

Appendicitis in Pregnancy: Clinical and Imaging Update

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Appendicitis during pregnancy is a serious complication. Physical findings, laboratory results, and imaging help the clinician proceed with diagnostic decisions.

FOCUSPOINT

Diagnosing appendicitis in pregnancy can be difficult because the symptoms can also be features of pregnancy.

Acute appendicitis is the most common extrauterine reason for laparotomy in pregnancy and occurs in about 1 in 1,700 pregnancies. Diagnosing appendicitis in pregnancy can be difficult because the nausea, vomiting, and abdominal pain of appendicitis can also be features of pregnancy. Physical examination may not be reliable in pregnant patients.¹ Right lower quadrant pain is the most common symptom of appendicitis in pregnancy.

The clinical diagnosis of appendicitis becomes even more difficult in the later stages of gestation, due to the variable displacement of the appendix out of the pelvis by the enlarging uterus.² Fever may not be present in acute appendicitis. Normal pregnant patients can have a physiologic leukocytosis, especially at about the time of delivery, and an elevated white blood cell count may not

be helpful in diagnosing appendicitis in pregnancy (Table 1).¹

DIAGNOSTIC TESTS

Ultrasound

Imaging is playing an increasingly crucial role in the timely diagnosis of appendicitis in pregnancy.^{3,4} Ultrasound (US) with graded compression technique (Figure 1) has traditionally been considered the preferred initial imaging technique to diagnose appendicitis in pregnancy, because of the lack of ionizing radiation. However, the normal appendix is rarely identified in pregnancy, and nonvisualization on US cannot reliably exclude appendicitis.^{1,5,6}

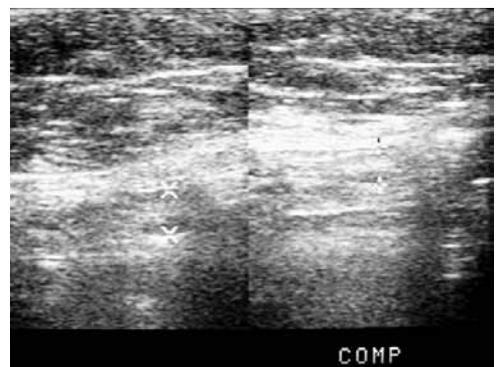


FIGURE 1. Sonographic axial images of the right lower quadrant in a pregnant patient with pain in this region during her first trimester. The images were obtained without (left) and with (right) compression applied using a linear ultrasound transducer. The appendix is mildly dilated and does not compress, representing acute appendicitis, which was subsequently proven at surgery. Images courtesy of Douglas Katz, MD.

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TABLE 1. Appendicitis in Pregnancy: Clinical Diagnoses

Clinical diagnosis of appendicitis in pregnancy may be difficult based on physical findings and laboratory studies.

- Right lower quadrant pain is the most common symptom of appendicitis in pregnancy.
- The uterus can displace the appendix out of the pelvis, and symptoms/signs may not be in the right lower quadrant, although this is variable.
- Peritoneal findings may not be detected, because the gravid uterus can prevent contact of the inflamed appendix with omentum or peritoneum.
- Nausea, vomiting, and gastrointestinal symptoms may occur with both normal pregnancy and appendicitis but are not usually associated with pain in normal pregnancy.
- Normal leukocytosis of pregnancy (up to 30,000 cells/mm³ in labor) may obscure the diagnosis of appendicitis.

Computed Tomography

Computed tomography (CT) in pregnancy is controversial because of the theoretical risk of fetal developmental delays or malformations, especially in the first trimester, from fetal exposure to ionizing radiation (about 17.15 mGy for average estimated fetal exposure from a single abdominal and pelvic CT in one series).⁴ But at radiation doses lower than 50 mGy, these fetal risks are considered negligible by most radiation biologists and medical physicists. The issue of whether these radiation doses pose any future risk for carcinogenesis remains controversial.^{3,7}

In the relatively small series published to date, CT appears to be highly accurate for diagnosing appendicitis in pregnancy.² CT findings were used to establish a specific cause for abdominal pain on 35% of examinations of pregnant women, with a negative predictive value of 99% for appendicitis

when CT followed negative US findings.⁸

However, an accepted imaging goal is to eliminate direct fetal irradiation from diagnostic imaging, if at all possible.

Magnetic Resonance Imaging

Based on the moderately sized series published to date, magnetic resonance imaging (MRI) (Figure 2) is highly accurate for the diagnosis or exclusion of appendicitis in pregnancy, when interpreted by experienced radiologists, and is both more useful and more accurate than US in the diagnosis of appendicitis in pregnancy. In one series, MRI for the diagnosis of appendicitis in pregnancy demonstrated sensitivity of 90.0%; specificity, 98.1%; accuracy, 97.5%; positive predictive value, 81.8%; and negative predictive value, 99.1%.⁶ The normal appendix in pregnancy was identified on MRI in 87% versus 2% with US in the larg-

TABLE 2. Appendicitis in Pregnancy: Diagnostic Decisions

- Delay in diagnosis of appendicitis (beyond 24 to 36 hours) increases risk for rupture.
- Diagnosis and decision to proceed with surgical therapy for appendicitis should be based on
 - Clinical findings
 - Laboratory studies to exclude alternative diagnoses
 - Diagnostic imaging results.
- MRI can be extremely helpful, particularly if the interpreting radiologist is experienced with abdominal imaging in pregnancy. In diagnosing or excluding appendicitis or other diagnoses, avoid undue delays while waiting for imaging studies. Ideally, CT should be avoided if at all possible, to eliminate fetal irradiation.
- Ultrasound imaging is rarely helpful in making the diagnosis of appendicitis in pregnancy but may be used to identify or exclude other diagnoses, particularly a right ovarian/adnexal process.
- Laparoscopic appendectomy may be a useful option in appendicitis in pregnancy.
- Consult a general surgeon when clinical judgment or imaging studies suggest appendicitis.

