Approach to Acute Abdominal Pain

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KEYWORDS

• Acute abdomen • Abdominal pain • Peritonitis

Abdominal pain is the most common reason for a visit to the emergency department accounting for 8 million (7%) of the 119 million emergency department (ED) visits in 2006.[1] Skill in the assessment of abdominal pain is an essential requirement of emergency medicine (EM). Although a common presentation, abdominal pain is often a symptom of serious disease and may be difficult to diagnose, resulting in a high percentage of medicolegal actions against both general and pediatric EM physicians.[2,3] The modern physician should know that despite diagnostic and therapeutic advances (computed tomography [CT], ultrasonography, laparoscopy), the misdiagnosis rate of acute appendicitis has changed little over time.[4]

HISTORY

The clinician should try to obtain as complete a history as possible because this is generally the cornerstone of an accurate diagnosis. As with other undifferentiated symptoms, the history should include a complete description of the patient's pain and associated symptoms. The medical, surgical, and social history may provide important additional information.

Assessment of the Patient's Pain

The classic PQRST mnemonic for a complete pain history is as follows:

P3: positional, palliating, and provoking factors
Q: quality
R3: region, radiation, referral
S: severity
T3: temporal factors (time and mode of onset, progression, previous episodes).

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Emerg Med Clin N Am 29 (2011) 159–173
doi:10.1016/j.emc.2011.01.013 **emed.theclinics.com**
0733-8627/11/$ – see front matter

Although this mnemonic helps to ensure a thorough history, the above-mentioned sequence may result in a choppy interview, so it is preferable to ask the patient where they feel the pain (location), what kind of pain it is (character), when and how it began (onset), how bad it is (intensity), where else do they feel it, what makes it worse or better, how has it changed over time, and whether they ever had it before.

Location

Embryology determines where a patient feels visceral pain, which is generally perceived in the midline because afferent impulses from visceral organs are poorly localized. Pain fibers travel to the central nervous system via both autonomic nerves and spinal afferents. The latter fibers tend to synapse with second-order neurons in the posterior horns that are shared with afferent fibers from other visceral structures as well as somatic afferents (convergence). This arrangement with projections extending over several spinal cord levels results in poorly localized pain that may be referred to musculoskeletal structures as well as other visceral organs.[5,6] To further complicate the situation, numerous studies have indicated that patients with chronic painful or inflammatory conditions have heightened sensitivity to pain in anatomically remote visceral and somatic structures.[7,8]

Visceral nociceptors can be stimulated by distention, stretching, vigorous contraction, and ischemia. Pain from foregut structures, which include the stomach, pancreas, liver, biliary system, and the proximal duodenum, is typically localized to the epigastric region. The rest of the small bowel and the proximal third of colon, including the appendix, are midgut structures, and visceral pain associated with these organs is perceived in the periumbilical region. Hindgut structures, such as the bladder, distal two-thirds of the colon, and pelvic genitourinary (GU) organs, usually cause pain in the suprapubic region. Pain is often reported in the back for retroperitoneal structures, such as the aorta and kidneys.[9,10] The implications of the visceral innervation of the gallbladder are frequently overlooked by clinicians who exclude gallstone disease if patients do not have localized right upper quadrant pain. The gallbladder is innervated by visceral fibers, and studies consistently show that biliary colic is extremely poorly localized, with pain being perceived almost anywhere in the epigastrium or lower chest, and several investigators finding that it is less likely to be perceived in the right upper quadrant than in the epigastrium.[11,12] In summary, with afferent sensory pathways under active scientific investigation, the prudent clinician will be cautious in ascribing a patient's symptoms to a specific organ or location based solely on a patient's localization of his or her symptoms.

