INTRODUCTION — Abdominal pain continues to pose diagnostic challenges for emergency clinicians. In many cases, the differential diagnosis is wide, ranging from benign to life-threatening conditions. Causes include medical, surgical, intraabdominal, and extraabdominal ailments. Associated symptoms often lack specificity and atypical presentations of common diseases are frequent, further complicating matters.

The elderly, the immunocompromised, and women of childbearing age pose special diagnostic challenges. Elderly and diabetic patients often have vague, nonspecific complaints and atypical presentations of potentially life-threatening conditions leading to time consuming workups [1,2]. The immunocompromised patient may suffer from a wide range of ailments, including unusual and therapy-related conditions. Pregnancy leads to physiologic and anatomic changes affecting the presentation of common diseases. (See "Approach to abdominal pain and the acute abdomen in pregnant and postpartum women" and "Evaluation of abdominal pain in the HIV-infected patient".)

This topic review will discuss how to assess the adult patient presenting to the emergency department (ED) with abdominal pain, and provide a synopsis of important diagnoses to consider. Detailed discussions of specific diagnoses are found separately.

EPIDEMIOLOGY — Abdominal pain comprises 5 to 10 percent of emergency department (ED) visits [3-6]. Despite sophisticated diagnostic modalities, undifferentiated abdominal pain remains the diagnosis for approximately 25 percent of patients discharged from the ED and between 35 and 41 percent for those admitted to the hospital [4,7-9]. Approximately 80 percent of patients discharged with undifferentiated abdominal pain improve or become pain-free within two weeks of presentation [9].

Older patients with abdominal pain have a six- to eightfold increase in mortality compared to younger patients [1,10]. The elderly (ie, patients over 65 years of age) account for 20 percent of ED visits, of which 3 to 4 percent are for abdominal pain [1,10,11]. About one-half to two-thirds of these patients require hospitalization, while one-third requires surgical intervention [2,5,12-14]. Some studies suggest the elderly sustain increased mortality when their diagnosis is not determined in the ED [15].

The incidence of abdominal pain in the human immunodeficiency virus (HIV) patient population ranges from 12 to 45 percent [16,17]. Of HIV positive patients presenting with abdominal pain, 38 percent require admission [17]. Eleven percent of HIV positive patients requiring surgery had an acquired immune deficiency syndrome (AIDS) associated opportunistic infection. The remaining patients had pathology commonly seen in the immunocompetent population. The most common diagnosis in this group was undifferentiated abdominal pain.
DIFFERENTIAL DIAGNOSIS

Immediate life-threatening conditions — Abdominal pain may be caused by the following life-threatening conditions, which are described below:

- Abdominal aortic aneurysm
- Mesenteric ischemia
- Perforation of gastrointestinal tract (including peptic ulcer, bowel, esophagus, or appendix)
- Acute bowel obstruction
- Volvulus
- Ectopic pregnancy
- Placental abruption
- Myocardial infarction
- Splenic rupture (eg, secondary to Epstein-Barr virus [EBV], leukemia, trauma)

- Abdominal aortic aneurysm (AAA) – An aneurysm is a focal aortic dilation of at least 50 percent compared to normal, with any measurement greater than 3 cm considered abnormal. Most AAAs remain quiescent until rupture, but some manifest as abdominal, back, or flank pain. Aneurysm rupture typically causes exsanguinating hemorrhage and profound, unstable hypotension. (See "Clinical features and diagnosis of abdominal aortic aneurysm".)

A number of atypical presentations exist for ruptured AAA, contributing to a misdiagnosis rate of up to 30 percent [18]. AAAs can rupture into the retroperitoneum where they may tamponade, enabling the patient to remain normotensive initially. AAAs can present with back pain and hematuria leading to potential misdiagnosis as nephrolithiasis.

AAA is most common in men over 60 years, with risk increasing dramatically as patients age beyond 60. Chronic obstructive pulmonary disease, peripheral vascular disease, hypertension, smoking, and a family history are associated with AAA.

- Mesenteric ischemia – Mesenteric ischemia can be differentiated into four entities: arterial embolism (50 percent), arterial thrombosis (15 percent), nonocclusive mesenteric ischemia (20 percent), and venous thrombosis (15 percent). Mesenteric ischemia is associated with high mortality and prompt diagnosis is crucial albeit often difficult. (See "Overview of intestinal ischemia in adults".)

Acute mesenteric ischemia is classically said to present with rapid onset of severe periumbilical abdominal pain, often out of proportion to findings on physical examination. Nausea and vomiting are common. Sudden pain associated with few abdominal signs and forceful bowel evacuation in a patient with risk factors should greatly heighten suspicion for the diagnosis. The subset of patients with mesenteric venous thrombosis has a more indolent course and lower reported mortality. Risk factors include advanced age, atherosclerosis, low cardiac output states, cardiac arrhythmias (eg, atrial fibrillation), severe cardiac valvular disease, recent myocardial infarction, and intraabdominal malignancy.

- Gastrointestinal perforation – Many causes of gastrointestinal perforation exist, but peptic ulcer disease (PUD) is the most common. Perforation can also complicate appendicitis, diverticulitis, ischemic bowel, and toxic megacolon. Ulcer perforation should be suspected in patients with a history of peptic ulcer symptoms who develop the sudden onset of severe, diffuse abdominal pain. A detailed assessment reveals a history of PUD or ulcer symptoms in the majority of cases,
a notable exception being older individuals with nonsteroidal antiinflammatory drug (NSAID)-
induced perforation. Perforation is more common and lethal among the elderly. Delays in
diagnosis greater than 24 hours substantially increase mortality. Esophageal perforation
(Boerhaave syndrome), which can occur with severe retching, can present with severe and
progressive epigastric abdominal pain. (See "Overview of the complications of peptic ulcer
disease", section on 'Perforation'.)

- Acute bowel obstruction – The majority of bowel obstructions involve the small intestine.
Mortality from bowel strangulation varies from 8 percent when surgery is performed within 36
hours to 25 percent when surgery is delayed beyond 36 hours. (See "Epidemiology, clinical
features, and diagnosis of mechanical small bowel obstruction in adults" and "Overview of
management of mechanical small bowel obstruction in adults", section on 'Indications for
surgical exploration'.)

The most common symptoms of small bowel obstruction (SBO) are abdominal distention,
vomiting, crampy abdominal pain, and absence of flatus. In proximal obstruction, nausea and
vomiting can be relatively severe compared with distal obstruction, but distention of the
abdomen is somewhat less. The colon requires 12 to 24 hours to empty after the onset of bowel
obstruction so flatus and even passage of feces may continue after the onset of symptoms.
Abdominal pain is frequently described as periumbilical and crampy, with paroxysms of pain
occurring every four or five minutes. Pain progresses from crampy to constant and more severe,
and some clinicians feel that such progression is a sign of impending strangulation. Focal
abdominal pain in the presence of other symptoms of obstruction may be an ominous sign and
should not be ignored.

Previous upper or lower abdominal surgery increases the risk for obstruction. Causes of SBO
include: adhesions (50 to 70 percent), incarcerated hernias (15 percent), and neoplasms (15
percent). Gallstone ileus is the cause in up to 20 percent of cases among elderly patients.
Patients with Crohn's disease frequently present with obstruction.

- Volvulus – The majority of patients with cecal volvulus have a similar presentation to those with
small bowel obstruction. Symptoms include abdominal pain, nausea, vomiting, and obstipation.
The pain is usually steady, with a superimposed colicky component. The abdomen is often
diffusely distended. Fever, peritonitis, or hypotension may indicate the presence of intestinal
gangrene. Risk factors for cecal volvulus include adhesions, recent surgery, congenital bands,
and prolonged constipation. Mortality for cecal volvulus ranges from 12 to 17 percent; mortality
in the elderly can be as high as 65 percent. (See "Cecal volvulus".)

Sigmoid volvulus accounts for the majority of volvulus cases. Most patients present with
abdominal pain, nausea, abdominal distension, and constipation; vomiting is less common.
Younger patients may have a more insidious presentation with recurrent attacks of abdominal
pain and intermittent resolution, presumably due to spontaneous detorsion. Compromise of the
blood supply to the sigmoid colon can lead to gangrene with resulting peritonitis and sepsis. Pain
is usually continuous and severe, with a superimposed colicky component. The abdomen is
usually distended and tympanitic. Risk factors include excessive use of laxatives, tranquilizers,
anticholinergic medications, ganglionic blocking agents, and medications for Parkinsonism. (See
"Sigmoid volvulus".)

- Ectopic pregnancy – Clinicians must consider the diagnosis of ectopic pregnancy in any female
of childbearing age with abdominal pain and should obtain a human chorionic gonadotropin
Common conditions

Gastrointestinal

- Appendicitis – The early symptoms and signs of appendicitis are often subtle and nonspecific, and the examination unrevealing. Nausea and vomiting are generally not the first symptoms. Classically, patients initially experience anorexia along with vague periumbilical discomfort that develops into marked right lower quadrant pain. This progression occurs with an inflamed anterior or pelvic appendix. However, a retrocecal appendix may not cause focal signs of peritonitis. A pelvic appendix can present with urinary symptoms or diarrhea. (See "Acute appendicitis in adults: Clinical manifestations and differential diagnosis").

Patients who have had an appendectomy may still develop a stump appendicitis in which the appendix remnant becomes occluded, edematous, and infected. Presentation, diagnoses, and treatment are similar to that of appendicitis.
Clinicians often fail to diagnose appendicitis in elderly patients, in whom mortality can reach 70 percent. The elderly often present without the findings classically associated with appendicitis. Appendicitis is the most common extrauterine cause for abdominal surgery in pregnant women. The right lower quadrant is the most common location of pain regardless of gestational age, despite traditional teaching that the appendix migrates into the right upper quadrant during pregnancy. (See "Acute appendicitis in pregnancy".)

Biliary disease – Patients with acute cholecystitis typically complain of abdominal pain, most commonly in the right upper quadrant or epigastrium. The pain may radiate to the right shoulder or back. Pain is often steady and severe. Associated complaints may include nausea, vomiting, and anorexia. There is often a history of fatty food ingestion about one hour or more before the onset of pain. Patients are usually ill appearing, febrile, and tachycardic, with tenderness in the right upper abdomen. Murphy's sign may be present, although the sensitivity of the test can be diminished in the elderly. Progression to septic shock can occur with ascending cholangitis. (See "Acute cholecystitis: Pathogenesis, clinical features, and diagnosis" and "Treatment of acute calculous cholecystitis".)

Pancreatitis – Acute pancreatitis almost always presents with acute upper abdominal pain. The pain is steady and may be in the midepigastrium, right upper quadrant, diffuse, or, infrequently, confined to the left side. Band-like radiation to the back is common. Pain often reaches maximum intensity within 10 to 20 minutes of onset, but can persist for days. Nausea and vomiting is common. In severe cases, patients can present in shock or coma. Physical findings vary with severity. In mild disease, the epigastrium may be minimally tender; in severe episodes, upper abdominal distention, tenderness, and guarding are common. (See "Clinical manifestations and diagnosis of acute pancreatitis" and "Management of acute pancreatitis".)

