American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Acute Abdominal Pain and Fever or Suspected Abdominal Abscess**

Variant 1: **Postoperative patient with fever.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	8		High
CT abdomen and pelvis without contrast	7		High
US abdomen	6		None
MRI abdomen and pelvis with contrast	6	See statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray abdomen	5		Med
MRI abdomen and pelvis without contrast	5		None
X-ray contrast enema	4		Med
Ga-67 scan abdomen	4		High
X-ray upper GI series with small bowel follow-through	3		Med
Tc-99m or In-111 WBC scan abdomen and pelvis	3		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: **Postoperative patient with persistent fever and no abscess seen on CT scan within the last 7 days.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	8		High
CT abdomen and pelvis without contrast	6		High
US abdomen	6		None
Tc-99m or In-111 WBC scan abdomen and pelvis	6		Med
X-ray abdomen	5		Med
X-ray upper GI series with small bowel follow-through	5		Med
Ga-67 scan abdomen	5		High
MRI abdomen and pelvis without contrast	5		None
MRI abdomen and pelvis with contrast	5	See statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray contrast enema	4		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Acute Abdominal Pain and Fever or Suspected Abdominal Abscess**

Variant 3: **Patient presenting with fever, non-localizing abdominal pain, and no recent operation.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast	8		High
CT abdomen and pelvis without contrast	6		High
US abdomen	6		None
X-ray abdomen	6		Med
X-ray upper GI series with small bowel follow-through	5		Med
X-ray contrast enema	5		Med
Ga-67 scan abdomen	5		High
Tc-99m or In-111 WBC scan abdomen and pelvis	5		Med
MRI abdomen and pelvis without contrast	5		None
MRI abdomen and pelvis with contrast	5	See statement regarding contrast in text under "Anticipated Exceptions."	None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4: **Pregnant patient.**

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	8		None
MRI abdomen and pelvis without contrast	7		None
MRI abdomen and pelvis with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	None
CT abdomen and pelvis with contrast	5	Only after other studies without ionizing radiation have been utilized.	High
CT abdomen and pelvis without contrast	5		High
X-ray abdomen	4		Med
X-ray upper GI series with small bowel follow-through	2		Med
X-ray contrast enema	2		Med
Ga-67 scan abdomen	2		High
Tc-99m or In-111 WBC scan abdomen and pelvis	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

ACUTE ABDOMINAL PAIN AND FEVER OR SUSPECTED ABDOMINAL ABSCESS

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Summary of Literature Review

Acute abdominal pain with fever raises clinical suspicion of an intra-abdominal abscess or other condition that may need immediate surgical or medical attention. Infection or other inflammatory conditions are the usual cause. In these circumstances, emergency imaging is often employed, in conjunction with other clinical information, to make a quick and accurate diagnosis. This is crucial, as proper diagnosis facilitates expeditious and appropriate therapy, thus improving patient outcome. This discussion is arbitrarily limited to illnesses affecting the region between the diaphragm and the upper pelvis and excludes both renal and flank pathology. Pediatric patients are not considered.

The range of pathology that can produce abdominal pain and fever with or without abscess is very broad. It includes pneumonia, hepatobiliary disease, complicated pancreatic processes, gastrointestinal perforation or inflammation, bowel obstruction or infarction, abscesses anywhere in the abdomen, and tumor—among others. Of all patients who present to the emergency department with abdominal pain, about one-third never have a diagnosis established, one-third have appendicitis, and one-third have some other documented pathology. In the "other" category, the most common causes include (in order of frequency): acute cholecystitis, small bowel obstruction, pancreatitis, renal colic, perforated peptic ulcer, cancer, and diverticulitis [1]. When fever is also present, the need for quick, definitive diagnosis is considerably heightened.

A variety of clinical presentations occur in patients with acute abdominal pain accompanied by fever. This review concentrates on the evaluation of patients with acute diffuse abdominal pain, HIV-positive patients with acute abdominal pain and patients with suspected abdominal abscess. Other Appropriateness Criteria® topics address acute right upper quadrant pain, acute right lower quadrant pain, and acute left lower quadrant pain. Imaging evaluation varies slightly among patients with different clinical presentations. In general, computed tomography (CT) is the most important modality in evaluating patients with abdominal pain, more so in those with fever. Two reports have found CT superior to clinical evaluation for finding the cause of abdominal pain. CT was correct in 90%-96% of cases, while clinical evaluation was correct in 60%-76% of cases [2-4]. Additionally, the use of CT in patients with acute abdominal pain increases the emergency department clinician's level of certainty and reduces hospital admissions by 24% [5]. The presence of a white blood count (WBC) >11.5 has been correlated with a positive abdominal CT, and the combination of WBC >11.5, male sex, and age less than 25 years has been shown to correlate with a diagnosis of appendicitis [6]. Abdominal CT without the use of oral or intravenous (IV) contrast has been advocated as an alternative to abdominal radiographs for evaluating appendicitis [1,7]; however, the use of contrast agents greatly increases the spectrum of detectable pathology [5].