Character

Clinicians should seek to distinguish between the dull, poorly localized, aching or gnawing pain generated by viscerally innervated organs, compared with the characteristically sharp, more defined, and localized somatic pain caused by irritation of the parietal peritoneum or other somatically innervated structures. Somatic pain is transmitted via the spinal nerves from the parietal peritoneum or mesodermal structures of the abdominal wall. Noxious stimuli to the parietal peritoneum may be inflammatory or chemical in nature (eg, blood, infected peritoneal fluid, gastric contents).[9,13]

Onset

Acute onset pain, especially if severe, should prompt immediate concern about an intra-abdominal complication. The foremost consideration would be a vascular emergency, such as a ruptured abdominal aortic aneurysm (AAA) or aortic dissection. Other considerations for pain of acute onset include a perforated ulcer, volvulus, mesenteric ischemia, and torsion; however, these conditions may also occur without an acute

onset. For example, only 47% of elderly patients with a proven perforated ulcer report the acute onset of pain.[14] Likewise, volvulus, particularly of the sigmoid colon, can present with a gradual onset of pain.[15] Other serious vascular issues, such as mesenteric ischemia, may present with a gradual onset of pain. Conversely, a gradual onset in the setting of an infectious or inflammatory process may be expected. Pain that awakens the patient from sleep should be considered serious until proven otherwise.[16] The time of onset establishes the duration of pain and allows the physician to interpret the current findings in relation to the expected temporal progression of the various causes of abdominal pain.

Intensity

Pain that is severe should heighten the concern for a serious underlying cause; however descriptions of milder pain cannot be relied on to exclude serious illness, especially in older patients who may underreport symptoms.

Patterns of radiation and referral of pain

The previous discussion of afferent neural pathways and convergence gives rise to predictable patterns of referred pain and radiation. Kehr sign is a classic example in which diaphragmatic irritation, usually from free intraperitoneal blood, causes shoulder pain.[17] Any other inflammatory process or organ contiguous to the diaphragm can also cause referred shoulder pain. Another well-described example is ipsilateral scapular pain caused by biliary disease. Radiation may also reflect progression of disease such as with continued aortic dissection or ongoing passage of a ureteral stone. While considering referred pain, it is important to remember that deep musculoskeletal structures (especially of the back) are innervated by visceral sensory fibers with similar qualities to those arising from intra-abdominal organs. These fibers converge in the spinal cord, giving rise to scleratomes, which are regions of referral in the abdomen and flanks. Thus, in cases in which the patients' perceived location of symptoms seems to be completely unrevealing on physical examination, a careful assessment of musculoskeletal structures should be made.[18]

Duration and progression

Persistent worsening pain is worrisome, whereas pain that is improving is typically favorable. Serious causes of abdominal pain may present early in their course, allowing opportunity for intervention if promptly diagnosed. However, delays in onset of symptoms or in presentation frequently occur, especially in the elderly. Certain patterns of progression can be diagnostic, such as the migration of pain in appendicitis where the initial distention of the appendix causes a periumbilical visceral pain that shifts to the right lower quadrant once the inflammatory process is detected by the somatic sensors of the parietal peritoneum. It should be noted that in contrast to other forms of colic, gallbladder pain caused by an affected stone is not waxing and waning in quality. It is steady, almost never lasts less than 1 hour, and with an average of 5 to 16 hours duration, ranges up to 24 hours.[11,19] Small bowel obstruction typically progresses from an intermittent (colicky) pain to more constant pain when distention occurs. One would only expect somatic pain (arising from transmural ischemia or perforation contiguous to the parietal peritoneum) very late in the course.

Provocative and palliating factors

The clinician needs to ask what, if anything, worsens and improves the pain. It is important to establish whether jarring motions, such as coughing or walking, exacerbate the pain, suggesting peritoneal irritation.[13] Patients with peritonitis often remark on increased pain with jolts or bumps in the road. With upper abdominal pain, the

clinician should specifically determine if it is pleuritic because this may signify chest disease. Peptic ulcer disease may be exacerbated (gastric) or relieved (duodenal) by eating. Mesenteric ischemia may be precipitated by eating, as can the pain of intermittently symptomatic gallstones, often associated with fatty meals. The patient should be questioned about any self-treatment, particularly analgesics and antacids, and the response to these measures.

Previous episodes

Recurrent episodes generally point to a medical cause with the exceptions of mesenteric ischemia (intestinal angina), gallstones, ureterolithiasis, diverticulitis, or partial bowel obstruction.

