

# Emergency Medicine Reports

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*Women of childbearing age can present with a wide variety of abdominal disorders, some of which are of only minor concern and others that are potentially life-threatening. Patients who appear*

*stable and do not have pain—or have only vague, nonspecific, non-localizing pain—can have true surgical emergencies as their underlying pathology.*

*The risk of litigation remains high for missed appendicitis and ectopic pregnancies. Often, women who present to the emergency department (ED) with abdominal pain are found to be pregnant. Most emergency medicine physicians, as well as some gynecologists, have difficulty appreciating adnexal or ovarian masses on pelvic examination. More importantly, a nonspecific finding such as adnexal tenderness can be a manifestation of any pelvic or abdominal abnormality.*

*This issue presents an efficient algorithmic approach to the female patient with right lower quadrant (RLQ) abdominal pain. This approach is designed to enable the physician to make expeditious distinctions between surgical and nonsurgical entities. Laboratory tests that may aid in decision making can be*

*completed prior to the physical assessment. Unstable patients can be resuscitated by the ED staff working in tandem with surgical specialists. Stable, nonsurgical patients can be evaluated thor-*

*oughly, treated, and discharged.*

*Gynecologic, urologic, and gastrointestinal abnormalities are discussed in this article. Use of urinalysis and beta-human chorionic gonadotropin testing is reviewed. Recent trends in ultrasound and the choice between noncontrast and contrast computed tomography (CT) are discussed. Admission criteria, appropriate treatment regimens, and discharge are described.*

— The Editor

## Right Lower Quadrant Abdominal Pain in Women of Reproductive Age: An Algorithmic Approach

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## Introduction

Abdominal pain accounts for 4-10% of all ED visits.<sup>1-3</sup> It also is one of the most difficult presentations to assess; in up to 40% of patients with this complaint, no diagnosis is ever made.<sup>1</sup> In women of childbearing age, the cause of abdominal pain in the RLQ can be especially difficult to discern. The causes range from the life-threatening to the benign. (See Table 1.) The algorithm introduced in this paper can be used to narrow the differential diagnosis. (See Figure 1.)

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## History

The key to an efficient and accurate diagnosis is a detailed and thorough history. The following information should be obtained:

- Onset, location, radiation, and duration of pain;
- Aggravating or relieving factors;
- Severity of pain (constant or intermittent);
- Characteristics of the pain;
- History of the pain;
- Association with nausea, vomiting, anorexia, or diarrhea;
- Time of last bowel movement; and
- Recent use of analgesics, narcotics, or antibiotics.

In women of reproductive age, it especially is important to ask about urinary symptoms, the date of the last menstrual period (LMP), the presence of vaginal discharge, obstetric/gynecologic and sexual history (in detail), previous pelvic infections, birth

## Table 1. Differential Diagnosis of Right Lower Quadrant Abdominal Pain in Women of Reproductive Age

- Ectopic pregnancy
- Adnexal torsion
- Appendicitis
- Pelvic inflammatory disease
- Urinary tract infection (UTI) and pyelonephritis
- Kidney stones
- Ovarian cysts
- Endometriosis
- Uterine fibroids

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## Physical Examination

A complete physical examination is warranted in every patient, but in women of childbearing age with the chief complaint of RLQ abdominal pain, certain areas should receive particularly close attention. A complete set of vital signs includes orthostatics to determine if the patient is volume depleted and assessment of fetal heart tones if the patient is known to be more than 10 weeks pregnant. After the cardiopulmonary status is evaluated and deemed stable, a thorough and complete abdominal examination is essential and should include inspection for masses, scars, or distention. Next, the abdomen should be auscultated for bowel sounds and bruits. Percussion and palpation should follow. The physician should begin by palpating away from the area that is painful and working toward the area that is most tender.

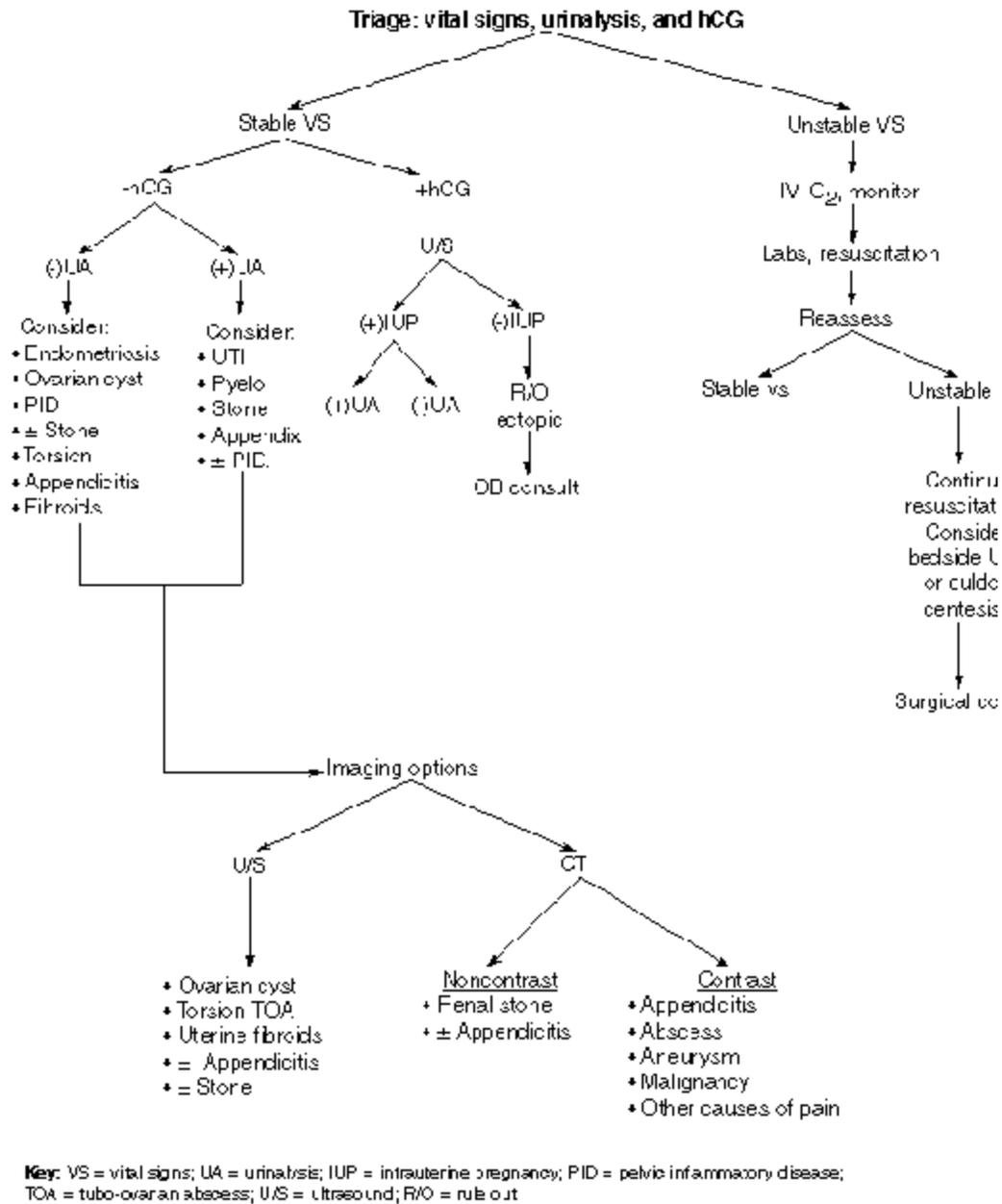
It also is important to palpate for any masses, organomegaly, rebound, or guarding. Equally important in this population is a detailed pelvic examination, which allows identification of external lesions, vaginal discharge, cervicitis, cervical motion tenderness, uterine size and tenderness, and adnexal masses or tenderness. Unfortunately, even under ideal conditions, with examinations performed under general anesthesia, the sensitivity of the bimanual examination is low for detection of adnexal masses, even by gynecologists.<sup>4</sup> A rectal exam should be considered, and the presence of pain, masses, or blood should be documented.

## Laboratory Tests

Since many women of childbearing age with abdominal pain are pregnant, it is imperative to diagnose or rule out pregnancy.<sup>1</sup> Two mandatory tests—a urine pregnancy test and urinalysis—can narrow the differential diagnosis and help direct the remainder of the patient workup. A standard urine pregnancy test can be completed in fewer than five minutes, so the result often is available by the time the patient is examined by the emergency physician. Urine pregnancy tests are reliable and allow diagnosis of pregnancy within six days after conception.<sup>5</sup> Qualitative urine pregnancy

control method, and use of fertility drugs. As with any patient, it is important to obtain a medical and surgical history, to ask about use of medications and about allergies, and to inquire specifically about previous abdominal surgery.

**Figure 1. Algorithm Differential Diagnosis of RLQ Abdominal Pain in Women of Reproductive Age**



tests are positive when intact human chorionic gonadotropin (hCG) exceeds 25 IU/L.<sup>5</sup> A urine sample should be sent for chemical screening (dipstick) as well as microscopic analysis.

A complete blood count (CBC) also commonly is done in women with lower abdominal pain. A CBC can be useful to check for significant blood loss, which is represented by low hemoglobin and hematocrit levels. It is important to remember, however, that if the blood loss is acute, the CBC may not yet be representative of the true hematocrit value. The white blood cell (WBC) count is neither sensitive nor specific for identifying the etiology of the abdominal pain, and the result rarely affects clinical decisions.<sup>1,6,7</sup> Specific testing is discussed in detail under each topic listed.

### Analgesia

Treatment should be individualized according to the presumed cause of the pain. In every case, however, early and adequate analgesia should be given.<sup>2</sup> In the past, pain medications often were withheld in the mistaken belief that they would interfere with the physical examination and mask the diagnosis. Early administration of opiates is both safe and effective for patients with acute abdominal pain and actually facilitates the diagnosis.<sup>8</sup> It allows the patient to relax, decreases voluntary guarding, and helps the examiner localize the area of maximum tenderness.<sup>8</sup> Another advantage to using opiates for pain control is that they can be titrated to effect and easily reversed with naloxone hydrochloride (Narcan) if necessary.

**Table 2. Risk Factors for Ectopic Pregnancy**

**STRONGLY ASSOCIATED**

- Previous ectopic pregnancy
- Diethylstilbestrol (DES) exposure
- Intrauterine device
- Prior tubal surgery
- Documented peritubal adhesions

**MODERATELY ASSOCIATED**

- Pelvic inflammatory disease
- Multiple induced abortions
- Smoking

**SLIGHTLY ASSOCIATED**

- Pelvic or abdominal surgery
- Vaginal douching
- First sexual intercourse before age 18

Adapted from: Ankum WM, et al. Risk factors for ectopic pregnancy: A meta-analysis. *Fertil Steril* 1996;65:1093-1099. (Web: <http://www.jr2.ox.ac.uk/bandolier/booth/hliving/Ectopreg.html>. Accessed 12/12/2001.)

**Differential Diagnosis**

**Ectopic Pregnancy.** The implantation of a fetus anywhere outside the uterine endometrium is considered an ectopic pregnancy.<sup>9</sup> In 85-90% of cases, the implant is in the distal ampullary region of the fallopian tube.<sup>5,10</sup> Sites of possible implantation also include other parts of the fallopian tubes, the uterine cervix, the ovary, and the peritoneal cavity.