Acute diffuse abdominal pain with fever can be caused by conditions that ordinarily instigate more localized pain. These conditions include complicated appendicitis, complicated acute calculous or acalculous cholecystitis, bile duct obstruction with infectious cholangitis, hepatitis, hepatic abscess, pancreatitis with or without infection, pyelonephritis or renal infarction, renal stones, omental infarction, epiploic appendagitis, mesenteric adenitis, and diverticulitis [8]. Other conditions that typically present with diffuse abdominal pain and fever include bowel obstruction, bowel ischemia or infarction, gut perforation from ulcer or tumor, diffuse colitis, typhlitis and other gastrointestinal infections, small bowel inflammatory disease, abdominal abscess, intraperitoneal or retroperitoneal hemorrhage, and diffuse malignancy [9,10]. Less common cases of abdominal pain include tuberculous peritonitis [11].

Again, radiographs may provide useful information about bowel gas pattern or free air, but they offer no incremental information if CT is performed [2]. Sonography may be useful in selected conditions, including cholecystitis, cholangitis, liver abscess, diverticulitis, appendicitis, and small bowel inflammation, where it may be used to assess activity of Crohn's disease [12]. While ultrasound (US) may be able to detect portions of an abscess or malignancy (such as lymphoma), it is blind to many areas of the abdomen, particularly in the presence of increased bowel gas or free air. The shortcomings of US are partially offset by its lack of ionizing radiation, particularly in younger patients. In women with pelvic inflammatory disease (PID), pelvic US can be especially useful in identifying the presence of a tubo-ovarian abscess (TOA) [13]. With CT of the abdomen and pelvis in a young adult, there is a small risk

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of the radiation causing a fatal cancer, which some believe may be as high as one in 2,000 patients [14]. Magnetic resonance imaging (MRI) offers imaging without ionizing radiation and has been shown to provide clinically useful information for rapid diagnosis of the following gynecological emergencies: ovarian hemorrhage, ectopic pregnancy, tumor rupture, torsion, hemorrhage, infarction, and PID [15-17]. Recent studies have shown that in the evaluation of pregnant women with nontraumatic abdominal pain, CT established the diagnosis in 30% of these patients, when US or clinical methods have failed [18].

In patients with high-grade bowel obstruction, CT sensitivity varies from 86%-100%, with slightly lower sensitivity reported for low-grade obstruction [19-21]. In this regard, CT considerably outperforms the combination of clinical evaluation and radiographs [19]. CT also has the ability to identify and localize the cause of obstruction in 73%-95% of cases [19-21]. Additionally, it can identify closed-loop obstruction (sensitivity 79%) and associated strangulation (sensitivity 67%) [22]. Multidetector-row CT with coronal reformations is an excellent method that adds confidence to the diagnosis and exclusion of small bowel obstruction [23]. For intestinal ischemia, reported sensitivity of CT varies from 65%-86% [24-26] based on findings of vessel thrombosis, intramural or portal gas, and lack of bowel wall enhancement. For intestinal infarction, CT (sensitivity 82%) considerably outperforms radiography plus US (sensitivity 28%) [27]. In gut perforation, while radiographs are sensitive to small volumes of free air, CT is more sensitive to even smaller volumes and can detect additional loculated air or air in the mesenteric root [28]. Other CT findings include extravasation of oral contrast, mesenteric edema, or phlegmonous mass adjacent to a site of perforation.

In patients with Crohn's disease or inflammatory colitis, the presence of fever raises the question of associated abscess or phlegmon, although CT is the procedure of choice for the diagnosis of abscess, regardless of cause [29,30]. The accuracy of US in detecting abscess formation among patients with known Crohn's disease has been reported to be to 86.9% compared to 91.8% for CT [31]. In addition, CT can show the extent of any related fistulas or sinus tracts [29,32]. However, the diagnostic accuracy of US and barium studies in detecting internal fistulas has been reported to be similar: 85.2% for US and 84.8% for barium studies [31]. Pseudomembranous colitis may have fever without abscess; CT findings are present in the colon in 88% of cases [33]. While Tc-99m HMPAO white-cell-labeled scanning has a high sensitivity for inflammatory bowel disease (91%-98%) and may have some role in diagnosing appendicitis in older patients [34-36], it does not do as well as CT in detecting the complications of abscess and fistula [37]. Rarely, diffuse tumors such as lymphomas or metastases may present with abdominal pain and fever; again, CT is the procedure of choice due to its ability to assess well all node groups and organs.

CT is the imaging procedure of choice to diagnose gastrointestinal complications in neutropenic patients. The causes of neutropenia are becoming more common, especially the iatrogenic ones in patients that receive cytotoxic chemotherapy and undergo bone marrow transplantation as treatments for malignancy. These complications include Clostridium difficile colitis, graft-versus-host disease, neutropenic enterocolitis, and bowel ischemia [38].