Assessment of the Associated Symptoms

Gastrointestinal (GI) and urinary symptoms are the primary focus; however, it is important to ask about fever and cardiopulmonary symptoms. Associated symptoms should be placed in the clinical context, including the patient's age and the current status in the course of the illness.

Anorexia

With appendicitis most physicians expect the patient to report anorexia. However, pooling of the literature indicates that, although anorexia is a discriminatory symptom, it is only present in 68% of patients with appendicitis.[20] The report of this symptom decreases to 20% to 44% in elderly patients with appendicitis.[21]

Vomiting

Vomiting may occur in almost any abdominal disease. Pain generally precedes vomiting in surgical conditions, with the important exception of esophageal rupture from forceful emesis.[16,22] It is usually present in small bowel obstruction unless the obstruction is partial or the patient is presenting early in the course. Many other serious entities, including large bowel obstruction, frequently present without vomiting. The nature of the vomiting may be diagnostically helpful. With small bowel obstruction, a progression from gastric contents to bilious to feculent emesis is anticipated as the duration of the illness increases. Frequent nonproductive retching can point to gastric volvulus,[23] whereas repetitive nonbilious vomiting may indicate gastric outlet obstruction. The presence of blood or bile should be noted. Bilious vomiting in an infant is always considered a harbinger of serious abdominal illness such as malrotation.[24] Blood or coffee-ground emeses is usually caused by gastric diseases or complications of liver disease. Hematemesis caused by aortoenteric fistula is bright red, massive, and usually catastrophic and should be suspected with a history of a prior AAA repair.[25] The key feature of vomiting from more benign causes, such as viral or food-borne illness, is that it is self-limited.

Bowel symptoms

Although diarrhea is a frequent accompaniment of more benign abdominal conditions, its presence alone should never rule out serious disease. For example, diarrhea is common with mesenteric ischemia and is frequently reported in conditions such as appendicitis.[20,26] In one series of 1000 ED patients presenting with abdominal pain, 18% presented with diarrhea. No patient younger than 40 years with diarrhea and continuous pain was found to have a surgical cause for their symptoms.[27] Conversely, diarrhea can occur in up to one-fifth of patients with colonic obstruction.[28] Diarrhea also occurs in early small bowel obstruction as the reflexively hyperactive bowel distal

to the obstruction clears itself, and with partial obstruction, diarrhea may be ongoing. Absence of flatus is a more reliable sign than constipation in bowel obstruction because the bowel clears gas more rapidly than fluid. In addition, gas, in contrast to fluid, cannot be replaced by intestinal secretory mechanisms distal to an obstruction. Bloody stool in the presence of significant abdominal pain should raise the suspicion for mucosal compromise from ischemia. Melena suggests an upper source of bleeding, whereas frank blood can indicate a lower source or a massive upper bleed with rapid transit time. In a patient with acute abdominal pain, the urge to defecate has been described as a harbinger of serious disease, including a ruptured aneurysm in the older patient or ruptured ectopic pregnancy in the young.[29]

Other symptoms

Many GU tract diseases can present with abdominal pain. Conversely, any inflammatory process contiguous to the GU tract (including appendicitis, cholecystitis, pancreatitis, or any inflammatory process involving bowel) may result in both pyuria and dysuria. This condition can lead to misdiagnosis of both GI and GU conditions. In men, testicular torsion may present as abdominal pain with nausea and vomiting, and chronic prostatitis may cause nonspecific symptoms. In women, pelvic inflammatory disease, endometriosis, and ovarian pathologic condition frequently cause abdominal or GI symptoms.[6] The enlarging uterus of pregnancy can itself cause discomfort and displace abdominal organs in such a way as to further complicate the diagnosis of many abdominal conditions, especially appendicitis. For these reasons a menstrual (where applicable), sexual, and GU history should be obtained in most patients with abdominal pain. The report of normal regular menses should not preclude consideration of current pregnancy.[30] Cardiopulmonary symptoms, such as cough and dyspnea, can point to a nonabdominal cause of abdominal pain. Syncope may indicate disease originating in the chest (pulmonary embolism, dissection) or abdomen (acute aortic aneurysm, ectopic pregnancy).

