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Differential Diagnosis of Abdominal Pain in Women of Childbearing Age

Appendicitis or Pelvic Inflammatory Disease?

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Objectives: The purpose of this article is to educate nurse practitioners about differentiating appendicitis from pelvic inflammatory disease. After reading this article, the nurse practitioner should be able to:

- Identify common manifestations of appendicitis and PID
- Explain the importance of diagnosing appendicitis and PID correctly
- Identify clinical data that is not significant in differentiating PID and appendicitis, and identify clinical data that is significant
- Describe how ED observation improves outcomes in the diagnosis of appendicitis.

Appendicitis and pelvic inflammatory disease (PID) are two of the most common causes of abdominal pain in women of childbearing age. Due to the similar presentations of these conditions, the rate of misdiagnosis is high. In fact, the most frequent reason for malpractice claims against emergency department physicians is missed appendicitis diagnosis.[1] It is important to be vigilant when evaluating and treating women at risk for appendicitis and PID because the sequelae of either condition left untreated can be as severe as death.

As two of the most common causes of abdominal pain, appendicitis and PID affect millions of women of childbearing age each year. PID is diagnosed in more than 1 million U.S. women each year (11%).[2] The lifetime risk of appendicitis is 7%, and approximately 250,000 cases of acute appendicitis occur annually in the United States.[3]

Although many patients with PID and appendicitis present with classic signs and symptoms, other cases are equivocal, and the risk of misdiagnosis is increased. Patient characteristics that contribute to misdiagnosis are female gender, reproductive age, stage of menstrual cycle and sexual history. Women of reproductive age have more perplexing presentations of lower abdominal pain due to the possibility of gynecologic causes. Pain associated with menses can further complicate the diagnosis.

The American College of Emergency Physicians reports that up to one-third of women of childbearing age with appendicitis are misdiagnosed.[4] The most common misdiagnoses are PID or urinary tract infection. Furthermore, the literature shows that the 20% to 30% false-positive appendectomy rate in men is almost twice as high in women.[5] A study of 174 women aged 15 to 45 found that 33% with appendicitis were misdiagnosed — with the most common misdiagnosis being PID.[6] Due to the severe complications associated with misdiagnosis of PID and appendicitis, all providers need to be aware of which evaluation strategies are helpful in diagnosis and which are not.

This continuing education article provides current information about the proper evaluation of women with equivocal signs and symptoms of appendicitis and PID. It is important to note that there are many etiologies of abdominal pain in women of childbearing age. This article focuses on the differences in manifestations of appendicitis and PID only.

Sequelae of Untreated Appendicitis or PID

A delay or lack of treatment for acute appendicitis usually results in appendix perforation. Although symptoms of pain may decrease for a while after perforation, the patient will eventually become systemically ill. The goal is to avoid the complication of perforation because it can lead to generalized peritonitis.[3] By decreasing the rate of perforation, you can minimize mortality and morbidity.

Delayed treatment of PID also has severe consequences. Sequelae of untreated PID can include increased risk for ectopic pregnancy, infertility, pelvic adhesions, pyosalpinx, chronic pelvic pain, dyspareunia, tubo-ovarian abscess, and recurrent PID.[7,8] It is important to note that the intensity of pain the woman experiences is not always directly related to the severity of the infection. Women with mild pain can have severe tubal disease.[8]

Clinical Manifestations

Appendicitis is an inflammation of the appendix secondary to a luminal obstruction caused by a variety of mechanisms.[3] Once inflammation has occurred, pain usually begins as a referred pain that gradually localizes to the right lower quadrant of the abdomen. If this inflammation and inadequacy of blood flow to the appendix progresses and infarction occurs, gangrene and perforation will ensue within 24 to 36 hours. The classic symptoms of appendicitis are migration of pain from mid-abdomen to the right lower quadrant

of the abdomen near McBurney's point along with nausea, vomiting, anorexia and low-grade fever.[5] These classic symptoms occur in one-half to two-thirds of patients. However, almost 50% do not present with classic signs and symptoms of appendicitis.[9]

Pelvic inflammatory disease is an infection that involves the uterus, fallopian tubes and adjacent pelvic structures.[2] Endometritis, parametritis, oophoritis, salpingitis, tubo-ovarian abscess and peritonitis are all conditions associated with PID.[7] PID may be classified as mild, moderate or severe, and a woman can be in any phase of this disease when she seeks care. The intensity of abdominal pain is not necessarily related to the stage of the disease. PID is a polymicrobial infection usually caused by *Neisseria gonorrhoeae* or *Chlamydia trachomatis* and is typically considered a sexually transmitted infection. However, it can also be caused by anaerobic and facultative bacteria. PID is thought to be an extension of an infection that originates in the cervix or the vagina and moves to the upper genital tract. Most women with PID have diffuse abdominal pain and other vague symptoms.

