Acute appendicitis in pregnancy

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Introduction

Acute appendicitis is the most common general surgical problem during pregnancy. The diagnosis is challenging during pregnancy because of:

1) the relatively high prevalence of abdominal/gastrointestinal discomfort,
2) anatomic changes related to the enlarged uterus,
3) and the physiologic leukocytosis of pregnancy.

- Appendiceal rupture occurs more frequently in pregnant women, especially in the third trimester (8%-12%-20%), possibly because these challenges and reluctance to operate on pregnant women delay diagnosis and treatment.
- The initial goal is to identify patients who have a serious or even life-threatening etiology for their symptoms and require urgent intervention.
Incidence

Acute appendicitis is suspected in 1/600 to 1/1000 pregnancies and confirmed in 1/800 to 1/1500 pregnancies.

- In a case control study of 53,000 women undergoing appendectomy, pregnant women were less likely to have appendicitis than age-matched, nonpregnant women. The incidence of appendicitis was slightly higher in the second trimester than in the first and third trimesters or postpartum.

- In addition, cohort study of over 350,000 pregnancies reported that the rate of acute appendicitis was 35 percent lower during the antepartum period than the time outside of pregnancy. This study reported the lowest rates of appendicitis during the third trimester. For women aged 15 to 34 years, there was NO increased risk in postpartum appendicitis compared with the time outside of pregnancy. In contrast, an 84 percent increased risk of postpartum appendicitis was reported for women older than 35 years.

- Gestational Age: ↑ maternal morbidity & mortality
CLINICAL FEATURES

— **In the "classic" presentation**, the patient describes the onset of abdominal pain as the first symptom. The pain is periumbilical initially and then migrates to the right lower quadrant. *Anorexia*, nausea and *vomiting*, if present, follow the onset of pain. *Fever* up to 101.0°F (38.3°C) and *leukocytosis* develop later.

— However, many patients have a **nonclassical presentation**, with symptoms such as *heartburn*, bowel irregularity, *flatulence*, *malaise*, or *diarrhea*.

— If the appendix is **retrocecal**, patients often complain of a **dull ache** in the right lower quadrant rather than localized tenderness. *Rectal or vaginal* examination in such patients is more likely to elicit pain than abdominal examination.

— A **pelvic appendix** can cause tenderness below McBurney's point (described below); these patients often complain of **urinary frequency** and *dysuria* or rectal symptoms, such as *tenesmus* and *diarrhea*. 
Symptoms

– 1) Abdominal pain: 96 percent
  – Right lower quadrant: 75 percent
  – Right upper quadrant: 25 percent
– 2) Nausea: 85 percent
– 3) Vomiting: 70 percent
– 4) Anorexia: 65 percent
– 5) Dysuria: 8 percent
Signs

• Right lower quadrant tenderness: 85 percent
• Rebound tenderness: 80 percent
• Abdominal guarding: 50 percent
• Rectal tenderness: 45 percent
• Right upper quadrant tenderness: 20 percent
• Temperature >37.8°C (100°F): 20 percent
Diagnosis

The clinical diagnosis should be strongly suspected in pregnant women with classic findings: abdominal pain that migrates to the right lower quadrant, right lower quadrant tenderness, nausea/vomiting, fever, and leukocytosis with left shift.

– With a nonclassical presentation, which often happens in pregnancy, imaging is indicated. The primary goal of imaging is to reduce delays in surgical intervention due to diagnostic uncertainty. A secondary goal is to reduce, but not eliminate, the negative appendectomy rate. In these cases, ultrasound may reveal the probable cause of the patient’s symptoms (eg, ovarian cyst or torsion, degeneration or torsion of a fibroid, nephrolithiasis, cholecystitis).
The diagnosis of acute appendicitis in a laboring patient requires a high index of suspicion, is especially difficult. Labor can be associated with pain that may be lateralized, fever, leukocytosis, and vomiting. Persistence or progression of these symptoms after delivery should prompt physical examination and imaging studies to evaluate for appendicitis.
History and physical examination — In addition to the usual diagnostic evaluation of adults with abdominal pain, pregnant women should be asked about their

