

Disaster Diagnoses in Geriatric Patients with Abdominal Pain



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KEYWORDS

• Geriatric • Abdominal pain • Biliary • Mesenteric ischemia

KEY POINTS

- Geriatric patients have increased morbidity and mortality compared with younger patients for most abdominal disorders.
- Geriatric patients show atypical signs and symptoms for many common abdominal conditions, contributing to misdiagnosis and worsened outcomes.
- Biliary disease is the most common surgical disease in older adults and often presents with complications.
- Acute mesenteric ischemia and abdominal aortic aneurysm are almost exclusively diseases of older adults and both carry very high mortalities.
- Potentially lethal conditions originating outside of the abdomen, including myocardial infarction, can present with abdominal pain in geriatric patients.

INTRODUCTION

Care of geriatric patients with abdominal pain can pose significant diagnostic and therapeutic challenges to emergency physicians. Older adults rarely present with classic signs, symptoms, and laboratory abnormalities. Incidence of life-threatening emergencies, including abdominal aortic aneurysm, mesenteric ischemia, perforated viscus, and other surgical emergencies, is high. This article explores the evaluation and management of several important causes of abdominal pain in geriatric patients, with an emphasis on high-risk presentations.

EPIDEMIOLOGY

Abdominal pain is among the most common presenting complaints in geriatric emergency department (ED) patients.¹ Altered physiology, comorbid conditions, medication side effects, and polypharmacy increase treatment difficulty and risk in this population. Despite widespread use of advanced imaging, diagnostic accuracy is

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reduced in patients more than 75 years old.¹ The need for surgery or other procedural intervention is high (25%–30%).^{1,2} Many older adult patients require admission, and those who are discharged should be carefully selected, because the ED recidivism rate is about 10%.¹

The risk of serious disorder and associated need for admission, morbidity, and mortality are all increased in older patients. In the past, morbidity rates for geriatric patients have been reported to be as high as 45%.² With improvements in the understanding of geriatric physiology and the availability of advanced imaging modalities and less invasive surgical techniques, mortalities have improved to approximately 5%.^{1,3}

FEATURES OF COMMON CONDITIONS

Biliary and Gallstone Disease

Gallstone disease is a common surgical problem in the geriatric population. Biliary disease, most notably cholecystitis, is the most common abdominal surgical emergency in geriatric patients.⁴ Older adult patients are at increased risk for complications, including emphysematous cholecystitis, perforation, and cholangitis (Fig. 1).^{5,6} Physiologic factors, including atherosclerotic weakening of the gallbladder wall and age-related dilatation of the common bile duct, increase the risk for perforation and choledocholithiasis, respectively.^{6,7}

Common symptoms such as nausea, vomiting, and fever are frequently lacking, often leading to delay in care or diagnosis, which contributes to the observed increase in complications.⁸ In one series of older adults with acute cholecystitis, fever occurred in only 16% of cases.⁹ Similarly, the Charcot triad of cholangitis (fever, jaundice, and right upper quadrant pain) is observed in only 20% to 45% of patients even in the setting of advanced disease.¹⁰ Ultrasonography is the recommended imaging modality for suspected gallbladder disease; however, computed tomography (CT) may offer

