

Abdominal Pain in Pregnancy

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In many respects abdominal pain in pregnancy is managed just as in a non-pregnant patient, but the diagnostic criteria, methods of diagnosis, therapy, and consequences of mismanagement differ. This article discusses appendicitis, cholecystitis, urolithiasis, pancreatitis, and intestinal obstruction—conditions that often manifest a similar clinical picture. The article presents epidemiologic data, distinguishing characteristics, modifications of the workup, and treatment appropriate to pregnancy and perinatal complications of each condition.

Diagnosis and management of acute abdominal pain in pregnancy presents many challenges to the clinician. Signs and symptoms of the acute abdomen may be nonspecific or atypical during pregnancy, often resembling those of pregnancy itself. The differential diagnosis is extensive, spanning several organ systems. Normal laboratory values during pregnancy that are elevated above normal values for nonpregnant women include the white blood cell count, erythrocyte sedimentation rate, serum cholesterol, triglycerides, free fatty acids, amylase, alkaline phosphatase, globulin, cortisol, progesterone, estrogen, and iron-binding capacity. Serum creatinine is lower and creatinine clearance is higher than in nonpregnant women. Other laboratory values are lower in pregnant women compared with nonpregnant women: neutrophil count, hematocrit, serum albumin, calcium, and iron.

Surgery in the pregnant patient may involve more risk than in the nonpregnant patient, not because of risks inherent to the surgery, but because of delays in diagnosis, thus increasing the severity of the surgical disease. Incision points must be carefully chosen with attention to altered anatomy during pregnancy. The enlarging uterus displaces the appendix to the right upper quadrant after the fourth month of gestation, for example. Postoperative complications are more com-

mon than in nonpregnant women. Atelectasis may develop because of decreased mechanical clearing of the respiratory tract. Thromboembolic phenomena may occur secondarily to the hypercoagulability of pregnancy. Anesthesia requirements must be adjusted because of altered renal clearance, oxygen requirements, and intravascular volume during pregnancy. Blood pressure may be difficult to maintain because of pressure on the inferior vena cava by the gravid uterus. Kammerer¹ reviews several series of surgical cases that showed no significant difference in perinatal mortality for pregnant patients with nonobstetrical surgical disease. He states: "While pregnancy itself does not increase surgical maternal mortality, the procrastination and confusion often associated with such cases may lead to more complex surgery and intraoperative and postoperative problems." The risks of procrastination have been well described in such series as the seven patients with acute abdomens in pregnancy described by Munro and Jones.² Fetal loss was 23 percent in one series of 74 laparotomies during pregnancy,³ but Kammerer¹ reviews three large series of surgical cases during pregnancy that showed no significant difference in perinatal mortality associated with surgical problems during pregnancy.

APPENDICITIS

The most common surgical condition in the antepartum period is acute appendicitis.¹ With an incidence of 0.005 to 0.240 percent of pregnancies,⁴⁻⁹ compared with 0.1 percent of the general population, appendicitis appears to be no more common in pregnant women than in the rest of the population. DeVore¹⁰ has

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reported that appendicitis appears most commonly in the second trimester, but others¹ disagree, saying appendicitis occurs during pregnancy as a coincidental event.

Symptoms of appendicitis include anorexia in about one half of the patients, nausea and vomiting in the majority, and abdominal pain in virtually all, usually in the right upper quadrant in the second and third trimesters, and generalized in advanced cases. Symptoms are usually present for one to two days before diagnosis, though delays of several days often occur.⁸ Urinary tract symptoms such as frequency and dysuria have been reported,^{4,7-9} as well as diarrhea.⁸

Physical examination reveals tenderness, except in rare instances. In the first trimester tenderness is manifested predominantly in the right lower quadrant, in the third trimester in the right upper quadrant, and occasionally in a generalized distribution. Even in the nonpregnant patient, the appendix may be located somewhere other than the right lower quadrant, such as in the pelvis or in the retrocecal area. Rebound or guarding is seen in about 60 percent, with guarding somewhat less frequently observed.^{4-6,8,9-12} Rebound and guarding are less often seen in appendicitis in pregnant patients than in nonpregnant patients, and fever is seen in about one half, often with chills.⁵ Only 18 percent of cases reviewed by Babaknia et al⁶ had fevers over 100.2°F. Rectal tenderness may also be noted.

