

# Acute Abdominal Pain in the Older Adult

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## KEYWORDS

• Acute abdominal pain • Elderly • Emergency department

Older adults, defined as those who are 65 years and older, are the fastest growing segment of the population in the United States and the highest emergency department (ED) users of any age group.<sup>1</sup> By some estimates, older patients will account for one-fourth of all ED visits in the United States by 2030.<sup>2</sup> Abdominal pain is the most common presenting complaint to the ED,<sup>1</sup> and in older adults, abdominal pain is the fourth most common chief complaint.<sup>3</sup> Challenges to the diagnosis and management of abdominal pain in older adults are multifactorial but start with the lack of overt clinical findings and varying presentations of intra-abdominal disorders. In a survey comparing younger and older adult patients, emergency medicine physicians (EPs) consistently found older patients more complex, requiring more time and resources to diagnose and treat. Out of the surveyed diagnoses EPs found abdominal pain in older adults the most difficult to evaluate.<sup>4</sup> This article starts with a review of the physical changes of aging and how these changes affect both the abdominal diseases to which the older adults are susceptible and the clinical features of abdominal pathology in this group. This discussion is followed by an analysis of the management of acute abdominal pain in older adults organized by the following pathologic processes: inflammatory, obstructive, vascular, and other causes.

## PATHOPHYSIOLOGIC CHANGES IN THE OLDER ADULT

Pathophysiologic changes secondary to aging cause an increased susceptibility to intra-abdominal diseases, as well as atypical clinical presentations. These changes occur from cellular to systemic levels, especially in the immune, genitourinary (GU), gastrointestinal (GI), nervous, and cardiovascular systems.

Older adults are at a higher risk for more frequent and severe infections due to immunosenescence. Aging of B cells decreases the ability to develop humoral (antibody) immunity to new infections or antigens, thereby increasing the risk for

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recurrence.<sup>5</sup> The T cell response also changes with aging, with decreased quantity and quality of the T cells and a decreased immune response to known antigens, possibly because of changes in the phenotype towards more immunosuppressive T cells.<sup>6,7</sup> These derangements have consequences for interpretation of the white blood cell count; on the one hand, a low count does not exclude an acute inflammatory condition, on the other, an elevated count does not exclude functional immunodeficiency. Aging is associated with a decreased response to pyrogens, lower basal body temperature, changes in thermal homeostasis, and a decreased production and conservation of heat. In one study, 30% of older adults who had surgical abdominal pain did not present with either a fever or leukocytosis.<sup>8</sup> Immunosenescence also results in decreasing immunosurveillance, the body's main defense against developing cancerous cells.

Renal changes with aging include decreased numbers of glomeruli and decreased glomerular function. These changes are caused by both long-term damage from comorbidities, such as hypertension and diabetes, and dysautoregulation of the afferent and efferent arterioles resulting in glomerular damage. Glomerular filtration rate decreases with age starting in the fourth decade and then diminishes by about 8 mL/min/decade, resulting in a reduction in the clearance of drugs and metabolites. Changes to the basement membrane and the development of small diverticula in the distal renal tubules promote urinary stasis and bacterial growth.<sup>9</sup> The aging kidneys also have diminished ability to concentrate urine, making older adults more prone to dehydration. Hormonally, the kidneys have reduced production of epoetin, inclining the older adult toward anemia from slow losses of blood.<sup>9</sup>

The effects of aging on the GI system also predispose patients to abdominal pathologic conditions. The stomach has a slightly decreased emptying time and fundal compliance. Acid secretion may increase secondary to decreased prostaglandin production. Liver mass and liver blood flow decrease with aging, resulting in decreased albumin synthesis and decreased phase 1 drug metabolism. The decrease in cytochrome P450 function and drug metabolism may be even greater in older men than in older women.<sup>10</sup> In the colon, the number of diverticula in the bowel increases with age. Because of physiologic anorexia of aging, there is decreased fluid and nutrient intake, predisposing the older adult to constipation.<sup>11,12</sup> Reduced physical activity for just 2 weeks almost doubles total colonic transit time in older adults,<sup>13</sup> which may contribute to the higher rate of postoperative ileus in this population.

Both the central and peripheral nervous systems are affected by aging. The prevalence of dementia and cognitive impairment increases, obscuring symptoms and obfuscating the medical history. Peripherally, pain and temperature sensation decreases as the type of pain sensing nerves slowly switches from A delta fibers (fast, sharp, prickly pain) to a reliance on slower-conducting C fibers.<sup>14</sup> This sensation decrease may contribute to the lack of peritoneal signs in many older adults. In a study of 212 patients with peritonitis, 55% had abdominal pain, but guarding or rigidity was observed in only 34%.<sup>15</sup> A review of patients with perforated ulcers found that only 21% of older adults presented with peritoneal signs.<sup>16</sup>

## DIAGNOSTIC OBSTACLES

Among the difficulties complicating the diagnosis of intra-abdominal disorders in older adults are preexisting illnesses that alter classical manifestations; an inability to obtain an accurate history; medications that can cause, confound, or mask disease processes; and alterations in laboratory baseline and physical findings.<sup>15,17,18</sup> In addition, older adults may be less likely to seek timely medical care and thus may have

later-stage disease or more serious illness when they present for care.<sup>4,19,20</sup> All these factors contribute to a higher morbidity and mortality for acute abdominal disorders in older adults.<sup>20</sup>

Chronic diseases accumulate with aging. Diabetes decreases peripheral nerve sensation in the abdomen as well as in the extremities. Previous abdominal surgery may diminish the perception of pain in the older adult.<sup>21</sup> Atherosclerotic cardiovascular disease places the patient at risk for cardiac ischemia, mimicking as abdominal pain, as well as other vascular catastrophes, including mesenteric ischemia and aortic aneurysm.