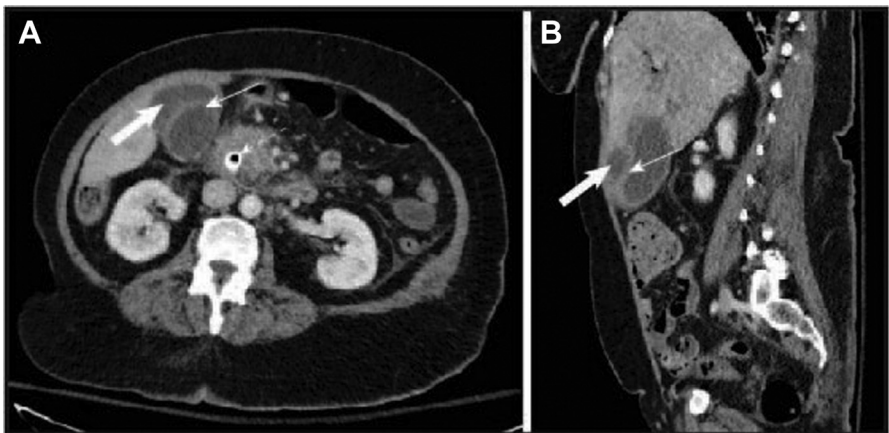


Fig. 1. Perforated gallbladder on computed tomography. (A) Transverse image showing fluid collection (*thick arrow*) adjacent to the gallbladder with thickened wall (*thin arrow*). Pancreatic stent placed because of coexisting malignancy also visible (*dashed arrow*). (B) Sagittal image showing fluid collection (*thick arrow*) anterior to gallbladder with thickened wall (*thin arrow*).

higher sensitivity, particularly for associated complications and alternative diagnoses.^{11,12}

Older adult patients with confirmed acute cholecystitis should be referred for emergent surgical evaluation. Mounting evidence supports early surgical management of acute cholecystitis in geriatric patients because increased rates of morbidity and mortality have been observed with a delayed surgical approach.^{13–15} Antibiotics should be administered in the setting of biliary disease with evidence of infection. The Infectious Diseases Society of America recommends single-agent cephalosporin coverage for most mild to moderate cases but recommends broader, dual-agent coverage for high-risk patients, including those of advanced age.¹⁶

Pancreatitis

Geriatric patients account for about one-third of cases of acute pancreatitis.¹⁷ Compared with younger patients with acute pancreatitis, older patients develop severe disease more frequently and have higher rates of morbidity.¹⁷ Advanced age does seem to increase mortality risk, particularly after age 80 years.^{17–19} Gallstone disease remains an important cause of pancreatitis in the older adult population, but other causes, including medication-induced pancreatitis and ischemic pancreatitis, should also be carefully considered.^{20,21} Diagnosis is made more difficult by the frequent absence of common symptoms. In one cohort of patients more than 65 years of age, abdominal pain was absent in almost 25% of patients and vomiting was absent in nearly 60%.¹⁹ The aggressive early fluid resuscitation commonly prescribed to patients with acute pancreatitis may be less tolerated in geriatric patients because of their higher rates of comorbid cardiac disease.

Bowel Obstruction

Small bowel obstruction (SBO) increases in both incidence and associated mortality with advancing age.²² Reported incidence ranges from around 30 to 40 cases per 100,000 in the 15-year to 44-year age group up to about 400 to 480 per 100,000 in patients more than 65 years old.²³ Large bowel obstructions (LBOs) are also more commonly encountered in the geriatric population.²⁴ The causes of bowel obstruction differ between the small and large bowel, with adhesions causing most SBOs and malignancy causing as many as 80% of LBOs (**Table 1**).^{23,25} The symptoms of LBO can be more insidious in onset compared with SBO, although abdominal pain and decreased passage of stool and flatus are still common. Sigmoid volvulus occurs at

Table 1
Bowel obstruction causes^{23,26}

Small Bowel Obstruction ²³	Large Bowel Obstruction ²⁶
<ul style="list-style-type: none"> • Adhesions • Hernia • Malignancy • IBD • Stricture 	<ul style="list-style-type: none"> • Malignancy • Volvulus • Diverticulitis • Intussusception • Hernia • IBD • Extrinsic compression • Fecal impaction

Causes listed by prevalence in descending order.

Abbreviation: IBD, inflammatory bowel disease.

a rate 3 to 4 times greater than cecal volvulus, likely a reflection of the chronic dilatation and redundancy observed in the sigmoid colons of geriatric patients.²⁶ Comorbidities associated with decreased gut motility are significant risk factors for the development of volvulus, with more than 60% of patients having comorbid neurologic or psychiatric conditions.²⁷ Complications of bowel obstruction can include ischemia, perforation, and intra-abdominal sepsis.