Predisposing factors include alcoholism, biliary tract disease, trauma, penetrating ulcer, infection, hypertriglyceridemia, drug reactions (eg, NSAIDs, furosemide, thiazides, sulfonamides, tetracycline, erythromycin, acetaminophen, corticosteroids, estrogens), hypercalcemia, carbon monoxide exposure, and hypothermia.

Diverticular disease – The presentation of diverticulitis depends upon the severity of inflammation and the presence of complications. Left lower quadrant pain is the most common complaint. Pain is often present for several days prior to presentation. Many patients have had one or more similar past episodes. Nausea and vomiting and/or a change in bowel habits often accompany the pain. Examination usually reveals abdominal tenderness in the left lower quadrant. Elderly patients are at increased risk for developing diverticula and their complications, which can include diverticulitis, perforation, obstruction, and hemorrhage. (See "Clinical manifestations and diagnosis of acute diverticulitis in adults" and "Acute colonic diverticulitis: Medical management".)

Peptic ulcer disease – Epigastric pain, indigestion, and reflux symptoms are classically associated with peptic ulcer disease (PUD), but none is sensitive or specific. In the absence of complications, examination findings are unremarkable. Complications include bleeding and perforation. Mortality from perforation is significantly higher in the geriatric population, particularly when the diagnosis is delayed 24 hours or longer. The elderly are often unaware they have PUD until a severe complication develops. (See 'Immediate life-threatening conditions' above and "Peptic ulcer disease: Clinical manifestations and diagnosis".)

Incarcerated hernia – Inguinal hernias are most common and often present with mild lower abdominal discomfort exacerbated by straining. Inguinal and incisional hernias are more
common in elder patients. Incarcerated hernias can cause severe pain and require immediate surgical consultation. (See "Classification, clinical features and diagnosis of inguinal and femoral hernias in adults").

- Gastroenteritis and other infectious causes – Although common, gastroenteritis is a diagnosis of exclusion in the ED, where the clinician must focus on life-threatening causes of abdominal pain. Infectious gastroenteritis, enteritis, and colitis have many etiologies (viral, bacterial, parasitic, antibiotic associated). Fever, diarrhea, and/or vomiting may be more prominent symptoms than abdominal pain. (See "Acute viral gastroenteritis in adults" and "Approach to the adult with acute diarrhea in resource-rich settings" and "Approach to the adult with acute diarrhea in resource-limited countries").

- Foodborne disease – Foodborne diseases typically manifest as a mixture of nausea, vomiting, fever, abdominal pain, and diarrhea. Vomiting or diarrhea may be more prominent than abdominal pain. Depending upon the nature of the illness, symptoms can develop anywhere from one hour to several days after the contaminated food is ingested. (See "Differential diagnosis of microbial foodborne disease", section on 'Approach to the patient'.)

- Complications of bariatric (weight loss) surgery – Complications can occur within weeks or years after bariatric surgery, and many involve abdominal pain as part of the presentation. In addition to such standard complications as bleeding and bowel obstruction, other potential complications (organized by procedure) include the following [20-22]:
  - Roux-en-Y gastric bypass: Gastric remnant distension; stomal stenosis; marginal ulceration
  - Gastric banding: Stomal obstruction; port infection; band erosion; band movement causing obstruction
  - Sleeve gastrectomy: Gastric outlet obstruction; gastric leaks (see "Late complications of bariatric surgical operations")

- Inflammatory bowel disease – Acute complications from inflammatory bowel disease can include pain, bleeding, perforation, bowel obstruction, fistula and abscess formation, and toxic megacolon. (See "Clinical manifestations, diagnosis and prognosis of Crohn disease in adults" and "Clinical manifestations, diagnosis, and prognosis of ulcerative colitis in adults").

- Hepatitis – Hepatitis has a multitude of possible etiologies, including infections (bacterial, viral, parasitic, fungal), toxins, medications, and immunologic disorders. (See "Approach to the patient with abnormal liver biochemical and function tests").

- Spontaneous bacterial peritonitis (SBP) – SBP involves an acute bacterial infection of ascitic fluid in patients with liver disease. Usually there is no apparent source of infection. SBP occurs in up to a quarter of patients admitted with cirrhosis and ascites. Mortality is high in patients with cirrhosis. (See "Spontaneous bacterial peritonitis in adults: Clinical manifestations" and "Spontaneous bacterial peritonitis in adults: Diagnosis" and "Spontaneous bacterial peritonitis in adults: Treatment and prophylaxis").

- Irritable bowel syndrome (IBS) – Although common, IBS is rarely diagnosed in the ED, where the clinician must focus on life-threatening causes of abdominal pain. Diagnosis of IBS requires persistent symptoms for three months over a one year period. Symptoms include abdominal pain associated with a change in stool frequency or consistency. (See "Clinical manifestations and diagnosis of irritable bowel syndrome in adults").
Genitourinary

- Urinary tract infection (UTI)/pyelonephritis – Lower urinary tract infections often present with suprapubic discomfort associated with urinary symptoms such as frequency, urgency, or dysuria. Fever (>38°C), flank pain, costovertebral angle tenderness, and nausea or vomiting suggest upper tract infection and warrant more aggressive diagnostic and therapeutic measures. (See "Acute uncomplicated cystitis and pyelonephritis in women" and "Acute complicated cystitis and pyelonephritis").

- Nephrolithiasis – Nephrolithiasis can present with severe abdominal pain, which may mimic that of abdominal aortic aneurysm. Pain is often colicky and radiates to the flank or groin. Hematuria is present in 70 to 90 percent of cases. (See "Diagnosis and acute management of suspected nephrolithiasis in adults").

- Adnexal torsion – The most common symptom of adnexal (or ovarian) torsion is sudden onset lower abdominal pain, often associated with waves of nausea and vomiting. Patients with ovarian cysts or other masses are at higher risk. Ovarian torsion is a gynecologic emergency. (See "Ovarian and fallopian tube torsion").

- Ruptured ovarian cyst – Rupture of an ovarian cyst may be asymptomatic or associated with the sudden onset of unilateral lower abdominal pain. Pain often begins during strenuous physical activity (eg, exercise or sexual intercourse) and may be accompanied by light vaginal bleeding. Significant intraperitoneal bleeding can occur in the absence of vaginal bleeding. Unilateral lower abdominal tenderness is often present. (See "Evaluation and management of ruptured ovarian cyst" and "Approach to vaginal bleeding in the emergency department").

- Preeclampsia – Preeclampsia usually occurs in the late stages of pregnancy and is defined by the triad of hypertension, proteinuria, and edema. Liver injury can occur producing right upper or epigastric abdominal pain. (See "Preeclampsia: Clinical features and diagnosis").

- Pelvic inflammatory disease (PID) – PID refers to acute infection of the upper genital tract in women. Lower abdominal pain is the cardinal symptom of PID. Pain that worsens during coitus or with jarring movement may be the only symptom; the onset of pain during or shortly after menses is suggestive. Pain is usually bilateral but may be mild. Abnormal uterine bleeding, new vaginal discharge, urethritis, and fever can be associated with PID but are neither sensitive nor specific. (See "Pelvic inflammatory disease: Clinical manifestations and diagnosis").

- Tubo-ovarian abscess (TOA) – Infrequently, PID is complicated by TOA. Ultrasound is the preferred study for diagnosing TOA, which may require surgical drainage. (See "Epidemiology, clinical manifestations, and diagnosis of tubo-ovarian abscess").

- Fitz-Hugh Curtis syndrome – Approximately 10 percent of patients with PID go on to develop perihepatitis (Fitz-Hugh Curtis Syndrome). Since these patients present with right upper quadrant pain and tenderness, the syndrome can mimic cholecystitis, pneumonia, or pulmonary embolus. (See "Pelvic inflammatory disease: Clinical manifestations and diagnosis").

- Endometriosis – Endometriosis is defined as endometrial-like tissue located outside the uterine cavity that produces an inflammatory reaction. Common symptoms include pelvic pain (which may be chronic but is often more severe during menses or at ovulation), dysmenorrhea, infertility, and deep dyspareunia. Examination is often unremarkable. (See "Endometriosis: Pathogenesis, clinical features, and diagnosis").
Trauma-related — Injuries sustained during trauma may not manifest for days to weeks after the event. Splenic rupture is a common example, but delayed presentations of perforated bowel, pancreatitis, and injuries to the liver, gallbladder, and genitourinary tract have all been reported. Diaphragmatic injury can even be delayed for months to even years and is often difficult to diagnose as the diaphragm is not well visualized by CT scan. Therefore, it is important to ask patients presenting to the ED with abdominal pain about recent and past trauma. Bedside ultrasonography may reveal intraperitoneal free fluid; CT imaging is often necessary in stable patients to make a definitive diagnosis. Immediate surgical consultation is needed for unstable patients in whom abdominal pain is suspected to be trauma-related. The initial evaluation and management of trauma is discussed separately. (See "Evaluation of the acute scrotum in adults").

Common extraabdominal diseases — A list of extraabdominal causes of abdominal pain is provided (table 1).

- Testicular torsion — Testicular torsion usually presents with the sudden onset of severe pain following vigorous activity or testicular trauma. Examination often reveals an asymmetrically high-riding, transversely oriented testis on the affected side and loss of the cremasteric reflex. Testicular salvage rates are over 80 percent if treatment is initiated within six hours of symptoms, but fall significantly thereafter. (See "Evaluation of the acute scrotum in adults").

- Diabetic ketoacidosis (DKA) — DKA is the initial presentation for approximately 3 percent of Type I diabetics. DKA can present with severe abdominal pain and vomiting. (See "Diabetic ketoacidosis and hyperosmolar hyperglycemic state in adults: Clinical features, evaluation, and diagnosis").

- Alcoholic ketoacidosis — Alcoholic ketoacidosis occurs in chronic alcoholics after a recent binge. The binge is followed by vomiting and decreased food intake. Up to 75 percent of patients present with nausea, vomiting, and abdominal pain. (See "Fasting ketosis and alcoholic ketoacidosis").

- Pneumonia — Symptoms of pneumonia may include nausea, vomiting, diarrhea, weight loss, anorexia, and abdominal pain. The abdominal pain stems from pleuritic irritation caused by a basilar infiltrate. The pain is generally sharp and aggravated by cough or deep inspiration. (See "Diagnostic approach to community-acquired pneumonia in adults").

- Pulmonary embolus (PE) — PE can present with a range of nonspecific symptoms and signs, which may include upper abdominal pain and shoulder pain [23]. Two possible mechanisms for abdominal pain are pleural irritation of the diaphragm causing an ileus and hepatic congestion from acute right ventricular failure. It seems unlikely that abdominal pain would be the sole manifestation of PE. (See "Overview of acute pulmonary embolism in adults").