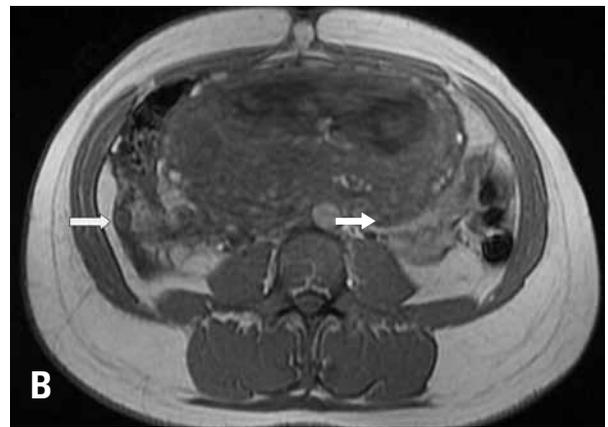
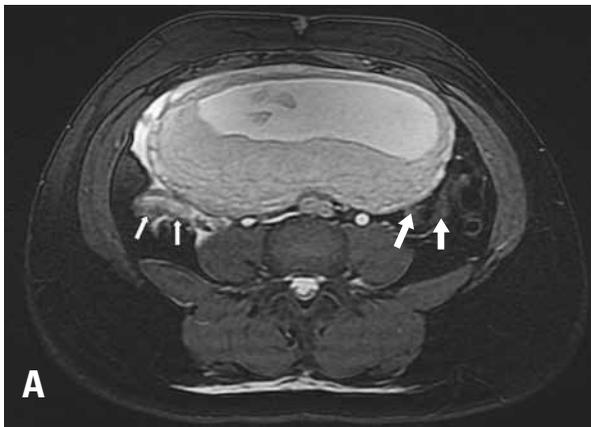


FIGURE 2. MRI examination of a 24-year-old woman, 17 weeks' pregnant, shows fluid-filled thick-walled appendix (arrows) and periappendiceal fluid and inflammatory changes. Acute appendicitis was subsequently confirmed at surgery and histopathologic examination.

A, axial fast imaging employing steady-state acquisition (FIESTA) image with fat suppression.

B, axial in-phase gradient-recalled-echo (GRE) image.

C, coronal single-shot fast spin-echo without fat suppression.

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est reported series to date to our knowledge, of 140 women who underwent initial US followed by MRI.⁵

MRI can reduce the negative laparotomy rate by demonstrating a normal appendix, therefore avoiding unnecessary surgery, which poses greater risks in pregnant women than in nonpregnant patients.^{9,10} MRI, unlike CT, does not expose the fetus to ionizing radiation. MRI also provides accurate alternative diagnoses. There are no known adverse fetal effects of unenhanced MRI, when performed on a 1.5 Tesla magnet.³ However, MRI may not be available on a 24-hour, 7-day-a-week basis, and radiologists may not be as comfortable interpreting MRI for appendicitis in pregnancy.^{1,2}

DIAGNOSTIC ALGORITHM

A reasonable algorithm for imaging pregnant women suspected of having acute appendicitis on clinical findings or judgment is graded-compression US, followed by MRI if the US is nondiagnostic. An alternative approach is to simply go straight to

MRI, if available, for pregnant patients with suspected appendicitis. CT is reserved for problem-solving cases when MRI is not available and US is nondiagnostic. If CT is used, a low-radiation-dose technique should be employed.

TIMELY DIAGNOSIS

Delay in diagnosis of appendicitis in pregnancy can result in greater maternal and fetal complications.¹ Delay puts patients at serious risks for morbidity and death, with the risk for appendiceal rupture rising from negligible within 24 hours to 5% beyond 36 hours.¹¹

The rate of fetal early delivery can increase from 4% in uncomplicated to 11% in complicated appendicitis. The rate of fetal death increases from 2% in uncomplicated to 6% in complicated appendicitis. The fetal loss rate can be as high as 20% with a perforated appendix.¹⁰

When clinical findings and judgment or imaging studies suggest appendicitis, then consultation with a general surgeon can

determine whether to proceed with laparotomy or possibly laparoscopy. Laparotomy should be through a lower midline vertical incision when the diagnosis is not certain. A review of 45 cases of laparoscopic appendectomy in pregnant patients showed no differences in rates of preterm delivery, adverse outcome, or operative time in any trimester.⁹

A key point is to try to avoid delay in diagnosis and intervention of more than 24 hours in appendicitis in pregnancy. A summary of diagnostic decisions is included in Table 2.

The authors report no actual or potential conflicts of interest in relation to this article.

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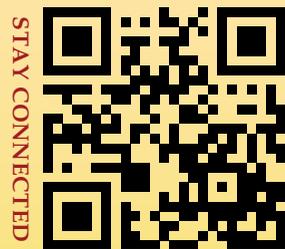
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