1) past and current obstetric history, as pregnancy complications may manifest as abdominal/pelvic pain (e.g., preeclampsia may be associated with placental abruption or hepatic bleeding, previous cesarean delivery may be associated with uterine rupture)

2) They should also be asked whether they have any vaginal bleeding or leaking of fluid. Bleeding in the first half of pregnancy may be related to miscarriage or ectopic pregnancy. Placental abruption and labor are common causes of abdominal/pelvic pain in the second half of pregnancy and often accompanied by vaginal bleeding and rupture of the fetal membranes.
– The uterine examination should evaluate size (which correlates with gestational age), tone, tenderness, and, in the second half of pregnancy, frequency of contractions. The normal uterus is nontender and soft. A rigid or tender uterus in the second half of pregnancy suggests placental abruption, intrauterine infection, uterine rupture, or possibly labor.

– Cervical dilation/effacement and whether the fetal membranes are intact should be assessed. Rupture of membranes often leads to initiation of labor and may be associated with intrauterine infection or placental abruption.

– The fetal heart rate should be documented.
Laboratory tests

- CBC diff
- Urinalysis
- Liver and pancreatic function tests (aminotransferases, bilirubin, amylase, lipase)
- Women with hemodynamic instability should have blood sent for coagulation studies and type and crossmatch. Electrolytes and renal function tests can be useful in women who are vomiting or anorectic.
- In the presence of fever or unstable vital signs possibly related to sepsis, blood and urine cultures are performed and may be helpful subsequently to confirm suspected infection and guide choice of antibiotic therapy.
Imaging

- **Ultrasonography** — The initial modality of choice for diagnostic imaging of the appendix in pregnancy is graded compression ultrasonography.
- noncompressible blind-ended tubular structure in the right lower quadrant with a maximal diameter greater than 6 mm. The diagnosis should not be excluded if the appendix is not visualized.
- in one review of studies of the value of ultrasound in diagnosing appendicitis in pregnancy, sensitivity ranged from 67 to 100 percent and specificity ranged from 83 to 96 percent, compared with the general population in whom sensitivity and specificity were 86 and 96 percent,
- respectively the wide variation in the reported diagnostic performance of graded compression ultrasonography for appendicitis during pregnancy is due to multiple factors such as gestational age, maternal body mass index (BMI), and importantly, the training and experience of the sonologist or radiologist
Ultrasound is typically the first-line modality for diagnostic imaging of the abdomen/pelvis in pregnant women.

When ultrasound findings are equivocal or uncertain, the choice of the second-line modality depends on the differential diagnosis and should consider availability, diagnostic performance, and fetal radiation exposure. Use of magnetic resonance imaging (MRI) is preferable to computed tomography (CT) because

1) it avoids ionizing radiation and, 2) for diagnosis of many disorders, performs as well as or better than CT. However, prompt diagnosis should not be delayed if MRI is not readily accessible. It is important to note that gadolinium crosses the placenta and may have potential harmful fetal effects. Therefore, the use of gadolinium generally should be avoided.
Magnetic resonance imaging (MRI) — For pregnant women whose ultrasound examination is inconclusive for appendicitis, magnetic resonance imaging (MRI) is the preferred next test as it avoids the ionizing radiation of computed tomography (CT) and appears to be cost-effective. When MRI is performed in pregnant women, gadolinium is not routinely administered. At least one study has reported an increased risk of a broad set of rheumatologic, inflammatory, or infiltrative skin conditions and for stillbirth or neonatal death for pregnancies exposed to MRI with gadolinium compared with no-MRI pregnancies.
- **MRI** has a high sensitivity and specificity for diagnosing appendicitis during pregnancy. A **meta-analysis** of 12 studies that included 933 pregnant women who underwent MRI evaluation for suspected acute appendicitis reported a sensitivity of 94 percent and specificity of 97 percent.