The incidence of ectopic pregnancy has increased steadily over the past 30 years, from 4.5 per 1000 pregnancies in the 1970s to 19.7 per 1000 in the early 1990s, which is equivalent to more than 100,000 cases per year in the United States.<sup>11-14</sup> After a woman has had one ectopic pregnancy, her risk of having another is 7-15%. Early diagnosis is essential, and prompt treatment can greatly decrease a woman's morbidity and mortality risk as well as increase her chances of future successful pregnancies.<sup>15</sup>

The multiple risk factors for ectopic pregnancies are listed in Table 2.<sup>2,9,10,12,14-16</sup>

**Clinical Presentation.** Ectopic pregnancy can present in a variety of ways, from the asymptomatic to the surgical abdomen.<sup>17</sup> The ectopic pregnancy can be an incidental finding, or the patient may experience vaginal bleeding, irregular menses, amenorrhea, and/or abdominal or pelvic pain.<sup>2,9,10,15,16</sup> The pain may be constant or crampy.<sup>9</sup> The woman's only complaint may be syncope; therefore, ectopic pregnancy should be considered in the differential diagnosis when a woman of reproductive age presents with this complaint.<sup>2</sup>

When abnormal physical findings are present, common findings on the physical examination are orthostasis, lower abdominal and adnexal tenderness (90%), an adnexal mass (60%), and cervical motion tenderness.<sup>10,13</sup> Unfortunately, up to 4% of women with hemoperitoneum due to a ruptured ectopic pregnancy have no pain, although many will have other symptoms that will bring them to the ED.<sup>13</sup> If rupture has occurred, the patient may have

abdominal distention, guarding, and rebound tenderness;<sup>10</sup> hemorrhagic shock may ensue.

**Diagnosis.** Regardless of history and physical findings, ectopic pregnancy needs to be considered in every woman in the ED who presents in her first 20 weeks of pregnancy. Transvaginal ultrasonography and quantitative measurement of the serum hCG level have become the standard of care in the workup of ectopic pregnancy. A woman with a positive urine hCG test should not be diagnosed merely as having early pregnancy and be discharged without further testing. Abnormal pregnancies usually are associated with abnormally low hCG levels.<sup>18</sup> Normally, the serum level of beta-hCG should double every 2.3 days, although this number is not absolute.<sup>16</sup> Up to 10% of normal pregnancies will have abnormal doubling times, and up to 15% of ectopic pregnancies will have normal times.<sup>19</sup> Generally, however, the absence of this doubling time on repeat beta-hCG measurements or a leveling off of the serum concentration is highly suggestive of either an ectopic pregnancy or an abnormal intrauterine pregnancy (IUP), which will abort spontaneously in 85-95% of cases.<sup>9,16,18</sup>

The diagnosis of ectopic pregnancy has been improved greatly by high-resolution transvaginal ultrasound, which can detect a gestational sac 5-6 weeks after the patient's last menstrual period.<sup>16,20</sup> The endovaginal probe allows for a more detailed evaluation of the endometrium, endometrial canal, and adnexa.<sup>21</sup> Different types of sonographic techniques and equipment have different hCG threshold levels or discriminatory zones above which gestational sacs are large enough to be seen on ultrasound. The threshold for a trans-abdominal ultrasound is greater than 1800 mIU/mL, and 500-1000 mIU/mL for endovaginal ultrasound.<sup>21</sup> Sonographic indications of ectopic pregnancy include an empty uterus, a solid or cystic mass with free fluid in the cul-de-sac, the appearance of a gestational sac in the tube, or a pseudogestational sac in the uterus.<sup>18,21</sup> Findings that do not support ectopic pregnancy include a live IUP or the intradecidual sign and double decidual sign of an early IUP. These two signs can be used to identify an IUP before visualization of the yolk sac.<sup>21</sup> The double decidual sign needs to be distinguished from the pseudogestational sac of an ectopic pregnancy. The pseudogestational sac is an intrauterine fluid collection surrounded by a single decidual layer.<sup>21</sup> A normal gestational sac is covered by the decidual capsularis and embedded within the decidual parietalis, giving the "double decidual sign."<sup>14</sup> Endovaginal ultrasound provides better differentiation of the pseudogestational sac vs. the double decidual sign of early pregnancy. Misinterpretation of these early ultrasound findings is one of the most common causes of the misdiagnosis of ectopic pregnancy.<sup>21</sup> (See Table 3.)

It previously has been assumed that the detection of a viable IUP by ultrasound essentially excludes an ectopic pregnancy. This was based on the reported incidence of a combined ectopic and uterine (heterotopic) pregnancy at 1:30,000.<sup>18,22</sup> This value, however, was calculated in the 1940s. The incidence of both ectopic pregnancy and heterotopic pregnancies has increased greatly in past decades as a consequence of the increased use of ovulation-inducing agents and the increased incidence of pelvic inflammatory disease (PID).<sup>12,18</sup> Recent estimates of heterotopic pregnan-

**Table 3. Risk Factors Associated with Delayed or Missed Diagnoses of Ectopic Pregnancy**

- Absence of abdominal pain; atypical pain
- Absence of adnexal mass on physical examination
- Negative aspiration on culdocentesis
- Nondiagnostic ultrasound
- Misinterpretation of sonographic image
- Falling hCG level

cies range from 1:4000-7000 in the general population to 1:100, or 1%, in the assisted-reproduction population.<sup>12,18,21-23</sup>

Although not readily available in every ED, determination of the patient's progesterone level also can aid in the diagnosis or exclusion of ectopic pregnancy. The serum progesterone levels reflect the production of progesterone by the corpus luteum, which is stimulated by a viable pregnancy.<sup>14</sup> Low serum progesterone levels (< 5 ng/mL) have been associated with ectopic pregnancy or impending abortion and require immediate evaluation by a gynecologic consultant.<sup>14,15,18</sup> A level of 25 ng/dL or higher defines normal pregnancy and obviates further testing.<sup>1,9,14,24</sup> With levels between 5 ng/dL and 25 ng/dL, further evaluation by ultrasound is required.

If the patient is unstable and an ectopic pregnancy is suspected, and if bedside ultrasonography is not available, culdocentesis can be done to check for intraperitoneal hemorrhage. In this procedure, the rectovaginal cul-de-sac is aspirated with a needle inserted through the posterior fornix of the vagina.<sup>13</sup> If the aspiration is dry, it has no diagnostic value. If clear, non-bloody fluid is aspirated, it is considered a negative test.<sup>13,16</sup> If non-clotting blood is aspirated, the tap is positive. A culdocentesis can be falsely negative if the bleeding is rapid and the intraperitoneal blood clots.<sup>17</sup> False positives can occur due to technical errors, such as hitting a vascular structure with the needle, or the bleeding could be to the result of the rupture of a leuteum cyst.<sup>17</sup>

**Treatment.** If ectopic pregnancy is diagnosed, an intravenous line should be established; a blood sample should be sent for CBC, type, and screen; and an obstetric/gynecologic consult should be obtained immediately.<sup>2</sup> Unstable patients need fluid resuscitation and may require emergent transfusion before surgical intervention by the consultant. If the patient is stable, the focus of treatment should be on preservation of fertility.<sup>16</sup>

Nonsurgical treatment is administration of methotrexate, a chemotherapeutic agent that is 95% successful in the treatment of ectopic pregnancy.<sup>18</sup> It is a folic acid antagonist that inhibits the spontaneous synthesis of purines and pyrimidines, thus interfering with DNA synthesis and cell multiplication.<sup>24</sup> The decision to use methotrexate must be made in consultation with a gynecologist. The drug can be given to women who are hemodynamically stable, if the ectopic pregnancy has not ruptured and the fetus is smaller than 4 cm when measured by ultrasound, no fetal cardiac activity is detected, and the serum hCG level is lower than 3500.<sup>9,18</sup> The 5% failure rate has been associated with advanced gestation and hCG concentration of greater than 5000.<sup>11</sup>

Methotrexate is given in four doses of 1 mg/kg IM or IV on four alternating days (days 1, 3, 5, and 7), with 0.1 mg/kg of leucovorin given on intervening days.<sup>18</sup> The most common side effect of methotrexate therapy is increased abdominal pain,<sup>25</sup> presumably caused by either tubal abortion or stretching of the tube by hematomas. The pain usually is self-limited and should be treated by administration of nonsteroidal anti-inflammatory drugs (NSAIDs) every six hours.<sup>25</sup> If sufficient doses of NSAIDs do not relieve the pain, the patient should be reevaluated. High-dose methotrexate also can cause bone marrow suppression, hepatotoxicity, pulmonary fibrosis, alopecia, and photosensitivity.<sup>25</sup> These side effects are extremely rare in the doses required for treatment of ectopic pregnancy, and the risk is further lessened by the use of leucovorin.<sup>25</sup> Patients who receive methotrexate should be monitored with weekly beta-hCG measurements until the level is undetectable.<sup>26</sup> If any of the criteria for methotrexate therapy listed above are not met, or if the patient is unstable, surgery is required.

**Adnexal Torsion.** Adnexal torsion occurs when an ovary or a fallopian tube twists on its pedicle, cutting off blood supply. It is a true gynecologic emergency, requiring immediate surgical intervention. Conservation of the tube and ovary and preservation of fertility are the goals. With early diagnosis and treatment, it may be possible to untwist the pedicle and save the organ.<sup>27</sup>

Ovarian torsion can occur at any age, but is seen primarily in females of reproductive age. The average age is 26; 70-75% of cases occur in women younger than 30 years of age.<sup>28-30</sup> Twenty percent of cases occur in pregnant women. It generally is unilateral, occurring more frequently on the right side than on the left.<sup>30-33</sup>

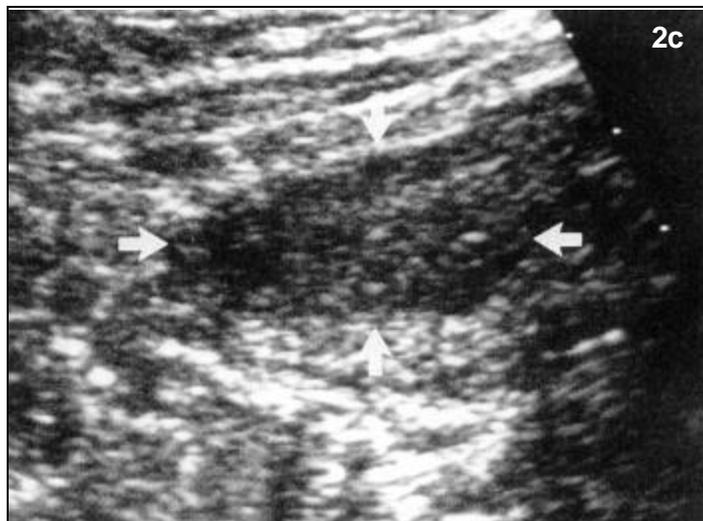
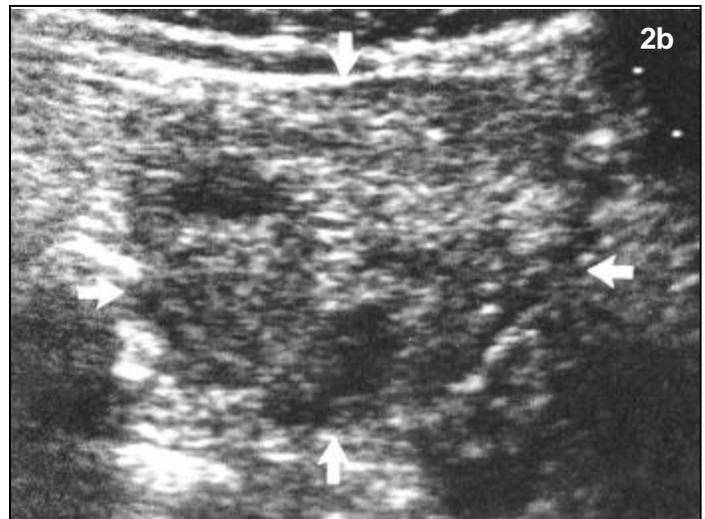
The onset of pain usually is sudden, corresponding to occlusion of the vascular supply to the torted organ. Initially, the venous and lymphatic circulation is compromised, which leads to edema, hemorrhage, and enlargement of the adnexa. If this persists, the arterial circulation becomes occluded. Once the arterial supply is cut off, ischemic infarction and necrosis ensue.<sup>28,33,34</sup> If left untreated, it can progress to infection, peritonitis, sepsis, and ultimately, death.<sup>29,33,35</sup> The ovary will remain viable for only six hours from the moment torsion occurs. Time is fertility.<sup>29</sup>