Although plain radiographs have poor sensitivity and specificity for SBO, they can offer rapid evidence of volvulus or free air.²³ CT offers the best diagnostic utility in the investigation of bowel obstruction in older adult patients, because CT can identify important features of an obstruction, including location, severity, presence of a predisposing lesion, and associated complications.

Evidence of bowel obstruction should prompt urgent surgical consultation. Although some bowel obstructions can be managed nonoperatively, nonoperative management is associated with a higher rate of recurrence.²³ Some cases of LBO, specifically volvulus, may be treated nonoperatively with endoscopic reduction and decompression with a rectal tube. Advanced age increases risk of mortality; however, some literature suggests that improvements in supportive care and surgical techniques are narrowing this gap.^{22,23} Supportive care, including resuscitative fluids, analgesics, and antiemetics, should be administered. Placement of a nasogastric tube can be considered in the setting of severe symptoms from pain, distention, or intractable nausea; however, data regarding their impact on successful nonoperative management are limited.²⁸ Antibiotics covering gram-negative and anaerobic organisms should be administered to patients with obstructing diverticulitis or evidence of perforation or sepsis (**Table 2**).¹⁶

Appendicitis

Geriatric patients account for approximately 10% of appendicitis cases but a significantly greater proportion of deaths from the disease.²⁹ Complications including necrosis, gangrene, and (most commonly) perforation increase significantly after age 65 years.^{29,30} The cause of this increased risk is likely multifactorial and includes physiologic changes such as vascular sclerosis and fibrotic narrowing of the appendix and fatty infiltration and weakening of the bowel wall.³¹ In addition, older adult patients frequently have a delayed presentation from symptom onset compared with younger patients: 50 hours from symptom onset versus 31 hours in 1 large review.³²

Presenting symptoms can be notably different in geriatric patients and include absence of fever, migratory pain, rebound tenderness, and nausea.^{33,34} Right lower quadrant tenderness remains common and can be observed in more than 90% of geriatric patients.^{33,34} Laboratory studies are of limited benefit because 20% to 25% of patients do not show increased white blood cell count or left shift.³³ Geriatric patients were poorly represented in the derivation of diagnostic scoring systems including the Alvarado and RIPASA scores.^{35,36} The Alvarado score has been shown to perform poorly in a geriatric population; however, some have suggested that modification of traditional cutoffs may achieve adequate predictive values.^{33,34} Further study is required to determine what, if any, utility these scores offer in the diagnosis of appendicitis in older adults.

The diagnosis of appendicitis is often aided by diagnostic imaging, and this is even more apparent in older adults. High rates of associated complications, underlying malignancy, and increased diagnostic uncertainty make imaging studies, particularly CT, a valuable diagnostic tool.³¹

Appendectomy remains the recommended treatment strategy for acute appendicitis; however, an approach including an initial trial of antibiotics for uncomplicated

	Diagnosis	Mild Severity/Low Risk^a	Moderate to Severe/High Risk^b
Biliary	Cholecystitis	Ceftriaxone Cefazolin	Piperacillin/tazobactam, ciprofloxacin, meropenem, or cefepime Each in combination with metronidazole ^c
	Cholangitis	NA	
Extrabiliary	Appendicitis	Single agent: Cefoxitin Ertapenem Moxifloxacin	Single agent: Piperacillin/tazobactam Meropenem
		Combination: Ceftriaxone, cefazolin, or ciprofloxacin Each in combination with metronidazole	Combination: Cefepime, ciprofloxacin, or meropenem Each in combination with metronidazole ^d
	Diverticulitis	Single Agent: Cefoxitin Ertapenem Moxifloxacin Combination: Ceftriaxone or ciprofloxacin Each in combination with metronidazole	
	Peritonitis	NA	

Abbreviation: NA, not available.

^a Low risk: age less than 70 years, few medical comorbidities.

^b High risk: advanced age, immunocompromise, health care-associated infections.

^c May consider early oral therapy in select patients.

