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Acute Appendicitis: Meeting the Challenge of Diagnosis in the ED

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Patients with abdominal pain present some of the most challenging cases encountered in the emergency department (ED). Furthermore, "belly pain" is also one of the most common chief complaints. These patients are seen on every shift, can vary from the infant to the elderly nursing home patient, and often take much more time than the average patient to see and evaluate. Some patients with acute processes that require surgical intervention actually appear quite well early in their course, making it easy to miss the severity of their problem. Likewise, other patients initially appear ill with an "acute abdomen" only to improve dramatically during their ED stay and ultimately be discharged with gastritis or constipation as the cause. Even after a careful and thorough work-up by the best physicians, the end result of these patient encounters is frequently "abdominal pain of uncertain etiology." This diagnosis is applied to 40% of ED patients evaluated and discharged for abdominal pain.[1,2] While this ultimately is the correct diagnosis in many patients, the task of the emergency physician is to identify the subset of patients who require further intervention. The case of acute appendicitis is an important diagnosis to find, and a dangerous one to miss in these patients.

Appendicitis is a relatively common entity encountered in the ED, with one case per 1000 people per year.[3,4] Every person has a 6% lifetime risk of developing appendicitis.[5] It is the most common surgical emergency reported in children and pregnant patients.[6,7] While common, acute appendicitis is often difficult for both ED physicians and surgeons to diagnose accurately. Up to as many as 30% of patients with proven appendicitis are misdiagnosed and discharged by a physician before being correctly identified.[8] The negative laparotomy rate remains in the 20-25% range.[9] The rates are even higher for the elderly, women, and children, a testimony to the difficulty of making this diagnosis in these subgroups. Although morbidity and mortality have been reduced over time, the acceptable rate of perforation remains at about 20%.[10, 11] However, the rate approaches a staggering 70% in patients younger than 9 years and older than 60 years of age.[12,13] The mortality rate of simple appendicitis is 0.1%, but increases 20- to 60-fold with perforation.[3,14-16] The rate of wound infection in all patients increases to 35% with perforation.[17,18] It is easy to understand why misdiagnosis of appendicitis is the fifth leading cause of successful litigation against emergency physicians and accounts for 15% of all dollars paid in ED malpractice claims.[8,19]

Atypical presentations and appendicitis in high-risk populations, such as children, the elderly, and pregnant patients, are difficult to detect. The rate of complications, including death, is directly correlated with delay of diagnosis and surgery. The fact that no single laboratory test is 100% accurate for diagnosing appendicitis exacerbates the problem. With all these factors combined, it is not surprising that attempts to diagnose patients with appendicitis can lead to frustration and confusion for both the patient and doctor. Unfortunately, when a case of appendicitis is "missed," it can produce unsatisfactory outcomes for

both as well. The following review of acute appendicitis will help to update our perspective on this troublesome disease. A thorough overview of the pathophysiology of acute appendicitis and its clinical features in high-risk patients can help improve outcomes and reduce medico-legal risk.

— The Editor

Introduction

When evaluating a patient in whom the diagnosis of appendicitis is being considered, several key points should be emphasized. Appendicitis is most commonly seen in 10-30-year olds, but can be seen in patients of any age. Although rare in infants, it has been reported.[20] It should be included in the differential of *any* patient seen in the ED with abdominal pain. While most patients will present with right lower quadrant (RLQ) pain, the appendix can be found *anywhere* in the abdomen. One study of more than 10,000 cases revealed that the appendix was retrocecal in 65% of cases and in the pelvis in 31%.[21] Another landmark 40-year review of more than 70,000 cases found the appendix in the right upper quadrant in 4% of the subjects, the left upper quadrant in 0.06% and the left lower quadrant in 0.04%.[22] Undiagnosed congenital malrotation can explain some of these more bizarre locations.

Although not typical, recurrent episodes and even chronic appendicitis are recognized clinical entities.[9,23,24] There are even case reports of patients with ultrasound and clinical findings of acute appendicitis who are followed without surgery, and whose appendix on ultrasound returned to normal.[25,26] One author estimates recurrent appendicitis affects 6% of those individuals ultimately diagnosed with acute appendicitis.[27] Acute appendicitis should be considered even if a patient has had similar episodes of pain before, or if the pain has persisted for longer than 1- 2 weeks.

Finally, it is useful to keep in mind the myriad diseases that can be confused with acute appendicitis. At the top of the list are acute gastroenteritis (AGE) and pelvic inflammatory disease (PID). The striking point here is that each of these is more common than acute appendicitis in the ED. Do not neglect to consider the diagnosis of appendicitis in these patients. (Strategies for differentiating these entities from appendicitis will be discussed in later sections). Other conditions less commonly confused with appendicitis, but still important to remember, include: Crohn's disease, mittleschmerz, pancreatitis, testicular torsion, Meckel's diverticulum, diverticulitis, cholelithiasis, bowel obstruction, endometriosis, ovarian cyst, tubo-ovarian abscess, ectopic pregnancy, urinary tract infection, and pyelonephritis. The bottom line is, many patients seen daily with abdominal pain in the ED do not have appendicitis, but, unless the appendix has been taken out, any of them *could* have this condition.

Pathophysiology of Acute Appendicitis

Some of the difficulties in recognizing acute appendicitis can be diminished by an understanding of how this condition develops. Attention to the sequence of events and the body's reaction to them can help the physician identify appendicitis whether the patient presents 12 hours or two days into the disease. The appendix is a blind pouch that arises from the inferior border of the cecum. It contains lymphoid tissue, but the function of the appendix remains a mystery. No detectable loss is noted by its surgical absence; however, even a negative laparotomy *does* carry risks of wound infection, fetal loss, and myocardial infarction, among others.[28-30] While the appendix contains little lymphoid tissue at birth, more develops as we age. This continues, peaking in adolescent years and followed by atrophy of this tissue as we age. This parallels the risk and peak incidence of appendicitis, and might explain why 69% of cases are seen in patients 10-30 years old.[31] Obstruction of the appendix lumen is thought to be the first event in development of appendicitis.[32] Lymph tissue hypertrophy may play a role in luminal obstruction, especially in children. This may explain why acute appendicitis can follow gastroenteritis, upper respiratory infections, measles, or infectious mononucleosis.[33] Unfortunately, when appendicitis develops late in the course of a viral illness, distinguishing between these two entities may be difficult. The theory of lymphatic hyperplasia is also consistent with the fact that the majority of cases occur between October and

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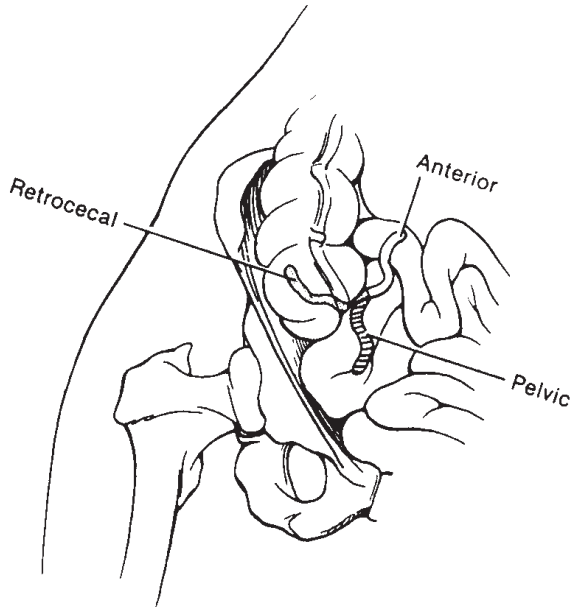
Table 1. Signs and Symptoms Seen in Presentation of Acute Appendicitis[1,4,14,31,37,96,144]

SYMPTOMS	FREQUENCY (%)
Abdominal Pain	97-100
Migration of Pain to RLQ	49-61
Nausea	67-78
Vomiting	49-74
Anorexia	70-92
Fever	10-20
Diarrhea	4 -16
Constipation	4 -16
SIGNS	
Abdominal tenderness	95-100
RLQ tenderness	90-95
Rebound tenderness	33-68
Rectal tenderness	30-40
Cervical motion tenderness	30
Rigidity	12
Psoas sign	5-3
Obturator sign	5-8
Rovsing's sign	5
Palpable mass	< 5
Mean Temperature	37.9°C

Figure 1. Variations in Normal Position of the Appendix



May, correlating with a higher frequency of enteric infections during this same time.[34]

Obstruction of the appendix lumen is also thought to occur from other factors as well. Some causes of obstruction include fecaliths, strictures, barium, tumors, pinworms, and foreign bodies. Examples of the more unusual foreign bodies include bones, seeds, wood, metal, plastic, and even chewing gum.[34] Obstruction of the lumen triggers a cascade of events culminating in acute appendicitis. First, the epithelial cells lining the appendix continue to secrete mucus after the lumen is blocked. Accumulation of this fluid results in distension of the appendix, which reduces venous and lymphatic drainage of the appendix. Bacteria multiply in the lumen, and rapidly invade the wall of the appendix. This creates further edema of the appendix and additional stretching of its muscular wall. The sensation of stretch of the appendix wall is transmitted by visceral autonomic nerves entering the spinal cord along T8 to T10. As visceral pain is poorly localized, this explains why the patient feels only vague periumbilical pain. At this stage, the patient has simple appendicitis. It takes an average of 17 hours for patients to present at this stage.[35] Consequently, it is important to realize that patients with only "a few hours" of vague abdominal pain can be well into their course of appendicitis. Identifying patients at this stage of their disease can reduce the risk of subsequent perforation.