Torsion can occur in normal adnexa, but more than 95% of cases are associated with adnexa enlarged by pathologic processes such as tumors and cysts.<sup>28,33,34</sup> The most common growth associated with torsion is a benign cystic teratoma, present in 3.5-16% of cases.<sup>27,31,35</sup> Risk factors include increased weight of the ovary, ovarian cysts larger than 4 cm, congenitally malformed tubes, excessive tortuosity of veins, and ovarian tumors.<sup>29</sup>

**Clinical Presentation.** The woman usually presents complaining of acute onset of lower abdominal pain that radiates to the back, pelvis, and thigh.<sup>29</sup> Pain often is preceded by strenuous activity such as exercise, intercourse, or straining.<sup>29</sup> The pain is constant and unilateral, localizes immediately, and often is associated with nausea and vomiting.<sup>28-30</sup> About 10% of patients report a history of similar episodes in the past, suggesting previous torsion and detorsion.<sup>28-30,33</sup>

The patient may have tachycardia due to pain or, if presentation is delayed, fever and dehydration.<sup>29</sup> The abdominal examination will show unilateral tenderness and decreased bowel sounds.

## Figures 2 a-c. Ovarian Torsion



**2a.** Transabdominal sagittal scan in 16-year-old girl presenting with acute, left-side, lower abdominal pain shows a large adnexal mass containing multiple peripheral anechoic follicles (see arrows). Note: B, Bladder.

**2b.** Transabdominal scan in a patient with 28-week twin pregnancy presenting with acute right lower abdominal pain shows markedly enlarged right ovary (see arrows) with a few peripheral anechoic follicles. Doppler showed no flow.

**2c.** Normal left ovary (see arrows) of patient in 2b.

Figures reprinted with permission from: Salem S. The uterus and adnexa. In: Rumack CM, Wilson SR, Charboneau JW, eds. *Diagnostic Ultrasound*, 2nd ed. St. Louis: Mosby; 1998: 551.

Common findings on the pelvic examination are adnexal tenderness,<sup>2,28,29</sup> a unilateral tender adnexal mass (in 50-80% of cases), and cervical motion tenderness (the same signs and symptoms of ectopic pregnancy). Unfortunately, these physical findings are nonspecific and difficult to differentiate from cases of ectopic pregnancy, tubo-ovarian abscess (TOA), or appendicitis, and necessitate further testing and imaging.

**Diagnosis.** The most sensitive imaging technique to date for diagnosis is color flow Doppler ultrasound.<sup>1,28</sup> On ultrasound, an ovarian mass often can be visualized and may be cystic, solid, or mixed; the color Doppler determines whether there is circulatory flow to the adnexa. (See Figure 2.) Large ovarian cysts have poor vascularity at baseline, making color flow Doppler less than 100% sensitive. The hCG level always should be measured, not only to rule out an ectopic pregnancy as the cause of the pain, but also because 20% of cases of torsion occur in pregnant women.

**Treatment.** ED treatment should include stabilization, pain control, antiemetics, and immediate gynecologic consult.<sup>2,29</sup> Prompt laparoscopy is essential, as the tissue only remains viable for up to six hours. The procedure also allows interventions that

help decrease the incidence and severity of complications.<sup>28,33</sup> (See Table 4.) If a teratoma is present, the treatment usually is ovarian cystectomy, with preservation of ovarian tissue, if possible.<sup>36</sup>

**Appendicitis.** Appendicitis is the most common non-traumatic abdominal surgical emergency.<sup>37</sup> The lifetime risk of appendicitis is 6-7%. More than 200,000 cases of appendicitis occur each year in the United States.<sup>37-41</sup> The incidence is 1.1 in 1000 per year and peaks in early adulthood.<sup>38-41</sup> Mortality due to complications is 0.2-0.8%, with the highest numbers in patients with comorbid conditions.<sup>39</sup> It remains an extremely difficult entity to diagnose (especially in women of childbearing age), and failure to do so remains a leading cause of litigation against emergency physicians.<sup>7</sup> In the general population, a normal appendix is removed in 15-20% of appendectomies performed for suspected appendicitis, and this number increases to 35-45% in women of reproductive age, mostly because of the prevalence of PID and other gynecologic disorders in this population.<sup>7,35,37,38,42,43</sup> On the other hand, patients who have appendicitis are misdiagnosed in about 33% of cases; these patients mistakenly are believed to have gastroenteritis, PID, or a urinary tract infection (UTI).<sup>7,37,39</sup> Women with

**Table 4. Complications of Adnexal Torsion**

- |               |                |
|---------------|----------------|
| • Infertility | • Sepsis       |
| • Infection   | • Adhesions    |
| • Peritonitis | • Chronic pain |

appendicitis often present more atypically than men, with diffuse lower abdominal pain, and they have a higher incidence of abnormal pelvic examination findings.<sup>37</sup> Appendicitis is especially difficult to diagnose in pregnant women, because the location of the appendix changes as the size of the uterus increases. Because of these difficulties, female patients have an increased incidence of perforation and other complications.<sup>37</sup>

The appendix is a 10-cm, blind-ended pouch that arises from the posterior medial wall of the cecum. Its position in the abdominal cavity is variable and greatly influences clinical signs.<sup>7,38</sup> The appendix contains a large number of lymphoid follicles, and it secretes about 5-6 mL of mucus per day, which empties into the cecum. Acute appendicitis begins with obstruction of the appendiceal lumen.<sup>7,38,39,41,44</sup> The cause of luminal obstruction is most commonly fecaliths, lymphoid follicle hyperplasia, foreign bodies, tumors, or calculi.<sup>38,39</sup> Obstruction leads to an increase in intraluminal pressure and eventual obstruction of venous and lymphatic drainage. The epithelial mucosa begins to break down and bacterial invasion occurs. This progresses until arterial flow is compromised, and if left untreated, gangrene and perforation with peritonitis and abscess formation will occur.<sup>7,38,39,41</sup> The initial appendiceal distention is received by visceral afferent pain fibers, which are vague and poorly localized in the periumbilical (T10) region. As the inflammation progresses, somatic pain fibers are activated and usually localize the pain to the RLQ, although the site can vary with the location of the appendix.<sup>41</sup>

*Clinical Presentation.* The presentation of appendicitis is notoriously inconsistent, adding to the difficulty of diagnosis. Only about 50% of patients present with the “classic” history of anorexia, periumbilical abdominal pain followed by nausea and vomiting, and then migration of pain to the RLQ.<sup>39</sup> Vomiting, when present, almost always follows the onset of pain,<sup>45</sup> and this is an important sequence to ascertain by asking the patient.<sup>7,38,39</sup> Twenty-three percent of patients report a previous history of similar pain.<sup>7,39</sup> If the appendix lies near the bladder or ureter, the patient may report urinary symptoms.<sup>39,41</sup> Fever and chills are present in 10-20% of patients, and 5-10% have either diarrhea or constipation.<sup>40</sup>

Most patients with appendicitis have RLQ tenderness, most commonly at McBurney’s point, which lies 5 cm from the anterior superior iliac spine on an imaginary line drawn from the umbilicus.<sup>1,38,40</sup> Other common findings include rebound tenderness, rigidity, guarding, rectal tenderness, and fever. Several other physical signs for which every intern is taught to check are rare. Rovsing’s sign—pain elicited in the RLQ by palpation of the left lower quadrant—is found in 5% of cases.<sup>38,40</sup> The obturator sign—pain when passively flexing the right hip and knee and internally rotating the leg at the hip—is seen in 5-8% of cases.<sup>38,40</sup> The psoas sign is an increase in abdominal pain when the patient,

while lying supine, lifts his or her thigh as pressure is applied at the knee; it is found in 3-5% of cases.<sup>38,40</sup> On pelvic examination, most women with appendicitis have nonspecific findings of cervical motion tenderness and right adnexal tenderness (as is evident in patients with other causes of RLQ pain).<sup>2</sup>

*Diagnosis.* In males, a diagnosis of appendicitis usually can be based on the history and physical examination alone. In females, further imaging studies are required to rule out a gynecologic/urologic cause prior to consulting a general surgeon. (See Figure 1.)

Appendicitis remains the most common extrauterine surgical emergency encountered in pregnancy.<sup>7</sup> It may be difficult to diagnose, not only because the appendix may be displaced by the gravid uterus, but also because nausea and vomiting may be mistakenly attributed to pregnancy.<sup>41</sup> The imaging studies of choice in the pregnant woman should start with ultrasound.

If the appendix lies in a retrocecal position near the bladder or ureter, both red and white blood cells may appear in the urine. Bacteriuria is seen in 15% of patients.<sup>7,39,46</sup> Urinalysis is abnormal in 20-40% of patients with appendicitis, and this number rises to 50% when the appendix has ruptured.<sup>1,41,47</sup>

The surgeon will ask for the results of the CBC, but the WBC count is unreliable and will add little to diagnostic decision making.<sup>7,41</sup> In 85-90% of cases, the patient has a WBC count greater than 10,000 cells/mm<sup>3</sup>; in other words, 10-15% of patients will have a normal WBC count.<sup>1,7,40</sup> However, an increase in the percentage of neutrophils or bands (“left shift”) with a normal WBC count is more supportive of the clinical diagnosis of appendicitis.<sup>48</sup>

