates, fresh frozen plasma, and platelet concentrates. Histopathological examination confirmed the presence of endometriosis. After the procedure, the patient recovered without complications. (30)

Sanders-Davis and Ritchie describe the case of a 35-year-old patient who was diagnosed with acute appendicitis along with a concomitant SARS-CoV-2 infection. The diagnosis of acute appendicitis was confirmed using MRI. Treatment began with intravenous antibiotic therapy including amoxicillin, metronidazole, and gentamicin. During a multidisciplinary meeting, it was decided that surgery was necessary. To avoid preterm labor, dexamethasone was administered. During the procedure, limited peritonitis was found, and the surgery proceeded without complications. After awakening, the patient’s respiratory function deteriorated, requiring oxygen therapy. Chest X-ray allowed for the diagnosis of bilateral lung consolidation. Antibiotic therapy was continued. At 33 weeks of pregnancy, a cesarean section was performed under general anesthesia. The patient’s respiratory function returned to normal, but the newborn required two doses of surfactant and intubation. After 24 hours, the infant was extubated and did not require respiratory support. (31)

Kiyose et al. describe the case of a 28-year-old pregnant woman with a history of endometriosis surgery. The patient was diagnosed with intrauterine infection threatening preterm labor (she was at 31 weeks of pregnancy). Tocolytics and antibiotics were administered. Despite this, the patient continued to experience pain in the lower right quadrant of the abdomen. Suspecting acute appendicitis, a non-contrast CT scan was performed, but it did not show signs of appendix distension. Due to the worsening condition, an MRI was ordered, which revealed peritonitis extending from the uterine fundus to the lumbar area, as well as hemorrhagic fluid in the Douglas pouch, without signs of acute appendicitis. Considering the patient's history, a spontaneous intra-abdominal hemorrhage was suspected, and a contrast-enhanced CT scan was ordered. This scan showed an air pocket beneath the right diaphragm without obvious signs of appendix perforation or air in the vicinity of the appendix. Suspecting an idiopathic gastrointestinal perforation, exploratory surgery was planned. During the procedure, a perforated appendix with a present abscess was found, so an appendectomy was performed. A cesarean section was then carried out, delivering a healthy newborn without complications, except for the preterm birth. The patient received both oral and intravenous antibiotic therapy and was discharged from the hospital in good condition after 9 days. Histopathological examination of the removed appendix indicated that the smooth muscle was almost entirely replaced by decidual cells, which weakened the wall of the appendix and ultimately led to its perforation. (32)

Saleh et al. describe the case of a 36-year-old pregnant woman who presented with abdominal pain for 2 days. During a vaginal examination using a speculum, yellow purulent discharge was observed from the posterior fornix of the vagina. The injury to the posterior vaginal wall could not be visualized during the

examination. Transvaginal ultrasound revealed a 5 cm x 2 cm fluid collection directly behind the cervix, which corresponded to a multi-compartment abscess. Due to the low location of the abscess, acute appendicitis was not initially considered by the physicians. MRI revealed torsion of the right ovary. The patient was treated with antibiotics, including ceftriaxone and metronidazole. After 24 hours, the patient met the criteria for sepsis, and her pain intensified along with a drop in blood pressure. A multidisciplinary team decided to add vancomycin and perform a diagnostic laparoscopy. The examination of the anesthetized patient revealed injury to the posterior fornix of the vagina with ongoing purulent discharge. The appendix was found to be adherent to the uterus and had formed an abscess, so an appendectomy was performed. The right fallopian tube and ovary were difficult to visualize due to the acute inflammatory process and adhesions in the right lower quadrant. The fetal well-being was good. A Penrose drain was removed on the fifth day post-surgery, and the patient was discharged in good general condition. The final diagnosis was a pelvic abscess caused by acute appendicitis without perforation, which resulted in the formation of a peritoneovaginal fistula. Additionally, endometriosis and the presence of decidual cells in the appendix were identified in the histopathological examination. (33)

Green and Biglione describe a 38-year-old pregnant woman who presented with abdominal pain in the right lower quadrant at 13 weeks of pregnancy, with suspected acute appendicitis. The symptoms started 5 days prior to the emergency room visit and did not improve after taking oral pain medications. The patient also reported intermittent, moderately heavy vaginal bleeding, which she described as brownish without clots. She did not report nausea, vomiting, or fever. Laboratory parameters were within normal limits. An abdominal ultrasound revealed multiple pedunculated and submucosal uterine fibroids. A subsequent MRI showed pedunculated, submucosal, and intramural fibroids. A significant amount of free fluid was also noted in the peritoneal cavity, especially in the right lower quadrant of the abdomen. The patient was admitted to the hospital, and fluid therapy and pain relief were initiated. As she did not report any alarming symptoms, she was discharged the following day in stable condition.(34)