Medical and Surgical History, Current Medications

A history of abdominal surgery can rule out a condition or raise the suspicion for a complication such as obstruction from adhesions. Although many chronic medical conditions cause acute abdominal pain (diabetic ketoacidosis, hypercalcemia, Addison disease, sickle cell crisis), the emergency physician first considers those that can precipitate an abdominal crisis, such as atrial fibrillation or chronic low-output heart failure (leading to mesenteric ischemia), or a history of pelvic inflammatory disease (a risk factor for ectopic pregnancy). Other less common metabolic causes of acute abdominal pain include uremia, lead poisoning, hereditary angioedema, and porphyria. The patient's current medications should be reviewed with attention to those affecting the integrity of the gastric mucosa (nonsteroidal antiinflammatory drugs [NSAIDs] and steroids), immunosuppressive agents (impair host defenses and the generation of painful stimuli), and any medication that can impair nociception (narcotics may also be a cause of pain due to constipation).

Social History

The patient's use of drugs and alcohol may have important diagnostic implications. Cocaine use may cause intestinal as well as cardiac ischemia. GI complications of alcohol abuse are extensive and well known. Direct questions regarding domestic violence may reveal a traumatic source of pain.

PHYSICAL EXAMINATION

The general appearance of the patient is always important. The clinician should take note of the patient's position, spontaneous movements, respiratory pattern, and facial expression. An ill-appearing patient with abdominal pain is always of great concern, given the variety of potentially lethal underlying causes. On the other hand, especially in the elderly, the clinician must not be misled by the well-appearing patient who may still have serious underlying disease.[31]

Vital Signs

Vital sign abnormalities should alert the clinician to a serious cause of the abdominal pain. However, the presence of normal vital signs does not exclude a serious diagnosis. Although fever certainly points to an infectious cause or complication, it is frequently absent with infectious causes of abdominal pain. For example, fever is absent in more than 30% of patients with appendicitis and in most of those with acute cholecystitis.[20,32] Tachypnea may be a nonspecific finding but it should prompt consideration of chest disease and metabolic acidosis from entities such as ischemic bowel or diabetic ketoacidosis.

The Abdominal Examination

The emergency physician should know the key elements of the abdominal examination while understanding their limitations. In particular, all techniques for the detection of peritonitis yields both false-negative and false-positive results.

Inspection, auscultation, and percussion

Inspection is important for the detection of surgical scars, skin changes including signs of herpes zoster, liver disease (caput medusa), and hemorrhage (Grey Turner sign of flank ecchymosis with a retroperitoneal source, Cullen sign of a bluish umbilicus with intraperitoneal bleeding).[17] With distention, percussion allows the differentiation between large bowel obstruction (drum-like tympany) and advanced ascites (shifting dullness). Auscultation is of very limited diagnostic utility, and prolonged listening for bowel sounds is ineffective use of time, although it may reveal high-pitched sounds in early small bowel obstruction or the silence encountered with ileus or late in the course of any abdominal catastrophe. Bruits have been described with aortic, renal, or mesenteric stenosis but are rarely appreciated in a busy emergency department.[33]

Palpation

The ED abdominal examination is directed primarily to the localization of tenderness, the detection of abdominal guarding, and the identification of peritonitis. For this reason, it should generally be limited to light and sensitive palpation. In contrast, the deep palpation traditionally conducted at the culmination of the abdominal examination was directed to the detection of abnormal masses and organomegaly. Deep palpation is extremely painful for a patient with a serious intra-abdominal condition, has limited diagnostic accuracy, and may interfere with the ability of any subsequent examiner to obtain an accurate examination due to the patient's apprehension. Furthermore, its purpose of identifying abdominal masses and organomegaly is anachronistic if modern tools of diagnostic imaging are available. Various strategies have been advocated to improve the palpation phase of the examination, including progression from nonpainful areas to the location of pain. It may be useful to palpate the abdomen of anxious or less cooperative children with the stethoscope to define areas of tenderness.[34] Meyerowitz[35] advocates following up the initial examination

with a secondary palpation with a stethoscope while telling the patient that one is listening to uncover exaggerated symptoms. It is preferable to have the patient flex the knees and hips to allow for relaxation of the abdominal musculature (see later discussion of guarding).