Laboratory findings include an elevated leukocyte count, 10 to 15 × 10³/μL, usually with a left shift,⁹ though it may rise above 15 × 10³/μL.^{6,12}

Diagnostic accuracy ranges from 62 percent⁵ to 100 percent in pregnant women^{5-8,11-13} to 70 percent in nonpregnant women and 90 to 95 percent in adult men.¹¹ Complications include perforation, abscess formation, and peritonitis. Occasionally pneumonia or intrauterine infection may develop.¹³ The delay in diagnosis accounts for most of the mortality—maternal mortality up to 11 percent,⁹ fetal mortality from 1 to 37 percent.¹¹ Mortality is several times higher in perforated compared with nonperforated appendicitis.^{3,10}

Treatment is the same as for any other case of appendicitis. It is much better to operate when appendicitis is suspected than to delay surgery and thus risk perforation. The incision can be extended to allow exploratory laparotomy if no appendicitis is found. The incision for suspected appendicitis is usually made at the point of maximum tenderness⁵⁻⁸ but can also be at the low midline in early pregnancy^{4,14} or at McBurney's point in a transverse direction during late pregnancy.^{6,7} Most agree that simultaneous appendectomy and cesarean section are inadvisable because of the risk of uterine infection. If perforation is suspected, antibiotics should be chosen to cover a broad spectrum of aerobes and anaerobes.

CHOLECYSTITIS

Biliary tract disease is four times as common in women who are postpubertal and premenopausal than in men of the same age group¹⁵ but is no more common in pregnant women than in nonpregnant women.¹⁶ Parity has no effect on incidence. Only 0.08 to 0.30 percent of deliveries reported by Printen and Ott¹⁶ required cholecystectomy during pregnancy. The most common cause of cholecystitis is cholelithiasis.¹⁰ Reasons for the formation of gallstones during pregnancy are unclear but may be based in hypercholesterolemia.^{15,16} Large et al,¹⁷ however, found no significant cholesterol increase in pregnant compared with nonpregnant women.

Symptoms of gallbladder disease include sudden onset of sharp or dull, usually constant, pain in the right upper quadrant, radiating around to the back or scapulae, usually peaking within 45 minutes but variable in duration and often recurrent. The pain is usually associated with nausea and vomiting. About one half the people with cholelithiasis are asymptomatic.¹⁰

Physical examination may show right upper quadrant tenderness, especially in acute cholelithiasis, rebound, a palpable gallbladder, fever, or jaundice (in only 3 of 29 women with gallstones in Glenn and McSherry).¹⁵

Laboratory tests are only occasionally helpful. The leukocyte count can be elevated in this and several other causes of abdominal pain. Bilirubin, alkaline phosphatase, and transaminases may be elevated, but not in the majority of cases.

Ultrasonography, which is 97 percent accurate in the diagnosis of gallbladder disease in pregnancy, reveals stones as characteristic grouped echoes with shadows posterior to the echoes.¹⁰ Whereas ultrasonography is highly (98 percent) specific in the diagnosis of cholelithiasis, it is only 86 percent specific in cholecystitis. The gallbladder may not be seen in one fifth of the patients undergoing ultrasonography, often as the result of excess intestinal gas.¹⁸ Zeman and colleagues¹⁹ suggest that in patients with possible acute cholecystitis, cholescintigraphy such as the N,a-(2,6-dimethylacetanilide), iminodiacetic acid (HIDA), or N,a-(p-isopropylacetanilide)-iminoacetic acid (PIPIDA) scans be employed first, resorting to ultrasonography only if the gallbladder is not visualized by scintigraphy.

Other radiographic studies have taken a secondary place in the diagnostic workup of gallbladder disease during pregnancy. Only 10 percent of gallstones are visible on plain abdominal films.²⁰ Oral cholecystograms are impossible in a vomiting patient, and intravenous cholangiograms are not helpful when alkaline phosphatase or bilirubin is elevated. In the study by Hill et al²¹ looking at 20 patients undergoing cholecys-

tectomy during pregnancy, oral cholecystogram showed a nonfunctioning gallbladder in 10 cases and a functioning gallbladder in 6 of 20 patients. These six gallbladders contained stones.