Nwashilli et al. describe a case of a 34-year-old woman who presented with a 7-hour history of right lower quadrant pain and vaginal bleeding, three weeks after undergoing in vitro fertilization (IVF). These symptoms occurred for the first time, and the patient also reported vomiting without any hemorrhagic content. A pregnancy test performed two weeks after embryo transfer was negative, but a repeat B-HCG test done at the hospital in the third week was positive. The patient had infertility due to polycystic ovary syndrome (PCOS) and had undergone two unsuccessful IVF attempts in the past. Ultrasound examination showed no embryo in the uterus and bilateral ovarian enlargement with numerous follicles. Additionally, a significant amount of fluid was found in the Douglas pouch. The ultrasound did not suggest acute appendicitis. A diagnosis of ovarian hyperstimulation syndrome (OHSS) was made to rule out an ectopic pregnancy. Given the patient's worsening condition and a drop in hemoglobin from 12.2 g/dl to 10.5 g/dl over 8 days, a diagnosis of ruptured ectopic pregnancy was made. Laparotomy was performed, which revealed 700 mL of hemoperitoneum on the right side and a leaking, unruptured embryo. The appendix showed signs of inflammation and was located retrocaecal. There were also signs of imminent perforation of the appendix. A right salpingectomy and appendectomy were performed. Histopathological examination of the fallopian tube revealed chorionic villi lined by typical epithelium in the muscle layer, while the appendix contained focal degenerative mucus cells and enlarged submucosal lymph nodes. The patient was discharged on the fifth day post-surgery in good overall condition. (35)

Yang et al. describe the case of a 28-year-old woman with a history of irritable bowel syndrome (IBS) who was undergoing treatment for gastrointestinal stromal tumor (GIST) with imatinib. After a 50% reduction in tumor size, she underwent surgery to remove the esophageal GIST, partial removal of the greater omentum, and resection of the bowel. The surgery was performed without complications. Three weeks after surgery, the patient was admitted for abdominal pain, vomiting, and leukocytosis. Uncomplicated acute appendicitis was diagnosed, and due to her recent surgery and stable hemodynamic status, antibiotic therapy was initiated. Six months later, the patient presented for routine CT imaging; however, a B-HCG test performed prior to the CT scan revealed a pregnancy. She decided to discontinue imatinib therapy, and GIST progression during pregnancy was monitored using MRI. Four days later, the patient came in with acute pain in the right lower quadrant of the abdomen, nausea, and leukocytosis. Abdominal ultrasound revealed an enlarged appendix and confirmed a 5-week intrauterine pregnancy. An appendectomy was performed with the surgical plan adjusted to the patient’s medical history. The procedure was completed without complications. (36) Chung et al. report a case of a 33-year-old pregnant woman who presented to the hospital with severe, sharp back pain radiating to the right lower quadrant of the abdomen, accompanied by nausea and vomiting, but without fever or dysuria.