- Herpes zoster — Herpes zoster is a reactivation of a latent varicella-zoster viral infection in a dorsal root ganglion. Pain and a rash develop in a dermatomal pattern, which may involve the abdomen. Pain can precede the rash by days to weeks. (See "Epidemiology and pathogenesis of varicella-zoster virus infection: Herpes zoster").

Other conditions — Some of the diagnoses listed below will not be made in the emergency department (ED), but are included as a reference and to enable clinicians to access more detailed information easily.

- Toxin/drug related — Many toxins and drug ingestions can cause abdominal pain. With corrosives (eg, aspirin, iron, mercury, acids, and alkali), abdominal pain is from mucosal injury that can
result in esophageal or gastric perforation. Anticholinergics and narcotics may cause abdominal pain secondary to ileus or obstruction. Charcoal and drug bezoars can cause mechanical obstruction. Amphetamines, ergotamines, and cocaine can cause abdominal pain from vasoconstriction producing bowel ischemia. Acetaminophen can cause hepatic injury and ddl (dideoxyinosine) can cause pancreatitis. Heavy metal (eg, lead) intoxication is included in the differential diagnosis of patients with a combination of abdominal pain and anemia. Mushroom poisoning can present with crampy abdominal pain, vomiting, and diarrhea. Abdominal pain can be a prominent symptom in patients withdrawing from opioids. (For discussions of specific toxins see the relevant toxicology topic review, including those listed here). (See "General approach to drug poisoning in adults" and "Caustic esophageal injury in adults" and "Anticholinergic poisoning" and "Adult occupational lead poisoning" and "Clinical manifestations and evaluation of mushroom poisoning" and "Opioid withdrawal in the emergency setting".)

- Neoplasm – Abdominal pain may be the presenting symptom for neoplasms. Ovarian cancer can present with abdominal swelling, dyspepsia, indigestion, abdominal distention, flatulence, anorexia, pelvic pressure, back pain, rectal fullness, or urinary urgency, or frequency. Colorectal cancer can present with abdominal pain associated with changes in bowel habits, weight loss, and rectal bleeding. Patients with leukemia can present with symptoms suggestive of an acute abdomen from a functional obstruction, possibly due to autonomic dysfunction, localized vascular derangements, or peritoneal irritation. (See "Epithelial carcinoma of the ovary, fallopian tube, and peritoneum: Clinical features and diagnosis" and "Clinical presentation, diagnosis, and staging of colorectal cancer".)

Chemotherapy and radiation treatments for neoplasms can produce abdominal pain. As an example, vincristine can produce severe colicky abdominal pain for up to 10 days after administration. Patients undergoing chemotherapy for leukemia can present with typhlitis or a necrotizing colitis involving the cecum or appendix. (See "Enterotoxicity of chemotherapeutic agents".)

- Sickle cell – Acute painful episodes associated with sickle cell, formerly called sickle cell crises, result from obstruction of arterioles, which can lead to splenic or mesenteric infarction. Abdominal pain is often a sickle cell patient's typical pain. If the abdominal pain is not typical, the clinician should investigate other causes. Sickle cell patients have a predilection for some common causes of abdominal pain (eg, gallstones). (See "Overview of the clinical manifestations of sickle cell disease".)

- Toxic megacolon – Causes of toxic megacolon include inflammatory bowel disease, infectious colitis (eg, Clostridium difficile), ischemic colitis, and obstructive colon cancer. Signs and symptoms of acute colitis, which are frequently resistant to therapy, are often present for at least one week prior to the onset of acute dilatation of the colon. Severe bloody diarrhea is the most common presenting symptom; improvement of diarrhea may herald the onset of megacolon. (See "Toxic megacolon".)

- Mesenteric lymphadenitis – Mesenteric adenitis is a common mimic of appendicitis caused by viral or bacterial inflammation of the mesenteric lymph nodes [24]. It is a diagnosis of exclusion in the ED. (See "Clinical manifestations and diagnosis of Yersinia infections", section on 'Pseudoappendicitis'.)

- Infectious mononucleosis – Among patients with infectious mononucleosis, approximately half will have splenic enlargement and a small percentage will develop a self-limited clinical hepatitis. Sudden left upper quadrant pain or generalized abdominal pain should raise concern for
spontaneous splenic rupture, although this is rare. (See "Infectious mononucleosis in adults and adolescents").

- Toxic shock syndrome – This syndrome is characterized by fever, rash, hypotension, and multiorgan involvement. Abdominal complaints are common and can include nausea, vomiting, diarrhea, and pain. (See "Staphylococcal toxic shock syndrome").

- Rocky Mountain spotted fever (RMSF) – The classic triad of fever, rash, and a history of tick exposure is present in a small percentage of patients during the first three days of illness. Abdominal pain is reported by 30 percent of patients. (See "Clinical manifestations and diagnosis of Rocky Mountain spotted fever").

- Porphyria – Porphyria is a rare autosomal dominant condition where there is a deficiency in the hepatic enzymes responsible for heme synthesis. Porphyria is an unusual cause of abdominal pain, but abdominal pain is the most common finding in acute porphyria attacks. Acute attacks can be precipitated by drugs or physical states that further interfere with heme synthesis (eg, estrogens, barbiturates, phenytoin, ethanol, sulfonamides, infection, severe dietary restriction, and menstruation). (See "Pathogenesis, clinical manifestations, and diagnosis of acute intermittent porphyria").

- Familial Mediterranean fever – Familial Mediterranean fever is an autosomal recessive disorder characterized by recurring attacks of fever and serosal inflammation of the peritoneum, pleura, or synovium. Attacks begin with fever and peak symptoms occur in the first 12 hours. Abdominal pain is present in over 95 percent of cases. (See "Clinical manifestations and diagnosis of familial Mediterranean fever").

- Angioedema – Both acquired angioedema in the setting of underlying malignancy and hereditary angioedema can cause recurrent abdominal pain and pseudo-obstruction. (See "Hereditary angioedema: Epidemiology, clinical manifestations, exacerbating factors, and prognosis").

- Rectus sheath hematoma – Causes may include trauma, anticoagulation therapy, physical exertion, paroxysmal cough, pregnancy, leukemia, and hypertension.

- Systemic lupus erythematosus (SLE) – SLE involves the gastrointestinal tract, generally with nonspecific symptoms, in fewer than 50 percent of patients. However, several disorders that cause abdominal pain may be associated with SLE, including peritonitis, peptic ulcer disease, mesenteric vasculitis with intestinal infarction, pancreatitis, and inflammatory bowel disease. (See "Gastrointestinal manifestations of systemic lupus erythematosus").

- Henoch-Schönlein purpura (HSP [IgA vasculitis (IgAV)]) – HSP (IgAV) is a hypersensitivity vasculitis most commonly occurring in children, although adults may be affected. It is characterized by palpable purpura, arthralgias, hematuria secondary to glomerulonephritis, colicky abdominal pain, nausea, vomiting, and diarrhea. (See “Henoch-Schönlein purpura (immunoglobulin A vasculitis): Clinical manifestations and diagnosis").

- Polyarteritis nodosa – Polyarteritis nodosa is a systemic disease that includes gastrointestinal symptoms in greater than 50 percent of cases. These may include abdominal pain, nausea, vomiting, diarrhea, and bleeding. Up to a third of patients will develop surgical complications, such as bowel infarction, perforation, or hemorrhage, associated with high mortality. (See "Clinical manifestations and diagnosis of polyarteritis nodosa in adults").

- Eosinophilic enteritis – Eosinophilic enteritis is a rare cause of recurrent right lower quadrant
The combination of a careful history and physical examination can often distinguish between organic and nonorganic causes of abdominal pain and is crucial for creating a focused and appropriate differential diagnosis. When trying to determine the etiology of a patient's abdominal pain it is important to consider the patient's age, sex, past medical and surgical history, and medications, and to characterize the pain as precisely as possible (table 2). (See 'Characterization of pain' below.)

The elderly are far more likely to have severe disease and "atypical" symptoms [14,25,26]. The risk for certain diseases, such as ruptured abdominal aortic aneurysm (AAA), mesenteric ischemia, atypical presentations of myocardial infarction, and colon cancer increases significantly in patients older than 50 years. The clinician must remember that older patients often present with different symptoms and signs than younger patients and take medications, such as prednisone, that mask classic symptoms and signs. As an example, older patients diagnosed surgically with cholecystitis presented far more often with nausea or vomiting than pain, and among those over 65 years, 84 percent had neither epigastric nor right upper quadrant pain [26]. (See "Evaluation of the adult with abdominal pain", section on 'History' and "Causes of abdominal pain in adults".)

In women of childbearing age, pregnancy status must be determined. If the patient is pregnant, the differential diagnosis includes complications of pregnancy such as an ectopic gestation and preeclampsia. However, pregnant patients are also at risk for common diseases such as appendicitis and cholecystitis. (See "Approach to abdominal pain and the acute abdomen in pregnant and postpartum women".)

- Hypercalcemia – Patients presenting with hypercalcemia can present with vague abdominal pain. The pain is associated with anorexia, nausea, vomiting and constipation. (See "Clinical manifestations of hypercalcemia".)

- Spider bite (Lactrodectus mactans) – Venom from this species stimulates release of acetylcholine peripherally and centrally, and symptoms usually begin within one to eight hours. Some patients may develop abdominal pain without physical findings while others present with board-like rigidity, although bowel sounds are normal. (See "Approach to the patient with a suspected spider bite: An overview".)

- Thoracic nerve root dysfunction – Thoracic nerve root dysfunction can present with severe constant abdominal pain that becomes worse at night. There may be associated loss of pinprick sensation over the abdominal wall.

- Glaucoma – Typical symptoms of acute glaucoma include ocular pain and decreased vision. However, abdominal discomfort, nausea, and headache can occur. (See "Open-angle glaucoma: Epidemiology, clinical presentation, and diagnosis".)

- Pheochromocytoma – Pheochromocytoma is a rare catecholamine secreting tumor with a classic presentation of headache and hypertension. Nausea is common and epigastric pain may occur. (See "Clinical presentation and diagnosis of pheochromocytoma".)

- Ovarian hyperstimulation syndrome – This gynecologic emergency occurs in women undergoing ovulation induction. Multiple, large ovarian cysts can precipitate acute fluid shifts with depletion of intravascular fluid and a shock-like syndrome. Consider the diagnosis in women taking fertility medications who present with abdominal pain. (See "Pathogenesis, clinical manifestations, and diagnosis of ovarian hyperstimulation syndrome".)

**HISTORY** — The combination of a careful history and physical examination can often distinguish between organic and nonorganic causes of abdominal pain and is crucial for creating a focused and appropriate differential diagnosis. When trying to determine the etiology of a patient's abdominal pain it is important to consider the patient's age, sex, past medical and surgical history, and medications, and to characterize the pain as precisely as possible (table 2). (See 'Characterization of pain' below.)
Genitourinary causes of abdominal pain are numerous and should not be overlooked in nonpregnant women and men. Inquire about vaginal bleeding or discharge, recent changes in menstruation, dysuria or hematuria, penile discharge, and scrotal pain or swelling, and any recent trauma.