Treatment for gallbladder disease is surgical if medical measures (intravenous fluids, nasogastric suction, analgesia, and bowel rest) fail or if complications such as cystic duct obstruction develop. Appropriate surgical intervention can prevent disastrous complications such as empyema or rupture of the gallbladder. The optimal time for surgical treatment is during the second trimester when the risk of miscarriage and premature labor is lower. Treatment of asymptomatic gallstones should be delayed until after delivery.

The prognosis is usually excellent and depends on associated conditions such as sepsis and acute pancreatitis. Fetal loss may be seen in up to 5 percent of cases, but maternal mortality is the same as in nonpregnant women.¹⁶

UROLITHIASIS

Symptomatic urolithiasis is characterized by sharp, aching, or colicky abdominal and flank pain, usually severe. Incidence cited ranges from 1 in 715 deliveries to 1 in 1,705 deliveries.²² Most authors agree that renal stones occur no more often during pregnancy than in nonpregnant women of similar age,²³ though some have concluded that stones are more common during pregnancy.²⁴ Associated abnormalities discussed by Coe et al²³ include hypercalciuria (42 percent of cases), hyperuricosuria (13 percent), infection (13 percent), primary hyperparathyroidism (15 percent) and cystinuria (3 percent). Nineteen percent of cases are idiopathic.²³

The etiology of urolithiasis lies partly in the physiologic changes of pregnancy.²⁴ Hormonal changes cause smooth muscle hyperplasia and hypertrophy, resulting in ureteral dilatation, decreased peristalsis, more marked in the right than on the left, and stasis.²⁴⁻²⁹ These changes usually begin during the seventh month of gestation, and most resolve within a month postpartum. Other possible causes include hyperparathyroidism, characterized by an elevated serum calcium and an elevated parathyroid hormone^{21,26,30,31}; increased vitamin D or calcium intake; and infection,²⁴ especially with urea-splitting organisms.²⁸ There is no significant association between the risk of urolithiasis and the amount of dilatation or history of urinary tract infections or prior asymptomatic bacteriuria.²⁷ Stones are most commonly made of calcium oxalate; calcium phosphate, uric acid, and struvite (mixed) stones are also common, and occasionally cysteine, magnesium, or ammonium phosphate stones are recovered.²⁶

Patients often report a history of typical pain, infection, and family history of renal stones. Symptoms include crampy sharp abdominal pain on the side of the stone, usually constant and dull but varying in intensity. Pain usually originates in the flank and radiates to the lower quadrants with nausea, vomiting, frequency, urgency, and dysuria. Stones may be present without pain or hematuria.^{25,32} Occasionally patients remain completely asymptomatic. Amar²⁵ describes one woman who was asymptomatic for seven years.

Physical examination may show abdominal tenderness, flank tenderness, fever, abdominal distension, ileus, and an extremely uncomfortable patient. Peritoneal signs are sometimes present.³²

Laboratory findings include hematuria, pyuria, or sometimes a normal urinalysis.²⁸ Urine culture is positive in 20 percent²³ and will often yield a urea-splitting organism such as one of the *Proteus* species or *Escherichia coli*.³¹ Stones may appear on abdominal radiographs as negative shadows in the case of uric acid stones²⁶ or radiopaque densities (easily confused with fetal bones) in the case of calcium-containing stones.^{25,26} Stones in the right upper quadrant may be located in either the biliary or urinary tracts. Noninvasive urologic studies are important in the diagnosis of urolithiasis and are indicated in pregnancy if history or physical examination suggest urolithiasis or if recurrent urinary tract infections occur during pregnancy. The workup should also include testing for serum uric acid.³⁰ The potential risk to the fetus must be considered for any radiographic procedures; usually a scout film and a film 20 minutes after dye injection will provide the diagnosis. This procedure will expose the patient to 0.2 to 0.3 roentgens out of a lifetime safe dose of 10.0 roentgens.²² Ultrasound studies are also useful to detect proximal ureteral stones, renal stones, ureteral dilatation, obstruction, and hydronephrosis.