Her medical history included kidney stones, abdominal venous thrombosis, preeclampsia, bipolar disorder, and a history of substance abuse. A diagnosis of kidney stones was made based on a CT scan performed the day before her hospital admission, which revealed a 1mm kidney stone, but did not show the appendix. Abdominal ultrasound did not show signs of kidney obstruction. The patient was consulted urologically, and it was determined that her symptoms did not correlate with the 1mm kidney stone. On the day of admission, laboratory test results were abnormal, and on the second day, leukocytosis and mild hyponatremia were noted. Despite receiving morphine and co-analgesics, her pain did not subside, though it did exacerbate her vomiting. Obstetric consultation optimized antiemetic treatment for hyperemesis gravidarum, and psychiatric consultation optimized treatment for her bipolar disorder. At this point, musculoskeletal pain was considered the most probable cause. An MRI and pelvic and abdominal venography were performed, revealing acute appendicitis (without perforation) and surrounding inflammatory changes, as well as an enlargement of the renal pelvis. Despite negative blood cultures, due to a procalcitonin level of 0.61 ng/ml, intravenous antibiotic therapy with piperacillin/tazobactam was initiated. Surgery was not recommended due to the uncomplicated nature of the appendicitis. After six days of intravenous antibiotic therapy and improvement in the patient's condition, oral antibiotic therapy was initiated, and the patient was discharged in stable condition. (37) Aroke et al. describe a case of a 30-year-old pregnant woman in her 11th week of pregnancy who presented with bilateral lower limb swelling and pain lasting for 5 days. The pain was mainly localized to the right lower quadrant of the abdomen and was described as dull, non-radiating, initially intermittent, and then constant. Additionally, she experienced a mild fever. The patient was advised that these symptoms could be related to early pregnancy and was recommended to take paracetamol. However, the symptoms did not resolve and actually worsened. Based on the physical examination, an initial diagnosis of acute appendicitis was made, with ovarian cysts considered as a differential diagnosis. An appendectomy was planned. During the procedure, it was found that the appendix did not meet the criteria for inflammation, and the ovary appeared normal. Despite the surgery, the pain persisted, and the patient also reported new pain in her right thigh. Three days later, she was discharged from the hospital. Two days after discharge, the pain shifted to her left calf, and the swelling of the lower limbs intensified, more on the right side. The pain worsened, making walking difficult. The patient returned to the hospital, where, based on the examination and symptoms, a diagnosis of pelvic vein thrombosis was made. Due to a lack of resources to treat this condition, the patient was transferred to a higher-level referral center, where ultrasound confirmed pelvic vein thrombosis and deep vein thrombosis (DVT) in both lower limbs. She was started on unfractionated heparin, which led to clinical improvement and symptom relief after 5 days. A follow-up ultrasound after 6 weeks showed no signs of thrombosis.(38)

5. Discussion

Acute appendicitis in pregnant women constitutes a significant clinical challenge due to its nonspecific presentation, limitations of imaging modalities, and anatomical alterations associated with pregnancy. It is essential to emphasize the multifactorial nature of diagnostic and therapeutic difficulties in this population. The displacement of abdominal organs by the gravid uterus, atypical or migrating localization of pain, and nonspecific symptoms such as elevated inflammatory markers may contribute to diagnostic delay and inappropriate management, as illustrated by several reported cases (27–30, 33). Furthermore, physiological leukocytosis during pregnancy reduces the diagnostic utility of this laboratory parameter. The limited sensitivity and specificity of ultrasonography in diagnosing acute appendicitis—particularly during the second and third trimesters—has, in many cases, led to delayed or incorrect diagnoses (28, 30, 33). Magnetic resonance imaging (MRI) is currently considered the gold standard in diagnostic imaging due to its high accuracy; however, its availability in emergency settings remains restricted, especially during acute presentations, which are typical for this condition. A personalized, patient-specific therapeutic approach is crucial. Conservative management has been effective in selected cases (14, 24, 25, 37), yet surgical treatment remains the generally recommended strategy due to the potential risk of complications such as fetal loss, perforation, or sepsis. Although laparoscopic appendectomy was once a controversial technique in pregnant patients, current meta-analyses and clinical guidelines support its safety—particularly when performed before the 20th week of gestation (22, 23). The case analyses presented underscore the importance of interdisciplinary collaboration among obstetricians, surgeons, and radiologists throughout the diagnostic and therapeutic process. Delays in diagnosis and treatment frequently result in maternal and fetal complications. Special attention should be given to differential diagnoses that may mimic acute appendicitis, such as ovarian cysts, endometriosis, pelvic vein thrombosis, or ectopic pregnancy(29, 30, 35 38). In such complex scenarios,

exploratory surgery and subsequent histopathological examination may be the only means to establish a definitive diagnosis and initiate appropriate treatment.

6. Conclusions

Acute appendicitis in pregnant women remains a significant challenge for healthcare providers, despite advances in diagnostic and therapeutic techniques. In many cases, the clinical presentation may be misleading, mimicking other conditions or masking the true cause of the symptoms. Among imaging modalities, magnetic resonance imaging is the most accurate; however, its availability can be limited in smaller medical facilities. The diagnostic value of ultrasound, unfortunately, remains less reliable. Laboratory tests are not able to definitively diagnose acute appendicitis, although certain parameters have been reported to suggest its presence.Surgical treatment is generally recommended, with the choice between laparoscopic or open methods depending on the patient's condition. Laparoscopic surgery appears to be associated with a lower risk of miscarriage, but it reduces hospitalization time compared to the traditional open approach; however, this trend is not consistent across all studies. Given these challenges, diagnostic and therapeutic decisions are largely dependent on the experience and expertise of the attending physician.

Disclosure

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In preparing this work, the authors used ChatGPT for the purpose of improving language and grammar correction. After using this tool, the authors reviewed and edited the text as needed and accept full responsibility for the substantive content of the publication.

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