Clinicians should consider both intra- and extra-abdominal causes of pain (Table 1). Upper abdominal symptoms may reflect thoracic disease, particularly in elder patients, so it is important to ask about such symptoms as dyspnea, cough, and palpitations.

Preexisting medical and surgical conditions and medications can increase a patient’s risk for specific diseases. As an example, a history of cardiovascular or peripheral vascular disease corresponds with an increased risk for mesenteric ischemia and AAA. A history of atrial fibrillation or heart failure places patients at risk for mesenteric ischemia from emboli or low-flow respectively. A history of HIV predisposes to opportunistic infection or a medication-related complication (e.g., pancreatitis or renal colic). Previous surgery increases the risk for bowel obstruction. A history of nonsteroidal antiinflammatory drug (NSAID) use predisposes to peptic ulceration and bleeding. Concurrent antibiotic or steroid use may mask infections, while some antibiotics increase the risk for Clostridium difficile colitis. (See “Evaluation of abdominal pain in the HIV-infected patient” and “Clostridium difficile infection in adults: Clinical manifestations and diagnosis”.)

The social history can be of great importance. Alcohol abuse places patients at risk for pancreatitis, hepatitis, cirrhosis, and spontaneous bacterial peritonitis. Abdominal pain and nausea often figure prominently among the symptoms of patients withdrawing from opioids. Smokers have a greater risk of bladder and other cancers that may cause abdominal pain [27]. (See “Opioid withdrawal in the emergency setting”.)

An occupational and travel history may help to identify unusual causes. Occupational exposures to toxins or chemicals, recent travel, or similar symptoms among family or friends may be important clues indicative of a nonsurgical cause of pain.

**PAIN DESCRIPTION**

**Types of pain** — Abdominal pain can be divided into three types: visceral, parietal (or somatic), and referred. The neurologic basis of abdominal pain is discussed in detail elsewhere. (See “Causes of abdominal pain in adults”, section on ‘Pathophysiology of abdominal pain’.)

Visceral pain fibers originate in the walls of hollow organs and the capsules of solid organs and enter the spinal cord bilaterally at multiple levels. Thus, stimulation of visceral nerves produces a dull, poorly localized pain felt in the midline. Pain is perceived in the abdominal region corresponding to the diseased organ’s embryonic origin. Visceral pain from structures that originated from the foregut (stomach, pancreas, liver and gallbladder, and proximal duodenum) manifests in the epigastrium; visceral pain from structures of the midgut (remainder of duodenum, small bowel, proximal large bowel) manifests in the periumbilical region; and visceral pain from structures of the hindgut (middle and distal large bowel, pelvic genitourinary organs) manifests in the suprapubic region. Ischemia, inflammation, or distention of hollow organs or capsular stretching of solid organs produces visceral type pain.

Parietal pain stimuli are transmitted to specific dorsal root ganglia on the same side and dermatomal level as the origin of the pain. Therefore the pain is more distinct (usually sharper) and localized. Ischemia, inflammation, or stretching of the parietal peritoneum produces parietal pain.

Referred pain is felt at a site far from the diseased organ (e.g., gallbladder disease experienced as pain in the right subscapular area, a perforated duodenal ulcer causing shoulder pain secondary to...
diaphragmatic irritation). Shared central pathways for afferent neurons from different locations cause this phenomenon.

Characterization of pain — Accurate characterization of abdominal pain includes:

- Onset (eg, sudden, gradual)
- Provocative and palliating factors (eg, does pain decrease after eating?)
- Quality (eg, dull, sharp, colicky, waxing and waning)
- Radiation (eg, to the shoulder, back, flank, groin, or chest)
- Site (eg, a particular quadrant or diffuse)
- Symptoms associated with pain (eg, fever, vomiting, diarrhea, bloody stool, vaginal discharge, painful urination, shortness of breath)
- Time course (eg, hours versus weeks, constant or intermittent)

A table summarizing high-risk features of abdominal pain is provided (table 2).

Location may help to narrow the differential diagnosis (table 3). Pain from abdominal viscera often localizes according to the structure's embryologic origin, with foregut structures (mouth to proximal half of duodenum) presenting with upper abdominal pain, midgut structures (distal half of duodenum to middle of the transverse colon) presenting with periumbilical pain, and hind gut structures (remainder of colon and rectum, pelvic genitourinary organs) presenting with lower abdominal pain.

Right upper quadrant pain is often associated with the liver or gallbladder, although pain from biliary colic may be poorly localized and patients may complain of lower chest, epigastric, or back discomfort [28]. Other causes of right upper quadrant pain include myocardial infarction, right lower lobe pneumonia, and right-sided pulmonary embolus (PE) [29]. Left upper quadrant pain can be from pancreatitis, gastric disease, or splenic enlargement. Other causes include left lower lobe pneumonia and myocardial infarction. Both appendicitis and ectopic pregnancy may present with right lower quadrant pain. Diverticulitis usually presents with left lower quadrant pain.

However, clinicians should not base the differential diagnosis solely upon the location of pain; diagnosis and pain location often do not correspond [30]. As an example, the diagnosis of appendicitis in patients presenting with right upper quadrant pain may be missed if the clinician fails to consider that retrocecal appendicitis can present in this manner. One study looking at patterns of abdominal pain found that only 60 to 70 percent of patients would be correctly diagnosed based on "typical" exam findings alone, yielding a misdiagnosis rate of 30 to 40 percent [31].

Pain location may change over time, reflecting progression of disease. As a classic example, the pain of appendicitis may begin as periumbilical (reflecting its embryologic origin), but move to the right lower quadrant as the inflamed appendix irritates the peritoneum. Another example would be the changing location of pain associated with an extending aortic dissection. Radiation of pain may aid diagnosis (figure 1). As examples, pain from pancreatitis may radiate to the back while pain from gallbladder disease may radiate to the right shoulder or subscapular region.

Pain acuity, duration, and intensity can provide clues to disease severity [3,31,32]. Pain with maximum intensity at onset is concerning for abdominal or extraabdominal vascular emergencies (eg, aortic rupture or dissection, mesenteric ischemia, PE) [33]. The sudden onset of significant pain often reflects a serious underlying disorder, such as organ perforation or ischemia (eg, acute mesentery artery occlusion, ovarian torsion), or obstruction of a small tubular structure (eg, biliary tract or ureter). A more gradual onset of symptoms suggests an inflammatory or infectious process (eg, appendicitis, diverticulitis), or obstruction of a large tubular structure (eg, bowel). Severe pain of
sudden onset and constant or worsening pain lasting over six hours (but less than 48 hours) suggest a surgical cause. Nonsurgical causes tend to be less painful.

Aggravating and alleviating factors are important. The pain of peptic ulcer disease may improve after meals, whereas biliary colic worsens after meals. Pancreatitis pain may improve when the patient sits upright and increase when the patient reclines. Patients with peritonitis lie still and coughing can worsen their pain, whereas the patient with nephrolithiasis is restless and cannot find a comfortable position. Ask the patient whether going over bumps during the drive to the hospital caused pain. A positive response suggests peritonitis and is roughly 80 percent sensitive, but only 52 percent specific, for appendicitis [10].

The character of the abdominal pain is often linked to a specific diagnosis. Burning pain is associated with an ulcer, tearing pain with aortic dissection, and colicky or crampy pain with distention or stretching of a hollow tube, such as with kidney stones in the ureter. Sharp pain develops when inflammation or noxious stimuli (eg, blood, stomach acid, bowel contents) contact parietal peritoneum.

Associated symptoms can help narrow the diagnosis, especially with extraabdominal causes. Inquire about fever, cough, dyspnea, and chest pain, since pneumonia, pulmonary embolism, and myocardial infarction can all present with abdominal pain [23]. Though vomiting and nausea are nonspecific, the order of these symptoms may provide a clue to the diagnosis. If vomiting occurs after the onset of pain, the pain is more likely to stem from a surgical process, such as bowel obstruction [3]. Vomiting from relatively benign causes is usually self-limited. The type of vomiting may suggest a diagnosis. Bilious vomiting may be caused by an obstruction distal to the duodenum. Causes of coffee-ground or hematemesis include peptic ulcer disease, varices, and, in patients with a history of aortic aneurysm repair, aortoenteric fistula. Diarrhea is often associated with an infectious cause or diverticulitis, but can occur with mesenteric ischemia, in which case it may be bloody, or possibly bowel obstruction.

Associated genitourinary symptoms can be important. In women, inquire about vaginal bleeding or discharge and recent changes in menstruation; in men, inquire about penile discharge and scrotal pain or swelling. (See "Approach to vaginal bleeding in the emergency department".)

Keep in mind that the presentation and characteristics of abdominal pain may be dramatically different in elder patients despite the presence of a life-threatening condition. As an example, a perforated ulcer may present without the sudden onset of pain [28]. (See 'History' above.)

PHYSICAL EXAMINATION — Begin the physical examination by assessing the vital signs. Though fever increases the suspicion for infection, there are certain patient populations, such as the elderly and the immunocompromised, that may be unable to mount a fever. Elderly patients with an intraabdominal infection are four times more likely than younger patients to present with hypothermia [2]. An oral temperature may be affected by respiratory rate, which is often elevated in those with pain [34]. If there is concern about an inaccurate reading, check a rectal temperature. An elevated respiratory rate may itself be a compensatory reaction and should alert the clinician to the possibility of underlying metabolic acidosis.

Next, inspect the patient. While requiring only a few seconds, inspection can provide many clues to the diagnosis. The patient who is restless, curled up, and agitated may suggest renal colic, while a patient lying perfectly still in bed with knees bent raises concern for peritonitis. Inspection may reveal signs of previous surgeries (eg, midline incision scar), abdominal pulsations, or signs of systemic disease (eg, pallor in shock, spider angioma in cirrhosis), which can be especially important in
those who are unable to provide a history.

On auscultation, listen for bowel sounds for two minutes. Bowel sounds are normally heard as two to twelve medium-pitched gurgles per minute. The absence of bowel sounds over two minutes suggests peritonitis. Hyperactive medium-pitched bowel sounds are associated with blood or inflammation within the gastrointestinal (GI) tract. Periodic rushes of high-pitched "tinkling" bowel sounds or the complete absence of bowel sounds, in the presence of abdominal distention, suggests bowel obstruction [35]. A bruit may be heard in the presence of an abdominal aortic aneurysm (AAA).

Palpation of the abdomen enables the clinician to identify the location and degree of tenderness and to detect signs of peritoneal irritation, such as involuntary guarding and rigidity. One approach is to initially perform light palpation in the area away from the site of pain. Palpation can then be extended in either a clockwise or counterclockwise rotation towards the area of maximal pain. Once the area of maximal tenderness is localized, maneuvers to elicit somatic signs can be performed. If a specific area of tenderness is not identified with light palpation, deeper palpation can be performed to identify other abnormalities such as hepatomegaly, splenomegaly, aortic dilatation, or signs of a retrocecal appendix.