The usual clinical approach of a diagnostic workup based on a history taking and physical examination is complicated in older adults by multiple factors. Some patients downplay their symptoms or are unable to understand questions pertaining to cognitive or hearing impairment. Caregivers may be a helpful source of history taking but are not always available. At times, the presenting symptom of an underlying intra-abdominal process may itself be altered mental status.<sup>22–24</sup>

Patients' medications can also disguise or contribute to disease. On average, the older adult takes 4.5 prescription drugs and 2.1 over-the-counter medications. Many older adults are taking nonsteroidal antiinflammatory drugs (NSAIDs). These drugs can not only cause GI and renal diseases but also diminish the febrile response. Chronic steroid use also increases the risk of ulcer disease and blunts the immune response.  $\beta$ -Blockers blunt the tachycardia associated with fever, pain, or infections. Narcotic or analgesic use may blunt the patient's perception of abdominal pathologic conditions. Several other medications can themselves cause abdominal pain as is discussed later.

Laboratory values are rarely diagnostic in the evaluation of abdominal pain in any age group and should be interpreted with even greater caution in the elderly. Aging is associated with a mild elevation in alkaline phosphatase. Hyperamylasemia is nonspecific and may be seen in pancreatitis but may also occur with mesenteric ischemia. Bacteriuria is common and often represents colonization rather than infection. Lean body mass and endogenous creatinine production declines with aging. High normal and minimally elevated values of creatinine may indicate substantially reduced renal function.

With atypical and delayed presentations, pathophysiologic and pharmacologic effects, decreased ability to communicate, and higher morbidity and mortality rates, accurate diagnosis of older adults with acute abdominal pain can be extremely challenging. One approach, when presented with these patients, is to organize the differential diagnosis into categories based on underlying pathologic processes: inflammatory, obstructive, vascular, or other causes.<sup>25</sup>

### ***Inflammatory Causes of Abdominal Pain***

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Infection and inflammation are the final common pathway of most abdominal diseases in any age group. In this section inflammatory causes of pain are reviewed from the upper to the lower GI tract.

#### ***Peptic ulcer disease***

Although the incidence of peptic ulcer disease (PUD) and the related complications and mortality of PUD have decreased over the past few decades in younger adults, hospital admission rates for PUD-related complications have increased in older adults. This increase may be secondary to increased use of aspirin and NSAIDs. Nearly 40% of older adults are prescribed NSAIDs, and age is an independent risk factor for developing gastroduodenal injury with NSAID use.<sup>26</sup> The risk of bleeding

from a peptic ulcer is higher in short-term versus long-term users of NSAIDs or aspirin.<sup>13,27–29</sup> Another factor contributing to PUD is the increased prevalence of *Helicobacter pylori* colonization with age.<sup>30,31</sup> Approximately 53% to 73% of older adults who have PUD are *H pylori* positive.<sup>32</sup>

In older adults, the typical presentation of epigastric pain is less common than in younger adults.<sup>33</sup> About 35% of older adults with endoscopically proven PUD do not experience pain.<sup>34</sup> In many cases, the initial presentation is with complications, the most common of which is GI bleeding. With long-term blood loss, patients may present with anemia or its consequent symptoms such as angina, decreased exercise tolerance, or congestive heart failure.

Perforation is a serious complication, more commonly seen with duodenal ulcers, and occurs in 5% to 10% of older adults with PUD. In one study, only 47% of patients with a perforated gastroduodenal ulcer had a sudden onset of pain and only 21% presented with rigidity.<sup>16</sup> Disturbingly, plain radiographs failed to identify free air in 39% of cases of perforation.<sup>16</sup> Once perforation occurs, the mortality is 30%, three times higher than in younger adults. Other less common complications of PUD include gastric outlet obstruction and penetration into adjacent organs. The overall mortality of PUD is 100 times higher in older than in younger patients.

### **Pancreatitis**

Pancreatitis is the most common nonsurgical cause of abdominal pain in older adults.<sup>35</sup> The top 2 causes of pancreatitis in older adults are gallstones and idiopathic causes compared with gallstones, hyperlipidemia, and alcohol use in younger patients.<sup>36,37</sup> Classically, the disease presents with upper abdominal pain radiating to the back, but it can also present as diffuse abdominal, back, or chest pain, with associated nausea and vomiting. Imaging is particularly helpful in patients with atypical presentations. Recent guidelines suggest that 2 out of 3 of the following should be present for the diagnosis of pancreatitis: (1) upper abdominal pain; (2) elevated levels of pancreatic enzymes; and (3) findings suggestive of acute pancreatitis on ultrasonography (U/S), computed tomography (CT), or magnetic resonance imaging (MRI). In the acute setting, CT is the preferred confirmatory imaging modality.<sup>38</sup>

In one series, gallstone pancreatitis accounted for more than half the cases in older adults compared with only 36% of younger patients.<sup>39</sup> Endoscopic retrograde cholangiopancreatography (ERCP) is the recommended therapeutic and diagnostic test for those patients who have common bile duct dilation on CT or U/S or a recent cholecystectomy.<sup>39</sup> ERCP is safe in older adults with a complication rate insignificantly higher than in younger patients, even when considering the subset of older adults on anticoagulation. The complication rate for ERCP remains constant for the young-old (65–74 years), the old-old (75–84 years), and the very old (>85 years).<sup>40</sup> Older adults may require subsequent ERCP sessions to completely clear the duct because of a higher stone burden.<sup>41</sup>

The Ranson criteria and the APACHE II (Acute Physiology and Chronic Health Evaluation II) criteria are used to predict patients at risk for severe disease and complications. In patients hospitalized for acute pancreatitis, older age is an independent risk factor for progression to organ dysfunction, systemic inflammatory response syndrome, or death.<sup>42</sup> Although mild pancreatitis can be managed in a regular unit with fluid resuscitation, analgesia, and antiemetics, patients with severe pancreatitis should be managed in an intensive care unit (ICU) with early surgical consultation and increased attention to their comorbidities and decreased physiologic reserve. Thromboprophylaxis with low-molecular weight heparin is suggested, given the increased inflammatory state.<sup>43</sup> Enteral nutrition via nasogastric or nasojejunal tube

feed is the preferred mode of nutrition in severe acute pancreatitis because it seems to reduce oxidative stress, stabilize the catabolic state induced by pancreatitis, and improve outcomes.<sup>44,45</sup>

### **Biliary disease**

Biliary tract disorders are the most common cause of abdominal pain in the older adult and the most common indication for intra-abdominal surgery.<sup>46</sup> The incidence of gallstones increases with age, with the prevalence reaching 33% by the age of 70 years.<sup>47</sup> Changes in bile acid production, bile cholesterol saturation, and decreased gallbladder sensitivity to cholecystokinin predispose older adults to the formation of gallstones.

Gallstones become symptomatic when they obstruct the neck of the gall bladder, resulting in intermittent symptoms of pain, often with associated anorexia, nausea, and vomiting. Symptomatic cholelithiasis can be managed by elective cholecystectomy if pain is controlled, if the patients are tolerating oral intake, and if patients do not appear sick. Early surgical intervention decreases repeat ED visits and complications, including acute cholecystitis (AC), pancreatitis, cholangitis, perforation and empyema.<sup>48</sup> Choledocholithiasis occurs more frequently in older adults<sup>49</sup> and can lead to obstructive jaundice, pancreatitis, and ascending cholangitis. U/S has low sensitivity but high specificity for detecting these stones. Magnetic resonance cholangiopancreatography and endoscopic U/S can detect bile duct stones with higher sensitivity and specificity than U/S and have comparable accuracy to ERCP but are much less invasive.<sup>49</sup> ERCP is the first-line therapeutic intervention.

If gallbladder outlet obstruction lasts more than 12 to 24 hours, there is increasing likelihood of progression to inflammatory changes in the gallbladder walls and onset of AC. A third of older adults with AC will present with minimal abdominal pain and minimal to no peritoneal signs, and presentation may not correlate with the severity of disease.<sup>50</sup> In one study of older adults with AC, 40% of severely ill patients had empyema of the gallbladder, gangrenous AC, or free perforation, and 15% had concomitant subphrenic or hepatic abscess; yet, of these patients, more than one-third were afebrile and a quarter did not have abdominal tenderness.<sup>51</sup> Fever is also not a sensitive indicator in older adults, as in one series only 71% with nongangrenous AC and 59% with gangrenous AC were afebrile. Approximately, 32% lacked leukocytosis and 28% lacked both fever and leukocytosis. In patients with gangrenous AC, more than a quarter of the patients lacked leukocytosis, and 16% lacked both fever and leukocytosis.<sup>52</sup> The ED treatment of AC begins with fluid resuscitation, administration of broad-spectrum antibiotics, and surgery consultation with cholecystectomy as definitive treatment.<sup>53</sup>

Emphysematous cholecystitis occurs predominately in older adults, particularly in men and diabetic patients, and is less likely to be associated with gallstones. This disease accounts for only 1% of all cases of AC but carries a mortality ranging from 15% to 25%, five times greater than the operative mortality for nonemphysematous AC.<sup>54</sup> Gas-forming clostridial species are the most common causative agent. With the high risk of perforation, empiric broad-spectrum antibiotic administration, including anaerobic coverage and surgical intervention, are critical for survival. Diagnostic imaging considerations for biliary disease in the elderly are similar to those in other age groups.

### **Appendicitis**

Acute appendicitis is a diagnostic challenge in patients of all ages, but more so in older adults. Appendicitis presents classically with periumbilical pain that later localizes to

the right lower quadrant with associated anorexia, nausea, and vomiting. Approximately 3% to 4% of older adults presenting with acute abdominal pain will have appendicitis.<sup>46,55</sup> The oldest old patients, octogenarians and older, have a significantly higher risk of delayed surgery and perforation compared with even younger-old (65–79 years old) patients.<sup>56</sup> In a case series of 601 patients older than 65 years with acute appendicitis, patients with perforation tended to wait a day longer before presenting to the ED and to have greater delays from presentation to surgery. Age had a larger effect on perforation than comorbidities.<sup>57</sup> As with other age groups, no laboratory test reliably diagnoses appendicitis in the elderly. Recent efforts to use C-reactive protein for this purpose and for risk stratification show some promise, but definitive imaging or laparotomy is still required.<sup>58,59</sup> Diagnostic imaging considerations in the elderly are similar to those of other age groups.

### ***Diverticulitis and colitis***

Aging and lifestyle changes place the elderly at high risk for constipation and diverticulosis and thus for colitis and diverticulitis. In necropsy studies, the prevalence of diverticulosis increases from 13% in those younger than 55 years to 50% in those older than 75 years.<sup>60</sup> In Western nations, left-sided diverticulosis and diverticulitis are more prevalent. Uncomplicated diverticular disease (diverticulosis) is not typically associated with acute abdominal pain.<sup>61</sup> A prospective study following patients with bowel complaints (pain, constipation, bloating) and diverticulosis found a crossover of only 1.7% to acute diverticulitis over 5 years.<sup>62</sup>

Diverticulitis classically presents as left lower abdominal pain associated with cramping, change in bowel movements, nausea, or fever. Diagnosis is confirmed by contrast-enhanced CT. One study comparing CT with U/S showed similar accuracy for diagnosing diverticulitis.<sup>63</sup> A recent meta-analysis shows summary sensitivities of 92% for U/S versus 94% for CT and summary specificities of 90% for U/S versus 99% for CT.<sup>64</sup> CT, however, is the preferred test because it can rule out alternative diagnoses that may not be well visualized by other imaging modalities. Initial treatment consists of broad-spectrum antibiotics against gram-negative and anaerobic bacteria, with a typical course of 7 to 10 days.<sup>65</sup> Admission decisions depend on the severity of the illness as well as the presence or absence of complications. Approximately, 25% of patients have a recurrence in which complications of abscess, phlegmon, or perforation are as likely as in the initial episode.<sup>66,67</sup> In sick or unstable patients, ED surgical consultation should be obtained. With contraindications to surgery, CT-guided drainage of diverticular abscess is an alternative.

Colitis can have a similar presentation to diverticulitis. Causes include infectious agents, such as *Clostridium difficile*, and inflammatory bowel disorders, such as ulcerative colitis (UC) and Crohn disease. *C difficile* is the most common cause of infectious diarrhea in nursing homes in the United States with a mortality estimated at more than 17%.<sup>68</sup> UC and Crohn disease have bimodal age distributions, and thus a significant portion of new diagnoses is made in older adults. Older patients make up more than 20% of admissions for Crohn disease and more than 30% of admissions for UC.<sup>69</sup> Stool antigen analysis, CT scan, and colonoscopy may help delineate between these different causes of colonic inflammation.

### ***Obstructive Causes of Abdominal Pain***

In the elderly, bowel obstruction accounts for 10% to 12% of ED visits for abdominal pain.<sup>20,55,70</sup> Obstruction is 3 times more common in older adults than in younger patients.<sup>50</sup> After biliary disease, bowel obstruction is the second most common reason for emergency surgical intervention in this age group.<sup>71</sup> Presentations vary and

depend on the type and location of obstruction. Complications of obstructions include dehydration, ischemia, sepsis, and perforation. The types of obstruction can be broken down into small versus large bowel and mechanical versus functional obstruction.

### **Small bowel obstruction**

The small bowel is the most common site of obstruction. The small bowel is more mobile, smoother, and smaller in diameter, making it more prone to both adhesions and herniation than large bowel.<sup>72</sup> The 3 most common causes of small bowel obstruction (SBO) are adhesions (50%–74%), hernias (15%), and neoplasms (15%).<sup>71,73</sup> As with younger patients, older adults with SBO present with colicky abdominal pain, nausea, vomiting, abdominal distension, and constipation. Gallstone ileus is a rare disease that accounts for 1% to 4% of mechanical obstructions.<sup>74</sup>

Plain radiography, often the initial study of choice, have a sensitivity of 66% and specificity of 57%.<sup>75</sup> Flat and upright abdominal radiographs may show distended loops of bowel, collapsed loops of bowel distal to the obstruction, paucity of gas in the rectum, air fluid levels, or stack-of-coins appearance (**Fig. 1**). Plain radiography is limited in assessing the degree, location, and cause of obstruction. CT imaging should be obtained when radiographs are nondiagnostic or to discriminate between complicated (vascular involvement) and uncomplicated (bowel involvement only) obstruction and assess the location and cause of obstruction. Closed-loop obstructions have a higher risk of strangulation. When strangulation of the bowel occurs, mortality increases 10-fold.<sup>76</sup> The clinician should bear in mind that even CT only has a sensitivity of 92% and specificity of 93% in the diagnosis of complete SBO.<sup>77</sup>

The acute management of SBO includes nasogastric decompression, intravenous (IV) fluid hydration, bowel rest, and symptomatic management. Patients with signs and symptoms of complications, such as strangulation and ischemia, require aggressive resuscitation and immediate surgical involvement. When considering disposition, it is important to recognize that morbidity and mortality in older adults with SBO is approximately 26%.<sup>78</sup> Studies show that patients with SBO managed on a surgical service have decreased length of stay and lower incidence of postoperative complications compared with those admitted to medical services.<sup>78–80</sup> Thus, it is prudent to



**Fig. 1.** SBO showing stack-of-coins appearance due to the plicae circulares that extend across the entire bowel in contrast to the haustra of the colon. (Courtesy of Joshua Broder, MD, Duke University, Durham, NC)



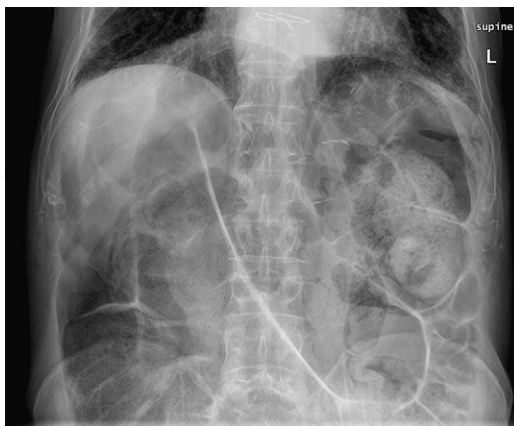
obtain early surgical consultation for almost all elderly patients with SBO. Those with uncomplicated bowel obstructions can sometimes be managed by the medical service because 30% to 50% resolve with conservative treatment.<sup>79</sup>

### **Large bowel obstruction**

Most large bowel obstructions (LBOs) are caused by malignancy (60%), volvulus (10%–15%), or diverticulitis.<sup>81,82</sup> Across all age groups, these obstructions are much less common than SBO but are more prevalent in older adults because the prevalence of underlying causes increases with age. LBO classically presents as abdominal pain, distension, and constipation. Vomiting occurs late in the disease process, if at all. Patients with malignant obstruction may provide a history of unintentional weight loss or change in stool caliber.

In older adults, sigmoid volvulus is the most common type, accounting for 40% to 85% of all cases.<sup>83–85</sup> Mortality in the United States from sigmoid volvulus ranges from 12% to more than 50% depending on whether the sigmoid is viable or gangrenous.<sup>86</sup> Medications and diseases that alter bowel motility can predispose patients to volvulus.<sup>87</sup> Sigmoid volvulus tends to present with gradual onset of symptoms of left lower quadrant crampy or intermittent pain that progress to abdominal distension and obstipation. Cecal volvulus tends to have a younger age of distribution and occurs less frequently than sigmoid volvulus. Predisposing factors in the older adult include previous abdominal surgeries and adhesions. Unlike sigmoid volvulus, cecal volvulus presents with acute onset of abdominal pain similar to SBO with associated nausea and vomiting. Patients with these conditions are at high risk for perforation and require immediate surgical intervention.

Although plain radiographs are more accurate in detecting LBO than SBO, CT remains the imaging study of choice.<sup>88,89</sup> Other diagnostic modalities include a barium enema, although this does not allow for visualization of mural changes and extracolonic abnormalities.<sup>88</sup> Sigmoid volvulus presents classically on radiographs as a dilated colon with a bent inner-tube appearance with the “bend” directed to the right upper quadrant (**Fig. 2**). CT or contrast enema may be used when diagnosis is unclear. Typical findings on barium enema include the “bird’s beak” deformity at the point of narrowing in the pelvis. Definitive diagnosis of a cecal volvulus is more difficult with



**Fig. 2.** Sigmoid volvulus showing bent inner-tube appearance. (Courtesy of Joshua Broder, MD, Duke University, Durham, NC)



plain radiographs. Radiographs may show the classic coffee bean sign, a large oval gas shadow with a line down the middle, representing the bowel bent over on itself.

### ***Ileus and acute colonic pseudo-obstruction***

Impaired intestinal transit time can be because of mechanical obstructions as discussed or because of decreased peristalsis from functional impairment of the GI system. The latter, an ileus, is seen most often postoperatively and can occur anywhere in the GI tract. Many medications can also cause ileus, including opioids, anticholinergics, and tricyclic antidepressants (TCAs).<sup>90</sup> Other causes of ileus include critical illness, metabolic derangements, neurologic disorders, intra-abdominal or retroperitoneal inflammation, or severe infections.<sup>91</sup> Patients present with mild diffuse abdominal pain and distension with hypoactive bowel sounds. Plain radiographs may show findings similar to SBO, and CT scan is necessary to rule out this condition. Treatment is mainly supportive.

Acute colonic pseudo-obstruction, also known as Ogilvie syndrome, is more common in adults older than 60 years, with a slight predisposition in men.<sup>92,93</sup> Ogilvie syndrome is an uncommon cause of functional obstruction that tends to occur in debilitated patients who have had prolonged hospitalizations or are institutionalized or have had recent non-GI surgery.<sup>94,95</sup> Anticholinergic medications, antiparkinsonism medications, phenothiazines, calcium channel blockers, and H<sub>2</sub> blockers are associated with this condition.<sup>92,96</sup> Symptoms tend to develop over days. Plain radiography and CT show massive colonic dilatation that extends to the rectum, in contrast to other forms of LBO. Barium enemas and colonoscopy are helpful in establishing the diagnosis, and colonoscopy successfully decompresses 80% of cases, but there is a 22% recurrence rate.<sup>93</sup> Immediate treatment is similar to that of SBO and involves IV hydration, nasogastric tube suctioning if there is evidence of small bowel involvement, and close observation. Electrolyte abnormalities should be corrected and offending medications discontinued. In stable patients, pharmacologic decompression can be achieved with the use of neostigmine with an immediate response rate of 90%.<sup>97–99</sup> Surgical intervention is typically reserved for patients with perforation or ischemia.

### ***Vascular Causes of Abdominal Pain***

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Vascular causes of abdominal pain are typically seen only in older adults because of the high prevalence of atherosclerosis, atrial fibrillation, hypertension, and peripheral artery disease. Although the incidence of disease is relatively low, mortality is very high. Vascular diseases can be grouped into those causing end-organ ischemia, arterial aneurysms, and arterial dissections.

#### ***Acute mesenteric ischemia***

Although acute mesenteric ischemia is a relatively rare cause of acute abdominal pain in older adults, it is frequently difficult to diagnose and has a high reported mortality rate of 60% to 90% depending on cause.<sup>100–102</sup> Mortality is directly associated with the time from presentation to surgical interventions. Mortality can range from 14%, if the time from evaluation to surgery is less than 6 hours, to 65%, if the time delay is greater than 12 hours.<sup>103</sup> Despite advances in imaging, mortality has not changed over the past several decades. A high index of suspicion is required to save these patients.

Mesenteric ischemia is classified by chronicity and etiology. Acute mesenteric ischemia accounts for 80% of intestinal ischemia. Acute mesenteric ischemia can be occlusive or nonocclusive, with occlusive forms more prevalent. Occlusion can

occur in either the arterial or venous system. Arterial occlusions are responsible for 75% of cases, whereas occlusions in the venous system cause 8% of the cases; the remaining 17% are secondary to nonocclusive mesenteric ischemia.<sup>104</sup>

Arterial occlusions are caused by emboli or by intra-arterial thrombosis. Most acute emboli lodge in the superior mesenteric artery (SMA) perhaps because of its orientation almost parallel with the aorta. The usual source of emboli is the heart where thrombi can form as the result of dysrhythmias, such as atrial fibrillation, recent myocardial infarction, or chronic congestive heart failure.

Mesenteric ischemia secondary to intra-arterial thrombus occurs most commonly in the setting of atherosclerotic disease. Patients may have had prior symptoms of postprandial abdominal discomfort (intestinal angina) and weight loss. Typically, this process occurs over time, so collaterals have developed and symptoms progress subacutely. Ischemia or infarction may occur when the remaining visceral artery or collaterals become completely occluded. Occlusions typically occur in the proximal portion of the vessel and can affect a larger portion of the bowel than embolic disease. Risk factors are similar to those for cardiac ischemia.

Nonocclusive mesenteric ischemia is caused by mesenteric vasoconstriction in response to dehydration, intravascular hypovolemia, or hypotension, often in combination with a systemic low-flow state, such as heart failure. Medications that alter mesenteric vascular flow include digoxin, ergotamine, catecholamines, angiotensin II blockers, vasopressin, and  $\beta$ -blockers. Patients are often already in the ICU setting for other processes, obscuring the diagnosis and symptoms. Abdominal pain may gradually increase or be discontinuous and colicky in nature.

Mesenteric venous thrombosis is the least common cause of mesenteric ischemia and the least fatal. Presentations can be acute or subacute. Risk factors include hypercoagulable states, portal hypertension, portal vein thrombosis, abdominal inflammations, and a history of previous surgery or abdominal trauma.

Classically, acute mesenteric ischemia presents with pain out of proportion with abdominal examination, associated with nausea, vomiting, and diarrhea. Early on, the abdomen is often soft and nontender. As ischemia evolves into infarction, peritoneal signs emerge. Only one-third of patients present with the classic triad of abdominal pain, fever, and heme-positive stools.<sup>105</sup> As noted, venous occlusion can present more indolently, with more colicky symptoms lasting for more than 48 hours. Nausea, vomiting, anorexia, and diarrhea may occur. Occult blood in stools is frequent; massive hemorrhage is an ominous sign of infarction. High white blood cell counts more than 20,000; elevations in amylase, aspartate aminotransferase, lactate dehydrogenase, and creatine phosphokinase levels; and a metabolic acidosis are indicative but neither sensitive nor specific.<sup>106,107</sup> Elevations in phosphate and lactate levels suggest bowel necrosis.<sup>108,109</sup> D-Dimer levels may also be elevated.<sup>110,111</sup> Importantly, the absence of abnormal laboratory values does not exclude the diagnosis.

Thumbprinting or thickening of bowel loops is seen on plain radiographs in less than 40% of patients. CT is more sensitive, 82% to 100% sensitive, for venous thrombosis but may miss arterial thrombi.<sup>112</sup> Bowel wall thickening is most often seen in arterial occlusion, although bowel walls may be normal.<sup>113</sup> Bowel dilatation or wall attenuation may be present but is nonspecific. Pneumatosis is a nonspecific late finding present in only 6% to 30% of cases.<sup>114</sup>

Angiography is the gold standard for the diagnosis of arterial mesenteric ischemia and allows for the direct intravascular therapeutic interventions described later. However, angiography is invasive, is not readily available, is not feasible in unstable patients, and may delay surgical embolectomy. An alternative is multidetector

CT angiography. This technology is more readily available, rapidly acquired, and less invasive, with a sensitivity of 93% to 96% and a specificity of 94% to 100%.<sup>115,116</sup> Doppler U/S and MRI are helpful in the diagnosis of chronic mesenteric ischemia but have little role in the diagnosis of acute ischemia.

Treatment is initially supportive with fluid resuscitation, circulatory stabilization, and treatment of the underlying condition. In settings of hypotension unresponsive to fluid resuscitation, vasopressors may be required but are likely to exacerbate ischemia. Vasopressin and alpha-agonists should be avoided, except in extremis.<sup>117</sup> In cases of arterial emboli and nonocclusive ischemia, infusion of papaverine or other vasodilators into the SMA may be successful. If there are no contraindications, pharmacologic treatment includes the initiation of heparin and broad-spectrum antibiotics. Patients with peritoneal signs or evidence of perforation should be taken to the operating room immediately.

### ***Ruptured abdominal aortic aneurysm***

Aortic aneurysms are the 14th leading cause of death in the United States and the 10th leading cause of death in older men.<sup>118</sup> Ruptured abdominal aortic aneurysm (AAA) is a leading cause of sudden death, with 50% prehospital mortality. For patients who reach the hospital, mortality is still 80% to 90%. Even in a cohort of patients with rapid diagnosis who were transported to the operating room within 12 minutes of arrival, there was a 30-day mortality of 70%.<sup>119</sup>

Risk factors for AAA include older age (>60 years), smoking, male sex, white race, family history of AAA, occlusive atherosclerotic disease, and connective tissue disorder.<sup>120</sup> Aneurysm size is the most likely predictor of rupture. The yearly risk of rupture for an AAA with an initial diameter of 3 cm ranges from 0.2% to 0.4%; with a 4-cm aneurysm, the range increases to 0.8% to 1.1%, and for aneurysms measuring 4.5 cm, the yearly risk increases to 1.2% to 2.1%.<sup>121</sup> This risk is increased in patients with hypertension, chronic obstructive pulmonary disease, familial AAA, and tobacco abuse.<sup>122</sup>

The classic triad of hypotension, pulsatile mass, and abdominal or low-back pain is diagnostic but only seen in 30% to 50% of acute AAA.<sup>123</sup> Initially, patients may experience transient hypotension or syncope but may be stable by the time of presentation to the ED. A study of ruptured AAA showed that hypotension and tachycardia was absent in 50% of admitted patients who progressed to death within the next 2 hours. Signs and symptoms of acute AAA can be varied and nonspecific. The symptoms in 30% of patients are initially misdiagnosed or mistaken for renal colic, diverticulitis, and GI bleed.<sup>124</sup> Acute AAA may present with abdominal pain (83.6%) or back pain (over 50%).<sup>125</sup> It may mimic renal colic with unilateral flank pain radiating to the groin and microscopic hematuria. Any older adult presenting with symptoms of new-onset renal colic should be evaluated for acute AAA. Other symptoms include lower-extremity neuropathy with or without dysesthesias caused by ischemia and or compression of neural structures and intractable back pain. Aneurysms can rupture into the GI tract, leading to massive GI bleeding, or into the vena cava or left renal vein, but these are usually rapidly fatal.<sup>123</sup> Physical examination for the diagnosis of AAA may be impeded by increased abdominal girth.<sup>126</sup> Bedside U/S by ED physicians is highly accurate but does not distinguish an acute from a nonacute AAA, although this difference is usually clear from the clinical context.<sup>127</sup> U/S may be technically limited by habitus or bowel gas in a small proportion of patients. For stable patients, a noncontrast CT scan can evaluate the caliber of the aorta as well as identify nephrolithiasis.

Early consultation with a vascular surgeon and immediate resuscitation is imperative for suspected acute AAA. In unstable patients, a bedside ultrasonography can

be obtained during ongoing resuscitation. At least 2 large-bore IV catheters should be established, and the patient should be typed and crossed for a minimum of 10 units of packed red blood cells. Expeditious transfer to the operating room may decrease mortality. Confirmatory imaging studies may be obtained in stable patients. IV contrast-enhanced CT is considered the gold standard, with a sensitivity ranging from 79% to 94% and specificity ranging from 77% to 95% for the identification of acute AAA.<sup>120</sup> If IV contrast is contraindicated, a noncontrast CT scan is done to visualize AAA and many cases of acute hemorrhage.

### ***Aortic dissection***

The incidence of aortic dissection is low but potentially fatal if not treated. The typical patient is a man in his seventh decade of life.<sup>128</sup> Risk factors include systemic hypertension, previous coronary cardiac surgeries, and atherosclerosis.<sup>128</sup> Patients can present with acute onset of abdominal pain, particularly, if the dissection is in the descending aorta. In patients who present with pain or symptoms above and below the diaphragm, a high index of suspicion should be maintained. Contrast-enhanced CT is the diagnostic imaging study of choice. MRI or U/S (a combination of transthoracic, transesophageal, and transabdominal approaches may be needed) can be used in cases in which IV contrast is contraindicated. This condition is managed with immediate resuscitation, blood pressure management, and either surgical or medical treatment depending on the location of the dissection.

### ***Other Causes of Abdominal Pain***

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Many other intra-abdominal and extra-abdominal causes present with either vague or localized abdominal pain in the elderly.

### ***GU***

Acute urinary tract infections (UTIs) and pyelonephritis are common causes of abdominal pain in older adults. UTIs are frequent in older adults and are a consequence of previously discussed changes of aging. Caution should be exercised in ascribing abdominal pain to a UTI because asymptomatic bacteriuria is found in up to 18% of community-dwelling women who are 65 years or older and in up to 10% of all community-dwelling men older than 65 years.<sup>129,130</sup> The rate increases to 27% in women older than 80 years and to 16% in men older than 80 years,<sup>131</sup> and, approximately 58% of institutionalized older adults have been found to have asymptomatic bacteriuria.<sup>132</sup> Acute urinary retention usually presents with anuria, abdominal pain, and a palpable bladder but may be easily overlooked in patients unable to provide a history of this condition. Causes include medications (anticholinergics, antihistamines, and TCAs), bladder outlet obstruction, or neurogenic disease processes.

Renal causes account for 5% to 10% of abdominal pain in the older adult.<sup>55,70</sup> The incidence of renal stones is increasing in the older adult population.<sup>133</sup> Patients may present with abdominal pain and/or flank pain, often with concomitant nausea and vomiting. Noncontrast CT scan is the study of choice and can also rule out AAA. Treatment is similar to that of younger adults, with the exception that more caution should be taken in prescribing NSAIDs. Other GU causes of abdominal pain to consider in older adults are prostatitis, epididymitis, gonadal cancer, testicular torsion, and Fournier gangrene.<sup>134</sup>

### ***Constipation***

As discussed earlier, the older adult is at high risk for constipation. Unlike younger patients in whom constipation tends to be mainly the result of low fiber intake, in the older adult, medication effects, decreased stomach emptying time, impaired

mobility, and comorbid diseases all make constipation increasingly prevalent. Constipation occurs more frequently in women than in men, possibly because of the association with pelvic floor dysfunction.<sup>135</sup> Symptoms of constipation include the feeling of fullness, urgency, abdominal pain, and inability to pass stool. Unlike children, radiography is still a recommended first-line diagnostic test in older adults because many serious diseases, including bowel obstruction and perforation, may present with similar symptoms.

### ***Malignancy***

Intra-abdominal malignancy may cause acute abdominal pain, as well as biliary symptoms, obstruction, peritonitis, ascites (with or without pain), and abdominal mass. A history of unexplained weight loss, anorexia, or night sweats or a lack of primary care or cancer screening tests makes newly diagnosed carcinoma more likely. In the setting of known intra-abdominal cancer, obstruction as well as cancer-specific diagnoses should be considered. Colon cancer has a propensity for GI bleeds and perforation. Prostate cancer can cause bone metastases to the pelvis and spine with pain or urinary obstruction. Gynecologic cancers may cause painful masses, peritoneal spread with peritonitis, and intermittent obstructive or urinary symptoms. Pancreatic and biliary cancers can cause upper or lower abdominal symptoms. In a study of more than 2000 patients presenting with acute abdominal pain, 2.8% were found to have an abdominal malignancy at 1-year follow-up, with almost half undiagnosed at discharge. Constipation, intestinal obstruction, and nonspecific abdominal pain were the most common diagnoses in patients whose malignancy was initially unrecognized.<sup>136</sup> GI and GU system cancers are also disproportionately common among older adults. At present, comprising only 12.8% of the US population,<sup>137</sup> this group makes up most of the new diagnoses of GI cancers (63.1%) and diagnoses of GU cancers in men (59.4%).<sup>138</sup> According to the American Cancer Society, 1 in 6 men and 1 in 10 women older than 60 years will develop invasive cancers.<sup>139</sup> With the expected population growth in this age group and increasing longevity, an increase in the number of malignancies should be expected.

### ***Extra-abdominal causes***

The many extra-abdominal and systemic diseases that are known to cause abdominal symptoms are discussed by Dean and McNamara elsewhere in this issue. Almost all such diseases occur with increasing frequency with aging and can be divided into cardiac/vascular, pulmonary, metabolic, neurologic, or other causes. Vascular causes include myocardial infarction (most notably inferior wall) that can present with epigastric pain, nausea, or vomiting. An electrocardiogram should be obtained in older adults who present with epigastric pain. Pulmonary processes, such as pneumonia, pneumothorax, and pulmonary embolus, can present as abdominal pain. Metabolic causes of abdominal pain include alcoholic or diabetic ketoacidosis, heavy metal poisoning, Addisonian crisis, hemochromatosis, aspirin overdose, opioid withdrawal, and porphyria. Neuropathic pain from herpes zoster or radiculopathies can present as abdominal pain.

Older adults with processes occurring in the abdominal wall, such as ventral hernias, rectal sheath hematomas (particularly in patients who are anticoagulated), cellulitis, and abscess, may also complain of abdominal pain. As noted earlier, medications can predispose patients to abdominal diseases by a variety of mechanisms and interfere with patients' ability to recognize these diseases. In addition, several medications can also be directly responsible for abdominal symptoms. Digoxin, colchicine, and metformin and antibiotics can cause nausea, vomiting, diarrhea, and abdominal pain. Erythromycin is commonly known to cause gastric irritation

and intestinal cramping. Phenothiazines, antidepressants, oral hypoglycemic agents, and diuretics may cause abdominal pain by causing liver dysfunction.<sup>113</sup> Although rarely overwhelming, these extra-abdominal causes should be considered when evaluating older patients with abdominal pain.

## SUMMARY

Evaluation of acute abdominal pain in older adults can be challenging in the ED. Atypical or delayed presentations of abdominal diseases are much more common among older adults who are also at higher risk of complications and have higher mortality rates. Inaccurate diagnosis can lead to an increase in morbidity and mortality.<sup>16</sup> Given the wide range of possible acute abdominal emergencies in older adults, it is helpful to categorize the possibilities into groups based on causes, such as inflammatory, obstructive, vascular, and other causes.

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