^d Consider adding methicillin-resistant *Staphylococcus aureus* coverage with vancomycin for health care-associated infections.

Data from: Solomkin JS, Mazuski JE, Bradley JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Clin Infect Dis.* 2010;50(2):133-164. <https://doi.org/10.1086/649554>.

cases has shown some efficacy in the overall population.^{31,37} This treatment strategy is not recommended in older adults because they have been poorly represented in antibiotic-first trials and show high rates of occult perforation and necrosis missed on CT imaging.^{30,37} Antibiotics are strongly recommended in the setting of perforated appendicitis and preoperatively in uncomplicated cases (see **Table 2**).^{16,31}

The World Society of Emergency Surgery recently produced guidelines for the diagnosis and treatment of appendicitis in older adult patients, which highlighted the overall lack of high-quality evidence in this population.³¹

Diverticulitis

Diverticulosis is the most common condition identified on routine colonoscopy.³⁸ The incidence of diverticulosis increases with age, affecting more than 70% of octogenarians.³⁸ The rate of development of diverticulitis in the setting of diverticulosis was long quoted in the 10% to 25% range; however, these figures predate routine screening colonoscopy and are thus likely overestimated.^{39,40} A more recent study of more than 2000 veterans showed an incidence of diverticulitis of approximately 4%.⁴¹

In Western populations, more than 90% of cases affect the sigmoid and descending colon, producing the hallmark symptom of left lower quadrant pain.⁴² The pain of diverticulitis is variable; it may be mild and intermittent or severe and constant. Other reported symptoms, including urinary symptoms, constipation, or diarrhea, can lead to misdiagnosis.⁴³ Markers of infection, including increased white blood cell count and fever, may be present; however, their absence should not be relied on to rule out disease.⁴²

Although diverticulitis can be a clinical diagnosis, caution is warranted in geriatric patients. In a review of more than 400 geriatric patients who were ultimately diagnosed with diverticulitis, CT altered the pre-CT diagnosis in a significant proportion of patients.⁴⁴ Although diverticulitis is associated with a more aggressive presentation and higher recurrence rate in younger patients, older patients experience higher perioperative morbidity, prolonged hospitalization, and higher in-hospital mortality.⁴⁵

A variety of treatments are available depending on disease severity and associated complications.⁴³ Uncomplicated cases have classically been treated with bowel rest and oral antibiotics. Evidence regarding the utility of antibiotics in the treatment of uncomplicated diverticulitis is evolving. At present, the available research suggests that antibiotic use does not reduce time to resolution, but it may reduce rates of recurrence and complications.⁴⁶ Antibiotic therapy alone may be used to treat mild to moderate diverticulitis, including patients with early complications such as a phlegmon. Treatment of more severe, complicated diverticulitis ranges from percutaneous drainage to staged resection. Antibiotics, both oral and intravenous preparations, should be selected to cover aerobic and anaerobic gram-negative bacteria (see [Table 2](#)).¹⁶

Mesenteric Ischemia

Older adult patients are more commonly affected by acute mesenteric ischemia (AMI), largely because of the concurrent and causative risk factors associated with AMI.⁴⁷ Despite advancements in treatment, the mortality from AMI remains as high as 40% to 50%.^{47–49} The challenge of this cannot-miss diagnosis lies in its nonspecific presentation. Abdominal pain is common and is often described as pain out of proportion to the examination. Frequently leading to a misdiagnosis of gastroenteritis, symptoms commonly progress to include vomiting and/or diarrhea, although constipation has also been reported.⁵⁰ The duration of symptoms, as well as associated risk factors, are frequently tied to specific past medical comorbidities that the patient may carry.

Mesenteric ischemia is classified into 4 categories based on the cause of injury, with the categories exhibiting subtle differences in precipitating risk factors and clinical presentation ([Table 3](#)),^{47,51–56} Regardless of cause, the pathologic result is significant bowel ischemia requiring urgent intervention to prevent permanent damage.