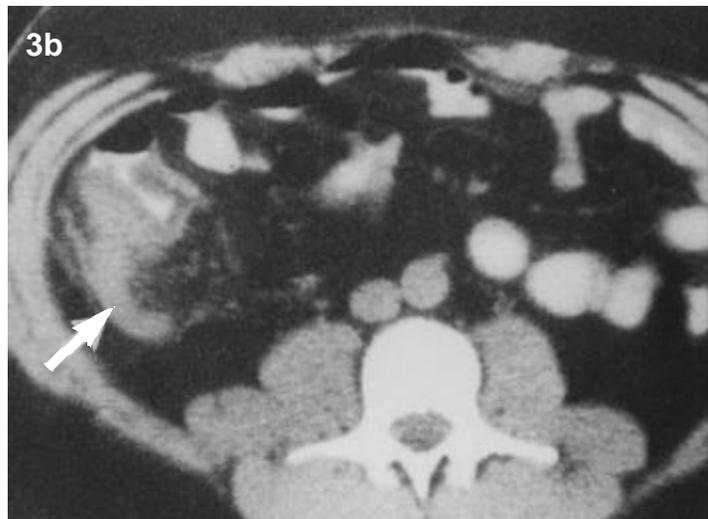
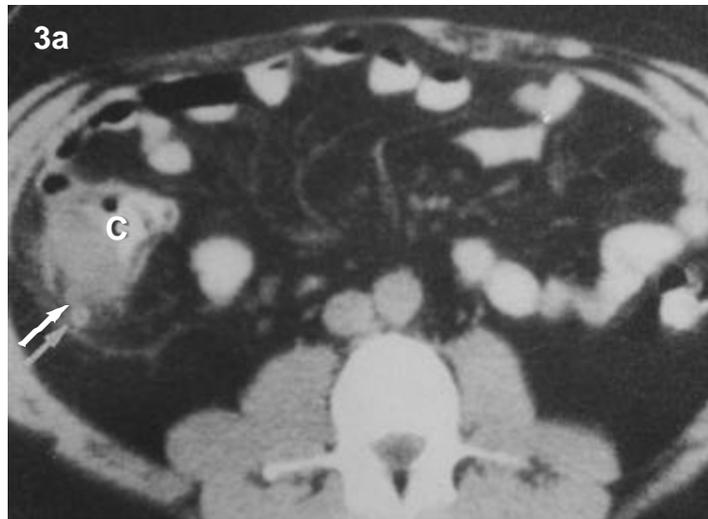
A C-reactive protein (CRP) is an acute-phase reactant synthesized by the liver in response to infection.<sup>39</sup> An absolute elevation in the CRP, or an increase of 1 mg/dL when the CRP is rechecked in a few hours, suggests appendicitis.<sup>1,7</sup> When viewed together, an elevated CRP level, a WBC count greater than 10, and bandemia markedly increase the sensitivity of diagnosis.<sup>7,40</sup>

A plain frontal supine radiograph of the abdomen (kidney/ureter/bladder [KUB] film) is neither sensitive nor specific and is rarely helpful, as only a small percentage will show a calcified appendicolith.<sup>1,38-40</sup> This film may be useful to rule out the presence of obstruction or free air.<sup>41</sup>

Abdominal ultrasound has a sensitivity in adults of 80-90% and a specificity of 90-100% for appendicitis.<sup>37,39-41</sup> Diagnostic findings of appendicitis on ultrasound include visualization of a noncompressible appendix that is greater than 6-7 mm in diameter with a dilated lumen, periappendiceal fluid, and lack of peristalsis.<sup>40,41</sup> Advantages of ultrasound are that it is noninvasive, uses no radiation, and can suggest an alternate diagnosis if negative for appendicitis (i.e., gallstones, ectopic pregnancy). It remains the diagnostic test of choice in pregnant women because of the lack of radiation. The primary disadvantage of ultrasound is that the accuracy of the test depends on visualization of the appendix. The appendix often is not seen secondary to bowel gas and the patient’s body habitus. Other disadvantages include lack of availability in some institutions, the quality of the examination is operator-dependent, and it can be a very painful examination for the patient.<sup>7,37,39</sup>

Helical CT scan has become the test of choice in many institutions. When triple contrast is used, sensitivities are 97-100%,

**Figures 3 a-b. Uncomplicated Appendicitis**



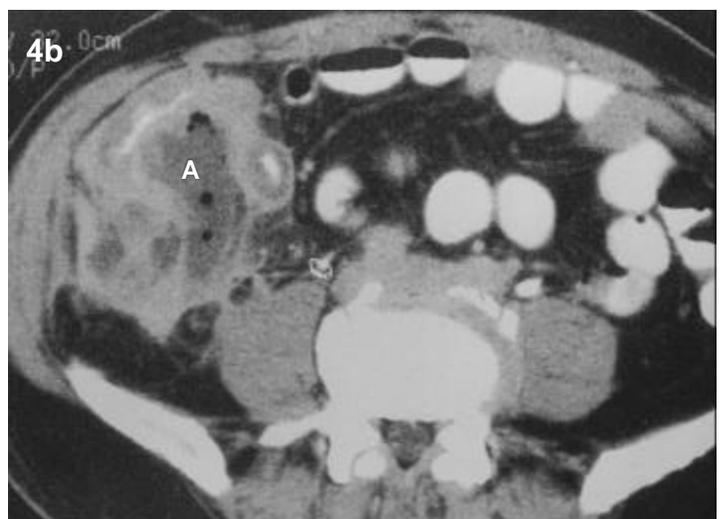
3a. Thickened and inflamed wall of the cecum narrows the cecal lumen (C). The arrow points to an appendolith at the junction of the appendix and cecum.

3b. A slightly lower-level scan shows the dilated appendix (see arrow) and the surrounding inflammatory change in the pericolic fat. There is no evidence of perforation.

Adapted from: Salem S. The uterus and adnexa. In: Rumack CM, Wilson SR, Charboneau JW, eds. *Diagnostic Ultrasound*, 2nd ed. St. Louis: Mosby; 1998: 551.

with specificity of 95%.<sup>39-41,49</sup> Comparable sensitivity and specificity have been achieved with unenhanced CT, a modality that decreases the time needed for diagnostic studies and allows surgical treatment to begin more quickly.<sup>50,51</sup> The CT scan is read as positive if a thickened appendix (> 6 mm) is visualized, there is secondary peri-appendiceal inflammatory changes, or an abscess or fluid collection is seen.<sup>7,41,49</sup> (See *Figures 3 and 4.*) CT scanning also can facilitate the identification of alternative surgical diagnoses (e.g., abdominal aneurysms).<sup>52</sup>

**Figures 4 a-b. Perforated Appendicitis and Abscess Formation**



4a. The cecum (C) is markedly distorted, with a thickened and inflamed wall. Just behind the cecum is an abscess (A) containing lower-density pus and collections of gas (shown as small black bubbles). Note the extensive inflammatory change in the surrounding mesenteric sac. The appendix is not well seen.

4b. Scan taken at slightly lower level. More of the abscess (A) and surrounding inflammatory change can be seen.

Adapted from: Novelline RA. *Squire's Fundamentals of Radiology*, 5th ed. Cambridge, MA: Harvard University Press; 1999: 295.

*Treatment.* Intravenous antibiotics that cover gram-negative aerobes and anaerobes are indicated in patients with acute appendicitis and should be given peri-operatively in consult with the surgeon.<sup>53,54</sup> Early pain medication should be given. If suspicion of appendicitis is high based on the history and physical examination alone, then an immediate surgical consult should be obtained. If suspicion is low or moderate, the workup should include a CT scan or an ultrasound, serial abdominal examinations, and a surgery consult.<sup>40</sup> Patients whose pain resolves in the ED, and who have a negative workup for other causes, may be discharged, to

return for a recheck in 8-12 hours. Strict and explicit precautions need to be given to every patient discharged without a clear diagnosis.

**Pelvic Inflammatory Disease.** PID is an infection of the uterus, fallopian tubes, and adjacent pelvic structures.<sup>53,55,56</sup> It is a diagnosis that should be considered in every female of reproductive age who presents with lower abdominal or pelvic pain.

PID is the single most frequent serious infection of women in the United States. More than 1 million cases occur each year, affecting 10-20 per 1000 women of reproductive age,<sup>53,55-57</sup> and requiring more than 250,000 hospitalizations. The average annual cost of treatment exceeds \$10 billion.<sup>28</sup>

PID results from an ascending spread of organisms from the cervix and vagina.<sup>53,57</sup> Gonorrhea and/or chlamydia cause more than 50% of cases.<sup>5,53,56</sup> Among the many pathogens, *Chlamydia trachomatis* is most invasive and can cause severe structural damage to the fallopian tube; unfortunately, many women with this type of infection may be asymptomatic. Other bacteria that can cause PID include *Bacteroides*, *Peptostreptococcus*, *Gardnerella vaginalis*, *Escherichia coli*, *Haemophilus influenzae*, *Mycoplasma*, and *Ureaplasma*. Mixed infections account for about 70% of cases.<sup>28,53,55,57,58</sup> If the patient uses an intrauterine device (IUD), the infection might be caused by *Actinomyces israelii*.<sup>10,55</sup>

Risk factors for PID include multiple sex partners, a history of sexually transmitted diseases (STDs), frequent douching, smoking, and young age (> 75% of cases are in women < 25 years old).<sup>28,53,56,57</sup> IUDs are associated with a two- to four-fold increased risk of PID. Menses, sex, or strenuous activity may exacerbate acute PID, possibly because of the breakdown of the antibacterial barrier of the cervical mucus, which allows bacteria from the cervix and vagina to ascend to the upper genital tract.<sup>10</sup> Although pregnancy is protective against acquiring a new infection, PID can be present before pregnancy occurs and increases the risk of fetal loss.<sup>57</sup>

**Clinical Presentation.** A detailed sexual and gynecologic history should be obtained; most patients report a history of STDs.<sup>28,59</sup> Patients usually complain of lower abdominal or pelvic pain, abnormal vaginal discharge, abnormal vaginal bleeding, dysuria, and dyspareunia. PID often is associated with nausea, vomiting, and fever. Symptoms usually begin during the first half of the menstrual cycle.<sup>2,10,34,55-57,59</sup>

A classic triad of PID is present in up to 90% of cases: cervical motion tenderness, lower abdominal tenderness, and adnexal tenderness.<sup>56</sup> On speculum examination, a purulent discharge from the cervical os is seen in approximately 95% of women with PID.<sup>1,2</sup> Vital signs may indicate the presence of fever, tachycardia, and orthostasis.

**Diagnosis.** For every patient assessed for PID, urinalysis, urine pregnancy test, wet prep, and cervical cultures should be done.<sup>10,55,57</sup> The gold standard for diagnosis is laparoscopy, although this is not practical, and the diagnosis usually is made clinically.<sup>56</sup> The emergency physician needs to maintain a high index of suspicion and a low threshold for treatment.<sup>53</sup> The diagnosis is made if the patient meets all three major criteria and at least one minor criterion.<sup>28,53,55,57</sup> (See Table 5.) If an adnexal mass

## Table 5. Diagnostic Criteria for Pelvic Inflammatory Disease

### MAJOR CRITERIA

- Cervical motion tenderness
- Lower abdominal tenderness
- Adnexal tenderness

### MINOR CRITERIA

- Temperature > 38°C
- White blood cell count > 10.5
- Erythrocyte sedimentation rate > 15
- Gram stain of vaginal discharge positive for gram-negative diplococci
- Cervical culture positive for gonorrhea or *Chlamydia*
- Purulence on culdocentesis
- Adnexal mass consistent with tubo-ovarian abscess

is palpated and a TOA is suspected, pelvic ultrasonography should be performed.<sup>1,28,55</sup> Laparoscopic findings diagnostic of PID include pronounced hyperemia of the fallopian tubes, edema of the tubal walls, and a sticky exudate on the tubal surface.<sup>60</sup>

**Treatment.** Antibiotic treatment should be aimed at coverage of the most common etiologies.<sup>56,61</sup> (See Table 6.) Intravenous rehydration should be initiated if needed, and pain should be controlled; an IUD, if present, should be removed.<sup>55,57</sup> The patient should be admitted for IV antibiotic treatment if any of the following criteria are met: 1) a surgical emergency causing the pain cannot be ruled out; 2) the patient is pregnant; 3) treatment failure with previously prescribed oral antibiotics; 4) the patient cannot tolerate the outpatient regimen; 5) the patient is severely ill with clinical signs of bacteremia; 6) a TOA is present; 7) the patient is immunodeficient; 8) the patient is nulliparous; or 9) there is poor likelihood of outpatient follow-up.<sup>28,38,53,55,61</sup> If the patient is discharged, complete discharge instructions should be given, with the following recommendations: close follow-up in the next 48-72 hours, abstention from sexual intercourse for two weeks, and treatment of sexual partners.<sup>2,28,53,55,56</sup> Patients should be encouraged to be tested for syphilis and the human immunodeficiency virus (HIV).

**Complications.** PID causes severe scarring of and damage to the fallopian tubes. This results in a six-fold increase in the risk of ectopic pregnancy and is the leading cause of infertility in women. The incidence of infertility after one episode of PID is 5%, 20% after two episodes, and 40% after three or more.<sup>53,56</sup> Other complications include chronic pain, pelvic adhesions, and TOAs.<sup>10,28,53,57</sup>

Potentially fatal complications are the entrapment of purulent material in an occluded tube or pus leaking from a tube, which causes an abscess in the ovary or peritoneal cavity.<sup>28,53</sup> Patients with a TOA are extremely ill, with severe pain, a high fever, nausea, vomiting, tachycardia, and possibly sepsis. They may be febrile, with high temperature, rigid abdomen, and palpable pelvic masses.<sup>10</sup> Ultrasound is the most useful study for confirming the diagnosis of TOA.<sup>53</sup> These patients need to be admitted with bed rest, IV fluids, IV antibiotics, and pain control.<sup>10,28</sup> If the TOA has

**Table 6. Emergency Department Management of Cervicitis and Outpatient Treatment of Pelvic Inflammatory Disease (PID)<sup>33,60</sup>**

**A. CERVICITIS**

**Gonorrhea treatment:**

Ceftriaxone 125 mg IM  
or Cefixime 400 mg PO  
or Ciprofloxacin 500 mg PO  
or Ofloxacin 400 mg PO

**Chlamydia treatment:**

Azithromycin 1 gm PO single dose  
or Doxycycline 100 mg PO x 7 days

**If pregnant or penicillin allergic:**

Azithromycin 2 gm PO single dose  
or Erythromycin base 250 mg PO x 14 days  
or Erythromycin ethylsuccinate 800 mg PO x 7 days

**B. OUTPATIENT PID:**

Choice for gonorrhea treatment from above list  
and Doxycycline 100 mg PO bid for 14 days  
or Ofloxacin 400 mg PO bid x 14 days plus clindamycin 450 mg PO bid x 14 days

entation of both cystitis and pyelonephritis is similar in pregnant and nonpregnant women.<sup>66</sup>

*Clinical Presentation.* Patients with UTI usually present complaining of dysuria, urgency, frequency, malodorous urine, and suprapubic abdominal pain.<sup>2,65</sup> About 40% of patients will have hematuria, and many will report fevers. Patients with pyelonephritis often have flank pain, nausea, vomiting, temperature higher than 103°F, and back pain. They also may complain of rigors, headaches, general malaise, and myalgias. Many will have symptoms of cystitis as well, but more than 50% of cases of pyelonephritis occur in the absence of these symptoms.<sup>64,65,67</sup>

The physical examination of a patient with acute cystitis may be rela-

ruptured, the patient will have acute abdominal pain and require immediate surgery.<sup>62</sup> If an unruptured TOA does not respond to conservative therapy with IV antibiotics and bed rest, then laparotomy is warranted for surgical drainage.

**Urinary Tract Infection and Pyelonephritis.** In patients with UTI, pathogenic microorganisms are detected in urine, but symptoms may not be present.<sup>63,64</sup> The growth of more than 100,000 organisms/mL from a clean-catch urine specimen equals infection.<sup>64</sup> Pyelonephritis is an infection of the renal parenchyma and pelvis, with inflammation resulting from local bacterial infection.

There are 6-7 million episodes of acute cystitis and 250,000 episodes of pyelonephritis each year in the United States. The cost of evaluation and treatment exceeds \$1 billion annually.<sup>65</sup> The vast majority of these cases are found in young, sexually active females. In fact, 25-35% of women ages 20-40 have had at least one UTI episode.<sup>66</sup>

Bacteria gain access to the bladder primarily via the urethra, causing acute cystitis, which can then ascend to the kidney, causing pyelonephritis.<sup>66</sup> *E. coli* causes 70-95% of all UTIs. Other etiologic agents include *Staphylococcus saprophyticus* (5-20%), *Proteus*, *Klebsiella*, *Enterococcus*, and *Pseudomonas*.<sup>63-65</sup> The etiology of pyelonephritis is similar to that of a UTI, with 90% of cases being caused by *E. coli*.

Females are very prone to UTIs because the urethra is short (~4 cm), close to the anus, and terminates beneath the labia. Sexual intercourse increases risk because urethral massage during intercourse introduces bacteria into the bladder. Voiding after intercourse lessens this risk. Any form of urinary obstruction, bladder dysfunction, or vesicoureteral reflux increases the risk of infection.<sup>63</sup>

The urinary tract is the most common site of infection during pregnancy, because of increased urinary stasis. Mild hydronephrosis is common after mid-pregnancy: right-sided in 75% of women and left-sided in 33%. Asymptomatic bacteriuria occurs in 2-10% of pregnant women. Acute cystitis occurs during 1% of pregnancies and acute pyelonephritis during 2%. The pres-

tively unremarkable except for some suprapubic tenderness. A pelvic examination is indicated for any woman with abdominal pain unless the ED physician can be certain her symptoms are only related to a UTI. In addition, a pelvic examination provides the opportunity to look for herpetic ulcers as the cause of dysuria and pyuria.<sup>65</sup> The presence of cervicitis suggests urethritis as the cause of dysuria.

*Diagnosis.* A urinalysis and pregnancy test should be obtained for every patient. The presence of leukocyte esterase in the urine is 75-95% sensitive and 94-98% specific for UTI.<sup>66</sup> The urine also will show the presence of WBCs, bacteriuria, and nitrites. Hematuria is present in 40% of cases. Blood cultures will be positive in 25-50% of patients with pyelonephritis,<sup>67</sup> but multiple studies have shown blood cultures in pyelonephritis to be unnecessary as they add cost without changing management.<sup>68-70</sup> Imaging studies such as renal ultrasound or CT scan are indicated only for patients with complicated pyelonephritis.<sup>67</sup>

*Treatment.* The treatment regimen depends on whether the patient has a complicated or uncomplicated infection. A sexually active, nonpregnant woman with recent onset of symptoms, who has not had recent instrumentation or antibiotics and has no history of a genitourinary abnormality, has an uncomplicated infection. Left untreated, 50-70% of these cases will clear spontaneously. However, most doctors treat in response to the patient's discomfort.<sup>65</sup> Acute uncomplicated cystitis should be treated with a short course of antibiotics. This increases compliance, is cheaper, and decreases the incidence of adverse reactions compared with longer courses of antibiotics. Studies have shown that 85-95% of cases are eradicated by a single dose of trimethoprim/sulfamethoxazole (Bactrim) and 81-89% after a single dose of ciprofloxacin (Cipro). However, three days of treatment with trimethoprim/sulfamethoxazole has proven even more effective than a single dose, but there has been no proven benefit to treating longer than three days.<sup>66</sup> Studies comparing three-day regimens of trimethoprim/sulfamethoxazole, nitrofurantoin (Macrobid),

cefadroxil, and amoxicillin have demonstrated that trimethoprim/sulfamethoxazole has the highest cure rate and is the least expensive of this group of antibiotics.<sup>65</sup> The patient should be encouraged to increase hydration to increase the removal of uropathogens. If the patient is having significant dysuria, she can be given a course of phenazopyridine (200 mg PO tid for one or two days) to alleviate her symptoms.

If the patient is pregnant and found to have a UTI or asymptomatic bacteriuria, she should be treated before it progresses to pyelonephritis.<sup>67</sup> As mentioned above, up to 30% of pregnant women with asymptomatic bacteriuria will develop pyelonephritis, which is associated with increased risk of spontaneous miscarriage. Nitrofurantoin is the recommended antibiotic for pregnant women.

Patients with uncomplicated pyelonephritis can be treated as outpatients if they are not pregnant, if they have no complicating illnesses, if they are nontoxic, if they have good pain control, if they are tolerating oral intake, and if they have good follow-up.<sup>65,67</sup> Fluoroquinolones are recommended for treatment and should be continued for 10-14 days.<sup>63,65</sup> A patient with any underlying renal or neurologic condition predisposing her to infection is said to have complicated pyelonephritis. These patients should be admitted, as should any patient with the inability to tolerate oral intake, severe pain, high fevers, or questionable compliance.<sup>65,67</sup> Any patient who is pregnant, diabetic, or immunocompromised should be admitted. These patients should be given IV antibiotics such as ceftriaxone, ciprofloxacin, or ofloxacin. Admission for IV administration of antibiotics decreases the incidence of complications such as sepsis, renal cortical scarring, and papillary necrosis.<sup>67</sup>

**Kidney Stones.** When a patient presents with acute, intense flank or side pain, ureteral stones are a primary consideration. Renal calculi arise due to papillary calcifications or precipitation of organized crystalline bodies of calcium salts, uric acid, cystine, or struvite (magnesium-ammonium-phosphate) in the urine.<sup>71</sup>

Kidney stones are very common in the United States, seen in 16 of 10,000 patients.<sup>72</sup> Women have a 5-10% lifetime risk of developing stones.<sup>72-74</sup> The age of presentation peaks in the third and fourth decades, and stones are three or four times more common in whites than blacks.<sup>71-75</sup> Recurrence rates are very high: 10% after one year, 35% after five years, and 50% after 10 years.<sup>58,67,73,76</sup>

The precise cause of renal stones is unknown; however, theory suggests urinary supersaturation of solute followed by a crystal precipitate or a decrease in normal urinary proteins that inhibit crystal growth.<sup>77</sup> Seventy-five percent of stones are made of calcium in conjunction with oxalate, phosphate, or both.<sup>77</sup> Uric acid stones account for 5-10% of cases, struvite stones for 5-10%, and cystine for 1-5%.<sup>38,76</sup> Etiologies for the formation of these different types of stones include hypercalciuria, hyperuricuria, hypocitraturia, hyperoxaluria, hypomagnesuria, cystinuria, chronic urinary tract infections, and low urine volume.<sup>58,78</sup>

Any systemic illness that leads to the above-mentioned conditions increases the risk of stone formation. For example, hypercalciuria is seen in patients with hyperparathyroidism and bowel dis-

orders. Absorptive hypercalciuria is due to increased intestinal calcium absorption in the gut, but the precise cause is unknown. Oxalate excretion is enhanced in patients with bowel diseases such as Crohn's disease and ulcerative colitis, as well as by small bowel bypass surgery.<sup>77</sup> Chronic UTI by urea-splitting organisms leads to the formation of struvite stones.<sup>79</sup> Nutritional and environmental factors also play a significant role. High dietary intake of salt, calcium, purine, and proteins increase risk, as does living and working in a hot, humid environment.<sup>58,76,77</sup> Certain medications also increase risk by increasing urinary pH or by increasing excretion of calcium or phosphate. Examples include indinavir, diuretics, antacids, vitamin C, and allopurinol.<sup>77,79</sup>

*Clinical Presentation.* Patients with a stone usually present complaining of the acute onset of severe, intermittent, colicky pain, usually beginning in the flank and radiating to the lower abdomen, groin, and thigh.<sup>2,67,75,77,79,80</sup> Twenty percent of patients also complain of nausea and vomiting.<sup>81</sup> Many have gross hematuria. If the stone is lodged in the ureterovesical junction, urinary symptoms such as dysuria and frequency are present.<sup>58,71,75,79</sup> The patient often reports that the pain makes her want to "roll around" to find a comfortable position.<sup>67,77</sup> As renal colic is the most common misdiagnosis of an abdominal aortic aneurysm, this more severe condition must be considered when evaluating older patients with suspected renal colic.

The patient most likely will appear very uncomfortable and may be writhing around on the bed. A common finding is pain out of proportion to physical findings. The patient may exhibit costovertebral angle tenderness and suprapubic tenderness. If there is a concurrent infection, the patient may be febrile.<sup>78</sup>

*Diagnosis.* Each patient should have a urinalysis and urine pregnancy test. A CBC and measurement of creatinine and blood urea nitrogen (BUN) may be considered in patients with complicated presentations.<sup>72,75,79,80</sup> The urinalysis commonly exhibits hematuria, but a normal urine does not rule out a stone (the urine will be normal in 10-15% of cases).<sup>72,77,82</sup> A urine pH of less than 5.5 suggests a uric acid or cystine lithiasis, and a pH of greater than 7.5 suggests infection or a struvite lithiasis.<sup>67</sup> It is imperative to rule out concurrent urinary infection.

Despite that 90% of all kidney stones are radiopaque, a plain KUB film has poor sensitivity and specificity for stones.<sup>1,16,80,83</sup> This partly is because the stones are very small and can be obscured by overlying fecal content in the bowel or by the vertebral process or bony pelvis. Two better studies for diagnosis of stones are IVP and noncontrast helical CT. IVP consists of a scout film followed by a repeat KUB film 5, 10, and 20 minutes after injection of IV contrast. A stone is likely if there is delay in the appearance of the nephrogram or visualization of the entire ureter.<sup>77</sup> If an abnormality is seen, films should be repeated after several hours. The sensitivity for kidney stones is 65-90%, and the specificity is 94-100%.<sup>77,80</sup> Advantages of IVP include that it shows urinary system flow and function, is easy to perform, is inexpensive, and is universally available. Disadvantages include its invasiveness and the possibility of reactions to IV contrast; in addition, when the study is positive, it takes several hours to perform, and, when it is negative, it fails to provide an alternative diagnosis.<sup>83</sup>

Noncontrast helical CT is rapidly replacing IVP as the study of choice. CT is more effective than IVP in precisely identifying stones and is equally effective in determining the presence of obstruction.<sup>78</sup> CT allows direct cross-sectional visualization of the entire genitourinary system. It is 97% sensitive and 96% specific in the diagnosis of stones.<sup>77,80</sup> Advantages of CT include that it is complete in fewer than 5 minutes, no IV contrast is needed, it allows precise determination of size and location of the stone, and it can demonstrate nonurinary causes of pain if no stone is present.<sup>1,77,78,80,83</sup> If one is unsure of the diagnosis but a kidney stone is high in the differential, a noncontrast CT should be obtained primarily, as contrast would obscure the visualization of a stone if present. If this study does not demonstrate a stone or other obvious cause of the pain, then a CT with contrast should be considered.

**Treatment.** The goals of ED management are adequate pain relief, IV hydration if the patient is dehydrated, ruling out infection, and determining if the stone will pass spontaneously or requires intervention.<sup>84,85</sup> Pain control usually is well achieved with IV NSAIDs or narcotics, and antiemetics may be required. If an infection is present, antibiotics should be given. Management of the stone depends on its size, location, and composition. Stones smaller than 4 mm pass spontaneously 80% of the time, and stones 4-6 mm pass spontaneously 60% of the time.<sup>77,80</sup> Stones located in the distal ureter pass much more frequently than those in the proximal ureter. Patients should be admitted for very large stones, persistent uncontrolled pain and emesis, infection, pregnancy, the presence of only one kidney, or persistent obstruction.<sup>16,79,80,85</sup> If the patient can be discharged safely, she should be sent home with return precautions and adequate pain medicine and should be encouraged to drink 2-3 liters of fluid a day and be given a urine strainer.<sup>81,84</sup> Every patient should be set up with urology follow-up within seven days.<sup>67</sup>

**Ovarian Cysts.** Physiologic or pathologic enlargement of an ovary is the most common cause of adnexal pain.<sup>28</sup> Follicular cysts occur in the initial 2-3 weeks of the menstrual cycle. Follicular dysgenesis occurs when the hypothalamic-pituitary axis malfunctions or because of anatomic defects in the reproductive system.<sup>35</sup> Risk factors include smoking, early menarche, infertility, and hypothyroidism.<sup>35</sup> Follicular cysts can grow to 8-10 centimeters and generally regress spontaneously within 1-3 months. Stretching of the cyst wall can cause pain, or the cyst may rupture, leading to sharp, severe unilateral midcycle pain (mittelschmerz).<sup>28</sup>

Failure of degeneration of the corpus luteum leads to luteal cyst formation. These cysts are found in the final one or two weeks of the menstrual cycle, and they can become inflamed or hemorrhage spontaneously.<sup>35</sup> Corpus luteum cysts can grow to 5-10 centimeters and can cause unilateral pelvic pain, amenorrhea, and if ruptured, peritoneal irritation and bleeding.<sup>28</sup>

Ovarian cysts occur in 30% of females with regular menses and in 50% of females with irregular menses.<sup>35</sup> The majority occur during childbearing years, are benign, and have a predilection for the right side.

**Clinical Presentation.** Ovarian cysts are asymptomatic unless complicated by rupture, torsion, or hemorrhage. The patient will

most commonly present with mid- or late-cycle lower abdominal pain that is sharp, intermittent, severe, and of sudden onset. It may have been preceded by strenuous activity or sexual intercourse. The patient also may complain of nausea, vomiting, or vaginal spotting. The physical examination most likely will elicit tachycardia, lower abdominal and adnexal tenderness, cervical motion tenderness, and possibly an adnexal mass.<sup>35</sup> Although uncommon, hemorrhage may be significant, leading to signs of shock.

**Diagnosis.** If significant hemorrhage is suspected, the following laboratory tests should be obtained: CBC, type and cross-match, and coagulation profile. All patients should have a urinalysis and urine pregnancy test. If the woman is unstable, culdocentesis can be done to diagnose or rule out peritoneal hemorrhage. If the patient is stable, transvaginal ultrasound is the study of choice to assess the size, structure, and complexity of the cyst and to rule out torsion.<sup>35</sup>

**Treatment.** If the woman is unstable, IV fluids and blood products should be given aggressively, and emergent gynecologic consult and surgery are required. If the patient has a simple, uncomplicated ovarian cyst, she can be given adequate pain control and gynecologic referral as an outpatient, because most cysts of this type resolve spontaneously.<sup>35</sup>

**Endometriosis.** Endometriosis is the presence of estrogen-dependent functioning endometrial glands and stroma outside the uterus and often is associated with pelvic pain and infertility.<sup>9,86,87</sup> It can be a therapeutic challenge for emergency physicians, and it is a diagnosis of exclusion.

Endometriosis occurs in 10-15% of women, commonly presents in the third decade, and regresses after menopause.<sup>10,86,87</sup> It is found in 60% of patients evaluated for infertility.<sup>86</sup>

The exact cause of endometriosis is unknown. It is postulated to occur secondary to the partial occlusion of the cervix, causing retrograde menstrual flow to pass into the fallopian tubes and into the abdominal cavity, where it implants and comes under the influence of cyclic female hormones.<sup>9,87</sup> Other theories include transtubal dissemination or the iatrogenic deposition of endometrial tissue following invasive gynecologic procedures.<sup>87</sup> The most common sites of deposition are the ovaries, the broad ligaments, and the peritoneal surfaces of the cul-de-sac. When endometriosis involves the peritoneal surfaces, it appears flat and brown and is described as "powder burns." As the disease progresses, numerous abdomen and pelvic adhesions form. The rectosigmoid colon can become tightly bound by adhesions to the posterior wall of the uterus, resulting in a fixed, retroverted uterus.<sup>10</sup> Also possible is endometrioma of the ovary; that is, the ovary forms a cyst that becomes filled with a thick, chocolate-colored fluid consisting of aged, hemolyzed blood and desquamated endometrium.<sup>10</sup>

Risk factors for endometriosis among women of reproductive age are low parity, long intervals between pregnancies, short menstrual cycle (less than 27 days), long and heavy flow (> 7 days), and spotting before menses.<sup>26</sup> Risk decreases with smoking cessation and regular exercise.<sup>26</sup>

**Clinical Presentation.** The most common complaint is severe dysmenorrhea and pelvic pain that generally begins two days before the onset of menses, lasts throughout menses, and extends

several days after.<sup>26</sup> As the disease progresses, pelvic pain occurs outside of menses and usually is described as dull, aching, deep, and radiating to the back, hips, rectum, or thighs.<sup>5</sup> Many women also report dyschezia; premenstrual and postmenstrual spotting; and dyspareunia, especially with deep penetration. The intensity of the pain does not appear to correlate with the extent of disease.<sup>87</sup>

During pelvic examination of a patient with endometriosis, tender nodules can be felt along the thickened uterosacral ligaments, the posterior uterus, and in the cul-de-sac. These are felt most easily on the rectovaginal examination.<sup>10,86,87</sup> The patient also may have diffuse, nonlocalized, abdominal tenderness and a retroverted uterus. If the patient has an endometrioma, a tender, fixed, adnexal mass may be detected.

**Diagnosis.** The evaluation of a woman suspected of having endometriosis should include urinalysis, urine pregnancy test, and cervical cultures. The only way to make a definitive diagnosis is by laparoscopy, which shows the hallmark "powder burn" blue-black lesions. An endometrioma can be visualized with transvaginal ultrasound, which will show a cystic mass with thickened walls and diffuse acoustic enhancement or scattered internal echoes.<sup>26</sup> Magnetic resonance imaging may be helpful in making the diagnosis, as it can detect pigmented hemorrhagic lesions, loss of a clear margin of the uterus, and a tethered appearance of the rectum.<sup>26</sup>

**Treatment.** ED management includes excluding a life-threatening or other treatable cause of pain, appropriate analgesia, and outpatient follow-up with a gynecologist.<sup>87</sup> Hormonal therapy relieves pain in up to 89% of patients, but should be initiated by a gynecologist.<sup>87</sup>

**Complications.** Common complications of endometriosis include infertility, pelvic adhesions, and chronic pelvic pain.<sup>87</sup> An endometrioma can rupture, leading to a chemical peritonitis requiring emergent surgery.

**Uterine Fibroids.** Uterine fibroids, or leiomyomas, are the most common benign tumor of the uterus. Uterine fibroids are found in 20% of women older than age 35. They are twice as common in African-American women as in white women.<sup>88</sup>

The growth of fibroids, particularly multiple fibroids, may be an inherited tendency. Isolated leiomyomas more likely are due to gene mutations that cause overgrowth of the muscle cells of the uterus. Estrogen enhances the growth of fibroids; therefore, up to 20% of gravid women may experience growth during the latter half of pregnancy and in the postpartum and postabortion periods.<sup>88</sup> Other factors associated with the growth of fibroids include 1) increased body mass index; 2) nulliparity; and 3) onset of menstruation before the age of 10.<sup>89</sup>

**Clinical Presentation.** Uterine fibroids may present clinically along a spectrum from an asymptomatic incidental finding, to alteration in uterine bleeding, to acute pelvic pain. Other symptoms may include pressure on the bladder, causing urinary frequency and urgency; pressure on the rectum, causing constipation; infertility; or increased abdominal girth or a change in abdominal contour.

Pelvic pain usually is caused by one of three complications, all of which are associated with ischemic necrosis. The first is

ischemic degeneration, which is most common during pregnancy, when the fibroid can outgrow its blood supply. This can be difficult to differentiate from other causes of pelvic pain, particularly in the absence of a palpable mass. Signs include ileus, fever, and elevated WBC count. The second typical cause of pelvic pain is torsion of a pedunculated fibroid on its vascular stalk, which can cause colicky pain. The third is an aborting submucosal fibroid, which can cause profuse and prolonged vaginal bleeding and uterine cramping.

**Diagnosis.** ED evaluation of a patient with fibroids should include urinalysis and a pregnancy test. Palpation of a fibroid or finding on ultrasound can confirm the diagnosis. Uterine fibroids appear on ultrasound with typical sonographic patterns: they are hypoechoic and heterogeneous and have an echogenic rim.<sup>90</sup> They can be submucosal, subserosal, or pedunculated. Degeneration is seen as small, cystic spaces within a fibroid. Pedunculated fibroids can appear like ovarian masses, so a thorough search for both ovaries must be done. Other tests, including endometrial biopsy, hysteroscopy, and hysterosalpingography, are beyond the scope of the ED workup.

**Treatment.** Treatment of uterine fibroids depends on the presenting symptoms and may include observation; NSAIDs for treatment of pelvic pain; oral contraceptives, which may decrease menstrual flow and pelvic pain; GnRH analogs or RU-486 to decrease estrogen levels; myomectomy; or hysterectomy. Uterine artery embolization, although beyond the scope of the emergency physician, is a promising new nonsurgical alternative. The technique is similar to that done for the treatment of emergent hemorrhage. It can be done as an outpatient procedure with a low same-day admission or delayed admission rate.<sup>91,92</sup>

## Conclusion

Abdominal pain in women of childbearing age continues to be a major concern and difficult to assess in the ED. Patients who appear non-toxic actually may have an underlying surgical emergency, and some "sick" patients ultimately will be diagnosed with benign conditions. A patient's history of pregnancy as well as the accuracy of a pelvic examination may be unreliable. STDs remain epidemic in the United States, increasing the risks of ectopic pregnancy. An algorithmic approach is presented, which distinguishes between pregnant and nonpregnant women; differentiates normal and abnormal urinalysis; and allows early surgical consultation and imaging, leading to rapid assessment, diagnosis, and appropriate treatment.

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### Physician CME Questions

- Approximately how many women of childbearing age who present to the emergency department with abdominal pain are pregnant?
  - 5%
  - 13%
  - 21%
  - 25%
- In a normal intrauterine pregnancy, how often should serum beta hCG levels double?
  - every day
  - every 2 days
  - every 4 days
  - every week

3. Which of the following serum levels aids in the diagnosis or exclusion of ectopic pregnancy?
  - A. Progesterone
  - B. Estrogen
  - C. Lipase
  - D. LDH
  
4. Which of the following is not a contraindication to giving methotrexate for the treatment of an ectopic pregnancy?
  - A. positive fetal cardiac activity
  - B. A fetus larger than 4 cm
  - C. Hemodynamic instability
  - D. Serum hCG lower than 3500
  
5. Ovarian tissue will remain viable for how long after the onset of torsion?
  - A. 2 hours
  - B. 5 hours
  - C. 6 hours
  - D. 12 hours
  
6. Which of the following is *not* associated with acute appendicitis?
  - A. Obturator sign
  - B. Rovsing sign
  - C. Psoas sign
  - D. Murphy's sign
  
7. The etiology of PID in women with an IUD may be due to which of the following organisms?
  - A. *Actinomyces israelii*
  - B. *Mycoplasma*
  - C. *Pasteurella multocida*
  - D. *S. epidermidis*
  
8. The classic triad of PID includes all of the following *except*:
  - A. cervical motion tenderness.
  - B. fever higher than 101°F.
  - C. lower abdominal tenderness.
  - D. adnexal tenderness.
  
9. What percentage of kidney stones are radio-opaque?
  - A. 10%
  - B. 25%
  - C. 70%
  - D. 90%
  
10. What is the study of choice to evaluate an ovarian cyst?
  - A. CT scan with contrast
  - B. KUB
  - C. Transvaginal ultrasound
  - D. MRI of the pelvis

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Urologic Emergencies

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# Emergency Medicine Reports

## RLQ Abdominal Pain in Women of Reproductive Age

### Differential Diagnosis of RLQ Pain in Women of Reproductive Age

- Ectopic pregnancy
- Adnexal torsion
- Appendicitis
- Pelvic inflammatory disease
- Urinary tract infection (UTI) and pyelonephritis
- Kidney stones
- Ovarian cysts
- Endometriosis
- Uterine fibroids

### Risk Factors Associated with Delayed or Missed Diagnoses of Ectopic Pregnancy

- Absence of abdominal pain; atypical pain
- Absence of adnexal mass on physical examination
- Negative aspiration on culdocentesis
- Nondiagnostic ultrasound
- Misinterpretation of sonographic image
- Falling hCG level

### Complications of Adnexal Torsion

- Infertility
- Infection
- Peritonitis
- Sepsis
- Adhesions
- Chronic pain

### ED Management of Cervicitis and Outpatient Treatment of Pelvic Inflammatory Disease

#### A. CERVICITIS

##### **Gonorrhea treatment:**

Ceftriaxone 125 mg IM  
 or Cefixime 400 mg PO  
 or Ciprofloxacin 500 mg PO  
 or Ofloxacin 400 mg PO

##### **Chlamydia treatment:**

Azithromycin 1 gm PO single dose  
 or Doxycycline 100 mg PO x 7 days

##### **If pregnant or penicillin allergic:**

Azithromycin 2 gm PO single dose  
 or Erythromycin base 250 mg PO x 14 days  
 or Erythromycin ethylsuccinate 800 mg PO x 7 days

#### B. OUTPATIENT PID:

Choice for gonorrhea treatment from above list  
 and Doxycycline 100 mg PO bid for 14 days  
 or Ofloxacin 400 mg PO bid x 14 days plus clindamycin 450 mg PO bid x 14 days

### Risk Factors for Ectopic Pregnancy

#### STRONGLY ASSOCIATED

- Previous ectopic pregnancy
- Diethylstilbestrol (DES) exposure
- Intrauterine device
- Prior tubal surgery
- Documented peritubal adhesions

#### MODERATELY ASSOCIATED

- Pelvic inflammatory disease
- Multiple induced abortions
- Smoking

#### SLIGHTLY ASSOCIATED

- Pelvic or abdominal surgery
- Vaginal douching
- First sexual intercourse before age 18

Adapted from: Anjum WM, et al. Risk factors for ectopic pregnancy: A meta-analysis. *Fertil Steril* 1996;65:1093-1099. (Web: <http://www.jr2.ox.ac.uk/bandolier/booth/hliving/Ectopreg.html>. Accessed 12/12/2001.)

### Diagnosis Criteria for Pelvic Inflammatory Disease

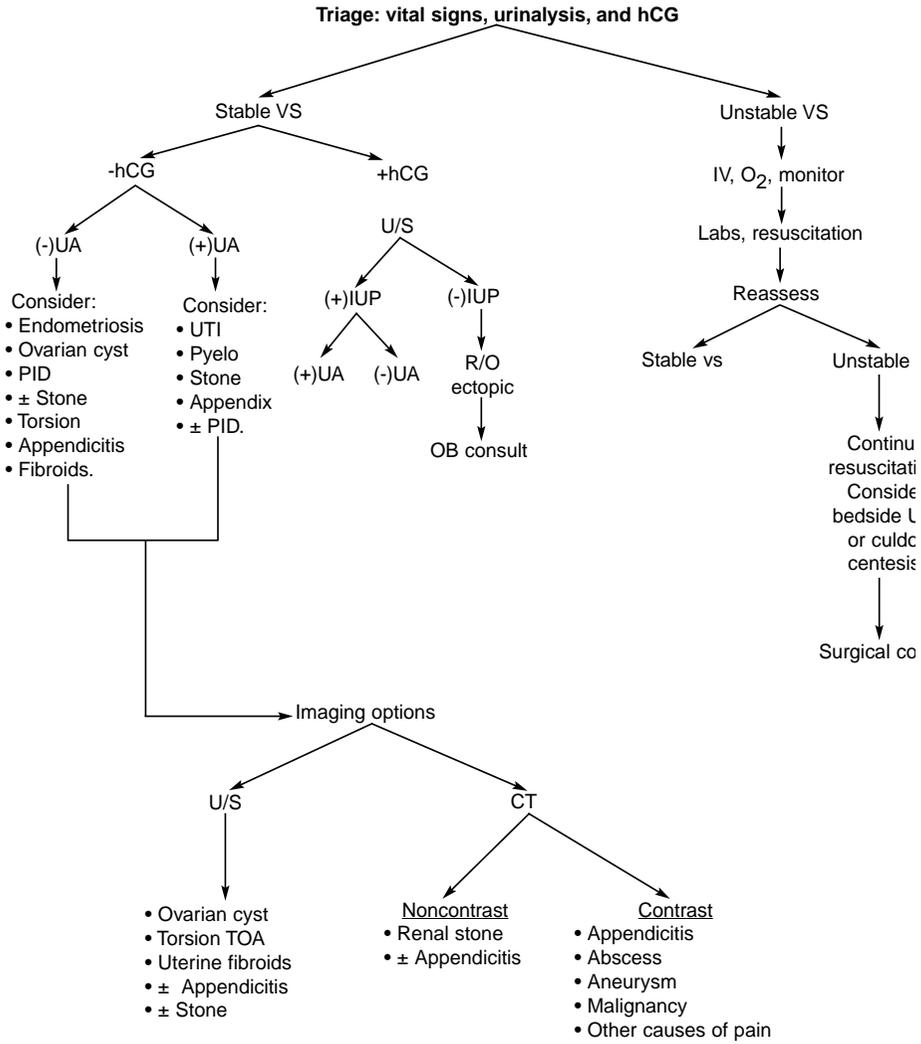
#### MAJOR CRITERIA

- Cervical motion tenderness
- Lower abdominal tenderness
- Adnexal tenderness

#### MINOR CRITERIA

- Temperature > 38°C
- White blood cell count > 10.5
- Erythrocyte sedimentation rate > 15
- Gram stain of vaginal discharge positive for gram-negative diplococci
- Cervical culture positive for gonorrhea or *Chlamydia*
- Purulence on culdocentesis
- Adnexal mass consistent with tubo-ovarian abscess

# Algorithm Differential Diagnosis of RLQ Abdominal Pain in Women of Reproductive Age



**Key:** VS = vital signs; UA = urinalysis; IUP = intrauterine pregnancy; PID = pelvic inflammatory disease; TOA = tubo-ovarian abscess; U/S = ultrasound; R/O = rule out

# Emergency Medicine Reports

Volume 22

SUPPLEMENT

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Volume 22, Numbers 1-26

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# BIOTERRORISM WATCH

Preparing for and responding to biological, chemical and nuclear disasters

## Ring of Fire: CDC plan to immunize around first smallpox cases has the devil in the details

*Used successfully to eradicate smallpox in 1980*

Should a bioterrorist strike with smallpox, the Centers for Disease Control and Prevention's (CDC's) recently released response plan calls for investigators to rapidly immunize a "ring" around the first cases. The ring concept calls for isolation of confirmed and suspected smallpox cases followed by contact tracing, vaccination, and close surveillance of contacts.

"Ring vaccination — sometimes called search and containment — is identifying individuals with confirmed smallpox and then identifying and locating those people who came in contact with that person, and vaccinating those people in outward rings of contact," says **Harold Margolis**, MD, CDC senior adviser for smallpox preparedness. "This produces a buffer of immune individuals and was shown to prevent smallpox and to ultimately eradicate this disease."