Localized tenderness is generally a reliable guide to the underlying cause of the pain. More generalized tenderness presents a greater diagnostic challenge. Unless the patient has had an appendectomy, the authors recommend, given its frequency as a serious cause of abdominal pain, continued consideration of appendicitis in any patient with right lower quadrant tenderness. Despite the known issues with diagnosing appendicitis in the elderly, virtually all of them have right lower quadrant tenderness.[14] If tolerated by the patient, palpation or percussion may include assessment of the liver and spleen size, a search for pulsatile or other masses, and an assessment of the quality of femoral pulses. A tender pulsatile and expansile mass is the key distinguishing feature of an acute AAA, although this and most other masses are much more accurately diagnosed with the aid of a bedside ultrasound machine, if available.[36] The femoral pulses may be unequal with aortic dissection.[37] Inspection and palpation of the patient while they are standing may reveal the presence of hernias undetected in the supine position.

Tests for peritoneal irritation

Determining the presence or absence of peritonitis is a primary objective of the abdominal examination; however, the methods for detecting it are often inaccurate. Traditional rebound testing is performed by gentle depression of the abdominal wall for approximately 15 to 30 seconds with sudden release. The patient is asked whether the pain was greater with downward pressure or with release. Despite limitations, the test was one of the most useful in a metanalysis of articles investigating the diagnosis of appendicitis in children.[34] *Cope's Early Diagnosis of the Acute Abdomen* recommends against this test because it is unnecessarily painful; it suggests gentle percussion as more accurate and humane.[33] The literature demonstrates traditional rebound testing has sensitivity for the presence of peritonitis near 80%, yet its specificity is only 40% to 50%, and it is entirely nondiscriminatory in the identification of cholecystitis.[32,38,39] The use of indirect tests, such as the cough test, in which one looks for signs of pain such as flinching, grimacing, or moving the hands to the abdomen on coughing, has a similar sensitivity but a specificity of 79%.[40] In children, indirect tests would include the "heel drop jarring" test (child rises on toes and drops weight on heels) or asking the child to jump up and down while looking for signs of abdominal pain.[34,41]

Guarding is defined as increased abdominal wall muscular tone and is only of significance as an involuntary reflex when it reflects a physiologic attempt to minimize movement of the intraperitoneal structures. In contrast, voluntary guarding can be induced by any person with conscious control of their abdominal wall musculature and is frequently seen in completely normal patients with apprehension about the abdominal examination. Rigidity is the extreme example of true guarding. To identify true guarding, the examiner gently assesses muscle tone through the respiratory cycle, preferably with the knees and hips flexed to further relax the abdomen. With voluntary guarding, the tone decreases with inspiration, whereas with true guarding, the examiner is able to detect continued abdominal wall tension throughout the respiratory cycle. With delicate palpation it may also be possible to detect asymmetry of the abdominal muscular tension with a localized unilateral inflammatory process, such as appendicitis or diverticulitis. The clinician should also be aware that true guarding may also occur with a thoracic inflammatory process adjacent to the diaphragm.

Guarding and rigidity may be lacking in the elderly because of laxity of the abdominal wall musculature. However, only 21% of patients older than 70 years with a perforated ulcer presented with epigastric rigidity.[14]

The Rectal Examination

The diagnostic value of a rectal examination in the evaluation of acute abdominal pain is limited; however, it may be of use in detecting intestinal ischemia, late intussusception, or colon cancer. The routine performance of a rectal examination in suspected appendicitis is not supported by the available literature.[42] It is recommended that, as a general rule, one should not perform this examination in children because it adds little to the diagnostic process at the cost of significant discomfort.[43] On the other hand, the examination's utility may increase with the patient's age, and one study found that within 1 year, nearly 11% of patients older than 50 years diagnosed with nonspecific abdominal pain in an ED were found to have cancer, principally of the colon.[44] The use of the rectal examination in other age groups should be targeted to diagnoses in which it may yield important information.[42]

Special Abdominal Examination Techniques

There are several examination techniques that may be useful to the emergency physician in helping to establish a diagnosis. Some of these tests have not been well studied, but documentation of their presence or absence on the chart indicates a consideration of a specific disease process such as appendicitis.