Acute Abdominal Pain with Fever in the HIV-Positive Patient

Common causes of acute diffuse abdominal pain with fever in the HIV-positive patient are more diverse than they are in other patients. In addition to more usual conditions, typhlitis, intramural gut hemorrhage, and small bowel or colonic perforation with associated abscess may occur. The liver and biliary tree may be involved with HIV-related cholangiopathy, hepatic abscesses, or hepatic bacillary angiomatosis, a peliosis-like condition. The spleen is subject to focal infarction or abscess [39]. Gut mucosal disease may include gastrointestinal tuberculosis, ulcerating colitis cytomegalovirus (CMV), Clostridium difficile colitis, histoplasmosis, candida, mycobacterium avium complex (MAC)-related enteritis, and opportunistic bowel infection (cryptosporidiosis, giardia, Isospora, and strongyloides). Tumors with adenopathy and bowel involvement include Kaposi's sarcoma and lymphoma of gut, either of which may lead to bowel obstruction, pneumatosis intestinalis, perforation, or intussusception [40].

CT with oral, IV, and (frequently) rectal contrast is almost always the procedure of choice in an HIV-positive patient with acute abdominal pain and fever [40-43]. Supplemental barium studies of the mucosa of the stomach, small bowel, and colon may add additional information to that obtained from CT, particularly when mucosal lesions are small and fine. If there is any chance of gut perforation, barium should not be used. Occasionally, US of the biliary tree and gallbladder may be useful in evaluating HIV-related cholangiopathy. If CT is performed, radiographs have little incremental value. The use of radionuclide scanning in this subgroup has not been reported.

Suspected Abdominal Abscess

Patients suspected of having abdominal abscesses may present in a number of ways: with fever, with diffuse or localized abdominal pain, or with a history of a condition that may predispose to abdominal abscesses, such as recent surgery and inflammatory bowel disease, pancreatitis, etc. Imaging studies that have been used to detect abdominal abscesses include radiographs (supine and upright, and occasionally decubitus views); nuclear medicine studies such as gallium-, indium-, or technetium-tagged leukocyte studies; US; CT; and more recently MRI. Positron emission tomography (PET) using fluorine-18-2-flouro-2deoxy-D-glucose (FDG) and PET/CT are currently under investigation for evaluating

infection and inflammation. They potentially could replace nuclear medicine studies such as gallium-, indium-, or technetium-tagged leukocyte studies [44]. The current literature has recently focused on the role of CT in percutaneous drainage of abdominal abscesses. The implication is that CT scan is already the primary means of diagnosing abdominal abscess.

CT scanning has been shown to be the first and best test for diagnosing of intra-abdominal abscess in patients who have recently had abdominal surgery, and in patients with localizing signs for abscess [45]. Among intensive care unit (ICU) patients with sepsis of unknown origin, CT of the torso revealed the source of sepsis in five of 38 patients, and CT of the abdomen and pelvis revealed the source of sepsis in seven of 45 patients [46]. The CT scan can be very helpful in determining whether a patient with pancreatitis has developed a pancreatic abscess, and it can occasionally be useful in detecting abscess formation in patients with diverticulitis or Crohn's disease [47-51]. However, its sensitivity in detecting abscesses in this latter group of patients is reduced compared with the other categories mentioned above [52]. Although CT scans can be quite accurate in detecting abnormalities of the psoas, the differentiation of psoas abscesses from other psoas lesions is difficult when only imaging criteria are used [53].

US is often useful in specific cases, but when compared with CT scanning, the results are usually of lower sensitivity and specificity [54-56]. This is especially true in bacterial infections of the kidney [57]. Gallium scanning and indium and technetium leukocyte scanning are often useful when the CT scan is negative or equivocal [58-60]. Nuclear scintigraphy affords the possibility of whole-body imaging and the detection of sites of infection beyond the abdominal region. The literature on technetium-labeled leukocytes suggests a very high sensitivity and specificity for abdominal abscesses as well, although there are no adequate recent comparisons with CT [61,62]. Although gallium is excreted in the GI tract, making it a poor choice for the primary imaging of abdominal abscesses, among patients with persistent fever following colorectal surgery, the diagnostic accuracy for Ga-67 in detecting occult abscesses has been reported to be as high as 91.2% (compared to a diagnostic accuracy of 97.1% for CT among the same patients) [63]. One study suggests that MRI is an accurate examination for detecting abdominal abscesses [64].

There is little current information on radiography's role in detecting abdominal abscesses. Some reports suggest that radiographs may be useful, but this is far from proven [65].

Patients without previous surgery or with a low clinical suspicion of abscess are effectively evaluated with CT, and may also be studied with indium- or technetium-labeled leukocytes to search for infection or inflammation [66].

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [67].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations	
Relative Radiation Level	**Effective Dose Estimate Range**
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence Table

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