Laboratory evaluation for patients with AMI is helpful in assessing overall patient status and secondary injury, but no laboratory test is specific for the diagnosis of AMI.⁵⁷ Identification and correction of acid-base disturbance and electrolyte derangement can improve patient outcomes. Significant ischemia can lead to increased lactic acid level but a normal lactic acid level should not rule out the diagnosis; ideally, AMI will be diagnosed before irreversible bowel injury.⁵⁸ Importantly, diagnostic evaluation with imaging should be based on clinical suspicion rather than laboratory evaluation.

Computed tomographic angiography (CTA) is the preferred diagnostic tool to identify AMI as well as assess for complications and extent of disease.⁵⁸ CTA sensitivity is best for arterial disorders; however, multiphase imaging can improve diagnostic sensitivity for venous disease and should be specifically requested if venous thromboembolism is suspected. Ultrasonography with duplex imaging and magnetic resonance angiography can be used; however, patient illness, discomfort, time away from the

Category	Risk Factors	Presentation	Treatment
Thrombotic (40%) ⁵⁶	<ul style="list-style-type: none"> • Coronary artery disease • Hyperlipidemia • Diabetes • Hypertension⁴⁷ 	<ul style="list-style-type: none"> • Prior history of food intolerance • Sudden worsening • Nausea/vomiting • Diarrhea • Pain out of proportion to examination⁵³ 	<ul style="list-style-type: none"> • Heparin • Emergent revascularization or stenting
Embolic (25%) ⁵⁶	<ul style="list-style-type: none"> • Atrial fibrillation • Congestive heart failure • Endocarditis • Cardiac valvular dysfunction⁵² 	<ul style="list-style-type: none"> • Sudden onset • Severe pain • Nausea/vomiting • Diarrhea • Pain out of proportion to examination⁵³ 	<ul style="list-style-type: none"> • Heparin • Emergent revascularization or stenting
Nonocclusive (25%) ⁵⁶	<ul style="list-style-type: none"> • Dialysis • Sepsis • Cardiogenic shock • Vasopressor use • Prolonged hypotension^{51,54} 	<ul style="list-style-type: none"> • Severe abdominal pain after hemodialysis • Critical illness with increasing lactic acid 	<ul style="list-style-type: none"> • Treat underlying cause • Consider local vasodilator
Venous thrombosis (10%) ⁵⁶	<ul style="list-style-type: none"> • Hypercoagulability • Recent surgery • Malignancy • IBD 	<ul style="list-style-type: none"> • Insidious • Severe abdominal pain • Younger population • Prior history of deep vein thrombosis or pulmonary embolism (20%)⁵⁵ 	<ul style="list-style-type: none"> • Heparin • Long-term anticoagulation

department, and operator skill (for ultrasonography) often preclude their routine or recommended use. The diagnostic gold standard of catheter angiography has been largely supplanted by the less invasive and more widely available CTA. Catheter angiography is now mostly used to confirm and treat AMI.⁵⁸

Definitive treatment of mesenteric ischemia is largely surgical; however, early medical intervention can improve outcomes. Once this diagnosis has been made, patients should be anticoagulated with heparin. Because many of these patients need open surgical intervention, longer-acting agents such as low-molecular-weight heparin should be avoided. Broad-spectrum antibiotics should be given because of the high incidence of bacterial translocation and risk of secondary infection (see [Table 2](#)).^{16,58}

Peptic Ulcer Disease

Peptic ulcer disease (PUD) remains a frequent cause of hospitalization and mortality in older adult patients.⁵⁹ PUD is the most common cause of upper gastrointestinal (GI) bleeding in geriatric patients and carries a mortality up to 50-fold higher than that of younger populations.^{60,61} *Helicobacter pylori* infection, found in 70% of geriatric patients with PUD, use of nonsteroidal antiinflammatory drugs, and smoking are important contributors to the development of bleeding ulcers.^{62,63}