Carnett sign

Abdominal wall tenderness can be caused by trauma and, with increasing numbers of patients on therapeutic anticoagulation, abdominal wall hematoma. The following technique, described by Carnett in 1926, may confirm the abdominal wall as the source of the patient's pain. The point of maximal pain is identified and palpated, with the abdomen wall relaxed and then tensed through the performance of a half sit-up with the arms crossed. Increased pain with the wall tensed is a positive sign of abdominal wall pathologic condition; a decrease in pain is considered a negative test result. When prospectively applied in 120 patients, the test result was positive in 24, with only 1 having intra-abdominal pathologic condition.[45] Other investigators have found it less accurate but still useful.[46] This test should not be routinely applied but is considered when there is a supportive history and absence of indicators of other illness.[47]

Cough test

Originally described by Rostovzev in 1909, this test seeks evidence of peritoneal irritation by having the patient cough.[48] Jeddy and colleagues[49] described a positive test result as a cough causing a sharp localized pain. They applied this description prospectively to patients with right lower quadrant pain and found it to have near perfect sensitivity with a 95% specificity for the detection of appendicitis or peritonitis (1 patient with perforated diverticulitis). Bennett and colleagues[40] consider signs of pain on coughing such as flinching, grimacing, or moving ones hands to the abdomen as a positive test result and reported a sensitivity of 78% with a specificity of 79% for the detection of peritonitis in a prospective study of 150 consecutive patients with abdominal pain.

Closed eyes sign

Based on the assumption that the patient with an acute abdominal condition carefully watches the examiner's hands to avoid unnecessary pain, this test is considered an

indicator of nonorganic cause of abdominal pain. The test result is considered positive if the patients keep their eyes closed when abdominal tenderness is elicited. In a prospective study of 158 patients, Gray and colleagues[50] found that 79% of the 28 patients who closed their eyes did not have identifiable organic pathologic condition.

Murphy sign

Murphy described cessation of inspiration in cholecystitis when the examiner curled their fingers below the anterior right costal margin from above the patient.[51] Now most commonly performed from the patient's side, inspiratory arrest while deeply palpating the right upper quadrant is the most reliable clinical indicator of cholecystitis, although it only has a sensitivity of 65%.[32] The sonographic Murphy sign is actually gallbladder palpation under direct sonographic visualization. It is performed by bringing the ultrasound probe as close to the gallbladder as possible below the costal margin and asking the patient whether pressure, applied with the probe directly in the direction of the gallbladder, reproduces the symptoms. If the answer is affirmative, the same question is asked when similar pressure is applied in the epigastrium at a location remote from the gallbladder. The same procedure is repeated again directly on the gallbladder and in the midaxillary line, lateral to the gallbladder. If the patient can consistently discriminate between probe pressure applied to the gallbladder from that applied elsewhere, the test result is deemed positive. In the hands of emergency physicians, the sensitivity of the sonographic Murphy sign is remarkably consistent at around 75%, whereas specificity ranges from 55% to 80%.[52–54] The test appears to be more sensitive in the hands of emergency physicians than when performed in radiology imaging suites (without loss of specificity).[52,55] This difference may be because of the clinical experience that practicing physicians bring to the test compared with ultrasound technologists.

The psoas sign

The psoas sign is provoked by having the supine patient lift the thigh against hand resistance or with the patient laying on their contralateral side the hip joint is passively extended. Increased pain suggests irritation of the psoas muscle by an inflammatory process contiguous to the muscle. When positive on the right, this is a classic sign suggestive of appendicitis. Other inflammatory conditions involving the retroperitoneum, including pyelonephritis, pancreatitis, and psoas abscess, also elicit this sign.

The obturator sign

The obturator sign is elicited with the patient supine and the examiner supporting the patient's lower extremity with the hip and knee both flexed to 90°. The sign is positive if passive internal and external rotation of the hip causes reproduction of pain. It suggests the presence of an inflammatory process adjacent to the muscle deep in the lateral walls of the pelvis. Potential diagnoses include a pelvic appendicitis (on the right only), sigmoid diverticulitis, pelvic inflammatory disease, or ectopic pregnancy.