If obstruction of the lumen is not relieved, increased intraluminal pressure compromises venous arterial blood supply to the appendix. Subsequent ischemia of the appendix wall leads to necrosis, perforation, and abscess formation. When inflammation indirectly reaches the parietal peritoneum through the inflamed appendix wall or directly through perforation, somatic pain develops. Interestingly, classical rebound RLQ tenderness is actually a sign of probable or impending *perforation*. Stimulation of somatic pain receptors produces stronger, localized RLQ pain. This is the basis of pain migration from the periumbilical area to the RLQ and can be a key feature for differentiating appendicitis from other diseases. Average time from onset of disease to perforation is 34 hours; 72 hours is required for abscess formation.[35] When perforation occurs, the luminal pressure of the appendix decreases, and this may explain why some patients experience a brief period of pain relief. In adults, the abscess is often contained by the omentum. However, young children have a lesser-developed omentum, and rupture of the appendix leads more quickly to diffuse peritonitis.

Atypical Presentations Aren't Rare

Classical presentations aren't really that classical. The patient who presents looking healthy and complains of indigestion can be just as likely to have an acute myocardial infarction as the one that appears ill and complains of "an elephant sitting on my chest." The ED physician quickly learns to be especially vigilant for "atypical" presentations of angina, and to treat these patients conservatively with admission if one cannot safely exclude the diagnosis of unstable angina. While acute appendicitis may not be as common as unstable angina, the ED physician needs to remain suspicious of patients presenting with abdominal pain and sometimes approach them in a similar fashion. In other words, if you cannot safely exclude appendicitis as the diagnosis, it may be prudent to obtain a consult or admit the patient for your protection and theirs. The following discussion will illustrate just how variable the signs and symptoms of acute appendicitis can be.

While no ED physician would miss a patient presenting with the classic symptoms of pain beginning periumbilically and moving to the RLQ and associated with vomiting, anorexia, rebound, and fever, it is essential to realize how many patients present *without* classic features. "Classical" presentations of appendicitis are reported in only 50-60% of patients.[14,19,36,37] Table 1 summarizes the frequency of signs and symptoms seen in patients with proven appendicitis. While most patients present with abdominal pain, only about half (49-61%) give the history of migration of the pain to the RLQ. Only about two-thirds complain of nausea, vomiting, or anorexia. The number with RLQ tenderness is near 100%, but only one-third to two-thirds have rebound tenderness. Worse still, 30% of females can have cervical motion tenderness (CMT) on exam![14,19,36,37] The classic psoas and obturator signs are absent in 85-90% of exams. It is imperative to remember that peritoneal signs are reliably present after perforation has occurred. The mean temperature on presentation does not even reach the classic cut-off of 38°C to define the presence of a fever. The take-home message from these numbers is that one should not discount appendicitis in a patient with abdominal pain just because the "classic" features are not present.

The fact that the appendix can be found in a variety of anatomic locations helps explain some of this variability. *(See Figure 1.)* Only when the appendix lies anteriorly can it make contact with the anterior peritoneum and produce a classical presentation. If the appendix tip lies retrocecally, less inflammation will reach the bowel to produce anorexia, nausea, or vomiting. These patients may even present with flank pain instead of abdominal pain. The extreme example of this problem is encountered when the appendix lies in an extraperitoneal position; fortunately, this is an infrequent occurrence. When the appendix is retroileal, inflammation of the ureter occurs, causing testicular pain or lab findings consistent with urinary tract infection. *(See Urinalysis section on pg. 75.)* When the tip reaches the right upper quadrant, as in pregnancy, the findings can be more consistent with acute cholecystitis than appendicitis. *(See section on High-Risk Patient Populations for more information on diagnosis of appendicitis in pregnancy.)*

Diagnostic Tests

No laboratory test can establish the diagnosis of acute appendicitis with 100% accuracy. With this in mind, a patient with a "classical" presentation should not have any laboratory tests done that will *delay* their transition to surgery. As stated above, however, most patients do not have such a clearcut presentation. In these patients, ancillary tests will be used in combination with observation and repeated exam to help support the diagnosis of appendicitis, or to rule out another diagnosis. The following section will discuss the strengths and weaknesses of commonly used lab tests, as well as recent studies evaluating imaging by computed tomography (CT) and ultrasound. Remember that while some of these tests can be helpful, the most useful "tests" are the history and physical, followed by surgical consultation, and observation when the diagnosis is in doubt.

White Blood Cell Count. The usefulness of the white blood cell count (WBC) for diagnosing acute appendicitis in the ED has long been controversial. The conversation is familiar: The general surgeon/resident asks "What's the white count?" and the ED physician/resident states to the consultant "What difference will it make?" Then, the general surgeon/resident responds with "I'll see the patient after the WBC, films, etc. are done." Fortunately, the issue is slowly being resolved; even the surgical literature is reporting that the WBC is not essential and does not affect the decision to operate.[38] In general, ED physicians still get a WBC count when considering appendicitis, and surgeons will sometimes take the patient to the OR without labs. The best advice is to know the preferences of the consultants with whom you regularly interact, and do as they prefer, or provide them with papers to inform them of the opposing view.

The facts are that leukocytosis is seen in 75-80% of patients with acute appendicitis,[5] and a similar number have an increased number of immature band forms or "left shift."[39] Both of these values alone have been shown not to be useful in ruling out appendicitis, as they are too nonspecific; they can be seen in many of the diseases (AGE, PID) that are confused with appendicitis as well.[40,41] However, several authors report only 4-11% of patients with appendicitis will have *both* a WBC count less than 10,000 and normal differential of less than 75% neutrophils.[5,32,42,43] While the combination of a normal WBC and differential apparently makes appendicitis less likely in these patients, again, it will not rule it out in all patients. It may also take time for this elevation to occur; one study noted that while the WBC count did eventually show elevation, it was still normal in 80% of patients during the first 24 hours.[44,45] Furthermore, some high-risk populations are less likely to present with an increased WBC count. Elderly patients have normal WBC counts in up to 45% of patients on presentation.[46]

The typical WBC range for simple appendicitis is between 12,000 and 18,000 cells per mm^3. Unfortunately, many of the diseases that can simulate acute appendicitis (i.e., PID, ovarian cyst rupture, AGE, ectopic pregnancy, etc.) can also produce a WBC in this range. Furthermore, progressive increase of the WBC with time has been shown to be unreliable in differentiating appendicitis from other diseases.[47,48] As mentioned above, a recent article showed that the WBC itself did not affect the decision by surgeons to operate on patients with RLQ pain.[39] In addition, a WBC count of 15,000 to 25,000 cells per mm^3 is reported to be associated with perforation.[49] However, another recent article reviewing 1919 cases challenges this by showing the height of the WBC count could not predict the presence of perforation. This study found the proportion of patients with an elevated WBC count and perforation at surgery was equal to the proportion perforated with a normal WBC count.[50] This is consistent with other studies.[51,52]

Other serum markers, such as C-reactive protein levels alone,[53] leukocyte elastase,[54] and even technetium leukocyte scans[61] have also been investigated for possible use in diagnosis of appendicitis. However, they have not yet been shown to be consistently reliable to recommend general use.[56,57] Lastly, the combination of C-reactive protein levels with WBC and differential, the "triple test," has also been