The few studies that have looked at traditional techniques for assessing rebound tenderness suggest that these tests have limited sensitivity and specificity [36,37]. Gentler methods to elicit signs of peritoneal irritation include having the patient cough or drop their heels to the ground after standing on their toes [38,39]. The heel test can also be performed by striking a recumbent patient's heel. Studies of these tests are limited and their characteristics remain uncertain. Nevertheless, a rigid abdomen is cause for concern.

In patients older than 50 years, it is worthwhile and safe to attempt to palpate the aorta. To do so, have the patient lie supine with their feet on the stretcher and knees bent, thereby relaxing the abdominal wall musculature. Abnormal width of the aortic pulsation suggests the diagnosis of AAA. Depending upon the patient's body habitus and their aortic anatomy, the accuracy of the physical examination for detecting an AAA may be limited, but it can provide important information.

**Other examination findings to note include Carnett's sign, Murphy's sign, obturator sign, psoas sign, and Rovsing's sign.** In Carnett's sign, there is increased tenderness when the abdominal wall muscles are contracted. Tenderness exacerbated by muscular contraction is more likely to be due to pathology within the abdominal wall. In one small study, Carnett's sign was found to be 95 percent accurate at distinguishing abdominal wall pain from visceral pain [40].

Although insensitive, the psoas, obturator, and Rovsing signs have good specificity for acute appendicitis. A positive psoas sign consists of pain elicited when the examiner passively extends the right hip of the patient, who lies on their left side. A positive psoas sign may be seen with a retrocecal appendix. A patient with a pelvic appendix may have a positive obturator sign. Pain elicited when the clinician performs passive internal rotation of the flexed right thigh represents a positive test. Rovsing's sign consists of pain in the right lower quadrant elicited by palpation of the left lower quadrant. (See "Acute appendicitis in adults: Clinical manifestations and differential diagnosis", section on 'Physical examination'.)

Murphy's sign occurs when a patient abruptly stops a deep inspiration during palpation of the right upper quadrant. This test can be useful in some patients with suspected cholecystitis, but its sensitivity may be diminished in the elderly [41,42].

Perform testicular examinations in men and pelvic examinations in females with pain in the lower half of the abdomen. No preexamination criteria exist that enable the clinician to determine if the pelvic
examination will provide useful information [6]. Pain from pelvic inflammatory disease (PID) may not
be localized to the suprapubic region. The rectal examination may reveal a mass or gastrointestinal
bleeding, but its usefulness in patients with undifferentiated abdominal pain and no gastrointestinal
bleeding has been questioned [43,44]. (See "Evaluation of the acute scrotum in adults" and "The
gynecologic history and pelvic examination").

Physical examination cannot reliably predict or exclude significant disease in the elderly [12].
Abdominal tenderness may not localize because of changes in the nervous system affecting pain
perception. Rebound or guarding may not be present because of lax abdominal wall musculature. In
one retrospective study looking at elderly in-patients with peritonitis, only 34 percent manifested
Guarding or rebound tenderness [45].

Physical examination can be difficult during pregnancy. Pregnant patients may have fewer clinical
findings and may not demonstrate peritoneal signs [46]. This may be a result of the gradual growth
and stretching of the peritoneal cavity, which desensitizes the pregnant patient to peritoneal irritation.
(See "Approach to abdominal pain and the acute abdomen in pregnant and postpartum women",
section on 'General principles'.)

Many extraabdominal causes of abdominal pain exist and the clinician should not neglect other parts
of the physical examination. Auscultate the heart and lungs. Atrial fibrillation noted on physical exam
may increase suspicion for mesenteric ischemia. Localized decreased breath sounds or coarse
breath sounds may raise suspicion for pneumonia. Palpate the chest wall, spine, and pelvis. Pain at
the costovertebral angles may suggest pyelonephritis. Assess hip range of motion as infectious and
inflammatory processes can refer pain to the lower abdomen.

The skin exam is important and often overlooked. This is especially true in the elderly, who have a
higher incidence of herpes zoster. Ecchymosis of the abdomen (Cullen's sign) or flank (Grey Turner's
sign (image 1)) suggests intraabdominal or retroperitoneal hemorrhage, possibly caused by a
ruptured or leaking AAA or hemorrhagic pancreatitis. The skin may be cool and damp in patients with
shock. (See "Clinical manifestations of varicella-zoster virus infection: Herpes zoster", section on
'Clinical manifestations'.)

In a patient with equivocal signs and symptoms, serial examinations can improve diagnostic
accuracy [47].

ANCILLARY STUDIES — The clinician should not rely on ancillary studies to make a diagnosis but
should use them as adjuncts. In one small prospective study assessing diagnostic testing for
nontraumatic abdominal pain in the emergency department (ED), diagnostic tests led to a change in
diagnosis in 37 percent of patients and a change in disposition in 41 percent [48].

Laboratory tests — In an otherwise healthy adult, laboratory tests should generally only be ordered
to rule in a clinically suspected diagnosis or to assess a patient with an acute abdomen of unclear
etiology. The threshold for ordering a broader range of tests is lower for the immunosuppressed,
elderly patients unable to provide a comprehensive history (eg, nonverbal, altered mental status),
and those with significant underlying disease (eg, diabetes, cancer, HIV, cirrhosis).

A pregnancy test is required in women of child-bearing age. Either a urine or serum qualitative
human chorionic gonadotropin (hCG) test may be used. Both tests are extremely sensitive. Patient
self-assessment of pregnancy status is not uniformly reliable [49]. (See "Ectopic pregnancy: Clinical
manifestations and diagnosis").

A bedside fingerstick glucose should be performed immediately in seriously ill patients and known
diabetics to assess for hyperglycemia and exclude the diagnosis of diabetic ketoacidosis. If the patient is hyperglycemic, basic electrolyte measurements should be obtained to assess the severity of disease.

Although often ordered, the complete blood count (CBC) is nonspecific and rarely alters management [48,50,51]. While the white blood cell count may be elevated in up to 80 percent of patients with acute appendicitis [51], it is also elevated in 70 percent of patients with other causes of right lower quadrant abdominal pain [52]. Of note, older or immunocompromised patients with an acute abdomen can present with normal leukocyte counts [53], while healthy pregnant patients can have a leukocytosis. (See “Hematologic changes in pregnancy” and “Causes of abdominal pain in adults”.)

Patients with clinically significant upper or mid abdominal pain should have liver and pancreatic enzyme concentrations measured. Elevations in serum amylase concentrations are neither sensitive nor specific for pancreatitis, and may indicate a more ominous process, such as mesenteric ischemia or bowel perforation. Serum lipase is more sensitive and specific than amylase for pancreatitis, but elevations may be caused by a number of diseases. Elevation in the serum total bilirubin and alkaline phosphatase concentrations are not common in uncomplicated cholecystitis. (See “Clinical manifestations and diagnosis of acute pancreatitis” and “Approach to the patient with elevated serum amylase or lipase” and “Approach to the patient with abnormal liver biochemical and function tests”.)

Urinalysis can provide useful information but can also be misleading. The presence of pyuria, proteinuria, and hematuria suggests the diagnosis of urinary tract infection (UTI), but these findings may also be present with acute appendicitis or any inflammatory process occurring adjacent to either ureter. About 20 to 48 percent of patients with appendicitis have blood, leukocytes, or bacteria in their urine [54,55]. Of note, many elderly patients have chronic, mild pyuria. Hematuria may be present in as many as 87 percent of patients with AAA, which can lead to the misdiagnosis of nephrolithiasis [56]. (See “Acute uncomplicated cystitis and pyelonephritis in women” and “Acute appendicitis in adults: Clinical manifestations and differential diagnosis”.)

Plain radiographs — Indiscriminate use of plain radiographs to assess general abdominal pain is an extremely low-yield practice [57,58]. Only a small percentage is abnormal. Plain radiographs can be helpful when bowel obstruction, bowel perforation, or a radiopaque foreign body is suspected, but cannot be relied upon to exclude these disorders.

The diagnosis of bowel perforation can be confirmed by the presence of free intraperitoneal air on an upright chest radiograph (image 2). The location of the perforation determines the likelihood of detecting free air. With gastroduodenal perforation, free air is present in only two-thirds of cases; with perforation of the distal small bowel or large bowel, free air is present in one-third of cases. Sensitivity decreases further in patients with previous abdominal surgery or a walled off perforation [59]. If free air is not seen on a posteroanterior (PA) upright chest radiograph, an upright lateral chest radiograph can be obtained, which is more sensitive for pneumoperitoneum (image 3 and image 4) [60]. A left lateral decubitus radiograph can be obtained in patients too ill for upright films and may detect free air over the diaphragm above the liver edge (image 5).

Approximately 5 mL of free air is detected by plain abdominal radiography, while an upright chest radiograph detects as little as 1 to 2 mL after the patient has been upright for 5 to 10 minutes [59,61]. Detection can be improved by placing a nasogastric tube and injecting 50 mL of air or water soluble contrast.

Overall, plain radiographs are up to 69 percent sensitive and 57 percent specific for patients
ultimately diagnosed with an obstruction [62]. The radiographic finding of a curvilinear array of small gas bubbles ("string of beads" sign) is pathognomonic for small bowel obstruction (SBO) (image 6) [59]. This occurs when small gas bubbles collect between the valvulae conniventes floating in a fluid-filled bowel. If the small bowel is dilated more than 2.5 cm, obstruction is likely. Other findings consistent with SBO include gaseous distention and air-fluid levels.

Initial radiographs in patients with mesenteric ischemia are often unremarkable. Abnormal findings correlate with increased mortality. Late findings include ileus, "thumbprinting," and intramural air (pneumatosis intestinalis). In one study, patients with these findings had a mortality of 78 percent compared with 29 percent mortality in patients with normal radiographs [63].

**Ultrasound** — Ultrasound is rapid and can be performed at the bedside. Because of the lack of radiation exposure, it is the study of choice in pregnancy. It is the initial study of choice when abdominal aortic aneurysm (AAA) (image 7) or gallbladder disease (image 8 and image 9) is suspected. It can provide useful information about many conditions, such as ectopic pregnancy (image 10), hemoperitoneum (image 11), renal colic (hydronephrosis may be seen) (image 12), pancreatitis, and venous thrombosis. It is not useful for detecting free air (eg, from a bowel perforation) or retroperitoneal bleeding.

One preliminary prospective observational study of 1021 patients with nontraumatic acute abdominal pain presenting to the emergency department (ED) found that an imaging strategy in which computed tomography (CT) was performed only after a negative or inconclusive ultrasound (performed in all study patients) improved sensitivity for urgent diagnoses and reduced radiation exposure [64]. Another prospective observational study using a consecutive sample of 128 patients presenting to the ED with nonspecific abdominal pain reported that bedside ultrasound would lead to improved diagnostic accuracy and reductions in the use of additional imaging studies and other tests when evaluating such patients [65]. Controlled studies are needed to confirm the effectiveness of this approach.