The Rovsing sign

The Rovsing sign is a classic test used in the diagnosis of appendicitis. It is a form of indirect rebound testing in which the examiner applies pressure in the left lower quadrant, remote from the usual area of appendiceal pain and tenderness. The test result is positive if the patient reports rebound pain in the right lower quadrant when the examiner releases pressure.[20]

In limited studies, the psoas, obturator, and Rovsing signs demonstrate a low sensitivity (15%–35%) but a relatively high specificity (85%–95%) for appendicitis.[20,34,56]

Other Examination Elements

Careful examination of adjacent areas is a key part of the assessment of the patient with abdominal pain. In addition to skin inspection, the back should be assessed for tenderness at the costovertebral angle, spinous processes, and paraspinal regions. Because virtually any chest disease can present with abdominal pain, particular attention should be paid to the cardiopulmonary examination. The groin is assessed for hernias. If this diagnosis is under serious consideration, this examination should be performed with the patient standing. The male patient must be inspected for testicular pathologic condition, including torsion and infection. In female patients with lower abdominal pain, a pelvic examination is almost always necessary. Even if all potentially offending structures have been surgically removed, the examination may reveal a rectovaginal fistula or abscess, an unanticipated mass, or acute cystitis. The pelvic examination presents an opportunity to assess the pelvic peritoneum directly for signs of inflammation through the assessment of cervical motion tenderness and for evidence of cystitis by palpation of the bladder through the anterior wall of the vagina. If Fitzhugh-Curtis syndrome is a consideration, a pelvic examination may be indicated with upper abdominal pain.[13]

Analgesia and the Abdominal Examination

The emergency physician should not hesitate to administer adequate analgesic medication to the patient with acute abdominal pain. When studied, the administration of narcotic analgesics does not obscure the diagnosis or interfere with the treatment of the patient, and multiple well-designed randomized trials have demonstrated that the use of analgesia in acute abdominal pain does not lead to adverse outcomes.[57–63] The United States Agency for Health care Research and Quality issues reports regarding making health care safer and recommended this practice after a review of the literature.[64] Previously, *Cope's Early Diagnosis of the Acute Abdomen* was against the physician for administering morphine, but this stance has been reversed in more recent editions.[64,65] The current editor of this book, William Silen, was a co-author on a prospective study where the administration of up to 15 mg of morphine did not affect diagnostic accuracy in patients with acute abdominal pain. Thomas and colleagues[57] recommend its use in that it fulfills the physician's "imperative to relieve suffering."

APPROACH TO THE UNSTABLE PATIENT

On occasion, a patient with acute abdominal pain presents in extremis. The ill-appearing patient with abdominal pain requires immediate attention. This requirement is particularly so in the elderly because the overall mortality rate for all older patients with acute abdominal pain ranges from 11% to 14%, and those presenting in an unstable fashion have an even poorer prognosis.[31]

The usual sequence of resuscitation is applied to the patient with unstable abdominal pain, with airway control achieved as necessary. Hypotension requires the parallel process of treatment and an early assessment for life threatening conditions requiring emergent surgical intervention. Hypotension from blood and fluid loss from the GI tract is usually apparent from the history coupled with a digital rectal examination. If this evidence is lacking in the patient with abdominal pain, there needs to be early consideration of third spacing, which can cause enormous fluid shifts into the bowel lumen or peritoneal space in bowel obstruction or other intestinal catastrophes. Bedside ultrasonography is an extremely useful diagnostic adjunct in such patients. In the older patients, hypotension should prompt an immediate search for an AAA, immediately

followed by sonographic evaluation of the inferior vena cava for intravascular volume status, and sonography of the heart, pleural, and peritoneal spaces to exclude massive effusions or evidence of massive pulmonary embolus. Bedside echocardiography also identifies severe global myocardial depression as a cardiogenic cause of shock. In the younger patient, a large amount of free fluid detected by ultrasonography in an unstable patient is most commonly because of rupture of an ectopic pregnancy, spleen, or hemorrhagic ovarian cyst. An immediate urine pregnancy test is the first step in distinguishing these.