Figure 2. Examples of CT Findings in Acute Appendicitis

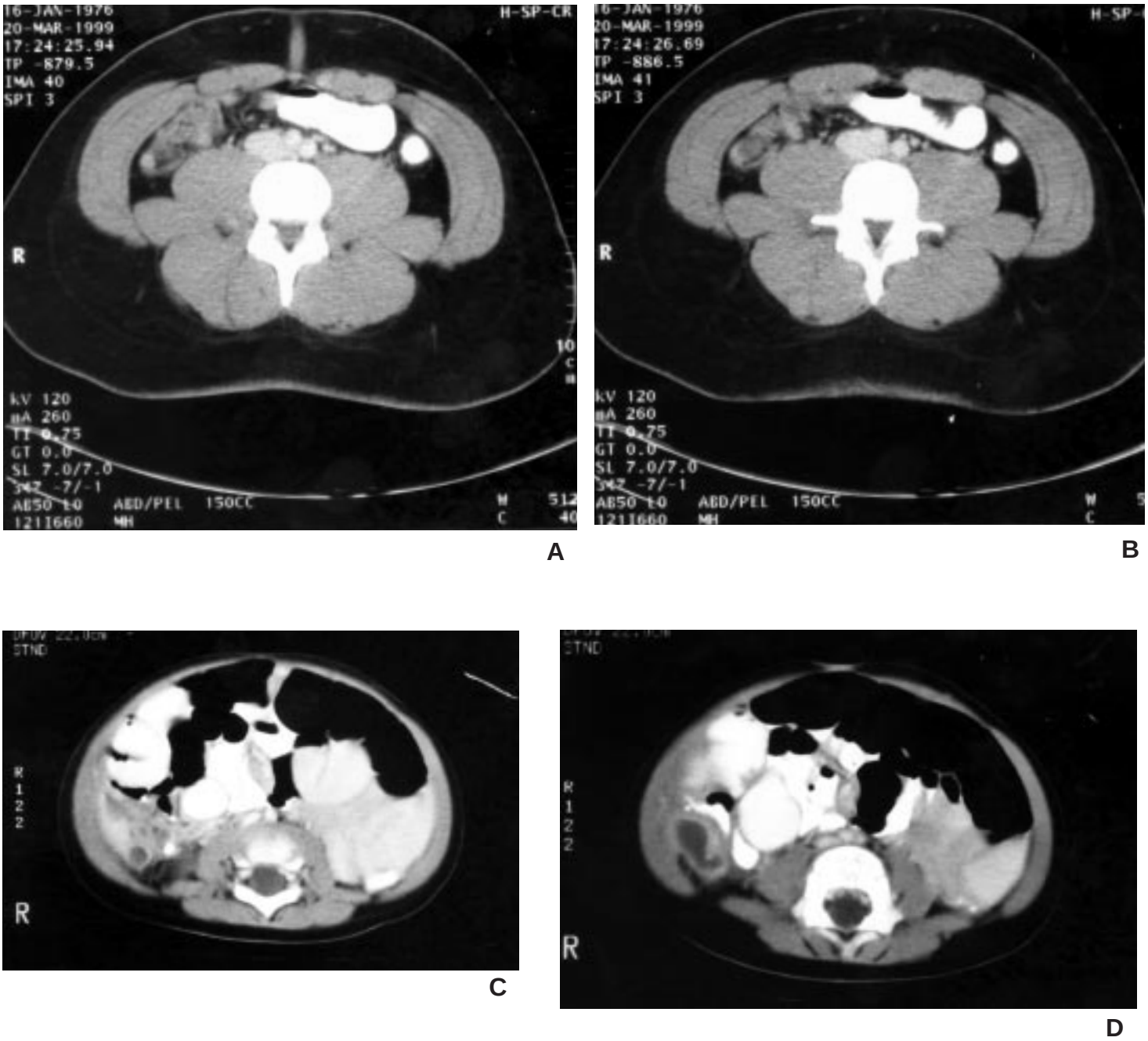


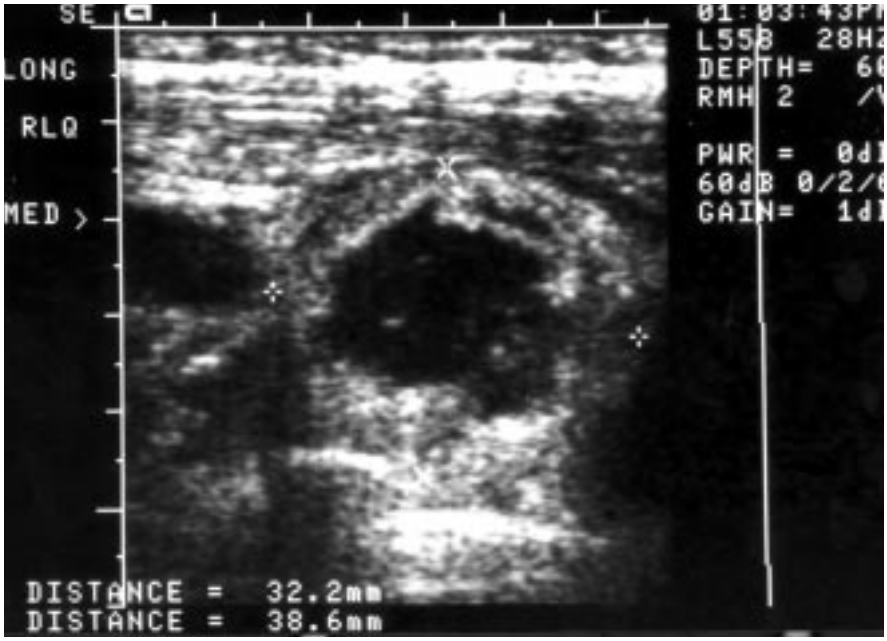
Figure 2 A shows an example of the early findings of simple appendicitis. An enlarged appendix (approximately 1.5 cm) is seen, and in the same patient inflammatory changes are seen in place of the appendix 2 centimeters distal to the first image. The next two figures show an example of CT findings in a more-advanced case of appendicitis. In figure 2 C, a fecalith can be seen just medial to a loculate fluid collection. Figure 2 D shows a well-developed abscess in the same patient, several centimeters distal to the first image.

prospectively evaluated.[58] While the ability to accurately predict appendicitis was again low (37%), the authors did find that there was a high negative predictive value of near 100%.[58] In other words, if all three tests are negative (WBC < 9000, neutrophil differential < 75%, C-reactive protein < 0.6 mg/dL), the likelihood of appendicitis is very small. This may prove useful after further verification with larger numbers of patients.

Urinalysis. A urinalysis (UA) is helpful to screen for renal colic, as appendicitis will not normally produce hematuria

Figure 3. Examples of Ultrasound Findings in Acute Appendicitis

A



B

These figures show close-up images of two patients with US findings consistent with appendicitis. Figure 3 A shows an enlarged appendix (approximately 2 cm), with a "bulls eye" finding of central solid matter in the appendix lumen surrounded by free fluid. Figure 3 B shows an example of appendiceal abscess as seen by US.

alone. But do not be led astray if the UA shows WBCs and bacteriuria. Though most authors state that greater than 30 WBCs is indicative of a urinary tract infection (UTI), if the appendix makes contact with the ureter, the UA in appendicitis can mimic a UTI. In documented appendicitis, up to 30% of UAs will show more than 5 WBC per high power field,[59] and bacteriuria can be present in up to 15%.[60] Finally, do not forget that a urine pregnancy test should be run on all women of childbearing age to rule out ectopic pregnancy.

Plain Radiography. Flat and upright abdominal films have long been used in the ED work-up of patients with suspected appendicitis. Physicians have noted that these tests are of little use in helping make the diagnosis of appendicitis.[61] The infamous fecalith is the only finding specific for appendicitis, but is rarely seen on plain films. The 2% incidence does not justify the expense of obtaining the study.[14,62,63] Other findings reported to be helpful in diagnosing appendicitis (local air-fluid levels, soft tissue mass, psoas obliteration, gas in the appendix, etc.) have also been shown to be present in other diseases[39,64] and in normal individuals.[62,65,66] Ultimately, plain films can help identify other diseases (i.e., bowel obstruction), but they are of little use in patients being evaluated for acute appendicitis.[39]

A similar consensus has been reached concerning the use of a barium enema to diagnose appendicitis. While the obstructed appendix is not supposed to fill with barium, the normal appendix will not fill in 10-12% of individuals,[67-69] thereby generalizing an unacceptable false-positive rate. Other studies have shown the converse as well; the "obstructed" appendix can also completely fill with barium.[67,70] To make matters worse, barium enema is also suspected as a cause of appendicitis.[71] These facts have led most authors to recommend discontinuing use of barium enema in work-up of appendicitis.[72,73]

Computed Tomography. Early studies with computed tomography (CT) found that while this modality is extremely helpful in diagnosing many kinds of abdominal pathology in the ED setting, it was not as helpful in the diagnosis of appendicitis.[74-76] Perhaps the small size and variable location of the appendix caused the initial low yield with CT in appendicitis. However, more recent investigations, including one prospective study,[77] have suggested helical CT to be much more accurate in appendicitis than previously reported. Sensitivities of 97-100%, a specificity of 95%, and an accuracy rate of 98% have been reported.[77,78] Even if appendicitis was not identified using this modality, an alternative diagnosis was found in 54-80% of patients.[77,78] Another retrospective study found that CT negative laparotomy rates decreased to 4% in adult males and 8% in ovulating women,[79] compared to typical rates of 20% in men and 45% in women of childbearing age. Interestingly, the perforation rates were not lower in these same cases, and remained in the 19-22% range.[79] The encouraging sensitivity and specificity rates have led one author to proclaim that "the great mimicker, acute appendicitis, has met its match."[80]

Table 2. Features that Aid in Differentiation of PID and Appendicitis*

FEATURE:	PELVIC INFLAMMATORY DISEASE	ACUTE APPENDICITIS
Abdominal pain:		
Location:	variable, may radiate to back	migration to RLQ
Duration:	present with pain > 2 days	present with pain < 2 days
Onset:	within 7 days of menstrual cycle	no relation to menstruation
Cervical motion tenderness:	common—82 %**	less common 28-30 %
Bilateral adnexal tenderness:	more common—58 %	unusual—8 %
History of prior PID:	more common—44 %	unusual—8 %
Presence of nausea/ vomiting:	less common	more common

* No one feature can distinguish reliably between PID and appendicitis.[4]
** All data from reference[4]

However, at least one expert has pointed out that a negative scan will not definitively rule out appendicitis,[74] and a recent review of the subject in the surgical literature emphasizes that improvements in outcome have not been demonstrated with routine use of new technology.[81] Clearly, further studies on larger numbers of patients are needed to settle this controversy. CT scans can be helpful in identification of a phlegmon or appendiceal abscess, but the clinical exam in these patients typically is sufficient for surgical intervention. Finally, CT will not always rule out ovarian pathology, PID, gastroenteritis, or other diseases in the differential, but it does have the advantage over ultrasound in that no pain is produced by the exam and obesity does not impair the study. Figure 2 illustrates typical CT findings of acute appendicitis in both early and advanced cases.

Ultrasound. Ultrasound (US) evaluation of patients with abdominal pain is rapidly expanding in the ED. The US findings in adults include visualization of a non-compressible appendix more than 6-7 mm in outer-wall-to-outer-wall diameter, single-wall diameter greater than 2 mm, dilated lumen, or presence of periappendiceal fluid. One expert team has identified three criteria for the diagnosis of appendicitis by US: 1) a tender, not-compressible appendix; 2) no peristalsis of the appendix; and 3) overall diameter greater than 6 mm.[83] Figure 3 shows an example of a non-compressible, dilated appendix on US and an example of appendiceal abscess. In adults, the sensitivity is reported to be 75-89%[84,85] and the specificity is 95%, yielding an overall accuracy of 87-96%.[84-86] A similar number range has recently been established using US in children with appendicitis,[87-89] although at least two published studies suggest the outcome is not improved by using US in children.[90,91]

The advantages of US are well known. The study is quick, readily available in most EDs, is non-invasive, has low-risk, and has been shown to be accurate.[84,85,92,93] Despite its usefulness, the diagnosis may be difficult if the appendix is not visualized on US. This is especially common in obese patients and patients with perforation and/or abscess.[83] The test may also be problematic if the patient's pain does not allow him or her to tolerate the pressure that must be applied with the probe in the RLQ to permit visualization of the appendix. In this regard, all of the diagnostic criteria depend upon visualization of the appendix, and, if it is not seen on US, the diagnosis of appendicitis is still possible. Indeed, one reason for lack of visualization is perforation, in which case sensitivity is reported to be as low as 29%.[94] Consequently, as good as US can be, it still lacks the ability to rule out the diagnosis 100% of the time. US appears to be most useful in the early stages of disease when the diagnosis is unclear. As in other situations we routinely encounter (i.e., chest pain and negative ECGs), positive findings are helpful, but negative studies mean "keep looking." Repeat exam, consultation, and admission for observation may be required to ensure safety of the patient. Observation in the ED or as an inpatient has been shown to be beneficial in patients with possible appendicitis[14,95] without increasing risk of complications.[96,97]