Unless obstruction is suspected, treatment for urolithiasis is usually conservative, including intravenous fluids, analgesia, sedation, and bed rest. Infections should be treated aggressively with hospitalization for parenteral antibiotics. Common organisms are *Proteus*, *Klebsiella*, and *Pseudomonas* species, and *Staphylococcus aureus*. Associated urinary tract infection is seen in 6.5 percent of women who had stones and then got pregnant and in 20.0 percent of women who first got pregnant and then developed stones. Infection is difficult to eradicate as long as a stone is present.²³

Urolithiasis demonstrates the dilemma of choosing between medical and surgical management and the conflict between treating, to the possible detriment of the fetus, and delaying treatment, possibly putting the mother at risk. Pregnancy should not interfere with the choice to remove an obstruction. Obstruction, however, can lead to infection and hydronephrosis, which

in turn can cause premature labor, morbidity (both maternal and fetal), sepsis, decreased renal function, and local spread of infection. Most stones²² will pass spontaneously without surgical intervention, especially if their diameter is 7 mm or less. The stone can often be recovered by straining the urine. In one series of 20 pregnant women,²⁹ 12 of 14 ureteral stones passed spontaneously before delivery, 1 passed within two days after cystoscopy, and 1 passed two weeks postpartum. Fetal loss is reported in 4 to 6 percent of cases.²³

Surgical intervention is best performed during the second trimester. The stone can be removed by cystoscope (11 of 14 cases in one series²⁴); percutaneous nephrostomy may be necessary if the pregnancy is far advanced, if a catheter cannot be passed, if infection recurs after the catheter has been removed, or if the stone is impacted in the lower ureter. Stones at the ureteropelvic junction can be removed by a ureteral catheter inserted up the ureter and into the renal pelvis. Complete obstruction is an emergency that should be treated by immediate removal of the stone. These measures can be performed under local anesthesia. As Arnell and Getzoff²⁴ advise: "When surgical intervention becomes the treatment of choice, pregnancy and parity should be secondary considerations."

Postpartum follow-up studies should include an intravenous pyelogram and serum and urine calcium, phosphate, urate, and creatinine.²⁸

PANCREATITIS

Pancreatitis is no more common during pregnancy than at any other stage of life. Incidence ranges from 1 in 1,066 deliveries³³ to 1 in 5,416 deliveries.²⁹ Parity has no effect on the likelihood of diagnosis,^{31,34-36} nor does gestational age. The most common cause is gallbladder disease (35 to 90 percent of cases).³⁶ Other causes, in order of frequency, are alcohol, hyperlipidemia, viral infections, toxic agents, thiazide diuretics, preeclampsia, hyperparathyroidism, surgery, obstruction at the ampulla of Vater, carcinoma, trauma, periateritis nodosa, pyelonephritis, and perforated ulcer.³³

Symptoms resemble those of several other conditions such as hyperemesis gravidarum, intestinal obstruction, pyelonephritis, salpingitis, ectopic pregnancy, and strangulated hernia. Many cases of pancreatitis are diagnosed at the time of laparotomy. Symptoms include nausea, vomiting, hyperesthesia, jaundice, fever, flank pain, frequency, dysuria, abdominal pain, chest pain (often pleuritic and right sided), and shock. Pain may not be present.^{31,33}

Physical examination may show abdominal tenderness, often with guarding or rebound, flank tender-

ness, flank ecchymosis, fever, and ascites. In Wilkinson's review³⁵ of 98 cases, two thirds of patients had a temperature greater than 100°F. Hypotension and shock may be seen; symptoms and signs of sympathetic pleural effusion may be present.