**Computed tomography scan** — Computed tomography (CT) is the study of choice in the evaluation of undifferentiated abdominal pain [66]. Approximately two-thirds of patients presenting to the ED with acute abdominal pain have a disease that can be diagnosed by CT [61]. One small retrospective study found that CT correctly diagnosed the cause of pain among patients with an "acute abdomen" in 90 percent of cases, compared with 76 percent of cases diagnosed correctly by history and physical examination alone [67]. CT is particularly useful in the elderly, establishing or suggesting the diagnosis in 75 percent of cases and 85 percent of emergent surgical conditions [1], but in the ED population at large, nonenhanced helical CT outperforms plain radiographs in the diagnosis of nontraumatic abdominal pain [68,69].

Ultrasound is the initial study of choice for unstable patients with suspected abdominal aortic aneurysm (AAA) leak or rupture. However, in stable patients with AAA, CT is an excellent study for defining aortic size and the extent of the aneurysm. Retroperitoneal hemorrhage can also be identified. Hemorrhage can be visualized in nonenhanced scans making IV contrast unnecessary in emergent situations or when IV contrast dye may be contraindicated. CT is not limited by bowel gas or obesity and has a sensitivity of nearly 100 percent in diagnosing AAA. (See "Clinical features and diagnosis of abdominal aortic aneurysm".)

Imaging is not necessary when the diagnosis of acute appendicitis is clear based upon clinical evaluation. However, CT with oral and IV contrast is a sensitive and specific study for diagnosing acute appendicitis. In some patient populations, CT without contrast demonstrates comparable accuracy. When using noncontrast CT to diagnose appendicitis, the most important findings are the
inflammatory changes in the pericecal and periappendiceal fat. Therefore, the diagnosis can be missed in young, slender patients with little retroperitoneal and mesenteric fat. CT, even unenhanced, is extremely useful and sensitive in diagnosing free air [66]. The use of imaging to diagnose acute appendicitis is discussed separately. (See "Acute appendicitis in adults: Clinical manifestations and differential diagnosis", section on 'Imaging studies'.)

Improvements in the quality of images provided by contemporary CT scanners have raised questions about the need for contrast. One prospective study compared the performance of noncontrast and contrast-enhanced CT in a convenience sample of patients with acute abdominal pain, and found the two modalities had a simple agreement of 79 percent (95% CI 70-87) [70]. Another prospective study of a convenience sample of 72 ED patients presenting with acute nontraumatic abdominal pain and initially evaluated with a noncontrast CT reported no missed diagnoses of consequence (defined as causing death or requiring abdominal surgery) in the seven days following their initial presentation [71].

In patients with concern for mesenteric ischemia, an accurate and less invasive alternative to standard angiography is CT angiography (CT-A). CT-A allows for visualization of the mesenteric vasculature and shows changes consistent with bowel infarction [72]. In addition, CT-A reveals other abdominal pathology when ischemia is not the cause of abdominal pain and is useful in the evaluation of gastrointestinal bleeding with the ability to detect bleeding rates of 0.3 mL/min [73]. (See "Chronic mesenteric ischemia" and "Nonocclusive mesenteric ischemia", section on 'Plain abdominal films' and "Mesenteric venous thrombosis in adults", section on 'Imaging' and "Overview of intestinal ischemia in adults", section on 'Advanced abdominal imaging'.)

**Angiography** — Angiography can be helpful in the diagnosis and treatment of mesenteric ischemia. Injection of papaverine into the superior mesenteric artery can help relieve vascular occlusion. However, if the patient is in shock or requiring vasopressors, diagnosis should be made during laparotomy. Angiography has no role in the emergent evaluation of ruptured AAA. (See "Nonocclusive mesenteric ischemia", section on 'Plain abdominal films' and "Mesenteric venous thrombosis in adults", section on 'Imaging' and "Overview of intestinal ischemia in adults", section on 'Advanced abdominal imaging'.)

**APPROACH TO DIAGNOSIS**

**Patients over 50** — Be wary of older patients with abdominal pain. Many older patients have significant illness and yet may present without signs, symptoms, or laboratory values that reflect the seriousness of their disease [25]. An algorithm for the management of these patients is provided (algorithm 1).

Standard presentations of major diseases provide the initial basis for assessment, even in older patients, but clinicians must remain mindful of so-called "atypical" presentations of common diseases and extraabdominal causes of abdominal pain (eg, myocardial infarction). Medications such as beta blockers and glucocorticoids and comorbidities such as diabetes are more common among the elderly, and likely to mask symptoms and signs.

The emergency clinician's first priority is to look for life-threatening conditions. Patients presenting in shock or with peritoneal signs require immediate surgical consultation. While resuscitating the patient, perform bedside ultrasound to gain crucial information about aortic diameter, peritoneal fluid, gallstones, and hydronephrosis. A portable left lateral decubitus radiograph may reveal free air.

Dangerous and common diagnoses to consider in the elderly include:
For hemodynamically stable patients, base the approach on the history and physical examination. For patients with risk factors for AAA, pain radiating to the back, a pulsatile abdominal mass, or a known history of AAA, the clinician should perform a bedside ultrasound and obtain surgical consultation. Stable patients can subsequently undergo a CT scan, which provides information on the extent and location of the aneurysm. Early surgical consultation is important in the event the patient deteriorates during evaluation and may be appropriate even if the CT does not clearly show aortic pathology. Chest pain which extends to the abdomen, particularly when associated with neurological symptoms, suggests a thoracoabdominal aortic dissection.

Mesenteric ischemia is another life-threatening diagnosis to be considered in patients over age 50 with associated risk factors (eg, atherosclerotic disease, low cardiac output, atrial fibrillation, hypercoagulable states). Pain is often sudden and severe; the pathognomonic finding of "pain out of proportion to exam" may be present. In patients at risk for mesenteric ischemia, obtain CT angiography of the abdomen and early surgical consultation. Blood in the stool and elevated serum lactate concentrations may not be present initially. (See "Overview of intestinal ischemia in adults".)

An abdominal radiograph series can provide crucial information quickly in patients with diffuse tenderness or distention associated with vomiting or abdominal rigidity. If free air is identified, obtain immediate surgical consultation. If signs of bowel obstruction are identified, perform a CT scan to determine the cause and site of the obstruction. CT is also necessary when plain radiographs are nondiagnostic in these patients. (See "Acute colonic diverticulitis: Medical management" and "Overview of the complications of peptic ulcer disease" and "Epidemiology, clinical features, and diagnosis of mechanical small bowel obstruction in adults".)

Obtain a chest radiograph in elderly patients with upper abdominal pain or with symptoms or examination findings suggestive of pneumonia. Obtain an electrocardiogram in both unstable and stable elderly patients with upper abdominal pain. Myocardial infarction can manifest as nausea, vomiting, and epigastric discomfort. (See "Criteria for the diagnosis of acute myocardial infarction".)

In the absence of the above clinical scenarios, the site of abdominal pain helps to guide the workup (table 3). The differential diagnosis of epigastric/right upper quadrant pain includes diseases of the liver and biliary system. Biliary tract disease is among the most common causes of abdominal pain in the elderly [74,75]. An ultrasound can help delineate pathology within the gallbladder or liver. Liver function tests (LFTs) and lipase may be helpful in determining the cause of right upper quadrant pain and potential complications of gallstones (eg, pancreatitis). However, LFTs may not be abnormal in...
elder patients or cases of uncomplicated cholecystitis. (See "Approach to the patient with abnormal liver biochemical and function tests").

For patients with tenderness in the lower quadrants, the differential diagnosis differs depending upon the patient's gender and age. In females, a pelvic examination is essential for diagnosis and to guide the selection of imaging studies. Pelvic pain is best evaluated with ultrasound. The patient with a normal pelvic exam, a negative pregnancy test, and concerning abdominal pain is best evaluated with a CT scan.

A testicular and scrotal examination is essential for male patients with lower quadrant abdominal pain. Patients with testicular tenderness or a tender scrotal mass require urologic consultation and a testicular ultrasound. Although more common in younger men, testicular torsion can occur in older patients. Consult a urologist immediately, prior to the performance of any studies, when torsion is suspected. Incarcerated inguinal hernia is more common in elder males. (See "Evaluation of the acute scrotum in adults").

Patients with a normal genitourinary examination can be grouped according to the clinician's suspicion for appendicitis. A male patient likely to have appendicitis requires prompt surgical consultation, as he may be taken to the operating room without further studies. If suspicion for appendicitis is not high, the options are to order a CT scan or observe the patient and perform serial examinations. For left lower quadrant pain, a CT scan is useful in diagnosing diverticulitis. While a CT scan is not necessary for all patients with suspected diverticulitis, the test is helpful in confirming the diagnosis in patients without a previous history of diverticular disease, and in assessing for complications (e.g., abscess formation) in patients with known disease who present with more than mild to moderate symptoms. (See "Acute appendicitis in adults: Clinical manifestations and differential diagnosis" and "Clinical manifestations and diagnosis of acute diverticulitis in adults").

The evaluation of patients with left upper quadrant tenderness follows the same decision tree as for right upper quadrant tenderness. Perform an ultrasound examination to evaluate for intraabdominal free fluid consistent with splenic rupture in patients with signs and symptoms of infectious mononucleosis, including Kehr's sign. Patients with a positive study require immediate surgical consultation. In the absence of a positive study, a CT scan may be useful.

Patients under 50 — The evaluation of patients under 50 years of age is similar to that of those over 50. However, in this age group abdominal aortic aneurysm, mesenteric ischemia, malignancy, and extra-abdominal causes of abdominal pain are much less likely, while common manifestations of disease are more likely. The evaluation for women under 50 is described immediately below. (See 'Women of childbearing age' below.)

Women of childbearing age — First determine whether the patient is unstable and identify peritoneal signs and shock. While resuscitating unstable patients, perform a bedside ultrasound looking for free fluid and signs of pregnancy. Obtain a pregnancy test, a blood type and cross match sample, and immediate surgical or gynecologic consultation. An algorithm for the management of these patients is provided (algorithm 2).

In stable patients, determine whether the patient is pregnant with a qualitative human chorionic gonadotropin (hCG). If so, perform an ultrasound and a sterile pelvic exam to assess for ectopic pregnancy and pelvic disease, and obtain a quantitative hCG. Immediate gynecologic consultation is required for any patient with an ectopic pregnancy. (See "Ectopic pregnancy: Clinical manifestations and diagnosis" and "Ultrasonography of pregnancy of unknown location").