The Centers for Disease Control and Prevention recommend that a woman be treated for PID when lower abdominal tenderness, adnexal tenderness and cervical motion tenderness are present (Table 1).[8] Other signs of the condition may include purulent cervical discharge, laboratory evidence of gonococcal or chlamydial cervicitis, oral temperature greater than 101º F, elevated erythrocyte sedimentation rate, elevated C-reactive protein, and adnexal mass diagnosed by palpation or ultrasonography.[8,10] If all women with PID presented with these symptoms, diagnosis would be easy. However, many women have equivocal signs leading to misdiagnosis.

Differentiating Data: Cautions

An abundance of discussion in the literature focuses on diagnostic techniques that have not proven useful in differentiating acute appendicitis from PID. While some of the following assessments are part of a thorough exam and may assist in ruling out other disease entities, research has not shown that they differentiate between appendicitis and PID.

Although cervical motion tenderness is highly sensitive (97%) in diagnosing PID, it is also present in 28% of patients with appendicitis. This is because cervical and uterine tenderness suggest peritoneal irritation, not just PID.[11] In a study of 100 patients with lower abdominal pain, researchers found that complete blood count (CBC) results were unreliable as an initial diagnostic screen.[12] Leukocytosis, elevated erythrocyte sedimentation rate (ESR) and elevated C-reactive protein are common in both appendicitis and PID, so they are not reliable indicators. Likewise, a white blood cell count can be elevated during pain or physiologic stress or can be normal in both disease entities, so it is of little use in differentiating these diagnoses.[2,5,10,11]

Historically, indicators such as the Rovsing sign (pain elicited in the right lower quadrant when the left lower quadrant is deeply palpated and released), the psoas sign (increased abdominal pain when the patient flexes the thigh against counter pressure above the knee), and the obturator sign (pain with passive flexion of the right hip and knee and internal rotation of the leg at the hip) were used to screen for appendicitis.[1] However, these signs are positive in less than 10% of patients with appendicitis.[3] Further, although ultrasonography can be useful at times, a tubo-ovarian abscess may be mistaken for appendicitis on ultrasound.[2] Sonographer expertise may be a factor in misdiagnosis based on ultrasound. In addition, the digital rectal exam, oral temperature, auscultation of bowel sounds, and plain radiographs have not proven effective in differentiating PID from appendicitis.[4,13,14]

Evaluation and treatment principles for these diseases are unchanged over the past 20 years, although there is substantial data in the literature to improve practice.[15] One beneficial change in practice would include discontinuing the ordering of futile diagnostic tests. Although new technology can assist with diagnosis of appendicitis and PID, diagnosis is primarily based on the woman's history and physical exam.

Practice Implications

The following practice implications are relevant to women of childbearing age who present for evaluation of lower abdominal pain and whose most likely etiologies are PID and appendicitis. Many women exhibit classic signs and symptoms of PID and appendicitis and should be treated accordingly. This article is designed to assist you in differentiating between the two conditions when the patient's presentation is equivocal (Table 2).

In all cases of abdominal pain, perform a full head-to-toe assessment with an emphasis on the strategies discussed in this article. It is imperative to rule out pregnancy in all women presenting with abdominal pain before initiating a full work-up. The most critical aspects of correctly diagnosing PID and appendicitis are the patient's history and physical exam. This is especially true in areas where ultrasonography or computed tomography (CT) is not available during nights and weekends.

Clinical Data: Appendicitis

In addition to the classic symptoms of appendicitis discussed earlier, the literature highlights several clues that can assist in making a diagnosis. The presence of nausea and vomiting is an important sign of appendicitis. Nausea and vomiting may be present in other conditions, but their absence makes appendicitis unlikely.[13] A person's risk of appendicitis is increased if he or she has a family history of appendicitis, thus you should question the patient about family history during the interview.[3] Additionally, some evidence suggests that whites are affected by appendicitis 1.5 times more often than non-whites.[3]

Patient position may be significant when evaluating abdominal pain. One article in the literature states that patients with appendicitis who experienced pain during a pelvic exam had relief of pain when placed in the Trendelenburg position, while patients with PID experienced no pain relief in this position.[16] No other study has corroborated this, however. Patients with appendicitis may feel less

pain in the right lateral decubitus position with slight hip flexion, so it is important to note the position of maximal comfort.[3]

The patient's number of episodes of pain and the length of time with pain are notable in differentiating PID and appendicitis. Typically, a shorter duration of pain is associated with appendicitis than with PID.[13] The pain associated with acute appendicitis usually lasts 24 to 36 hours before perforation, while the pain of PID can last for weeks or until treated. One study found that most women with appendicitis have a single episode of pain while women with PID may have up to three or more episodes before seeking care.[16] The progression of pain should be noted because the pain associated with acute appendicitis typically intensifies over time. As appendicitis progresses, the pain usually localizes to the right lower quadrant, whereas the pain of PID tends to remain diffuse.