Typically, patients with PUD experience upper abdominal pain, pain with eating, nausea with or without vomiting, and food intolerance.⁶³ In contrast, as many as 50% of geriatric patients present with complications such as perforation or bleeding without any of the previously listed symptoms.⁶⁴ Even in the setting of perforated

ulcer, a rigid abdomen is rarely present in older adults and cannot be relied on to rule out perforation.⁶⁴

There is no emergency bedside diagnostic test to confirm or exclude PUD or a bleeding peptic ulcer; however, laboratory studies and an electrocardiogram (ECG) can aid in diagnosis and management. ECG in particular should always be obtained, because an acute myocardial infarction can present with abdominal pain, and myocardial injury can occur secondary to acute blood loss.⁶⁵

Imaging for geriatric patients with suspected perforated PUD is always recommended. Upright chest radiograph can be diagnostic of a viscus perforation if free air is visualized. However, this finding occurs in only about 60% of cases; therefore absence of free air should not dissuade physicians from further imaging.⁶⁶ In geriatric patients, CT is useful for the diagnosis of occult perforation that would not be apparent on examination or radiograph.⁶⁷

As with management of PUD and upper GI bleeding at any age, management of geriatric patients should focus on resuscitation and assessment for surgical emergencies. The benefits of proton pump inhibitors in the acute setting are debatable; however, their administration is generally recommended.⁶⁸ In patients that are at risk for variceal bleeding, administration of octreotide or a similar vasoactive agent is recommended, although poorly studied in the older population who may be at risk for increased side effects.⁶⁸ Antibiotics should be administered as early as possible for patients with perforation.

Most geriatric patients presenting with complicated PUD require admission. Gastroenterology should be consulted early in the case of an upper GI bleed. Endoscopy is the diagnostic and therapeutic test of choice for bleeding peptic ulcers. In the case of a suspected perforation, surgical consultation is necessary and should be obtained emergently. If the patient's symptoms are mild, well controlled, and there is no concern on examination or imaging for complicated disease, the patient may be discharged home with strict return precautions. Initiating proton pump inhibitor therapy is reasonable and avoidance of alcohol, nonsteroidal antiinflammatory drugs, and steroids is paramount to prevent further risk of bleeding and perforation.⁵⁹ Outpatient recommendations should include follow-up with primary care and gastroenterology for *H pylori* testing and treatment.

Abdominal Aortic Aneurysm

Abdominal aortic aneurysm (AAA) is largely a disease of older adults, with men experiencing the disease approximately 5 times more often than women.^{69,70} Rupture of an AAA carries an extremely high mortality of 70% to 90%.⁷⁰ Alarmingly, the missed diagnosis rate remains high at about 42%.⁷¹

Although abdominal pain is a common presenting symptom, with 61% of patients reporting it, the classic triad of abdominal pain, hypotension, and pulsatile abdominal mass is present in fewer than half of patients with ruptured AAA.⁷¹ Therefore, the presence of abdominal pain, back pain, syncope, or hypotension should prompt consideration of ruptured AAA. In addition, vascular compromise may cause lower extremity pain, numbness, or weakness.⁷² Physical examination may reveal pulse deficits and atraumatic ecchymosis to the flank (Grey Turner sign), umbilical area (Cullen sign), or even the testicles (scrotal sign of Bryant).⁷³ Flank pain is a frequent complaint, often leading to a diagnosis of renal colic, the most frequent misdiagnosis in cases of ruptured AAA.⁷¹ Transient symptoms or abnormal vital signs should raise alarm because a ruptured AAA can temporarily tamponade.

CTA can identify the size and location of an AAA, supply evidence of active bleeding, and provide guidance for operative intervention.⁷⁴ Non-contrast-enhanced CT

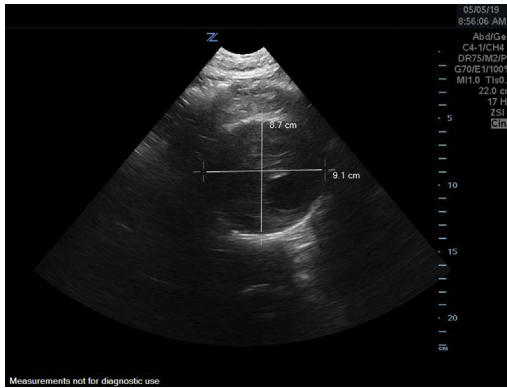


Fig. 2. POCUS showing large AAA with thrombus. (Image Courtesy of Dr. Leen Alblaidh, MBBS, MHA.)

remains highly sensitive for AAA as well as any retroperitoneal hematoma, but poorly visualizes active extravasation.⁷⁵ MRI may be used, but its practicality is limited by time, distance from the ED, and patient comfort and safety. Point-of-care ultrasonography (POCUS) has become the initial test of choice for most emergency physicians. Multiple studies have shown that POCUS performed by ED physicians requires little training and is both sensitive and specific for AAA (Fig. 2).^{76,77} Although not sensitive for retroperitoneal bleeding, the presence of an AAA on POCUS in an unstable or clinically suspicious patient should prompt vascular surgery consultation with or without additional imaging.

Management of a ruptured AAA is surgical; once a rupture is identified, vascular surgery should be consulted emergently. In a hypotensive, bleeding patient, avoid over-resuscitation with crystalloids and aim to use a balanced administration of blood products to limit the impact on coagulopathy and improve mortality.⁷⁸ Hypotensive patients that are otherwise stable with normal mental status may be allowed a degree of permissive hypotension (70–90 mm Hg systolic blood pressure) to limit bleeding and disruption of any clot formation.⁷⁴

Box 1

Extra-abdominal causes of abdominal pain

- Drug ingestion (eg, NSAIDs, ethanol)
- Herpes zoster
- Metabolic acidosis
- Myocardial infarction
- Pneumonia
- Pulmonary embolus
- Pyelonephritis
- Urinary retention
- Urinary tract infection

Abbreviation: NSAIDs, nonsteroidal antiinflammatory drugs.

Extra-Abdominal Causes of Abdominal Pain

The atypical presentations of abdominal complaints in geriatric patients pose significant diagnostic challenges to emergency physicians. Their presentation is further complicated by the myriad of extra-abdominal causes of abdominal pain. Many of these causes can be life threatening and therefore require consideration in geriatric patients with abdominal pain (**Box 1**).

Myocardial infarction can present with abdominal pain or discomfort as the only symptom. The absence of chest pain in myocardial infarction is more common in geriatric women, patients with diabetes, and nonwhite patients.⁷⁹

Disorders of the genitourinary tract, including urinary tract infections or pyelonephritis, are more common in older adults, particularly in nursing home populations.⁸⁰ Comorbid conditions such as benign prostatic hyperplasia and indwelling catheters often contribute to this increased prevalence in the geriatric population.

SUMMARY

Geriatric patients with abdominal disorders can show unusual patterns of symptoms, physical examination findings, and laboratory results, which can contribute to inaccurate or delayed diagnoses. Even when the correct diagnosis is made, older adult patients often have worse outcomes for a given condition compared with younger patients because of the geriatric patients' underlying comorbidities. Emergency physicians should remain cautious in their care of geriatric patients with abdominal pain and maintain a low threshold for advanced imaging and observation for serial examinations, and possibly repeat imaging.

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DISCLOSURE

The authors have nothing to disclose.

CLINICS CARE POINTS

- Charcot's triad of fever, jaundice and right upper quadrant pain is observed in as little as 20% of patients with acute cholangitis.¹⁰
- Geriatric patients with pancreatitis may require more judicious fluid resuscitation due to comorbid cardiac disease.
- Plain films offer poor sensitivity and specificity for small bowel obstruction but can provide quick evidence of volvulus or free air.²³
- Right lower quadrant tenderness is still among the most common signs of appendicitis in the elderly, observed in >90% of cases.³⁶
- Lab tests can be unreliable in geriatric patients and normal white blood cell counts or lactates cannot rule out important pathologies including appendicitis and mesenteric ischemia.^{33,58}

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