The proper place for the unstable patient with an acute AAA is the operating room or, in some centers, the interventional suite for emergency aortic stent placement. Attempts to obtain CT imaging may cause fatal delays in definitive treatment. With a high clinical index of suspicion (if possible supported by emergency bedside ultrasonography [EMBU]), most patients sent directly to surgery is found to have an acute AAA, and nearly all others have an alternative diagnosis that still needs operative intervention.[66]

DIAGNOSTIC STUDIES AND DISPOSITION

Appropriate diagnostic testing is covered in the respective articles for specific entities; however, it must be emphasized that there are significant limitations of imaging and laboratory studies in the evaluation of acute abdominal pain, and all diagnostic tests have a false-negative rate. If the history and physical examination lead to a high pretest probability of a disease, a negative test result cannot exclude the diagnosis. For example, the total leukocyte count can be normal in the face of serious infection such as appendicitis or cholecystitis.[34,67] CT is frequently used in evaluation of the patient with abdominal pain. Clinicians are assisted by the recent advances in the technology that have allowed for improved image resolution and shorter acquisition times along with coronal and 3-dimensional reconstruction. However, it remains an imperfect test for conditions such as appendicitis and may add little to the clinical assessment.[68,69]

As noted, EMBU is particularly useful in the unstable patient with abdominal pain because of the immediate information it can provide regarding intravascular volume status and cardiac function. EMBU is also helpful in narrowing the range of diagnostic possibilities in stable patients with undifferentiated abdominal complaints. EMBU assessment of the abdominal aorta is extremely accurate and obviates the transfer of a potentially unstable patient to the CT suite.[70] Ultrasonography in the hands of emergency physicians attains extremely high sensitivity for identification of gallstones (similar to that attained by imaging specialists: around 95%), although studies of its specificity (65%–95%) are more varied.[52–54] The accuracy of EMBU in the identification of acute cholecystitis also seems to have a high sensitivity around 90% with lower specificity.[54] In early pregnancy, the goal of bedside ultrasonography is to exclude ectopic pregnancy by the demonstration of definitive evidence of an intrauterine pregnancy (yolk sac or better). If the pretest index of suspicion is high (particularly in patients on progestational agents), it may be prudent to perform a formal complete radiology study to search for adnexal evidence of a heterotopic pregnancy. Smaller studies suggest that EMBU may also provide useful information beyond that obtained from the physical examination in nonpregnant patients with pelvic and right lower quadrant complaints.[71,72]

Plain abdominal radiographs are of limited utility in the evaluation of acute abdominal pain.[73] Although they may identify free intraperitoneal air, calcified aortic aneurysm, or air-fluid levels in obstruction, other diagnostic studies are almost always

indicated or perform better as the initial testing. If plain radiographs are used, the limitations must be appreciated. For example, a standard upright film does not demonstrate free air in up to 40% of patients with a perforated ulcer.[74]

The oft-repeated axiom of "treat the patient, not the test" certainly applies to the patient with acute abdominal pain. An unexpected negative test result should prompt a reassessment of the patient and consideration for observation and repeat examination for disease progression. Whenever the diagnosis is doubtful, serial examination as an inpatient or in an observation unit is a sound strategy. When a patient is discharged home after an evaluation for abdominal pain, the authors recommend instructions to return if the pain worsens, new vomiting or fever occurs, or if the pain persists beyond 8 to 12 hours. Such instructions are targeted at ensuring the return of a patient who has progressed from an early appendicitis or small bowel obstruction, the 2 most common surgical entities erroneously discharged from an emergency department.[17,22]

SUMMARY

The assessment of abdominal complaints calls on the traditional clinical method of a careful history and physical examination followed by targeted laboratory tests and imaging studies. There is no clinical finding or test result that is unfailingly accurate or diagnostic, so that each data point should be interpreted as a part of the overall clinical picture. Older or very young patients or those with conditions that interfere with the perception of pain require special caution. With serious abdominal conditions, ongoing monitoring, supportive care, pain relief, and empiric treatment are concurrent with the diagnostic workup.

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