Patients with an uncomplicated intrauterine pregnancy and concerning abdominal pain need further
evaluation. Appendicitis is the most common surgical disease encountered during pregnancy; ultrasound is the diagnostic study of choice to assess for appendicitis during pregnancy. Contrary to common teaching, the area around McBurney’s point is the most common location of pain in pregnant patients with appendicitis regardless of gestational age. Changes associated with pregnancy can make the diagnosis difficult. As examples, leukocytosis can be a normal finding and nausea, vomiting, and malaise occur often during the first trimester. Keep in mind that microscopic hematuria and pyuria occur in up to one-third of patients with acute appendicitis. Be wary of attributing concerning abdominal pain to a urinary tract infection (UTI). Obtain surgical and gynecologic consultation for patients with confirmed or suspected appendicitis. (See "Acute appendicitis in pregnancy" and "Approach to abdominal pain and the acute abdomen in pregnant and postpartum women").

For nonpregnant patients, further evaluation is guided by history and findings on abdominal and pelvic examination. Keep in mind extra-abdominal causes of pain. As an example, women with acute coronary syndrome are more likely to present with so-called atypical symptoms.

Transvaginal ultrasound is helpful to evaluate for ovarian torsion or ruptured ovarian cyst in patients with a consistent history or unilateral adnexal tenderness. Often these entities present with the sudden onset of sharp, lower abdominal pain associated with nausea. (See "Ovarian and fallopian tube torsion" and "Evaluation and management of ruptured ovarian cyst").

Stable patients with pelvic inflammatory disease (PID) by history and examination may need no further studies and can be treated with oral antibiotics and close follow-up as outpatients. For patients with PID and more severe symptoms (eg, persistent vomiting, toxic appearing, unstable vital signs), inpatient treatment with IV antibiotics is appropriate. (See "Pelvic inflammatory disease: Clinical manifestations and diagnosis").

Differentiating appendicitis from PID may be difficult without imaging, and misdiagnosis increases morbidity [76]. Clinical factors favoring appendicitis include migration of pain and the presence of nausea, vomiting, or anorexia [76-78]. Factors favoring PID include pain or tenderness outside the right lower abdomen, vaginal discharge, and cervical motion tenderness.

In women without pelvic findings but with predominantly right lower quadrant pain, evaluation for possible appendicitis can be performed with either CT scan or ultrasound. Imaging with MRI is an accurate, alternative approach that may be useful for making the diagnosis of appendicitis, particularly when trying to avoid radiation exposure. Other causes of right lower quadrant abdominal pain to consider include: UTI, nephrolithiasis, endometriosis, and neoplasm. Neoplasm is more common in women over 35 and may be accompanied by vaginal bleeding. (See "Acute appendicitis in pregnancy" and "Diagnosis and acute management of suspected nephrolithiasis in adults" and "Endometriosis: Pathogenesis, clinical features, and diagnosis" and "Approach to vaginal bleeding in the emergency department" and "Acute complicated cystitis and pyelonephritis").

Victims of domestic violence may present to the emergency department with abdominal or pelvic pain [79,80]. Particularly when the diagnosis is unclear in a young woman, clinicians should inquire about violence. (See "Evaluation and management of adult sexual assault victims" and "Intimate partner violence: Diagnosis and screening").

**HIV-infected patients** — The differential diagnosis and evaluation of HIV-infected patients with abdominal pain is reviewed separately. (See "Evaluation of abdominal pain in the HIV-infected patient").

**ANALGESIA** — At one time it was believed that analgesia interferes with the assessment of patients
with abdominal pain [81]. Multiple randomized controlled trials have disproved this notion, and patients being evaluated for abdominal pain in the emergency department (ED) should be treated judiciously with appropriate analgesics [82-86]. According to a systematic review of these studies, opioids can alter the physical examination of patients with acute abdominal pain but they do not increase the number of incorrect management decisions [85].

**Morphine** in doses of 0.05 to 0.10 mg/kg IV (typical adult dose 2 to 5 mg IV), given approximately every 15 minutes until pain is controlled, is one reasonable approach. If a shorter acting agent is desired, **fentanyl**, at doses of 0.1 to 0.3 mcg/kg IV (typical adult dose 10 to 25 mcg), can be given in five minute intervals until pain is controlled. Careful monitoring of drug effects, particularly respiratory drive, is essential for any patient being treated with opioids. Patients with opioid dependency or chronic pain generally require larger doses.

Small randomized trials of adults with non-traumatic abdominal pain treated in the ED have found that patient-controlled analgesia with **morphine** produced greater reductions in pain and no clinically significant differences in adverse events when compared to standard management using the same medication [87,88]. In addition, a small, randomized, double-blinded trial of adults with primarily non-traumatic abdominal or flank pain found that a non-dissociative dose of **ketamine** (0.3 mg/kg) produced comparable analgesia to morphine (0.1 mg/kg) without serious adverse events reported [89]. Further study is needed to confirm the efficacy and safety of these approaches.

When giving analgesics, the goal is to reduce pain to manageable levels, thereby making the patient more cooperative and possibly improving the accuracy of the abdominal examination by minimizing voluntary guarding. The goal is **not** to eliminate all pain and make the patient somnolent.

**DISPOSITION** — The elderly are at greater risk of significant disease, are less capable of tolerating such illness, and are more likely not to manifest clear and concerning symptoms and signs. Therefore, elderly patients with abdominal pain should be admitted or undergo prolonged observation if the clinician harbors any doubt about the nature of their disease.

Observation and reassessment is useful in the management of abdominal pain of unclear etiology. One retrospective cohort study found that a period of observation increased the certainty of diagnosing appendicitis [47]. Other retrospective studies support the use of observation periods in unclear cases [90].

Clinicians should consider the likelihood of disease and the comorbidities, reliability, and social supports of the patient when determining whether to observe the patient with abdominal pain of unclear etiology in the emergency department (ED) or allow the patient to be discharged and return to the ED or their primary care clinician in 12 hours for reevaluation. Patients to be discharged must be provided with clear, written instructions about potential danger signs and where and when to return for emergent care or reevaluation.

The large majority of patients discharged from the ED, after an appropriate evaluation, with a diagnosis of nonspecific abdominal pain have a benign condition that resolves without further intervention [9,91,92]. As an example, in a retrospective study of 1411 patients discharged from the ED with nonspecific abdominal pain, 112 patients (7.9 percent) represented with abdominal pain [93]. Of these, 85 were again diagnosed with nonspecific pain while 27 received a more specific diagnosis, including cholelithiasis (30 percent), appendicitis (19 percent), and gastrointestinal cancer (7 percent).

**PITFALLS IN MANAGEMENT**
● Failure to conduct a careful and timely evaluation of elderly patients with abdominal pain when overt signs of severe disease are absent.

● Failure to appreciate high-risk features of abdominal pain (table 2).

● Failure to perform pelvic and testicular examinations in patients with low abdominal pain.

● Over-reliance on laboratory studies.

● Failure to observe and reexamine or to arrange for reassessment of patients with pain of unclear etiology, particularly patients at higher risk.

INFORMATION FOR PATIENTS — UpToDate offers two types of patient education materials, “The Basics” and “Beyond the Basics.” The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on “patient info” and the keyword(s) of interest.)

● Basics topic (see "Patient education: Acute abdomen (belly pain) (The Basics)"

SUMMARY AND RECOMMENDATIONS

● Abdominal pain poses diagnostic challenges for emergency clinicians. Causes include medical, surgical, intraabdominal, and extraabdominal ailments. Associated symptoms often lack specificity and atypical presentations of common diseases are frequent.

● The elderly, the immunocompromised, and women of childbearing age with abdominal pain pose special diagnostic challenges. Elderly patients often have vague, nonspecific complaints and atypical presentations of potentially life-threatening conditions. Older patients with abdominal pain have a six- to eightfold increase in mortality compared to younger patients. Immunocompromised patients may suffer from a wide range of ailments, including unusual and therapy-related conditions. Pregnancy leads to physiologic and anatomic changes affecting the presentation of common diseases. (See 'Epidemiology' above and "Evaluation of abdominal pain in the HIV-infected patient" and "Approach to abdominal pain and the acute abdomen in pregnant and postpartum women".)

● Abdominal pain may be caused by the following life-threatening conditions:
  
  • Abdominal aortic aneurysm
  
  • Thoracoabdominal aortic dissection
  
  • Mesenteric ischemia
  
  • Perforation of gastrointestinal tract (including peptic ulcer, bowel, esophagus, or appendix)
  
  • Acute bowel obstruction
• Volvulus
• Splenic rupture
• Incarcerated hernia
• Ectopic pregnancy
• Placental abruption
• Myocardial infarction

● The differential diagnosis for abdominal pain is wide, ranging from benign to life-threatening conditions. A list of important and common causes of abdominal pain, including brief descriptions of their important clinical features and links to more extensive discussions, is provided in the text. (See 'Differential diagnosis' above.)

● The combination of a careful history, including a precise characterization of the pain, and physical examination can often distinguish between organic and nonorganic causes of abdominal pain and is crucial for creating a focused and appropriate differential diagnosis. High-risk features associated with life-threatening causes of abdominal pain are summarized in the accompanying table (table 2). (See 'History' above and 'Pain description' above and 'Physical examination' above.)

● The clinician should not rely on ancillary studies to make a diagnosis but should use them as adjuncts. Important laboratory and radiographic studies used in the diagnosis of abdominal pain are described in the text. Early consultation with surgery or obstetrics-gynecology can be critical and is discussed in the text. (See 'Ancillary studies' above.)

● The approach to diagnosing the cause of abdominal pain in the emergency department varies by age, gender, and condition. Algorithmic approaches for older and younger patients (algorithm 1), women of child-bearing age (algorithm 2), and HIV-infected patients are provided. (See 'Approach to diagnosis' above and "Evaluation of abdominal pain in the HIV-infected patient".)

Use of UpToDate is subject to the Subscription and License Agreement.