Laboratory studies can be quite helpful in making the diagnosis of pancreatitis. A serum amylase over 1,000 Somogyi U/mL suggests pancreatitis,^{35,37} usually peaking within 6 to 12 hours after the onset of symptoms.³⁵ A rise in the serum amylase of over 300 Somogyi U/h, or a urine amylase over 300 Somogyi U/mL is considered diagnostic of pancreatitis. There is no correlation between amylase level and mortality, either maternal or infant. False positives are rare if blood is drawn within 24 hours of the onset of symptoms. Amylase may be elevated in cholecystitis, perforated viscera, steroid therapy, ruptured ectopic pregnancy, small bowel obstruction, mesenteric thrombosis, mumps, and renal failure.³³ Urinary amylase rises within one or two days of the onset of symptoms and remains elevated for up to ten days. DeVore and associates³⁸ have studied the use of the ratio between amylase clearance and creatinine clearance (Cam/Ccr) using serial urine samples in the diagnosis of pancreatitis. An elevated Cam/Ccr can result from pancreatitis, severe hyperemesis gravidarum, and severe preeclampsia. Creatinine clearance values are higher during pregnancy, and thus the clearance ratio is lower during the first 28 weeks' gestation. Normal pregnant women have higher amylase levels than do nonpregnant women. Serum amylase rises gradually above normal in pregnant patients during the first two trimesters, peaking at 21 to 25 weeks' gestation, then gradually declining. Serum calcium is sometimes decreased with pancreatitis, and elevations of alkaline phosphatase, bilirubin, or serum glutamic oxaloacetic acid transaminase (SGOT) may also occur.³⁹

McKay et al¹⁸ observe that grey-scale ultrasonography is 73 percent accurate in the diagnosis of pancreatitis that is due to gallstones. It may reveal inflammatory swelling, which precedes pseudocyst formation.⁴⁰ Ultrasonography is also useful in the diagnosis of suspected pancreatic pseudocysts and inflammatory masses.

Treatment includes nasogastric suction, bowel rest, fluids, and intravenous fluids. Hyperalimentation may be required if symptoms persist longer than a few days.³⁴ Improvement is usually noted within 24 to 48 hours after treatment is started. If patients do not respond to medical therapy, surgery must be considered, but this must be weighed against the potential harm to the fetus. Most authors have rejected termination of pregnancy as a treatment for pancreatitis.^{33,37,39} In the prospective study by Ranson et al⁴¹ factors predictive of a poor prognosis included a white blood cell count over $16 \times 10^3/\mu\text{L}$, blood glucose over 200 mg percent,

TABLE 1. SYMPTOMS ASSOCIATED WITH ACUTE ABDOMEN IN PREGNANCY

	Appendicitis	Cholecystitis	Urolithiasis	Pancreatitis	Intestinal Obstruction
Abdominal pain	+	+	Sharp or aching, crampy, colicky, back or flank pain	Severe, constant pain Occasionally painless Flank pain, chest pain	Crampy or constant in any quadrant Back pain, flank pain; may be painless
Nausea	70 percent	+	+	+	+
Vomiting	70 percent	+	+	+	Especially in bilious
Fever	60 percent	±	+	+ in 2/3	+ (mild)
Chills	20 percent	±	±	±	±
Frequency	+	±	+	±	-
Dysuria	+	±	+	+	-
Urgency	±	±	+	+	-
Other symptoms	Anorexia in 5 percent			Hyperesthesia, ascites, jaundice, shock	Hematemesis, constipation, flatus, anorexia

serum lactic dehydrogenase over 350 IU/mL, SGOT over 250 sigma Frankel units/mL, hematocrit decrease over 10 percent points, blood urea nitrogen rise over 5 mg/dL, serum calcium under 8 mm/dL, oxygen pressure (pO₂) less than 60 mmHg, base deficit over 4 mEq/L, and estimated fluid sequestration over 6 L. Complications of pancreatitis may include congestive heart failure, embolic phenomena, pleural effusion, preeclampsia, disseminated intravascular coagulation, jaundice, fever, hypokalemia, hypochloremia, hypocalcemia, pneumonia, ketoacidosis, cholelithiasis, premature labor, fatty liver, fetal growth retardation, sepsis, and paralytic ileus. Complications such as biliary or bowel obstruction, abscess, hematoma, suspected cholecystitis, gastrointestinal hemorrhage, and rupture of the spleen may require surgery. Maternal mortality in pancreatitis during pregnancy ranges from 0 percent^{33,36,42} to 37 percent and exceeds the mortality rate in nonpregnant women.³⁵ Later studies estimate maternal mortality to be 5 to 15 percent.³⁹