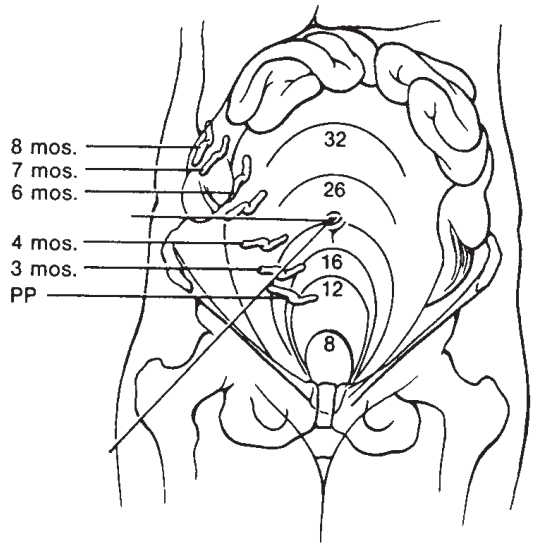
High-Risk Patient Populations

Unfortunately, healthy, adult men are the only group of patients in which an evaluation for possible appendicitis can be considered "routine." The "atypical" presentation is more likely to be encountered. The following sections review strategies for detecting acute appendicitis in other patient subgroups: ovulating women, pregnant women, children, the elderly, and immunosuppressed patients.

Ovulating Women. The principal reason that diagnosis of appendicitis in women can be difficult is because other, more common conditions, such as pelvic inflammatory disease (PID) and ovarian cyst rupture, may be confused with appendicitis. PID deserves special attention since it can be especially difficult to distinguish from appendicitis. The inflammatory process associated with PID can masquerade as appendicitis, producing RLQ tenderness, elevated WBC, fever, and a history consistent with appendicitis. The negative laparotomy rate of 30-50% in adult women is testimony to the difficulty of diagnosing appendicitis in this population.[14,98,99] A recent study of 174 non-pregnant women found that 33% had been misdiagnosed before being correctly identified as having appendicitis.[100] The majority of misdiagnosed women had atypical features in their presentations, including diffuse bilateral lower quadrant pain, CMT, and right adnexal tenderness.[100]

Many authors have tried to identify features that would differentiate these two diseases, and have suggested the follow-

Figure 4. Changes in Normal Position of the Appendix During Pregnancy



ing. *(See Table 2.)* The presence of anorexia/nausea/vomiting and onset of pain less than one day before presentation make appendicitis more likely in a retrospective review of 1000 cases of appendicitis.[14] Other features identified that made PID more likely were: pain greater than two days before presentation and onset of symptoms within seven days of last menstrual cycle. However, one study specifically looking at the usefulness of the timing of pain and stage of menstrual cycle found no difference between the onset of pain in PID or appendicitis and the stage of the patient's menstrual cycle.[101] Another prospective study suggested four additional criteria: history of sexually transmitted disease, abdominal tenderness other than RLQ, CMT, and bilateral adnexal tenderness.[4] A more recent retrospective review supports these criteria, and adds history of vaginal discharge, urinary symptoms, and discharge at the os as additional features to support a diagnosis of PID.[102]

Although these criteria may aid clinical judgement, they are *not* 100% reliable.[103] For example, CMT can occur with an appendix lying in the pelvis, and, therefore, cannot be used alone to make the diagnosis of PID.[104] Vaginal probe ultrasound may be a useful modality to help reduce the rate of complications and unnecessary surgery in adult women. Another approach recently evaluated is diagnostic laparoscopy, a strategy that reduced the negative appendectomy rate to 5%.[105]

Pregnancy. Although the two conditions may coexist, pregnancy has no influence on the frequency of acute appendicitis;[106] in fact, appendicitis occurs equally in each trimester[107] at a rate of about one per 1,500-2,200 pregnancies.[20,108] The risk for both mother and fetus is significant if appendicitis is not diagnosed early in its course, with mortality rates of about 2% for the mother and up to 35% for the baby having been reported.[109] One difficult aspect of diagnosis results from the shifting location of the appendix as pregnancy progresses. *(See Figure 4.)* The shifting position of the appendix in pregnancy may lead the physician to confuse appendicitis with cholecystitis or pyelonephritis, both of which are common in later pregnancy. Another problem is the similarity between symptoms encountered in early pregnancy and acute appendicitis; these include anorexia, nausea, vomiting, and mild abdominal pain. In addition, the natural elevation of WBC in pregnancy can further confuse the clinical picture. As a result, US may be the most useful test for confirming the diagnosis of appendicitis in pregnant patients. With US, there is no risk to the patient or fetus, and renal disease or gallstones can easily be identified in most patients. Use of US may lead to early surgical consultation. Ultimately, the best counsel is to be aware that appendicitis can occur in pregnant patients and to document other diagnoses before discharging or admitting the patient. Finally, consultation is mandatory when the clinical picture is not straightforward.

Children

While acute appendicitis is the most common surgical disorder in children, only 5% of visits for abdominal pain in children are due to appendicitis.[1] Seeing so many children with varied causes of abdominal pain, the majority of which are from a benign process, can lull the physician into a sense of false security and can increase the risk of missing the diagnosis. Indeed, up to 50% of children with documented appendicitis who are initially seen by a physician are misdiagnosed.[55,110] Furthermore, the younger the child, the more likely a delay in diagnosis will occur leading to perforation. Children younger than 2 years of age have rates of perforation that approach 100%; the perforation rate is about 71% in the 3-5 year age group, and 40% in the 6 to 10-year-old age group.[110,111] Some of the features associated with perforation include: younger age, home observation after initial visit, pain duration of more than two days, atypical clinical features, and temperature higher than 39°C.[112-114] The incidence of complications, including wound infection and even death, is correlated with perforation which is caused by delay to treatment.

One of the most common misdiagnoses for appendicitis in children is AGE. This is not surprising, since many signs, symptoms, and findings of the two diseases can overlap. Moreover, AGE is very common, and lymphoid hyperplasia secondary to viral illnesses is thought to trigger appendicitis as a result of luminal obstruction. It is impossible, however, to say how many of these "missed" cases of appendicitis actually represent appendicitis following AGE. In either case, several strategies can help reduce the chance of missing appendicitis in the setting of possible AGE. *(See Table 3.)* If the child has abdominal pain and vomiting but does not have diarrhea, then AGE should not be listed as a diagnosis and appendicitis should be more strongly considered. Furthermore, the presence of diarrhea does not exclude appendicitis from the differential. One study evaluated the presence of diarrhea in children younger than 3 years with appendicitis and found that diarrhea was present in 33% of cases.[115] Another investigator has pointed out that diarrhea from AGE is usually watery and abundant, whereas the diarrhea associated with appendicitis tends to be less voluminous and may have mucoid stools.[41] Constipation is often cited as a source

Table 3. Features that Aid in Differentiating Between AGE and Appendicitis

FEATURE:	ACUTE GASTROENTERITIS	ACUTE APPENDICITIS
Abdominal pain:		
Location:	poorly localized	poorly localized early in course, later localized to RLQ
Duration:	intermittent	more constant
Character:	crampy, diffuse	becomes more severe with time
Exam:	no peritoneal signs	peritoneal signs present
Vomiting:	begins with or before pain	begins after pain, sometimes hours later
Diarrhea:	watery, large volume	mucoid, small volume,
Fever:	present early on in course	absent initially, or low grade only

of abdominal pain in children and is present in 8% of children with appendicitis.[41]

Accordingly, the history of constipation should not "rule out" appendicitis. In one study, constipation predisposed patients to a high misdiagnosis rate.[116]

Fever is often absent early in appendicitis, but much less so with AGE.[41] The temporal relation of vomiting and pain are repeatedly given significance. In AGE, vomiting is said to occur before or concurrent with pain and in appendicitis; vomiting is to begin after pain is noted.[41] Finally, localizing tenderness should never be ignored or interpreted as a feature of AGE. Repeated exams may be necessary to establish localized tenderness, since abdominal exams in children can be difficult to assess within the framework of one attempt. The pain of AGE is more diffuse and crampy, where appendicitis should produce a consistently tender area that is localized. This area may not be localized in the classic "McBurney's point," as barium enema studies have shown that the actual location of the appendix is normally inferior and medial to McBurney's point.[117] One investigation stressed that 15% of appendiceal bases are more than 10 cm from McBurney's point! Therefore, reproducible point tenderness anywhere near the RLQ in a child should raise a strong suspicion for the presence of appendicitis.

Elderly

Older patients with abdominal pain can be difficult to evaluate in the ED. Geriatric patients are more likely to have serious pathology, and their vital signs and exam do not always reflect the severity of their underlying illness. Diagnostic problems with appendicitis in the elderly are well-documented. Only 5-10% of cases of appendicitis are diagnosed without delay in patients older than 60 years, but more than 50% of the overall mortality is in this age group.[9,18] Delays to presentation contribute to mortality in the following manner: most patients older than 60 years waited 24-48 hours before presenting to a physician.[118-120] One study noted 17% of patients older than 60 years had been seen and misdiagnosed with a non-surgical problem before being correctly diagnosed with appendicitis.[121] Common surgical misdiagnoses include bowel obstruction, cholecystitis, and peptic ulcer disease.[122] In addition, only 51% of patients were correctly identified as having appendicitis before surgery,[18,123] and 50% of patients older than 60 years who died from appendicitis were admitted for three days or more before surgery was performed.[124]

While their perforation rate is similar to that of small children (46-83%),[18,125] this may not be due only to delayed presentations and misdiagnosis. One study noted that in patients presenting within 24 hours of symptom onset, patients older than 50 years of age were twice as likely to have perforation (24% rate) compared to patients in their 30s.[118]

It is speculated that the appendix wall in elderly patients is weaker and perforates more quickly; in addition, older patients may not be able to mount as vigorous a defense. The presence of comorbid conditions in elderly patients also complicates assessment. Finally, physical exam can be misleading. RLQ pain and tenderness were noted to be absent in 23% of older patients,[126,127] and classical pain migration was not present in 60-80% of elderly individuals with appendicitis.[18,128,119] Nausea, vomiting, and anorexia were also noted to occur less often compared to younger adults.[18,118] A more recent review covering a 10-year period highlights the diagnostic challenges: only 20% of patients older than 60 years presented with "classic" anorexia, fever, RLQ pain, and an elevated WBC.[18] As with other high-risk groups, it should be stressed that atypical presentations are common, and, therefore, considering appendicitis in every elderly patient with abdominal pain is essential for improving outcomes.

Immunocompromised Patients

Although patients with HIV come to mind when considering immunocompromised individuals, patients on chronic steroids, sickle cell patients, those taking chemotherapy, diabetics, dialysis patients, and others with depressed immune systems are also at higher risk of complications and misdiagnosis of appendicitis. HIV-positive patients may have other causes of abdominal pain that can confuse the diagnosis (i.e. cryptosporidiosis, lymphoma, and cytomegaloviris [CMV] colitis). While there have been reports of mycobacterial infections mimicking appendicitis,[128] AIDS patients can also have appendicitis due to complications associated with their HIV. Appendicitis arising from Kaposi's sarcoma,[129,130] cytomegalovirus,[131] and mycobacterial infection[132] have also been reported. Patients with immune system dysfunction are at higher risk because their inflammatory response to infection and perforation is diminished, which leads to delayed presentation and masked signs and/or symptoms.[133] The perforation rate is reported to be as high as 50% in one series of HIV patients.[134] The WBC is not helpful in these patients, as bone marrow suppression prevents elevation. The early use of diagnostic laparoscopy has been recommended as an alter-

Table 4. Suggested ED Management Pathway for Acute Appendicitis*

HIGH CLINICAL PROBABILITY
History and physical examination (including pelvic and rectal)
NPO
Saline lock and fluid resuscitation
Urinalysis
Urine pregnancy test, if applicable
Surgical consultation
Antibiotic (cefotetan or cefoxitin)
Appendectomy
MODERATE CLINICAL PROBABILITY
History and physical examination (including pelvic and rectal)
NPO
Saline lock and rehydration if needed
CBC
Urinalysis
Urine pregnancy test, if applicable
Surgical consultation
Ultrasound or CT
If positive, appendectomy
If negative, observation and serial examinations
LOW CLINICAL PROBABILITY
History and physical exam (including pelvic and rectal)
CBC
Urinalysis
Urine pregnancy test, if applicable
Ultrasound or CT if symptoms persist at time of follow-up
Surgical consultation for follow-up
If follow-up in ED, see in 12-24 hours for repeat examination, with earlier return for increased symptoms

* Adapted from reference [82]

Table 5. Tips to Reduce Malpractice Risk in Suspected Appendicitis[9]

- All patients with RLQ tenderness have appendicitis until proven otherwise.
- Be aware that the "atypical" presentation is the common one.
- Beware of high-risk groups: children, ovulating or pregnant women, the elderly, and the immunocompromised.
- 50% of deaths from appendicitis occur in the elderly. Be especially vigilant for appendicitis presenting in atypical fashion in older patients.
- Vomiting following onset of abdominal pain is more consistent with appendicitis than other diagnoses.
- Document all physical exams well, including rectal/pelvic exams.
- Perform serial abdominal exams and document them. Diagnosing appendicitis is difficult enough without limiting data through incomplete exams.
- Never use a normal WBC to determine that the patient does not have appendicitis.
- Remember *no* test will rule out appendicitis with 100% accuracy.
- Do not give IV narcotics to patients with vague abdominal pain and unclear diagnoses. Always obtain surgical consultation and do *not* discharge patients with abdominal pain requiring narcotic pain relief when there is not a clear non-surgical diagnosis (i.e., mild pancreatitis).
- Use the diagnosis of "abdominal pain of uncertain etiology" for all patients with unclear presentations and explain to the patient that you "do not know yet what is causing their symptoms."
- Never write a discharge diagnosis of acute gastroenteritis if there is no history of diarrhea.
- Consult liberally in cases where the diagnosis of appendicitis is in question.
- Give complete and clear discharge/follow-up instructions, and document these well.
- Do not send patients home when the diagnosis is in question and there is reasonable doubt that the patient can or will return as directed (i.e., alcoholics, homeless, those without transportation, unreliable parents, etc.)
- Tell every patient discharged from the ED for abdominal pain that "appendicitis can develop in anyone in *only* 24 hours" so they understand the importance of a return visit for continued or worsening pain.

native to exploratory surgery in these patients to aid in early diagnosis and reduce complications as well as unnecessary surgery.[135]

Acute Appendicitis Pathway

Management of patients with suspected appendicitis in the ED can be divided into three patient risk groups: those with high, moderate, or low clinical probability of the diagnosis. Table 4 presents a summary of a suggested approach for these three patient groups. Those with a low clinical suspicion after evaluation can be safely sent home from the ED provided good follow-up precautions have been provided and the patient can return after 12-24 hours. From a risk management perspective, it is extremely important to stress to the patient and/or their family the risks of not following up as directed. Those with a moderate clinical suspicion and a negative US should either be observed in the ED for 4-6 hours, or, preferably, admitted to an observation unit for serial exams every 2-4 hours. It is always in everyone's best interest to obtain a surgical consult in patients in whom the diagnosis is unclear after an ED evaluation. Those with high clinical suspicion should not be subjected to any unnecessary delays in the ED before surgery. Intravenous (IV) fluid resuscitation should be initiated, all patients should be NPO, and antiemetics should be given to decrease discomfort from nausea and vomiting. Antibiotics should be initiated in the ED and should provide broad-spectrum anaero-

bic and gram-negative coverage. Cefotetan or cefoxitin (adult dose 2 grams IV) can both be given as single agents in appendicitis. In children, a triple antibiotic approach is often recommended; ampicillin (100-200 mg/kg/24 hr q 4 hr IV), clindamycin (30-40 mg/kg/24 hr q 6 hr IV), and gentamycin (5.0-7.5 mg/kg/24 hr q 8 hr IV).[136,137] Remember that gentamycin is a "category C" drug in pregnancy (safety has not been established), whereas the cephalosporins are "category B" (usually safe). Preoperative antibiotic use has been shown to reduce complication rates,[138] but should be given in consultation with the admitting physician.

Medication for pain relief in ED patients with severe abdominal pain deserves special attention. In general, every patient who has a high suspicion of appendicitis should be given something for pain relief. Although there is controversy regarding the timing of pain relief in ED patients with significant abdominal pain, prospective studies have shown that appropriate use of IV narcotics does not lead to misdiagnosis of patients with acute abdominal pain; it may actually increase the accuracy of diagnosis by making the exam more fruitful. This concept has support in both the surgical literature,[139,140] and emergency medicine literature.[141,142] In most patients, IV analgesia should be administered after speaking with the consultant, but this should not become a source of a "turf battle" between the ED physician and the surgeon. Simply state that the patient is very uncomfortable, is requesting some relief, and you feel that a small dose of your drug of choice will not alter the patient's diagnosis. By calling the consultant before any pain relief is given, he or she can be given the choice between coming to the ED to examine the patient before IV pain relief, or he or she can be actively involved in which drugs to give and in what doses. If the consultant is opposed to use of analgesia, a good alternative is use of droperidol (Inapsine®). Although this drug is an antiemetic related to haldol, it can reduce anxiety associated with severe pain, as well as alleviate nausea. The patient's perception that the physician cares about their pain enough to give them some relief without delay will help them to endure the wait until more adequate pain relief can be provided. If a surgeon is not immediately available, IV analgesia should be administered.

Risk Management Strategies

The diagnosis of acute appendicitis remains a clinical challenge. As many as 30% of patients with pathologically proven appendicitis have been seen and misdiagnosed by another physician before being correctly identified.[8] One study characterizing the features of misdiagnosis of appendicitis involving litigation against ED physicians found that only 55% of nonpregnant patients presented "classically."[143] Since misdiagnosis of appendicitis is among the top five leading causes of successful malpractice suits against ED physicians in the United States,[8,19] strategies for reducing this risk should be used. Table 5 summarizes several useful points to aid ED physicians in reducing risks when evaluating patients with possible appendicitis.

A recent review of litigation against ED physicians for missed appendicitis identified several features commonly encountered in these cases.[143] Seven statistically significant features of misdiagnosed cases include: lack of distress on presentation, no nausea or vomiting, absence of rebound on exam, lack of guarding on exam, lack of performance of rectal exam, giving narcotic pain medication in the ED, and ED diagnosis of gastroenteritis. In general, the diagnosis was more likely to be missed in patients who presented with atypical features, including lack of severe distress, lack of nausea and vomiting, and absence of rebound and guarding on exam. They suggested that perhaps patients were presenting in the interval after initial perforation and before signs of peritonitis could develop. The fact that the misdiagnosed patients had pain on average for 50% longer than control cases lends support to this interpretation. Patients whose appendicitis was missed also had poor documentation of the history and physical exam in their charts. Location, duration, quality, radiation, and increasing/decreasing features of pain were consistently missing. Physical exams were not complete in that rectal exams were not documented and/or not performed. Almost 50% of patients misdiagnosed were labeled as "gastroenteritis." Interestingly, no patient in this study whose appendicitis was missed had nausea, vomiting, and diarrhea documented as present in their charts. As mentioned before, discharging a patient with the diagnosis of gastroenteritis who does not have diarrhea is not advisable. It may be preferable to characterize the illness as "abdominal pain of uncertain etiology," and share this uncertainty with the patients and their relatives. This will underscore the importance of returning for repeat evaluation.

Although the use of pain medication in appendicitis has been discussed at length, this study makes an important distinction. Narcotic pain relief is appropriate in consultation with an admitting physician for a patient with probable appendicitis. This should not be construed to mean that narcotics should be given to patients in whom the pain is not severe if they are not admitted or have consultation in the ED. This study found that use of narcotic pain relief was more likely to be associated with misdiagnosis in patients labeled as having gastroenteritis. These patients were given the narcotics for vague abdominal symptoms only, and then sent home without consultation. Their control group of patients who were *not* misdiagnosed also had narcotic medications administered, but only after the diagnosis of appendicitis was written in the chart and surgical consultation was obtained. It is estimated that 50% of the missed cases might have been prevented if the patients requiring narcotics for their abdominal pain had been given surgical consultation or admission for observation instead of discharge home. Finally, the important point is that 3% of patients with missed appendicitis *died*, while none of the control group expired. This figure is consistent with a study noting deaths only in misdiagnosed patients.[116]

In a study focusing on children, a misdiagnosis rate of 28% in 181 cases was noted. In these 50 cases of misdiagnosis in children under the age of 13 years, Rothrock et al[116] found the most common misdiagnosis to be AGE. As with the study above, they found misdiagnosed patients presented "atypically" with a mean younger age (5.3 yrs vs 7.9 yrs) and had more complaints of constipation, diarrhea, dysuria, irritability, lethargy, and signs of upper respiratory infections. On physical exam, misdiagnosed patients also were less likely to have abdominal tenderness. Of note, though, is that 48% of the misdiagnosed patients did have maximal tenderness in the RLQ

and were *still* not thought to have a surgical problem. This underscores the point that RLQ tenderness in a child should never be considered insignificant until proven otherwise. Finally, physical exams were poorly documented, especially rectal exams. While many physicians may feel the rectal exam is of little use in adults, and at least one study verified this,[144] the results in children are markedly different. Several authors report up to 50-80% of children with appendicitis have localized tenderness on rectal exam and that 25% will have a rectal mass.[145,146]

Summary

Ultimately, the accurate diagnosis of acute appendicitis is difficult even for experienced emergency physicians and surgeons. As discussed in this article, atypical presentations are actually more common. Healthy adult males make up the only group of patients considered to be at low risk for misdiagnosis. The only patient in the ED who is safe from appendicitis is the patient who has already had his or her appendix removed! Only by recognizing the limitations of the diagnostic tests available and by maintaining a high suspicion for appendicitis in the high-risk groups, can the ED physician reduce the risk of misdiagnosis.

In the final analysis, there are three groups of patients—those who have it, those who don't, and those who might. The first group is comprised of those patients who present with exams and histories highly suspicious for appendicitis; they are easily recognized. Second, there are patients with a very low likelihood of appendicitis. These patients are also easily dispositioned, but should not go out the door without "the talk." At the end of the encounter, the ED physician should review the findings and his or her interpretation of the patient's complaint. The patient needs to be sent home with clear, written precautions indicating what to look for (worse belly pain, fever, vomiting, or concern about getting better) and when to return (within 8-12 hours). The patient and his or her relatives need to hear the risks if they do not return as directed (i.e., bad infection that can kill him or her). One version that accomplishes all of these goals in a very brief time is as follows: "Mr./Ms. X, I don't believe you have appendicitis now. However, you still have your appendix, and anyone with one can develop problems in only 24 hours and need surgery. If you feel worse, with more pain, fever, or vomiting you must return to be rechecked or else you can become very sick and even die from this." By keeping information clear, simple, and to the point, the patients are more likely to retain important information. This also gives the patients time to ask questions concerning their evaluation and diagnosis before they leave. While not every patient in a busy ED needs a lengthy discussion before being discharged, spending a few extra minutes with higher-risk patients is time well spent.

The last group is everyone in between; these patients that can be difficult to triage. Until an accurate diagnostic test is available, the patient in whom the diagnosis remains in question after ED evaluation should have surgical consultation and admission for observation. One pediatric series found that adherence to this recommendation reduced the negative laparotomy rate to 1.5%, with a perforation rate of 30%.[147] Both of these are dramatically lower than the typical rates for children.[4] Another recent study of 252 patients found short-term observation of 10 hours significantly improved diagnostic accuracy.[95] The surgeon's adage of "when in doubt, take it out" can be modified for the ED physician to "when in doubt, don't send them out!"

References

1. Brewer RJ, Golden GT, Hitch DC, et al. Abdominal pain: An analysis of 1,000 consecutive cases in a university hospital emergency room. *Am J Surg* 1976;131:219-223.
2. Staniland JR, Ditchburn J, de Dombal FT. Clinical presentation of acute abdomen: Study of 600 patients. *BMJ* 1972;3:393-398.
3. Pieper R, Kager L. The incidence of acute appendicitis and appendectomy: An epidemiological study of 971 cases. *Acta Chir Scand* 1982;148:45-49.
4. Bongard F, Landers DV, Lewis F. Differential diagnosis of appendicitis and pelvic inflammatory disease: A prospective analysis. *Am J Surg* 1985;150:90-96.
5. Catto J. Acute appendicitis. In: Tintinalli JE, et al, eds. *Emergency Medicine—A Comprehensive Study Guide*. 3rd ed. New York: McGraw Hill; 1992:461-463.
6. Janik JS, Firor HV. Pediatric appendicitis: A twenty year study of 1640 children at Cook County (Illinois) Hospital. *Arch Surg* 1979;114:717-719.
7. Babaknia A, Parsa H, Woodruff JD. Appendicitis during pregnancy. *Obstet Gynecol* 1977;50:40-44.
8. Rogers J. Abdominal pain: Foresight. Dallas: American College of Emergency Physicians; Dec 1986, Issue 3.
9. Salkin MS. Appendicitis: Avoiding failure to diagnose. *ED Legal Letter* 1996;7:113-124.
10. Williams GR. Presidential address: A history of appendicitis. With anecdotes illustrating its importance. *Ann Surg* 1983;197:495-506.
11. Berry J, Malt RA. Appendicitis near its centenary. *Ann Surg* 1984;200:567-575.
12. Stone HH, Sanders JL, Martin JD. Perforated appendicitis in children. *Surgery* 1971;69:673-678.
13. Owens BJ, Hamit HF. Appendicitis in the elderly. *Ann Surg* 1978;187:392-396.
14. Lewis FR, Holcroft JW, Boey J, et al. Appendicitis: A critical review of diagnosis and treatment in 1,000 cases. *Arch Surg* 1975;110:677-684.
15. Mittlepunckt A, Nora PF. Current features in the treatment of acute appendicitis: An analysis of 1,000 consecutive cases. *Surgery* 1966; 60:971.
16. Jess P. Acute appendicitis: Epidemiology, diagnostic accuracy, and complication. *Scand J Gastroenterol* 1983;18:161-163.
17. Scher KS, Coil JA. The continuing challenge of perforated appendicitis. *Surg Gynecol Obstet* 1980;150:535-538.
18. Horattas MC, Guyton DP, Wu D. A reappraisal of appendicitis in the elderly. *Am J Surg* 1990;160:291-293.
19. Trautlein JJ, Lambert RL, Miller J. Malpractice in the emergency department—Review of 200 cases. *Ann Emerg Med* 1984;13:709-711.
20. Doherty GM, Lewis FR. Appendicitis: Continuing diagnostic challenge. *Emerg Med Clin North Am* 1989;7:537-553.
21. Wakely CPG. The position of the vermiform appendix as ascertained by an analysis of 10,000 cases. *J Anat* 1933;67:277.
22. Collins DC. 71,000 human appendix specimens: A final report summarizing forty-year study. *Am J Proctol* 1963;14:365-381.

23. Mattei P, Sola JE, Yeo CJ. Chronic and recurrent appendicitis are uncommon entities often misdiagnosed. *J Am Coll Surg* 1994;178:385-389.
24. Savrin RA, Clausen K, Martin EW, et al. Chronic and recurrent appendicitis. *Am J Surg* 1979;137:355-357.
25. Heller MB, Skolnick ML. Ultrasound documentation of spontaneously resolving appendicitis. *Am J Emerg Med* 1993;11:51-53.
26. Migraine S, Atri M, Bret PM, et al. Spontaneously resolving acute appendicitis: Clinical and sonographic documentation. *Radiology* 1997;205:55-58.
27. Barber MD, McLaren J, Rainey JB. Recurrent appendicitis. *Br J Surg* 1997;84:110-112.
28. Chang FC, Hogle HH, Welling DR. The fate of the negative appendix. *Am J Surg* 1973;126:752-756.
29. Hobson T, Rosenman LD. Acute appendicitis—When is it right to be wrong? *Am J Surg* 1964;108:306-312.
30. Law D, Law R, Eiseman B. The continuing challenge of acute and perforated appendicitis. *Am J Surg* 1976;131:533-535.
31. Rothrock SG. Overcoming limitations and pitfalls in the diagnosis of appendicitis. *Emerg Med Rep* 1992;13:41-52.
32. Arnbjornsson E, Bengmank S. Obstruction of the appendix lumen in relation to pathogenesis of acute appendicitis. *Acta Chir Scand* 1983;149:789-791.
33. Hart LS. Conditions requiring surgery: appendicitis. In: Barkin RM, et al, eds. *Pediatric Emergency Medicine: Concepts and Clinical Practice.* 1st ed. Mosby-Year Book, Inc: 1997:847-850.
34. Brumer M. Appendicitis: Seasonal incidence and postoperative wound infections. *Br J Surg* 1970;57:93-99.
35. Misra SP, Dwivedi M, Misra V, et al. Preoperative sonographic diagnosis of acute appendicitis caused by *Acsaris lumbricoides. J Clin Ultrasound* 1999;27:96-97.
36. Linz DN, Hrabovsky EE, Franceschi D, et al. Does the current health care environment contribute to increased morbidity and mortality of acute appendicitis in children? *J Ped Surg* 1993;28: 321-328.
37. Pieper R, Kager L, Nasman P. Acute appendicitis: A clinical study of 1,018 cases of emergency appendectomy. *Acta Chir Scand* 1982;148:51-62.
38. Clarke JR, Schoffstall JM. Appendicitis. In: Schwartz GR, et al, eds. *Principles and Practice of Emergency Medicine.* Philadelphia, Lea & Febiger; 1992:1687-1897.
39. English CD, Allen W, Coppola ED, et al. Excessive dependence of the leukocytosis cue in diagnosing appendicitis. *Am Surg* 1977;43:339-402.
40. McLario D, Rothrock SG. Understanding the varied presentation and management of children with acute abdominal disorders. *Ped Emerg Med Reports* 1997;2:111-122.
42. Sasso RD, Hanna EA, Moore DL. Leukocytic and neutrophil counts in acute appendicitis. *Am J Surg* 1970;120:563-566.
43. Raftery AT. The value of the leukocyte count in the diagnosis of acute appendicitis. *Br J Surg* 1976;63:143-144.
44. Hoffman J, Rasmussen OO. Aids in the diagnosis of acute appendicitis. *Br J Surg* 1989;76:774-779.
45. Doraiswamy NV. The neutrophil count in childhood acute appendicitis. *Br J Surg* 1977;64:342-344.
46. Freund HR, Rubinstien E. Appendicitis in the aged: Is it really different? *Ann Surg* 1984;50:573-576.
47. Thimsen DA, Tong GK, Gruenberg JC. Prospective evaluation of C-reactive protein in patients suspected to have acute appendicitis. *Surg Gynecol Obstet* 1989;55:466-468.
48. Scott JH III, Amin M, Harty JI. Abnormal urinalysis in appendicitis. *J Urol* 1983;129:1015.
49. Stringel G. Appendicitis in children: A symptomatic approach for a low incidence of complications. *Am J Surg* 1987;154: 631-635.
50. Coleman C, Thompson JE, Bennion RS, et al. WBC count is a poor predictor of severity of disease in the diagnosis of appendicitis. *Am Surg* 1998;64:983-985.
51. Young DV. Results of urgent appendectomy for right lower quadrant tenderness. *Am J Surg* 1989;157:428-430.
52. Graham JM, Pokorny WJ, Harberg FJ. Acute appendicitis in preschool age children. *Am J Surg* 1980;139:247-250.
53. Paajanen H, Maniskka A, Laato M, et al. Are serum inflammatory markers age dependent in acute appendicitis? *J Am Coll Surg* 1997; 184:303-308.
54. Eriksson S, Granstrom L, Olander B, et al. Leucocyte elastase as a marker in the diagnosis of acute appendicitis. *Eur J Surg* 1995;161:901-905.
55. Henneman PL, Marcus CS, Inkiles SH, et al. Evaluation of children with possible appendicitis using technetium 99m leukocyte scan. *Pediatrics* 1990;85:838-843.
56. Hallen S, Asberg A. The accuracy of C-reactive protein in diagnosing acute appendicitis—A meta-analysis. *Scand J Clin Lab Invest* 1997;57:373-380.
57. van Dieijen-Visser MP, Go PM, Brombacher PJ. The value of laboratory tests in patients suspected of acute appendicitis. *Eur J Clin Chem Clin Biochem* 1991;29:749-752.
58. Dueholm S, Bagi P, Bud M. Laboratory aid in the diagnosis of acute appendicitis. A blinded, prospective trial concerning the diagnostic value of leukocyte count, neutrophil differential count, and C-reactive protein. *Dis Colon Rectum* 1989;32:855-859.
59. Scott JH, Amin M, Harty JI. Abnormal urinalysis in appendicitis. *Urology* 1983;129:1015.
60. Arnbjornsson E. Bacteriuria in appendicitis. *Am J Surg* 1988;155:356-358.
61. Campbell JPM, Gunn AA. Plain abdominal radiographs and acute abdominal pain. *Br J Surg* 1988;75:554-556.
62. Bakha RK, McNair MM. Useful radiologic signs in acute appendicitis in children. *Clin Rad* 1977;28:193-196.
63. Field S, Guy PJ, Upsdell SM, et al. The erect abdominal radiograph in the acute abdomen: Should its routine use be abandoned? *Br Med J* 1985;290:1934-1936.
64. Shimkin PM. Radiology of acute appendicitis. *AJR Am J Roentgenol* 1978;130:1001-1004.
65. Rothrock SG, Green SM, Harding M, et al. Plain abdominal radiography in the detection of acute medical and surgical disease in children. *Pediatr Emerg Care* 1991;7:281-285.
66. Schnaufer L, Soroosh M. Abdominal Emergencies. In: Fleisher GR and Ludwig S, eds. *Textbook of Pediatric Emergency Medicine.* 3rd ed. Baltimore: Williams and Wilkins; 1993:1309-1313.
67. Sakover RP, Del Fava RL. Frequency of visualization of the normal appendix with barium enema examination. *Am J Roentgenol Radium Ther Nucl Med* 1974;121:312-317.
68. Hatch Ei, Naffis D, Chanlder NW. Pitfalls in the use of barium enema in early appendicitis in children. *J Pediatr Surg* 1981;16:309-312.
69. Schey WL. Use of barium in the diagnosis of appendicitis in chil-

dren. *Am J Roentgenol Radium Ther Nucl Med* 1973;118:95-103.
70. Dietz WW. Fallacy of the roentgenologically negative appendix. *JAMA* 1969;208:1495.
71. Palder SB, Dalessandri KM. Barium appendicitis. *West J Med* 1988;148:462-464.
72. Preston CA, Karch SB. The influence of gender and use of barium enema on morbidity in acute appendicitis. *Am J Emerg Med* 1989;7:253-255.
73. Smith DE, Kirchmer NA, Stewart DR. Use of the barium enema in the diagnosis of acute appendicitis and its complications. *Am J Surg* 1979;38:829-834.
74. Balthazar EJ, Megibow AJ, Hulnick O, et al. CT of appendicitis. *Am J Roentgenol* 1986;147:705-710.
75. Balthazar EJ, Birnbaum BA, Yee J, et al. Acute appendicitis: CT verses US correlation in 100 patients. *Radiology* 1994;190:31-35.
76. Balthazar EJ, Megibow AJ, Siegel SE, et al. Appendicitis: Prospective evaluation with high-resolution CT. *Radiology* 1991;180:21-24.
77. Rao PM, Rhea JT, Novelline RA, et al. Helical CT technique for the diagnosis of appendicitis: Prospective evaluation of a focused appendix CT examination. *Radiology* 1997;202:139-144.
78. Funaki B, Grosskreutz SR, Funaki CN. Using unenhanced helical CT with enteric contrast material for suspected appendicitis in patients treated at a community hospital. *Am J Roentgenol* 1998;171:997-1001.
79. Balthazar EJ, Rofsky NM, Zucker R. Appendicitis: The impact of computed tomography imaging on negative appendectomy and perforation rates. *Am J Gastroenterol* 1998;93:786-771.
80. Malone AJ, Shetty MR. Diagnosis of appendicitis. *Lancet* 1997;14:349.
81. Wilcox RT, Traverso LW. Have the evaluation and treatment of acute appendicitis changed with new technology? *Surg Clin North Am* 1997;77:1355-1370.
82. Greenfield RH, Henneman PL. Disorders of the small intestine. In: Rosen P, et al, eds. *Emergency Medicine: Concepts and Clinical Practice.* 4th ed. Mosby-Year Book, Inc; 1998:2005-2021.
83. Promes SB. Miscellaneous applications: Appendicitis. In: Simon BC, Snoey ER, eds. *Ultrasound in Emergency and Ambulatory Medicine* 1st ed. Mosby-Year Book, Inc; 1997:252-256.
84. Puylaert JB, Rutgers PH, Lalisang RI, et al. A prospective study of ultrasonography in the diagnosis of appendicitis. *N Engl J Med* 1987;317:666-669.
85. Jeffrey RB, Laing FC, Lewis FR. Acute appendicitis: Sonographic criteria based on 250 cases. *Radiology* 1988;167:327-329.
86. Yacoe ME, Jeffry RB. Sonography of appendicitis and diverticulitis. *Radiol Clin North Am* 1994;32:899-912.
87. Crady SK, Jones JS, Wyn T, et al. Clinical validity of ultrasound in children with suspected appendicitis. *Ann Emerg Med* 1993;22:1125-1129.
88. Schulte B, Beyer D, Kaiser C, et al. Ultrasonography in suspected acute appendicitis in childhood—Report of 1285 cases. *Em J Ultrasound* 1998;8:177-182.
89. Ramachandran P, Sivit CJ, Newman KD, et al. Ultrasonography as an adjunct in the diagnosis of acute appendicitis: A four-year experience. *J Pediatr Surg* 1996;31:164-167.
90. Ford RD, Passinault WJ, Morse ME. Diagnostic ultrasound for suspected appendicitis: Does the added cost produce a better outcome? *Am Surg* 1994;60:895-898.
91. Roosevelt GE, Reynolds SL. Does the use of ultrasonography improve the outcome of children with appendicitis? *Acad Emerg Med* 1998;5:1071-1075.
92. Schwerk WB, Wichtrup B, Rothmund M, et al. Ultrasonography in the diagnosis of acute appendicitis: a prospective study. *Gastroenterol* 1989;97:630-639.
93. John H, Neff, Kelemen M. Appendicitis diagnosis today: Clinical and ultrasonic deductions. *World J Surg* 1993;17:243-249.
94. Abu-Youseff MM, Phillips ME, Franken EA, et al. Sonography of acute appendicitis. A critical review. *Crit Rev Diagn Imaging* 1989;29:381-408.
95. Graff L, Radford MJ, Werne C. Probability of appendicitis before and after observation. *Ann Emerg Med* 1991;20:503-507.
96. Jones PF. Active observation in management of acute abdominal pain in children. *BMJ* 1976;2:531-533.
97. White JJ, Santillana M, Haller JA. Intensive in-hospital observation: A safe way to decrease unnecessary appendectomy. *Ann Surg* 1975;41:793-798.
98. Hoffman J, Rasmussen AB. Aids in the diagnosis of acute appendicitis. *Br J Surg* 1989;76:774-779.
99. Pieper R, Kager L. The incidence of acute appendicitis an appendectomy: An epidemiological study of 971 cases. *Acta Chir Scand* 1982;148:51-62.
100. Rothrock SG, et al. Misdiagnosis of appendicitis in nonpregnant women of childbearing age. *J Emerg Med* 1995;13:1-8.
101. Robinson JA, Burch BH. An assessment of the value of menstrual history in differentiating acute appendicitis from PID. *Surg Gynecol Obstet* 1984;159:149-152.
102. Webster DP, Schneider CN, Cheche S, et al. Differentiating acute appendicitis from PID in women of childbearing age. *Am J Emerg Med* 1993;11:569-572.
103. Najem AZ, Barillo DJ, Spillert CR, et al. Diagnosing pelvic inflammatory disease. *JAMA* 1991;266:2594-2604.
104. Henneman PL, Marcus CS, Butler JA, et al. Evaluation of women with possible appendicitis using technetium-99m leukocyte scan. *Am J Emerg Med* 1990;8:373-378.
105. Borgstein PJ, Gordijn RV, Eijsbouts QA, et al. Acute appendicitis—A clear-cut case in men, a guessing game in young women. A prospective study on the role of laparoscopy. *Surg Endosc* 1997;11:923-927.
106. Tamir IL, Bongrad FS, Klein SR. Acute appendicitis in the pregnant patient. *Am J Surg* 1990;160:571-575.
107. Cunningham FG, McCubbin JG. Appendicitis complicating pregnancy. *Obstet Gynecol* 1975;45:415-420.
108. Babaknia A, Parsa H, Woodruff JD. Appendicitis during pregnancy. *Obstet Gynecol* 1977;50:40-44.
109. Kammerer WA. Non-obstetric surgery during pregnancy. *Med Clin North Am* 1979;63:1157-1164.
110. Savrin RA, Clatworthy HW. Appendiceal rupture: A continuing diagnostic challenge. *Pediatrics* 1979;63:36-43.
111. Schorlemmer GR, Herbst CA. Perforated neonatal appendicitis. *South Med J* 1983;76:536-537.
112. Samuels GA. Appendicitis in children. *West Indian Med J* 1971;20:105.
113. Brickman ID, Leon W. Acute appendicitis in childhood. *Surgery* 1966;60:1083.
114. Foster JH, Edwards WH. Acute appendicitis in infancy and childhood: A twenty year study in a general hospital. *Ann Surg* 1957;146:70.
115. Horwitz JR, Gursoy M, Jaksic T, et al. Importance of diarrhea as a presenting symptom of appendicitis in very young children. *Am J*

Surg 1997;173:80-82.
116. Rothrock SG, Skeoch G, Rush JJ, et al. Clinical features of misdiagnosed appendicitis in children. *Ann Emerg Med* 1991;20:45-50.
117. Ramsden WH, Mannion RA, Simpkins KC, et al. Is the appendix where you think it is, and if not, does it matter? *Clin Radiol* 1993;47:100-103.
118. Hirsch SB, Wilder JR. Acute appendicitis in hospital patients aged over 60 years. 1974-1984. *Mt Sinai J Med* 1987;54:29-33.
119. Hall A, Wright TM. Acute appendicitis in the geriatric patient. *Ann Surg* 1978;44:147-150.
120. Andersson A, Bergdahi L. Acute appendicitis in patients over 60. *Ann Surg* 1978;44:445-447.
121. Burns RP, Cochran JL, Russell WL, et al. Appendicitis in mature patients. *Ann Surg* 1985;201:695-704.
122. Reiss R, Deutsch AA. Emergency abdominal procedures in patients above 70. *J Gerontol* 1985;40:154-158.
123. Telfer S, Fenyo G, Holt PR, et al. Acute abdominal pain in patients over 50 years of age. *Scand J Gastroenterol* 1988;144(sup):47-50.
124. Albano WA, Zielinski CM, Organ CH. Is appendicitis in the aged really different? *Geriatrics* 1975;30:81-88.
125. Thorbjarson B, Loehr WJ. Acute appendicitis in patients over the age of 60. *Surg Gynecol Obstet* 1967;125:1277-1280.
126. Hubbell DS, Barton WK, Solomon OD. Appendicitis in older people. *Surg Gynecol Obstet* 1960;110:289-292.
127. Hall A, Wright TM. Acute appendicitis in the geriatric patient. *Am Surg* 1978;44:147-150.
128. Visvanathan K, Jones PD, Truskett P. Abdominal mycobacterial infection mimicking acute appendicitis in an AIDS patient. *Aust N Z J Surg* 1993;63:558-560.
129. Chetty R, Slavin JL, Miller RA. Kaposi's sarcoma presenting as acute appendicitis in an HIV-1 positive patient. *Histopath* 1993;23:590-591.
130. Zebrowska G, Walsh NM. Human immunodeficiency virus-related Kaposi's sarcoma of the appendix and acute appendicitis. Report of a case and review of the literature. *Arch Pathol Lab Med* 1991;115:1157-1160.
131. Neumayer LA, Maker R, Ampel NM, et al. Cytomegalovirus appendicitis in a patient with HIV infection. *Arch Surg* 1993;128:467-468.
132. Livingston RA, Siberry GK, Paidas CN, et al. Appendicitis due to *Mycobacterium avium* complex in an adolescent infected with HIV. *Clin Infect Dis* 1995;20:1579-1580.
133. Stellato TA, Shank RR. Gastrointestinal emergencies in the oncology patient. *Semin Oncol* 1989;16:521-531.
134. Savioz D, Lironi A, Zurbuchen P, et al. Acute right iliac fossa pain in acquired immunodeficiency: a comparison between patients with and without acquired immune deficiency syndrome. *Br J Surg* 1996;83:644-666.
135. Binderow SR, Shaked AA. Acute appendicitis in patients with AIDS/HIV infection. *Am J Surg* 1991;162:9-12.
136. Rosser SB, Nazem A. Appendicitis in the pediatric age group. *J Natl Med Assoc* 1988;80:401-403.
137. Bauer T, Vennits B, Holm B, et al. Antibiotic prophylaxis in acute non-perforated appendicitis. The Danish multicenter study group III. *Ann Surg* 1989;209:307-311.
138. Antimicrobial prophylaxis in surgery. *Med Lett Drugs Ther* 1993;35:91-94.
139. Zoltie N, Cust MP. Analgesia in the acute abdomen. *Ann R Coll Surg Engl* 1986;68:209-210.
140. Attard AR, Corlett MJ, Kinder NJ, et al. Safety of early pain relief for acute abdominal pain. *BMJ* 1992;305:554-556.
141. Pace S, Burke TF. Intravenous morphine for early pain relief in patients with acute abdominal pain. *Acad Emerg Med* 1996;3: 1086- 1092.
142. LoVecchio F, Oster N, Sturmenn K, et al. The use of analgesics in patients with acute abdominal pain. *J Emerg Med* 1997;15:775-779.
143. Rusnak RA, Borer JM, Fastow JS. Misdiagnosis of acute appendicitis: Common features discovered in cases after litigation. *Am J of Emerg Med* 1994;12:397-402.
144. Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann Emerg Med* 1986;15:557-565.
145. Bartlett RH, Eraklis AT, Wilkinson RH. Appendicitis in infancy. *Surg Gynecol Obstet* 1970;130:99-105.
146. Brickman ID, Leon W. Acute appendicitis in childhood. *Pediatr Surg* 1960;5:1083-1089.
147. Putnam TC, Emmens RW. Appendicitis in children. S*urg Gyn Obstet* 1990;170:527-532.

Physician CME Questions

57. What percentage of the cases of appendicitis are seen in the 10-30 year age group?
    A. 10%
    B. 69%
    D. 25%
    D. 91%

58. "Classical" presentations of appendicitis are reported in what percentage of patients?
    A. 5-10%
    B. 29%
    C. 50-60%
    D. 85%

59. Which presenting sign or symptom is most likely to be seen in appendicitis?
    A. Anorexia with nausea and vomiting
    B. Migration of pain to the RLQ as time progresses
    C. Rebound abdominal tenderness
    D. RLQ tenderness on physical exam
    E. Low-grade temperature

60. Ultrasound findings consistent with acute appendicitis include all but which of the following?
    A. Dilated appendix lumen
    B. Presence of periappendiceal fluid
    C. A compressible appendix
    D. Greater than 6 mm outer wall to outer wall diameter

61. Which of the following is true concerning the WBC in appendicitis?
    A. The WBC may be normal in up to 20 - 45 % of elderly patients with appendicitis.
    B. A WBC over 15,000 cells/mm^3 means the patient has a perforation.
    C. During observation of a patient with suspected appendicitis, a rising WBC is diagnostic of appendicitis.
    D. If the patient has both a normal WBC and differential, then they do not have appendicitis.

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62. Features which can help differentiate PID from appendicitis include:
    A. cervical motion tenderness (CMT).
    B. elevated WBC.
    C. fever.
    D. RLQ pain or tenderness.
    E. duration of symptoms.

63. The most common misdiagnosis of appendicitis is:
    A. PID.
    B. bowel obstruction.
    C. AGE.
    D. ovarian cyst rupture.

64. Which of the following is commonly found in litigation for failure to diagnose appendicitis?
    A. Documentation of a rectal exam or pelvic exam
    B. Documentation of adequate follow-up instructions
    C. Documentation of serial abdominal exams
    D. Discharge diagnosis of gastroenteritis

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