REFERENCES


Topic 290 Version 29.0
Selected extra-abdominal causes of acute abdominal pain

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Hematologic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial ischemia and infarction</td>
<td>Sickle cell anemia</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>Hemolytic anemia</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>Henoch-Schönlein purpura</td>
</tr>
<tr>
<td>Heart failure</td>
<td>Acute leukemia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thoracic</th>
<th>Toxins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonitis</td>
<td>Hypersensitivity reactions: insect bites, reptile venoms</td>
</tr>
<tr>
<td>Pleurodynia, Bornholm's disease</td>
<td>Heavy metals and corrosives (eg, lead or iron)</td>
</tr>
<tr>
<td>Pulmonary embolism and infarction</td>
<td></td>
</tr>
<tr>
<td>Pneumothorax</td>
<td></td>
</tr>
<tr>
<td>Empyema</td>
<td></td>
</tr>
<tr>
<td>Esophagitis</td>
<td></td>
</tr>
<tr>
<td>Esophageal spasm</td>
<td></td>
</tr>
<tr>
<td>Esophageal rupture (Boerhaave's syndrome)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Neurologic</th>
<th>Infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiculitis: spinal cord or peripheral nerve tumors, degenerative arthritis of spine</td>
<td>Herpes zoster</td>
</tr>
<tr>
<td>Abdominal epilepsy</td>
<td>Osteomyelitis</td>
</tr>
<tr>
<td>Tabes dorsalis (tertiary syphilis)</td>
<td>Typhoid fever</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metabolic</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uremia</td>
<td>Muscular contusion, hematoma, or tumor</td>
</tr>
<tr>
<td>Diabetes mellitus (ketoacidosis)</td>
<td>Narcotic withdrawal</td>
</tr>
<tr>
<td>Porphyria</td>
<td>Familial Mediterranean fever</td>
</tr>
<tr>
<td>Acute adrenal insufficiency</td>
<td>Psychiatric disorders</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>Heat stroke</td>
</tr>
<tr>
<td>Hyperparathyroidism</td>
<td></td>
</tr>
</tbody>
</table>


Graphic 60310 Version 7.0
# Features of high risk abdominal pain

## History
- Age over 65
- Immunocompromised (e.g., HIV, chronic glucocorticoid treatment)
- Alcoholism (risk of hepatitis, cirrhosis, pancreatitis)
- Cardiovascular disease (e.g., CAD, PVD, hypertension, atrial fibrillation)
- Major comorbidities (e.g., cancer, diverticulosis, gallstones, IBD, pancreatitis, renal failure)
- Prior surgery or recent GI instrumentation (risk of obstruction, perforation)
- Early pregnancy (risk of ectopic pregnancy)

## Pain characteristics
- Sudden onset
- Maximal at onset
- Pain then subsequent vomiting
- Constant pain of less than two days duration

## Exam findings
- Tense or rigid abdomen
- Involuntary guarding
- Signs of shock

CAD: coronary artery disease; HIV: human immunodeficiency virus; IBD: inflammatory bowel disease; PVD: peripheral vascular disease.

Graphic 68577 Version 2.0
## Causes of abdominal pain by location

<table>
<thead>
<tr>
<th>Right upper quadrant</th>
<th>Left upper quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis</td>
<td>Splenic abscess</td>
</tr>
<tr>
<td>Cholecystitis</td>
<td>Splenic infarct</td>
</tr>
<tr>
<td>Cholangitis</td>
<td>Gastritis</td>
</tr>
<tr>
<td>Biliary colic</td>
<td>Gastric ulcer</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>Pancreatitis</td>
</tr>
<tr>
<td>Budd-Chiari syndrome</td>
<td>Left lower quadrant</td>
</tr>
<tr>
<td>Pneumonia/empyema pleurisy</td>
<td>Diverticulitis</td>
</tr>
<tr>
<td>Subdiaphragmatic abscess</td>
<td>Salpingitis</td>
</tr>
<tr>
<td>Right lower quadrant</td>
<td>Ectopic pregnancy</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>Inguinal hernia</td>
</tr>
<tr>
<td>Salpingitis</td>
<td>Nephrolithias</td>
</tr>
<tr>
<td>Ectopic pregnancy</td>
<td>Irritable bowel syndrome</td>
</tr>
<tr>
<td>Inguinal hernia</td>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>Nephrolithias</td>
<td>Diffuse</td>
</tr>
<tr>
<td>Inflammatory bowel disease</td>
<td>Gastroenteritis</td>
</tr>
<tr>
<td>Mesenteric adenitis (yersina)</td>
<td>Mesenteric ischemia</td>
</tr>
<tr>
<td>Epigastric</td>
<td>Metabolic (eg, DKA, porphyria)</td>
</tr>
<tr>
<td>Peptic ulcer disease</td>
<td>Malaria</td>
</tr>
<tr>
<td>Gastroesophageal reflux disease</td>
<td>Familial Mediterranean fever</td>
</tr>
<tr>
<td>Gastritis</td>
<td>Bowel obstruction</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>Peritonitis</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>Irritable bowel syndrome</td>
</tr>
<tr>
<td>Pericarditis</td>
<td></td>
</tr>
<tr>
<td>Ruptured aortic aneurysm</td>
<td></td>
</tr>
<tr>
<td>Periumbilical</td>
<td></td>
</tr>
<tr>
<td>Early appendicitis</td>
<td></td>
</tr>
<tr>
<td>Gastroenteritis</td>
<td></td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td></td>
</tr>
<tr>
<td>Ruptured aortic aneurysm</td>
<td></td>
</tr>
</tbody>
</table>

**Diffuse**
- Gastroenteritis
- Mesenteric ischemia
- Metabolic (eg, DKA, porphyria)
- Malaria
- Familial Mediterranean fever
- Bowel obstruction
- Peritonitis
- Irritable bowel syndrome

DKA: diabetic ketoacidosis.

Graphic 70233 Version 4.0
Patterns of referred abdominal pain

Pain from abdominal viscera often (but not always) localizes according to the structure's embryologic origin, with foregut structures (mouth to proximal half of duodenum) presenting with upper abdominal pain, midgut structures (distal half of duodenum to middle of the transverse colon) presenting with periumbilical pain, and hind gut structures (remainder of colon and rectum, pelvic genitourinary organs) presenting with lower abdominal pain. Radiation of pain may provide insight into the diagnosis. As examples, pain from pancreatitis may radiate to the back while pain from gallbladder disease may radiate to the right shoulder or subscapular region.

Graphic 61375 Version 7.0
Grey Turner sign

Grey Turner sign refers to flank ecchymoses that result from blood tracking subcutaneously from a retroperitoneal or intraperitoneal source.

Reproduced from: Masha L, Bernard S. Grey Turner’s sign suggesting retroperitoneal haemorrhage. Lancet 2014; 383:1920. Illustration used with the permission of Elsevier Inc. All rights reserved.

Graphic 95719 Version 1.0
This plain AP radiograph of the chest taken with the patient upright reveals a small amount of free air under the right hemidiaphragm confirming the diagnosis of a perforated abdominal viscus. The lucent, crescent shaped free air is noted between the arrows. The dome of the liver (arrow) and the soft tissue shadow of the right hemidiaphragm (arrowhead) border the free air.

AP: anterior-posterior; PA: posterior-anterior.

Graphic 83050 Version 3.0
Free air and air-fluid level on x-ray

An A-P x-ray (A) shows free air under the diaphragm, a well-defined liver edge (dashed arrow), but no obvious free fluid. A lateral examination (B) shows an air fluid level (arrowhead) that was not obvious on the A-P examination. The free air above (arrow) outlines the liver edge with greater clarity (dashed arrow).

A-P: anteroposterior.

Graphic 93368 Version 1.0
A lateral examination (A) shows a small amount of air under the right hemidiaphragm (arrow) and a small amount of air under the left hemidiaphragm (arrowhead). Image B is a magnified view and highlights the small amount of air under the right hemidiaphragm (arrow) and a small amount of air under the left hemidiaphragm (arrowhead).

Graphic 93366 Version 1.0
The plain film examination of the abdomen in decubitus position reveals a large amount of free air collecting in the right flank, clearly outlining the bowel wall (open arrows). When air is present on both sides of the bowel, the wall is outlined with clear distinction because of the contrast differences created on both sides. This is called Rigler's sign and is pathognomonic for free air in the peritoneal cavity. The yellow arrows show air-fluid levels in distended bowel.

Upright abdominal x-ray of small bowel obstruction

This plain, upright abdominal radiograph shows dilated loops of small bowel with air-fluid levels consistent with a diagnosis of small bowel obstruction.

Courtesy of Richard A Hodin, MD.

Graphic 68738 Version 4.0
Ultrasound of an abdominal aortic aneurysm

The ultrasound examination of the abdominal aorta is shown in transverse projection (A) with Doppler interrogation (B) and reveals an abdominal aortic aneurysm measuring 4.75 cms in maximum transverse diameter. Turbulent flow in the aneurysm is reflected in the non-uniform heterogeneous Doppler pattern.

Graphic 83048 Version 2.0
Acute cholecystitis with pericholecystic fluid seen on ultrasound

(A) Longitudinal view of the gallbladder showing small shadowing stones in the dependent part of the gallbladder (arrow). The ultrasound also shows a thickened wall in both the longitudinal projection (small arrowhead) and transverse projection (B).

(B) A small amount of pericholecystic fluid is noted (large arrowhead).

(C) The Doppler study shows an increase in blood flow to the wall (dashed arrow) reminiscent of the hyperemia of an inflammatory process. These findings are consistent with acute calculous cholecystitis.

Graphic 83042 Version 3.0
Ultrasound image of acute calculous cholecystitis

There are two shadowing gallstones (S) lying dependently at the base of the distended gallbladder, associated with diffuse thickening of the gallbladder wall (arrows). There is no definite fluid accumulation in the gallbladder fossa. In the presence of a positive sonographic Murphy’s sign, or appropriate clinical setting, a diagnosis of acute calculous cholecystitis can be established.


Graphic 83107 Version 1.0
Two examples of ectopic pregnancy presenting as an extraovarian adnexal mass (arrows).

U: uterus; O: ovary.

*Courtesy of Tejas S Mehta, MD, MPH.*

Graphic 53149 Version 3.0
Female pelvic and abdominal hemoperitoneum

A) Sagittal transvaginal view of pelvis shows no intrauterine pregnancy. There is a large amount of complex fluid (F) and clot (C) surrounding the uterus (calipers). The ovaries were difficult to identify due to extent of hemorrhage and patient discomfort. B) Scanning of the upper abdomen showed fluid extending into Morrison's Pouch. This patient was unstable and went to the OR. The hemoperitoneum was attributed to a ruptured hemorrhagic corpus luteum.

*Courtesy of Tejas S Mehta, MD, MPH.*

Graphic 81382 Version 4.0
Ultrasound demonstrating hydronephrosis

Longitudinal sonogram of a hydronephrotic left kidney showing dilatation of the minor and major calyces and the pelvis.

*Courtesy of W Charles O'Neill, MD.*

Graphic 57935 Version 3.0
Approach to abdominal pain in patients over 50

AAA: abdominal aortic aneurysm; ACS: acute coronary syndrome; CT: computed tomography; CXR: chest x-ray; ECG: electrocardiogram; IVC: inferior vena cava; LFT: liver function test; RLQ: right lower quadrant; RUQ: right upper quadrant; US: ultrasound.

Graphic 65734 Version 4.0
Approach to abdominal pain in female of childbearing age

CT: computed tomography; HCG: human chorionic gonadotropin; OB/Gyn: obstetrics and gynecology; PID: pelvic inflammatory disease; RLQ: right lower quadrant; R/O: rule out; US: ultrasound; UTI: urinary tract infection.

* Pelvic examination should NOT be performed in the presence of third-trimester vaginal bleeding.

Graphic S4001 Version 3.0
Contributor Disclosures

John L Kendall, MD, FACEP  Nothing to disclose  Maria E Moreira, MD  Nothing to disclose  Robert S Hockberger, MD, FACEP  Nothing to disclose  Jonathan Grayzel, MD, FAAEM  Nothing to disclose

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy