

Appropriate Use of Imaging in Adult Patients with Nontraumatic Abdominal Pain

BY TODD CUNNINGHAM, MD

INTRODUCTION

Abdominal pain is a common clinical presentation in adult patients, encompassing a range of possible diagnoses, including infection, obstruction, perforation and abscess. The presentation of nontraumatic abdominal pain symptoms can vary extensively: patients may present with acute, intermittent or chronic symptoms; they may complain of a localized or generalized pain; or they may complain of associated symptoms such as nausea, fever or diarrhea. A focused history, physical examination, ultrasound and laboratory testing can help to narrow differential considerations and may guide initial patient management. Advanced imaging is often required, however, to make a definitive diagnosis and to guide treatment when the clinical picture remains unclear, when the patient presents with severe pain or distress, or when patients present with jaundice, fever, an elevated white blood cell (WBC) count, or a suspicion of neoplasm.

Conventional radiography, while not sensitive or specific, is often the first examination obtained. It is useful to evaluate for typical bowel gas patterns associated with obstruction or constipation, and is useful to evaluate for foreign bodies, radiodense kidney stones or free air.

Ultrasound, although not considered an advanced imaging modality, is the initial study of choice when the patient presents with pain in the right upper quadrant and a suspicion of gallstone-related disease. Ultrasound is also useful to detect and evaluate masses in the solid organs, pockets of free fluid, and pelvic and/or gynecologic anatomy. Anatomy is often obscured by intestinal gas on ultrasound, and as a result, it is of limited use in patients presenting with diffuse abdominal pain or lower quadrant pain.

CT is generally the preferred advanced imaging procedure in most patients presenting with non-traumatic abdominal pain, as it is both sensitive and specific for a number of pathologic entities. CT is accurate in the detection and evaluation of abscess, appendicitis, diverticulitis, bowel obstruction, perforation, abscess, neoplasm, kidney stone disease, and aneurysms of the abdominal aorta.

MRI may not always be readily available or may not be appropriate for patients presenting with acute pain and distress. The applicability is also limited for patients with claustrophobia and in patients with active or passive metallic implants. MRI can be useful to characterize masses of the solid organs. It also has value in the management of patients with inflammatory bowel disease.

Cholescintigraphy may be used in patients presenting with right upper quadrant pain suggestive of cholecystitis, particularly when ultrasound is inconclusive. In some instances, scintigraphy may be useful to evaluate patients with inflammatory bowel disease.

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This material summarizes key elements of Appropriate Use Criteria (AUC) developed by the CDI Quality Institute's Provider Led Entity (PLE). The CDI Quality Institute PLE has been qualified by the Centers for Medicare and Medicaid Services to develop AUC to guide the ordering of advanced imaging studies. The entire AUC library is available at myCDI.com/PLE.

This edition of *The Consult* summarizes criteria developed by Dr. Cunningham and panel of experts:

- Paul Allegra, MD; emergency medicine physician, Crosby, MN
- Thomas Gilbert, MD, MPP; CDI Chief Clinical Officer and PLE Chair, CDI Quality Institute, MN
- Andrew Kastenmeier, MD; Assistant Professor of General Surgery, Medical College of Wisconsin, WI

Clinical decision support (CDS) is not intended to replace clinician judgment, but rather to provide information to assist care team members in managing the complex and expanding volume of biomedical and person-specific data needed to make timely, informed, and higher-quality decisions based on current clinical science (National Academy of Medicine, 2017).

CLINICAL SCENARIOS

The strength of recommendations for imaging is indicated as follows:

- Green = indicated
- Yellow = indicated in specific scenarios
- Orange = probably not indicated, with limited exceptions
- Red = not indicated

Diffuse or poorly localized acute abdominal pain with or without fever (including clinical suspicion for perforated peptic ulcer disease, bowel perforation, abscess, incarcerated hernia, post-surgical complication, and symptomatic abdominal aortic aneurysm):

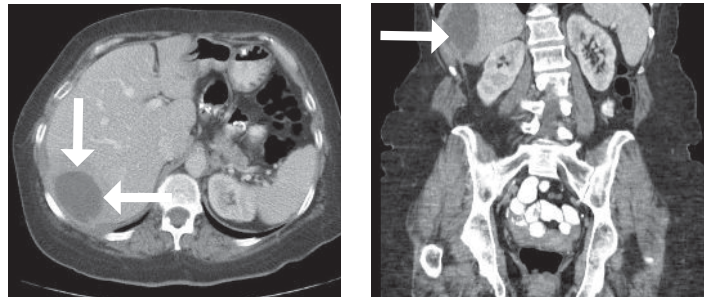
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen and pelvis with and without IV contrast or MRI of the abdomen and pelvis without IV contrast
●	CT abdomen and pelvis with IV contrast and/or CT angiography for suspected symptomatic AAA in patients with nondiagnostic, inconclusive, or positive ultrasound exam
●	MR angiography for suspected symptomatic AAA in patients with nondiagnostic, inconclusive, or positive ultrasound exam with allergy to contrast, poor or difficult IV access, or poor renal function
●	CT abdomen and pelvis with and without IV contrast except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis

CLINICAL NOTES

- The range of pathology that can produce abdominal pain and fever with or without abscess is very broad and includes pneumonia, hepatobiliary disease, complicated pancreatic processes, nephrolithiasis, gastrointestinal inflammation or perforation, bowel obstruction or infarction, and abscess (Scheirey et al. [ACR] 2018).
- Conventional radiography may be performed in the setting of acute abdominal pain. Conventional radiography, however, has a limited role in the evaluation of nontraumatic abdominal pain in adults. Although the use of radiographs has shown high sensitivity (90%) for detecting intra-abdominal foreign bodies and moderate sensitivity for detecting bowel obstruction (49%), its low sensitivity for sources of abdominal pain and fever or abscess limits its role in this setting (Scheirey et al. [ACR] 2018).
- In patients with epigastric pain and suspected peptic ulcer disease (PUD) without fever or suspected perforation, consideration should be given to a right upper quadrant (RUQ) ultrasound (US) to exclude gallbladder disease, and a gastric cocktail to test for PUD (PLE expert panel consensus opinion).
- Ultrasound can be used to screen the abdomen for sources of abdominal pain, but in general is less sensitive and specific than CT. Although ultrasound may be able to depict portions of an abscess or malignancy, it is not optimized to view

many areas of the abdomen, particularly in the presence of increased bowel gas or free intraperitoneal air. (Scheirey et al. [ACR] 2018).

- In patients with abdominal or back pain with a suspected aneurysm, an ultrasound is recommended to determine if an AAA is present and to identify other causes of pain. (Chaikof et al. [SVS] 2009, strong level of recommendation/moderate quality of evidence).
- The use of IV contrast increases the spectrum of detectable pathology and is recommended in preference to other methods of contrast administration (Scheirey et al. [ACR] 2018; Gans et al. 2015).
- In practice, the feasibility of MRI for acute abdominal pain will rely on institutional expertise, availability, and adoption of protocols that are aimed at rapid acquisition and multiorgan assessment (Scheirey et al. [ACR] 2018).



Subdiaphragmatic and perihepatic abscess

Right upper quadrant pain with suspected hepatobiliary disease with or without jaundice, with or without known gallbladder calculi, after initial evaluation with ultrasound (if available):

●	*
●	Cholescintigraphy in patients with suspected acute or chronic cholecystitis and a nondiagnostic or discordant ultrasound
●	MRI abdomen [with MRCP] in patients with suspected acute cholecystitis and a nondiagnostic or discordant ultrasound
●	CT abdomen with or without IV contrast in patients when other intra-abdominal processes are suspected, or when common bile duct obstruction is suspected
●	CT abdomen with and without IV contrast or CT abdomen with IV contrast in patients with suspected acute cholangitis
●	MRI abdomen [with MRCP] in patients with suspected acute cholangitis or gallstone pancreatitis, or in patients at intermediate risk for common bile duct stones (CBDS)
●	CT abdomen without IV contrast in patients with suspected acute cholangitis and allergy to CT contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen in patients with a low probability of common duct bile stones CBDS and negative ultrasound
●	MRI abdomen or CT abdomen as the initial imaging modality, except when ultrasound is not available
●	PET; PET/CT; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography; WBC scintigraphy

*In patients with suspected gallstone-related disease, the recommended initial test is ultrasonography (Alam et al. [UMHS] 2014; EASL 2016, NICE 2014).

CLINICAL NOTES

Upper abdominal pain with suspected gallstone related disease/biliary colic:

- The characteristic symptoms of gallbladder stones include episodic attacks of severe pain in the right upper abdominal quadrant or epigastrium for at least 15-30 minutes with radiation to the right back or shoulder (*EASL* 2016).
- Ultrasound is useful to evaluate biliary pain. Its accuracy for detecting gallbladder stones is in excess of 95% (*EASL* 2016).
- MRI with MRCP can demonstrate both the site and cause of biliary obstruction, and is the most sensitive noninvasive test for ductal calculi (Lalani et al. [*ACR*] 2012).

Acute cholecystitis:

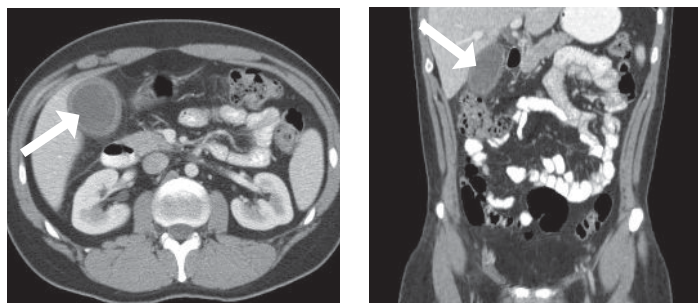
- Acute cholecystitis should be suspected in a patient with fever, severe pain located in the right upper abdominal quadrant lasting for several hours, and tenderness to palpation (*EASL* 2016).
- Ultrasonography shows 50-88% sensitivity and 80-88% specificity for acute cholecystitis (Yokoe et al. [*JSHBPS*] 2013; Alam et al [*UMHS*] 2014).
- Hepatobiliary iminodiacetic acid (HIDA) scintigraphy has a high sensitivity and specificity for acute cholecystitis. The accuracy of HIDA scintigraphy for the detection of acute acalculous cholecystitis is more limited (Dillehay et al. [*SNMMI*] 2017; Alam et al. [*UMHS*] 2014).

Acute cholangitis:

- Acute cholangitis can be diagnosed by the presence of the Charcot triad: pain and tenderness in the right upper quadrant, high spiking fever, and jaundice (*EASL* 2016).

Common bile duct stones (CBDS):

- Patients with jaundice, acute cholangitis, or acute pancreatitis should be evaluated for CBDS (*EASL* 2016).
- Patients at intermediate risk after ultrasound (age over 55, clinical gallstone pancreatitis, dilated CBD on US, or elevated liver enzymes or bilirubin <4mg/dl) generally undergo MRCP or EUS for the identification of CBDS (Williams et al. 2017; *ASGE Standards of Practice Committee* 2010).



Acute cholecystitis

Abdominal pain with suspected or known acute pancreatitis:

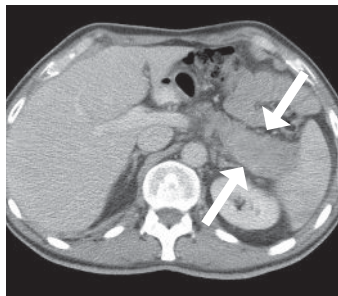
●	*
●	CT abdomen with IV contrast for severe or atypical abdominal pain and/or when amylase and lipase levels are equivocal
●	CT abdomen with IV contrast after 48 hours to assess the severity of disease, to guide management, or for follow-up
●	CT abdomen with IV contrast when there is a significant deterioration in the patient's clinical condition
●	MRI abdomen with and without IV contrast [with MRCP] for initial evaluation of acute pancreatitis if pain is atypical and/or when amylase and lipase are equivocal
●	MRI abdomen without IV contrast [with MRCP] for initial evaluation of acute pancreatitis in patients who are unable to receive or who refuse IV contrast if pain is atypical and/or when amylase and lipase are equivocal
●	CT abdomen without IV contrast after 48 hours if the patient has impending renal failure, allergy to CT contrast, or poor/difficult IV access for severe or atypical pain, when amylase and lipase levels are equivocal, or when there is significant deterioration in the patient's clinical condition
●	CT abdomen with or without IV contrast within 48 hours in patients with a typical clinical presentation and elevated amylase and lipase
●	CT abdomen with and without IV contrast except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; MR enterography/enteroclysis; CT enterography/enteroclysis; scintigraphy; MR angiography; CT angiography

*In patients with a suspected diagnosis of acute pancreatitis ultrasonography should be performed at baseline to evaluate the biliary tract to determine if the patient has gallstones and/or a stone in the common bile duct (Greenberg et al. [*Best Practice in General Surgery Group: University of Toronto*] 2016; Tenner et al. [*ASG*] 2013).

CLINICAL NOTES

- The diagnosis of acute pancreatitis is established by 2 of the 3 criteria: (i) abdominal pain consistent with the disease, (ii) serum amylase and/or lipase >3 times the upper limit of normal, and/or (iii) characteristic findings on abdominal imaging (Tenner et al. [*ACG*] 2013).
- Early CT may be useful to rule out bowel ischemia or intra-abdominal perforations in patients presenting with both acute pancreatitis and acute abdomen (*IAP/APA* 2013).
- In patients undergoing CT to assess for local complications of acute pancreatitis, intravenous contrast should be given unless contraindicated (Greenberg et al. [*Best Practice in General Surgery Group: University of Toronto*] 2016).
- It is recommended to perform multidetector CT with thin collimation and slice thickness (i.e, 5 mm or less), and 100-150 ml of non-ionic intravenous contrast material at a rate of 3 ml/s, during the pancreatic and/or portal venous phase (i.e, 50-70 s delay). During follow-up only a portal venous phase (monophasic) is generally sufficient (*IAP/APA* 2013).

- MRI offers similar diagnostic capabilities to MDCT with better depiction of stones and the pancreatico-biliary system, and does not use ionizing radiation. MRI, however, is typically not readily available in the acute setting, is more difficult to perform on acutely ill patients, and has longer acquisition times (Baker et al. [ACR] 2013).
- For MR, the recommendation is to perform axial FS-T2 and FS-T1 scanning before and after intravenous gadolinium contrast administration (IAP/APA 2013).



Pancreatitis of the pancreatic tail

Acute right lower quadrant pain with suspected appendicitis:	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen and pelvis with and without IV contrast or MRI abdomen and pelvis without IV contrast
●	CT abdomen and pelvis with and without IV contrast except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography

Abdominal pain with suspected chronic pancreatitis:	
●	CT abdomen with and/or without IV contrast for initial diagnosis of chronic pancreatitis
●	MRI abdomen with and without IV contrast [with MRCP] for initial diagnosis of chronic pancreatitis
●	MRI abdomen without IV contrast [with MRCP] in patients who cannot receive or refuse IV contrast for initial diagnosis of chronic pancreatitis
●	Repeat CT or MRI in patients with recurrent pain and known chronic pancreatitis, except in patients with atypical presentation or complications
●	PET; PET/CT; scintigraphy; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography

CLINICAL NOTES

- Chronic pancreatitis is characterized by chronic, progressive pancreatic inflammation and scarring, irreversibly damaging the pancreas, and resulting in loss of exocrine and endocrine function (Conwell et al. [APA] 2014).
- Intraductal pancreatic calcifications are the most specific and reliable sonographic and CT signs of chronic pancreatitis (Conwell et al. [APA] 2014).
- Ductal abnormalities are very specific and reliable MRI signs of chronic pancreatitis (Conwell et al. [APA] 2014).
- Signal intensity changes in the pancreas, seen on MRI, may precede ductal abnormalities and suggest early chronic pancreatitis (Conwell et al. [APA] 2014).
- Patients with equivocal or mild CT imaging findings or refractory symptoms may be referred to specialized centers for additional studies such as MRI/secretin-enhanced MRCP or endoscopic procedures such as endoscopic ultrasound, endoscopic retrograde cholangiopancreatography, and pancreas function testing (Conwell et al. [APA] 2014).
- In patients undergoing MRI for chronic pancreatitis, stimulation of the pancreas using IV secretin may improve the diagnostic accuracy in the detection of ductal and parenchymal abnormalities (Conwell et al. [APA] 2014).

CLINICAL NOTES

- The “classic” clinical presentation of patients with appendicitis consists of periumbilical abdominal pain migrating to the RLQ, loss of appetite, nausea or vomiting, with fever, and leukocytosis, and is present in about 50% of patients (Garcia et al. [ACR] 2018).
- Clinical decision tools, such as the Alvarado score, have not improved the outright diagnostic accuracy of the clinical examination, and demonstrate mixed results as an adjunct to help guide CT use (Garcia et al. [ACR] 2018).
- In adult populations, ultrasound had lower sensitivity (0.83) and specificity (0.89) than CT and MRI, and produced more non-diagnostic scans (Dahabreh et al. [AHRQ] 2015).
- [For the diagnosis of acute appendicitis] computed tomography (CT) had high sensitivity (summary estimates ranging from 0.96 to 1) and specificity (ranging from 0.91 to 0.99) in all populations of interest (Dahabreh et al. [AHRQ] 2015).
- Enteric and IV contrast may be more helpful in thin patients with low body mass index who lack sufficient mesenteric fat to demonstrate periappendiceal fat stranding that is associated with appendicitis (Howell et al. [ACEP] 2010).
- Increased sensitivity of newer-generation multislice CT scanners may improve diagnostic accuracy, obviating the need for contrast (Howell et al. [ACEP] 2010).
- Dose-reduction strategies in CT should be employed following the As Low As Reasonably Achievable principle (e.g., Mayo-Smith et al. 2014).
- MRI had high sensitivity (ranging from 0.91 to 1) but appeared to have variable specificity (ranging from 0.86 to 1), mainly due to the smaller number of available studies, (Dahabreh et al. [AHRQ] 2015).

Acute left lower quadrant pain with suspected diverticulitis:	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, and/or poor renal function
●	MRI abdomen and pelvis without IV contrast or MRI abdomen and pelvis with and without IV contrast
●	CT abdomen and pelvis with and without IV contrast
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography

CLINICAL NOTES

- Patients with diverticulitis may require surgery or interventional radiology procedures because of associated complications, including abscesses, fistulas, obstruction, or perforation. As a result, there has been a trend toward greater use of medical imaging to confirm the diagnosis of diverticulitis, evaluate the extent of disease and detect complications before deciding on appropriate treatment (McNamara et al. [ACR] 2014).
- Abdominal radiography is of limited value in evaluating diverticulitis, unless complications such as free perforation or obstruction are suspected (McNamara et al. [ACR] 2014).
- CT is widely available, reproducible, and has a reported overall accuracy of 99%. CT has a major role for depicting extracolonic disease extent; this assessment is rarely possible with a contrast enema. (McNamara et al. [ACR] 2014).
- Abdominal CT has been shown to have an excellent interobserver agreement for specific urgent diagnoses, such as diverticulitis (kappa value of 0.90) (Yaghmai et al. [ACR] 2012).
- The role of MRI in the setting of left lower quadrant pain has been evaluated, and preliminary data suggest that it may have diagnostic potential in patients with suspected diverticulitis, with reported sensitivity of 86%–94% and specificity of 88%–92% (McNamara et al. [ACR] 2014).

- Abdominal CT has been shown to have an excellent interobserver agreement for specific urgent diagnoses, such as bowel obstruction (kappa value of 0.81) (Yaghmai et al. [ACR] 2012).
- CT scans have been shown in Class II and III studies to be superior to plain film radiography in the overall diagnosis of small bowel obstruction. They can also provide additional information that alters patient management. CT scans have been shown to be 83% to 94% accurate at diagnosing obstruction (Maung et al. [EAST] 2012).
- CT scans can determine not only the level of obstruction (93%) but also the cause (80%-91%) in most patients. There are also Class II data to suggest that CT is 85% to 100% sensitive in detection of bowel ischemia (Maung et al. [EAST] 2012).
- Contrast enhanced CT is the preferred confirmatory diagnostic study for both cecal and sigmoid volvulus and has the advantage of identification of incidental pathology that may be missed with plain radiographs or fluoroscopic contrast studies (Vogel et al. [ASCRS] 2016).
- MRI should utilize T2 FSE breath holding techniques such as HASTE and breath holding T1-weighted sequences for imaging with IV contrast (PLE expert panel consensus opinion).

Abdominal pain with nausea, obstipation, vomiting, and/or distention with suspected bowel obstruction:	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen and pelvis with and without IV contrast
●	MRI abdomen and/or pelvis without IV contrast if the patient is unable to receive or refuses IV contrast
●	CT enterography/enteroclysis or MR enterography/enteroclysis for intermittent, recurrent, or low-grade small bowel obstruction
●	CT enterography/enteroclysis or MR enterography/enteroclysis in the acute setting
●	CT abdomen and pelvis with and without IV contrast, except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR angiography; CT angiography

Abdominal pain with distention, diarrhea, nausea, and/or vomiting with suspected inflammatory bowel disease*:	
●	MRI abdomen and pelvis with and without IV contrast or MR enterography with and without IV contrast
●	CT with IV contrast or CT enterography with IV contrast
●	MRI abdomen and pelvis without IV contrast or MR enterography without IV contrast for patients with allergy to contrast and/or poor or difficult IV access
●	CT without IV contrast or CT enterography without IV contrast for patients with allergy to IV contrast, poor or difficult IV access, and/or poor renal function when MRI or MR enterography is not available
●	CT enteroclysis or MR enteroclysis, except in patients with more indolent or chronic presentations
●	WBC scintigraphy, PET, or PET/CT, except in patients with more chronic presentations, when colonoscopy is incomplete, or other diagnostic modalities are negative
●	Cholescintigraphy; MR angiography; CT angiography; MR cholangiopancreatography

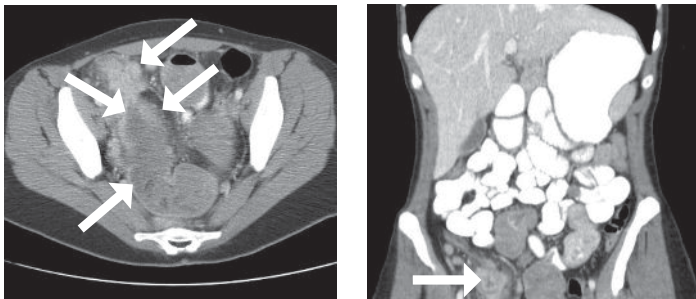
*This scenario refers to the management of patients with suspected inflammatory bowel disease, rather than to the management of patients with known or established Crohn's disease or ulcerative colitis.

CLINICAL NOTES

- The overall sensitivity of abdominal radiographs for the detection of small bowel obstruction ranges from 59% to 93% but is dependent on the radiologist's experience. Small-bowel ileus and large-bowel obstruction may also mimic small bowel obstruction findings in traditional planar radiographs. In addition, plain radiographs are nondiagnostic or nonspecific in many cases (Maung et al. [EAST] 2012).
- Water-soluble contrast study should be considered in patients who fail to improve after 48 hours of nonoperative management because a normal contrast study can rule out operative small bowel obstruction (Maung et al. [EAST] 2012, Level 2 recommendation).

CLINICAL NOTES

- Computed tomography enterography (CTE) is sensitive for the detection of small bowel disease in patients with Crohn's disease and is comparable to magnetic resonance enterography (MRE) (Lichtenstein et al. [ACG] 2018).
- CT enterography/enteroclysis has a sensitivity for CD of 75-90% and a specificity of >90% compared to endoscopy (Kim et al. [ACR] 2014).
- The performance of MR enterography for CD is very good and is similar to CT enterography. The sensitivity and specificity are 77%–82% and 80%–100%, respectively for active inflammation and complications. Overall, MR is more prone to respiratory and bowel-motion artifact, despite the use of glucagon, leading to suboptimal examinations and more difficult interpretations (Kim et al. [ACR] 2014).
- Tc-99m HMPAO white-cell-labeled scanning has a high sensitivity for IBD (91-98%) (Yaghami et al. [ACR] 2012).
- Ultrasound is the first-line test for gallstones and kidney stones, which should not be forgotten as complications of Crohn's disease. In expert hands, it has a high sensitivity for detecting disease, particularly in the terminal ileum. However, such expertise is not widely available (Mowat et al. [BSG] 2011).
- Because of the absence of any radiation exposure, MRE should be used preferentially in young patients (<35 years) and in patients in whom it is likely that serial exams will need to be performed (Lichtenstein et al. [ACG] 2018, summary statement).



Crohn's disease with inflammation

CLINICAL NOTES

Acute mesenteric ischemia (AMI):

- AMI should be suspected in patients with acute abdominal pain of sudden onset in whom there is no clear diagnosis, particularly when the pain is disproportionate to the physical examination findings, and in the elderly with a history of cardiovascular comorbidities (Tilsed et al. [ESTES] 2016).
- The sudden onset of severe pain with spontaneous emptying of the bowel with no significant physical findings in patients with a potential source of emboli are classic signs of embolic AMI (EAMI) (Tilsed et al. [ESTES] 2016).
- CT or MRI findings of colonic pneumatosis and porto-mesenteric venous gas can be used to predict the presence of transmural colonic infarction (Brandt et al. [ACG] 2015)
- Biphase multidetector CT is the most sensitive and specific tool for the detection of AMI (Tilsed et al. [ESTES] 2016).

Abdominal pain with suspected mesenteric ischemia/infarct, or ischemic colitis:

●	CTA for acute or chronic mesenteric ischemia
●	CT abdomen and pelvis with IV [and oral] contrast for ischemic colitis
●	CT abdomen and pelvis with and without IV contrast for acute or chronic mesenteric ischemia if CTA expertise is not available
●	CT abdomen and pelvis with IV contrast with CTA to supplement recent CT without IV contrast for acute or chronic mesenteric ischemia
●	MRI abdomen and pelvis with and without IV contrast with MRA for acute or chronic mesenteric ischemia in patients with a moderate or severe allergy to iodinated (CT) contrast
●	CTA for ischemic colitis, except when there is suspected involvement of the right side of the colon (e.g., suggestive of superior mesenteric artery occlusion)
●	CT abdomen and pelvis without IV contrast, except in patients who cannot undergo contrast-enhanced CT or MRI
●	Scintigraphy; PET; PET/CT; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis

Colonic ischemia (CI):

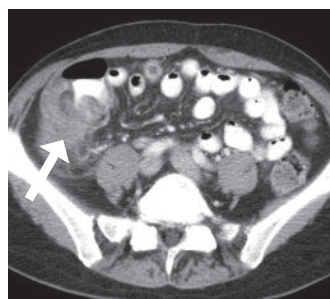
- The diagnosis of CI is usually established in the presence of symptoms of sudden cramping, mild abdominal pain, urgent desire to defecate, and passage of bloody diarrhea within 24 hours (Brandt et al. [ACG] 2015).
- The diagnosis of CI can be suggested based on CT findings, such as bowel wall thickening, edema, and thumbprinting (Brandt et al. [ACG] 2015).
- A diagnosis of non-isolated right CI (non-IRCI) should be considered when patients present with hematochezia (Brandt et al. [ACG] 2015).