Perinatal mortality associated with pancreatitis includes all the consequences of prematurity and ranges from 0 percent in several series to 38 percent in the 98 cases reported by Wilkinson.³⁵ The infant can suffer from hypoxemia and growth retardation. As many as 60 percent of pregnant women with pancreatitis in late pregnancy will deliver prematurely.⁴¹ Recurrence rate has been reported up to 52 percent³³ compared with 20 percent in nonpregnant subjects.³⁷

INTESTINAL OBSTRUCTION

The incidence of intestinal obstruction in a given popu-

lation increases proportionately with the number of laparotomies performed. The incidence was 1 in 10,000 deliveries in one study⁴³ and 1 in 7,500 deliveries in another.⁴⁴ Riley⁴⁵ describes the condition as an "occasional avoidable disaster" referring to volvulus as one of the often misdiagnosed medical conditions occurring during pregnancy. Volvulus accounts for 25 percent of large-bowel obstructions in pregnancy, compared with 3 to 5 percent of bowel obstructions in nonpregnant patients.⁴⁶ Intestinal obstruction is more common as pregnancy progresses than in the first trimester.¹

Causes include previous laparotomy, mechanical compression, volvulus, intussusception, malrotation, strangulated hernia, congenital defects, recovery from surgery, and adhesions.⁴⁴⁻⁵⁰

Symptoms of intestinal obstruction include nausea, vomiting, often bilious, and crampy or constant abdominal pain, which may occur in any quadrant. Also seen are back pain, flank pain, hematemesis, constipation, flatus, anorexia, distension, and sometimes no pain at all.

Physical examination may show mild fever, tachycardia, tachypnea, abdominal tenderness, decreased bowel sounds, abdominal mass, and rushing or high-pitched bowel sounds.

Radiographic contrast studies may reveal a "bird's beak" shape at the point of obstruction. Plain films may show distension and air-fluid levels. Gastrograffin enemas may also help elucidate the anatomy. Upright and supine plain films may also demonstrate obstruction and should be repeated after six to eight hours if negative.⁴⁷

Treatment includes nasogastric suction, intravenous

TABLE 2. PHYSICAL AND LABORATORY FINDINGS IN ABDOMINAL PAIN OF PREGNANCY

	Appendicitis	Cholecystitis	Urolithiasis	Pancreatitis	Intestinal Obstruction
Tenderness	Right lower quadrant 1st trimester; right upper quadrant 3rd trimester; generalized	Right upper quadrant ± palpable gallbladder	Abdominal, flank	Abdominal, flank	Abdominal with decreased or high-pitched bowel sounds
Rebound	60 percent	±	±	±	±
Guarding	60 percent	±	±	±	±
Rectal tenderness	+	-	±	-	±
Distension	±	±	+	±	+
White blood cell count	10-15 × 10 ³ /μL with left shift	10-15 × 10 ³ /μL with left shift		10-15 × 10 ³ /μL	
Urinalysis	May show pyuria, hematuria	Usually normal	Urine culture: commonly Escherichia coli, Proteus species	Usually normal	Usually normal
Chemistry	Usually normal	Usually normal	Serum or urine calcium and uric acid sometimes elevated	Elevated serum amylase, urine amylase, lipase, total bilirubin, transaminases, alkaline phosphatase; decreased serum calcium	Occasionally electrolyte abnormalities

fluids, correction of electrolyte and fluid abnormalities, and in most cases, surgery, usually with resection of gangrenous segments, derotation, and decompression of the bowel.⁴⁶ The incision may be performed over the area of the mass or at the level of the fundus. If feasible, vaginal delivery should be attempted. Maternal mortality ranges from 10 to 20 percent, premature labor and fetal death occur in up to one half of the cases.⁴³

CONCLUSION

Knowing the details of the history, physical examination, and the physiological changes of pregnancy, and cautiously adding information from diagnostic laboratory and procedures, the problem of abdominal pain in pregnancy can be approached rationally. Tables 1 and 2 summarize the symptoms and physical and laboratory findings. The situation must be reassessed repeatedly, and risks to both fetus and mother must be considered constantly, intervening as necessary using criteria similar to those used for nonpregnant patients with acute abdominal pain.

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