Indeed, the ring approach was used to successfully eradicate smallpox from the world in 1980. The only officially acknowledged stocks of live virus remaining are in the United States and Russia, but bioterrorism experts have long feared that smallpox may have fallen into other hands.

But the ring concept was effective when the demographics of smallpox were very different, when few were infected and the vast majority of people were already immune. The CDC plan acknowledges as much, noting that several current factors could contribute to a more rapid spread of smallpox than was routinely seen before this disease was eradicated.

These factors include virtually nonexistent

immunity to smallpox, increased mobility of the population, and delayed recognition of smallpox by health personnel who are unfamiliar with the disease, the plan states. Concerning the latter — similar to the fine line between initial symptoms of anthrax and influenza — one of the most confounding differential diagnoses for smallpox is chickenpox. (See related story, p. 3)

### *Preemptive strike*

While the ring strategy is a classic public health approach, some favor a more aggressive preemptive action in this new age of bioterrorism: Immunize response teams of health care workers throughout the nation.

"I would be in favor of a plan to prospectively immunize not only the strike force at the federal level, but [also] a cadre of people in each state," says **William Schaffner**, MD, chairman of preventive medicine at Vanderbilt University in Nashville.

Having groups of health care workers immunized in advance could also be critical if the "ring" is difficult to perceive, he notes.

"We think of it conceptually as a ring, but clearly people are not all in one geographic area," he says. "The people who may or may not have contact with this first case will be scattered all over the community. They went shopping

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there, had a church group here, and then they played bridge. The first thing we will be looking for is information from public health authorities about who is within the ring and who is outside the ring. If that is not articulated with great clarity everybody is going to be in deep trouble.”

The CDC is certainly aware of such issues and concerns, and discussions are still ongoing within the agency about preemptively immunizing some health care workers. “We have to weigh the risks and benefits of vaccination for any group, and that would include health care workers. We are kind of working through those issues right now,” **Lisa Rotz**, MD, medical epidemiologist in the CDC bioterrorism response program, tells *Bioterrorism Watch*.

The overriding factor in holding back immunization of health care workers is the hazards and side effects of the vaccine.

“In 1972 we actually discontinued routine vaccination [in the United States] because the risks of adverse events from the vaccine outweighed the risk of any one person coming down with smallpox, even though it was still occurring in other parts of the world,” Rotz says. “I think that still holds true here. We are dealing with a vaccine that presents problems in and of itself.”

Indeed, death occurs in about one per million primary vaccinations, usually as a result of progressive vaccinia, post-vaccinal encephalitis, or severe eczema vaccinatum. Other adverse events include inadvertent inoculation from the vaccinated site (e.g., to the eyes).

### *CDC will bring vaccine within ‘hours’*

In addition, the CDC has immunized approximately 100 of its personnel, who could be dispatched immediately to a stricken area and begin investigating and administering vaccine.

“We have people trained to respond to smallpox who can go rapidly to an area to evaluate a case, and then help the local and state officials begin implementing control measures,” Rotz says. “That would include helping them implement surveillance, making sure we have identified people who need to be vaccinated right away and to start setting that up. We would get things started there until they get their own response up and running.”

But instead of immunizing health care workers in advance, the CDC plan is to administer the vaccine after a case occurs. The CDC could deliver personnel and vaccine within “hours” to any area in the country, Rotz says. Moreover, the vaccine

can be effective up to four days after infection sets in, and may prevent death in the patient.

Among the top priority for immunizations after smallpox is reported are “those involved in the direct medical care, public health evaluation, or transportation of confirmed or suspected smallpox patients,” the CDC plan states. **(See story on priority immunization groups, p. 3.)** In addition, smallpox patients would be placed under airborne precautions similar to that used for tuberculosis patients, who are placed in negative pressure rooms (vented outside) and treated by workers with respirators.

Another important factor in favor of the CDC approach is that smallpox is not communicable in its incubation period, says **D.A. Henderson**, MD, director of the office of public health preparedness at the Department of Health and Human Services in Washington, DC.

“You have an incubation period of 10 to 12 days when the individual feels perfectly well and is not able to transmit infection,” he says. “Then he gets a fever for a couple of days and then the rash. It’s only when the rash begins that the individual transmits the disease. So, in fact, [those are] the people we’re really concerned about isolating so that they don’t transmit the disease. But just because somebody’s infected does not mean that they’re going to transmit infection during that incubation period. They won’t do that.”

### *Into the thousands very quickly*

Still, while emphasizing that the CDC plan is a good starting point, Schaffner argues that it would make sense — and allay subsequent chaos — to immunize groups of health care workers before an event occurs.

“The immediate [CDC] public health strike team is like being out on the beach and walking in up to your ankles, but the next step you take gets you into water over your head,” he says. “Because if you start thinking about [immunizing health care workers], you’re talking about emergency personnel, ambulance drivers, infectious disease doctors, [and] nurses in hospitals who would be designated to care for such patients. It could get into the many thousands very quickly.”

In addition, with the exception of the recently trained CDC personnel, few clinicians in the country know how to administer the smallpox vaccine using the “little pitchfork” bifurcated needle.

“That is one potential benefit of vaccinating a group of first responders around the country,”

Schaffner says. "You train these people how to administer the vaccine and all of sudden you have a bunch of trained people out there that we haven't had before. I think that would be a substantial additional benefit." ■

## Health workers, contacts priority for vaccination

*Others include lab personnel and waste disposal*

According to the Centers for Disease Control and Prevention (CDC), the following groups should be a high priority for smallpox vaccination should a bioterrorism release of the pathogen occur:

1. Face-to-face close contacts (less than or equal to 6.5 feet or 3 meters), or household contacts to smallpox patients after the onset of the smallpox patient's fever. Although individuals with smallpox are not infectious until the onset of rash, vaccinating contacts from the time of the onset of fever helps provide a buffer and assures that contacts who may have been exposed at the early onset of rash, when the rash may have been faint and unrecognized, have been vaccinated.

2. People exposed to the initial release of the virus (if the release was discovered during the first generation of cases and vaccination may still provide benefit).

3. Household members (without contraindications to vaccination) of contacts to smallpox patients' (to protect household contacts should smallpox case contacts develop disease while under fever surveillance at home).

Household members of contacts who have contraindications to vaccination should be housed separately from the other vaccinated household members until the vaccination site scab has separated (approximately two weeks) to prevent inadvertent transmission of vaccinia virus. They should also be housed separately from the contact until the incubation period for smallpox has passed and the contact is released from surveillance.

4. People involved in the direct medical care, public health evaluation, or transportation of confirmed or suspected smallpox patients (this includes personnel whose public health activities involve direct patient contact such as case interviewing).

5. Laboratory personnel involved in the collection and/or processing of clinical specimens from suspected or confirmed smallpox patients.

6. Other people who have a high likelihood of exposure to infectious materials (e.g., personnel responsible for hospital waste disposal and disinfection).

7. Personnel involved in contact tracing and vaccination, or quarantine/isolation or enforcement, or law-enforcement interviews of suspected smallpox patients.

8. People permitted to enter any facilities designated for the evaluation, treatment, or isolation of confirmed or suspected smallpox patients. (Only essential personnel should be allowed to enter such facilities.) Only personnel without contraindications to vaccination should be chosen for activities that would require vaccination for their protection. Personnel with contraindications should not perform duties that would place them at risk for smallpox exposure and should otherwise only be vaccinated if an exposure already has occurred.

9. People present in a facility or conveyance with a smallpox case if fine-particle aerosol transmission was likely during the time the case was present (e.g. hemorrhagic smallpox case and/or case with active coughing). Evaluation of the potential risk for aerosol transmission and initiation of vaccination for non-direct contacts will be done by CDC, state, and local public health personnel. The decision to offer vaccination to non-direct contacts of smallpox cases will be made jointly by federal and the state health officials. ■

## Smallpox or chickenpox? How to make the diagnosis

*Rash progression, location, will be different*

Smallpox or chickenpox? That clinical question has been long confined to the academic dustbin in the United States, where the last case of smallpox (variola) was diagnosed in 1949 in Texas.

Smallpox has been vanquished yet is still feared; chickenpox (varicella) remains a fairly common pediatric infection. Continuing use of the varicella vaccine (recommended for use in the United States in 1996) should continue to reduce cases of chickenpox in the years to come. With

## Smallpox vs. Chickenpox

	Variola	Varicella
Incubation	7-17 days	14-21 days
Fever prodrome	2-4 days	minimal/none
Distribution	face/extremities	trunk/clusters
Progression	synchronous	synchronous
Scab formation	10-14 d p* rash	4-7 d p* rash
Scab separation	14-28 d p* rash	<14 d p* rash
Lesions soles/palms	yes	no

\* d p = days after rash onset

Source: Centers for Disease Control and Prevention, Atlanta.

bioterrorism a reality and a whole generation of medical students having never seen a case of smallpox, the Centers for Disease Control and Prevention (CDC) is again emphasizing the classic distinctions between the two poxes.

Though similar at onset, the two rash diseases take distinctly different progressions that provide more than a few telltale signs, says **Lisa Rotz**, MD, medical epidemiologist in the CDC bioterrorism response program. **(See chart, above.)**

“The incubation period for both diseases spans similar time periods, but we do see a longer incubation period in the development of chickenpox as opposed to smallpox,” she says.

Usually symptoms such as high fever, malaise, and backache will proceed development of rash in smallpox cases. On the contrary, fever associated with chickenpox generally appears in conjunction with the first signs of rash.

“You will also see a different distribution of lesions of the rash between the two diseases,” Rotz says. “In general, smallpox lesions are much more numerous on the face and extremities.”

In contrast, chickenpox lesions are more numerous on the trunk, and occur in clots or clusters. Moreover, as rash progresses in smallpox, the lesions in a particular area of the body progress along the same lines and appear similar.

“Whereas in varicella in any one area of the body you may see lesions in different levels of progression,” she says. “You might see a vesicle next to a scab. Also the rash of varicella progresses much more quickly and resolves more quickly than the rash of smallpox. So the overall illness has a much shorter course for chickenpox vs. smallpox.”

As opposed to chickenpox, smallpox also will reveal itself through lesions on the soles and palms of those infected. Despite the disease

names, chickenpox lesions are usually smaller than those created by smallpox.

“It is difficult to distinguish early on between the two diseases, but they quickly diverge in their rash progression,” Rotz says. “By day five a child with smallpox is showing increasing numbers of lesions still occurring on the face, while the child with chickenpox has about the same number of lesions on the face as appeared on day three. By day seven the rash is still progressing in the patient with smallpox but seems to be resolving in the child with chickenpox.”

Though smallpox patient isolation measures are understandably more stringent, the patient isolation guidelines for the two diseases are actually very similar. The CDC recommends contact isolation for both (until scabs are gone) and airborne isolation measures for patients infected with either chickenpox or smallpox. Contact precautions include wearing gloves and a gown to enter the patient’s room; removing gloves and washing hands with an antimicrobial soap prior to leaving room; dedicating noncritical care items to individual patients; and taking extra care to clean the patient environment.

Airborne precautions call for placing the patient in a private room that has monitored negative air pressure in relation to the surrounding areas; six to 12 air changes per hour; and discharge of air outdoors or monitored high-efficiency filtration of room air before the air is circulated to other areas in the hospital. Keep the room door closed and the patient in the room, the CDC advises. Health care workers immune to chickenpox need not wear respiratory protection, but the CDC is calling for workers to wear N95 respirators — typically used for tuberculosis patients — when caring for smallpox patients. ■