Chronic mesenteric ischemia (CMI):

- CMI is characterized by postprandial abdominal pain and, when severe, by food aversion and weight loss (Bjorck et al. [ESVS] 2017).
- Patients with CMI should preferably be investigated and treated at specialized centers that can offer a multidisciplinary assessment, as well as both open and endovascular treatment (Bjorck et al. [ESVS] 2017).

Ischemic colitis:

- In the evaluation of ischemic colitis, oral contrast should be used and is useful to evaluate for mucosal ulceration (PLE expert panel consensus opinion).



Infectious colitis of the cecum

Summary: Appropriate Imaging for Adult Patients with Nontraumatic Abdominal Pain

● = indicated, ● = indicated in specific scenarios, ● = probably not indicated, with limited exceptions, and ● = not indicated

Diffuse or poorly localized acute abdominal pain with or without fever (including clinical suspicion for perforated peptic ulcer disease, bowel perforation, abscess, incarcerated hernia, post-surgical complication, and symptomatic abdominal aortic aneurysm):	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen and pelvis with and without IV contrast or MRI of the abdomen and pelvis without IV contrast
●	CT abdomen and pelvis with IV contrast and/or CT angiography for suspected symptomatic AAA in patients with nondiagnostic, inconclusive, or positive ultrasound exam
●	MR angiography for suspected symptomatic AAA in patients with nondiagnostic, inconclusive, or positive ultrasound exam with allergy to contrast, poor or difficult IV access, or poor renal function
●	CT abdomen and pelvis with and without IV contrast except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis

Right upper quadrant pain with suspected hepatobiliary disease with or without jaundice, with or without known gallbladder calculi, after initial evaluation with ultrasound (if available):	
●	*
●	Cholescintigraphy in patients with suspected acute or chronic cholecystitis and a nondiagnostic or discordant ultrasound
●	MRI abdomen [with MRCP] in patients with suspected acute cholecystitis and a nondiagnostic or discordant ultrasound
●	CT abdomen with or without IV contrast in patients when other intra-abdominal processes are suspected, or when common bile duct obstruction is suspected
●	CT abdomen with and without IV contrast or CT abdomen with IV contrast in patients with suspected acute cholangitis
●	MRI abdomen [with MRCP] in patients with suspected acute cholangitis or gallstone pancreatitis, or in patients at intermediate risk for common bile duct stones (CBDS)
●	CT abdomen without IV contrast in patients with suspected acute cholangitis and allergy to CT contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen in patients with a low probability of common duct bile stones CBDS and negative ultrasound
●	MRI abdomen or CT abdomen as the initial imaging modality, except when ultrasound is not available
●	PET; PET/CT; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography; WBC scintigraphy

*In patients with suspected gallstone-related disease, the recommended initial test is ultrasonography (Alam et al. [UMHS] 2014; EASL 2016, high quality evidence/strong recommendation; NICE 2014).

Abdominal pain with suspected or known acute pancreatitis:	
●	*
●	CT abdomen with IV contrast for severe or atypical abdominal pain and/or when amylase and lipase levels are equivocal
●	CT abdomen with IV contrast after 48 hours to assess the severity of disease, to guide management, or for follow-up
●	CT abdomen with IV contrast when there is a significant deterioration in the patient's clinical condition
●	MRI abdomen with and without IV contrast [with MRCP] for initial evaluation of acute pancreatitis if pain is atypical and/or when amylase and lipase are equivocal
●	MRI abdomen without IV contrast [with MRCP] for initial evaluation of acute pancreatitis in patients who are unable to receive or who refuse IV contrast if pain is atypical and/or when amylase and lipase are equivocal
●	CT abdomen without IV contrast after 48 hours if the patient has impending renal failure, allergy to CT contrast, or poor/difficult IV access for severe or atypical pain, when amylase and lipase levels are equivocal, or when there is significant deterioration in the patient's clinical condition
●	CT abdomen with or without IV contrast within 48 hours in patients with a typical clinical presentation and elevated amylase and lipase
●	CT abdomen with and without IV contrast except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; MR enterography/enteroclysis; CT enterography/enteroclysis; scintigraphy; MR angiography; CT angiography

*In patients with a suspected diagnosis of acute pancreatitis ultrasonography should be performed at baseline to evaluate the biliary tract to determine if the patient has gallstones and/or a stone in the common bile duct (Greenberg et al. [*Best Practice in General Surgery Group: University of Toronto*] 2016, high strength of evidence/strong guideline recommendation; Tenner et al. [ASG] 2013, strong recommendation/low quality of evidence).