- A subsequent **meta-analysis** of 19 studies reported similar results (sensitivity 92 percent, and specificity 98 percent).

- **Additional benefits** of MRI include potential **identification of peri-appendiceal** findings when the appendix is not visualized and recognition of other causes of abdominal pain.
Computed tomography

- CT is generally widely available
- Standard abdominal CT scanning with an oral contrast preparation and intravenous contrast or a specialized appendiceal CT scanning protocol can also be used, but are associated with higher fetal radiation exposure (20 to 40 mGy).
- We perform CT when clinical findings and ultrasound examination are inconclusive and MRI is not available,
- Diagnostic value of CT in nonpregnant individuals: overall sensitivity 94 percent, specificity 95 percent
DIFFERENTIAL DIAGNOSIS

- ectopic pregnancy
- normal early pregnancy
- Round ligament syndrome
- Pyelonephritis
- preeclampsia and HELLP
- Abruptio placenta and uterine rupture
- ovarian vein thrombophlebitis (OVT)
- Fibroid degeneration or torsion
- Bleeding ovarian cyst
MANAGEMENT AND SHORT-TERM OUTCOME

- Appendectomy

  - **Perioperative antibiotic** treatment should provide Gram-negative and Gram-positive coverage (e.g., a second-generation cephalosporin) and coverage for anaerobes (e.g., clindamycin or metronidazole).

  - Management with antibiotic therapy alone is not recommended because it is associated with both short-term and long-term failure, as delaying surgical intervention for more than 24 hours after symptom onset increases the risk of perforation, which occurs in 14 to 43 percent of such patients. Importantly, the risk of fetal loss is increased when the appendix perforates (fetal loss 36 versus 1.5 percent without perforation or when there is generalized peritonitis or a peritoneal abscess (fetal loss 6 versus 2 percent; early delivery 11 versus 4 percent).
the difficulties in the clinical diagnosis of appendicitis and the significant risk of fetal mortality if the appendix perforates, a higher negative laparotomy rate (20 to 35 percent) compared with nonpregnant women is generally considered acceptable. Aggressive use of radiologic imaging, including ultrasound, magnetic resonance (MR), and computed tomography (CT) scanning, has the potential to reduce the incidence of negative appendectomy.

There is some evidence that the higher rate of negative laparotomy in pregnant women is linked, at least in part, to a reluctance to perform preoperative CT in these patients.

A normal-appearing appendix at time of surgery should be removed because histological examination may reveal acute inflammation, excision avoids the potential for future evaluation and intervention for suspected appendicitis, and appendectomy is associated with a very low risk of complications.
Cesarean delivery is rarely indicated at the time of appendectomy. For patients who remain undelivered, the risk of dehiscence of the appendectomy incision during labor and vaginal delivery should not be increased when the fascia has been appropriately reapproximated.

Perforated appendix — The management of appendiceal perforation depends on the nature of the perforation: free versus walled-off.

1) Free perforation — A free perforation can cause intraperitoneal dissemination of pus and fecal material. These patients are typically quite ill and may be septic; they are at increased risk of preterm labor and delivery and fetal loss. Urgent laparotomy is necessary for appendectomy with irrigation and drainage of the peritoneal cavity.

2) Walled-off perforation — Nonpregnant patients who present with a long duration of symptoms (more than five days) and have findings of a contained perforation can be treated initially with antibiotics, intravenous fluids, bowel rest, and close monitoring. These patients will often have a palpable mass on physical examination and imaging may reveal a phlegmon or abscess. Many of these patients will respond to nonoperative management. Moreover, immediate surgery in patients with a long duration of symptoms and phlegmon formation is associated with increased morbidity due to dense adhesions and inflammation. Under these circumstances, appendectomy often requires extensive dissection and may lead to injury of adjacent structures. Complications such as a postoperative abscess or enterocutaneous fistula may ensue, necessitating an ileocolicectomy or cecostomy. Because of these potential complications, a nonoperative approach is a reasonable option if the patient is not ill-appearing.
Although there is good evidence to support this approach to walled-off perforation in nonpregnant individuals, there is only sparse evidence in pregnant women. In a single report including only two patients, antibiotic therapy (ampicillin, gentamicin, and clindamycin), intravenous fluids, and bowel rest were associated with improvement in symptoms over two to three days. In one patient, interval appendectomy was performed two months post-vaginal delivery. In the other patient, appendectomy was performed at cesarean delivery because of breech presentation with preterm labor; this patient had an appendiceal phlegmon that had been treated conservatively seven weeks earlier, but with recurrence of acute appendiceal inflammation. In both cases, treatment with antenatal glucocorticoids to induce fetal lung maturation and tocolytics was avoided due to concerns of suppressing clinical manifestations of worsening infection and delaying delivery if intraamniotic infection was also present. On the other hand, a letter to the editor described two deaths related to appendicitis in pregnant women who appeared to recover after treatment with antibiotics and were discharged from the hospital, we suggest that these patients be carefully monitored in the hospital for maternal sepsis and preterm labor.
Choice of approach — When the diagnosis is relatively certain, both open and laparoscopic appendectomy are considered and are reasonable. The relative benefits and concerns for the two different approaches were evaluated in a meta-analysis of 20 studies including over 6200 pregnant women who underwent appendectomy (1926 laparoscopic and 4284 open procedures):

- **Favoring laparoscopic approach** — The laparoscopic approach was associated with lower overall complication rates and shorter hospital stays compared with open procedures.

- **Favoring open approach** — Women who underwent open surgery had a reduced risk of fetal loss.

- Similar — **Similar outcomes** were reported for operative times, birth weight, incidence of preterm birth (<37 weeks of gestation), and cesarean delivery rates.
Open appendectomy — When performing an open appendectomy in a pregnant woman, a transverse incision is made at McBurney's point or, more commonly, over the point of maximal tenderness.

When the diagnosis is less certain, we suggest a lower midline vertical incision since it permits adequate exposure of the abdomen for diagnosis and treatment of surgical conditions that mimic appendicitis. A vertical incision can also be used for a cesarean delivery, if subsequently required for the usual obstetric indications.

It is prudent to minimize traction on the uterus and uterine manipulation, although an association between these maneuvers and preterm birth is unproven.
Laparoscopy — Laparoscopy is sometimes indicated in the evaluation of acute abdominal/pelvic pain, especially when the diagnosis is not clear after less invasive evaluations and the differential diagnoses include potentially life-threatening or organ-threatening disorders.

- It is usually performed in the first or second trimester, but is usually technically possible even in the early third trimester. Based on retrospective evaluation and survey data, laparoscopic surgery for evaluation of abdominal/pelvic pain in pregnancy appears to be as safe as laparotomy.

- When surgery is planned, the appropriate services (Obstetrics, General Surgery, Anesthesia, Pediatrics) should be consulted.
Laparoscopic appendectomy — Case reports, case series and small cohort studies on the use of laparoscopic appendectomy in pregnancy suggest that laparoscopy can be performed successfully during all trimesters and with few complications.

- The decision to laparoscopic approach should take into consideration the skill and experience of the surgeon, as well as clinical factors such as the size of the gravid uterus.

- Suggestions for modification of laparoscopic technique during pregnancy include slight left lateral positioning of the patient during the second half of pregnancy, avoiding the use of any cervical instruments, use of open entry techniques or placement of trocars under direct visualization, and limiting intraabdominal pressure to less than 12 mmHg.

- However, concern has been raised that laparoscopic appendectomy appears to be associated with higher rates of preterm delivery and fetal loss.