Abdominal pain with suspected chronic pancreatitis:	
●	CT abdomen with and/or without IV contrast for initial diagnosis of chronic pancreatitis
●	MRI abdomen with and without IV contrast [with MRCP] for initial diagnosis of chronic pancreatitis
●	MRI abdomen without IV contrast [with MRCP] in patients who cannot receive or refuse IV contrast for initial diagnosis of chronic pancreatitis
●	Repeat CT or MRI in patients with recurrent pain and known chronic pancreatitis, except in patients with atypical presentation or complications
●	PET; PET/CT; scintigraphy; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography

Summary: Appropriate Imaging for Adult Patients with Nontraumatic Abdominal Pain

● = indicated, ● = indicated in specific scenarios, ● = probably not indicated, with limited exceptions, and ● = not indicated

Acute right lower quadrant pain with suspected appendicitis:	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen and pelvis with and without IV contrast or MRI abdomen and pelvis without IV contrast
●	CT abdomen and pelvis with and without IV contrast except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography

Acute left lower quadrant pain with suspected diverticulitis:	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, and/or poor renal function
●	MRI abdomen and pelvis without IV contrast or MRI abdomen and pelvis with and without IV contrast
●	CT abdomen and pelvis with and without IV contrast
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis; MR angiography; CT angiography

Abdominal pain with distention, diarrhea, nausea, and/or vomiting with suspected inflammatory bowel disease*:	
●	MRI abdomen and pelvis with and without IV contrast or MR enterography with and without IV contrast
●	CT with IV contrast or CT enterography with IV contrast
●	MRI abdomen and pelvis without IV contrast or MR enterography without IV contrast for patients with allergy to contrast and/or poor or difficult IV access
●	CT without IV contrast or CT enterography without IV contrast for patients with allergy to IV contrast, poor or difficult IV access, and/or poor renal function when MRI or MR enterography is not available
●	CT enteroclysis or MR enteroclysis, except in patients with more indolent or chronic presentations
●	WBC scintigraphy, PET, or PET/CT, except in patients with more chronic presentations, when colonoscopy is incomplete, or other diagnostic modalities are negative
●	Cholescintigraphy; MR angiography; CT angiography; MR cholangiopancreatography

*This scenario refers to the management of patients with suspected inflammatory bowel disease, rather than to the management of patients with known or established Crohn's disease or ulcerative colitis.

Abdominal pain with nausea, obstipation, vomiting, and/or distention with suspected bowel obstruction:	
●	CT abdomen and pelvis with IV contrast
●	CT abdomen and pelvis without IV contrast for patients with allergy to contrast, poor or difficult IV access, or poor renal function
●	MRI abdomen and pelvis with and without IV contrast
●	MRI abdomen and/or pelvis without IV contrast if the patient is unable to receive or refuses IV contrast
●	CT enterography/enteroclysis or MR enterography/enteroclysis for intermittent, recurrent, or low-grade small bowel obstruction
●	CT enterography/enteroclysis or MR enterography/enteroclysis in the acute setting
●	CT abdomen and pelvis with and without IV contrast, except in patients with a known or suspected cancer or liver disease
●	PET; PET/CT; scintigraphy; MR cholangiopancreatography; MR angiography; CT angiography

Abdominal pain with suspected mesenteric ischemia/infarct, or ischemic colitis:	
●	CTA for acute or chronic mesenteric ischemia
●	CT abdomen and pelvis with IV [and oral] contrast for ischemic colitis
●	CT abdomen and pelvis with and without IV contrast for acute or chronic mesenteric ischemia if CTA expertise is not available
●	CT abdomen and pelvis with IV contrast with CTA to supplement recent CT without IV contrast for acute or chronic mesenteric ischemia
●	MRI abdomen and pelvis with and without IV contrast with MRA for acute or chronic mesenteric ischemia in patients with a moderate or severe allergy to iodinated (CT) contrast
●	CTA for ischemic colitis, except when there is suspected involvement of the right side of the colon (e.g., suggestive of superior mesenteric artery occlusion)
●	CT abdomen and pelvis without IV contrast, except in patients who cannot undergo contrast-enhanced CT or MRI
●	Scintigraphy; PET; PET/CT; MR cholangiopancreatography; MR enterography/enteroclysis; CT enterography/enteroclysis

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