Graded compression ultrasonography in the diagnosis of appendicitis can produce increased specificity and sensitivity, but accuracy ranges from 71% to 95%. Due to the often variable levels of accuracy, sonography should not supersede your judgment in diagnosing appendicitis.[17]

A more accurate test is the relatively new CT technique called FACT (focused appendix computed tomography), which has a reported diagnostic accuracy of 98%.[18] FACT is accomplished using a "helical" or spiral scan.[19] However, this type of computed tomography is not available in most hospitals, so standard abdomen or pelvic CT is recommended in lieu of the preferred appendiceal CT. The literature reports that computed tomography is more accurate than ultrasound, but that ultrasound is less expensive.[3]

For some time, Alvarado's MANTRELS scoring system — which includes eight predictive factors for appendicitis — was used as a diagnostic tool for patients with suspected appendicitis, but it has lost favor due to its lack of specificity and sensitivity.[3] However, it could be used to select patients appropriate to undergo imaging studies.[17] These eight predictive factors are: migration of pain, anorexia, nausea and vomiting, right lower quadrant tenderness, rebound pain, elevated temperature, leukocytosis and shift to the left (microscopic detection of disproportionate numbers of immature leukocytes in smears of peripheral blood).

Recommendations: Appendicitis
The most promising new development in the evaluation of appendicitis is the observation pathway for women with equivocal symptoms (Table 3).

Hospitals should develop an observation pathway by collaborating with providers in the emergency department (ED) and surgeons on staff. Inclusion criteria for patients admitted to observation units may include undifferentiated abdominal pain not clarified by initial ED evaluation and mild to moderate suspicion of appendicitis.[5]

Instead of sending a patient home with a possible misdiagnosis that could lead to perforation if appendicitis is present, the patient should be observed for more defining signs and symptoms, such as increasing level of pain, localization of pain and gastrointestinal distress. Following this pathway may also reduce the number of appendectomies without inducing significant pathology.

Patients with appendicitis typically develop more signs and symptoms during evaluation in an observation unit.[5] During observation, the patient should have repeated physical exams and pain level assessments, along with assessments of any new signs and symptoms. Serial complete blood counts (CBCs) with differentials can be useful to detect a shift to the left, an indicator of worsening infection. Although an initial CBC may not be useful in differentiating PID from appendicitis, repeated performance of this blood test can be important in diagnosing a worsening case of acute appendicitis over a period of observation.

One study states that in-hospital observation can increase diagnostic accuracy without increasing morbidity and mortality for appendicitis.[6,20] The same study found that sensitivity, specificity and accuracy of diagnosis are improved by observation.[20] This is corroborated by the American College of Emergency Physicians' clinical policy, which recommends serial evaluation in patients with an unclear etiology of abdominal pain.[4] Published data shows that the hospitals with lower normal appendectomy rates are those with formal observation programs.[5] Unfortunately, only 25% of acute-care hospitals have observation units in their emergency departments.[20]

If you are still undecided about the diagnosis of appendicitis, consult a surgeon before sending the patient home. Surgeons have a great deal of experience evaluating abdominal pain and can assist in making a final decision about an appendicitis diagnosis.[5] If you and the surgeon are unable to rule out appendicitis, an exploratory procedure may be justified.

Clinical Data: PID
History taking is an important and proven aspect of diagnosing PID as well. Teenage girls have the highest frequency of PID and are up to three times more likely than women of other age groups to contract this disease.[8] It is crucial to ask every female patient with abdominal pain whether she has ever had a chlamydia or gonorrhea infection. Most cases of PID are directly related to the organisms that cause those infections. Women with previous episodes of gonococcal PID are susceptible to recurrent PID of any type.[8]

Take a complete sexual history from each patient, including the number of sexual partners, last sexual exposure, history of sexually transmitted infections, condom use and whether her partner is monogamous. Always provide privacy during conversations about sexual activity, especially with adolescents. An adolescent patient may not have disclosed sexual activity to anyone yet.[10]

It is critical for all women with complaints of pelvic pain to undergo pelvic examination.[14] Findings of cervical discharge and cervical

erythema can assist with the diagnosis of PID and help differentiate it from other possible conditions. Evidence of *Neisseria gonorrhoeae* or *Chlamydia trachomatis* is supportive of PID.[7] The findings of 10 or more polymorphonuclear (PMN) leukocytes on a gram-stained endocervical smear is diagnostic of mucopurulent cervicitis and can help substantiate the diagnosis of PID.[11] Newer evidence documents that organisms associated with bacterial vaginosis have been found in women with laparoscopically proven PID.[21] However, it is important to realize that the sensitivity of the clinical diagnosis for PID based on a pelvic examination alone is only 60% to 70%.[21]

In situations where a male sexual partner is present, question him about his sexual history and symptoms of urethritis. With his consent, evaluate him for urethritis with a urethral Gram's stain, since at least half of urethritis cases are asymptomatic. Presence of urethritis in the patient's male sexual partner can corroborate the diagnosis of acute PID.[11]

An interesting aspect of the pertinent history in a woman with possible PID is the timing of menses. One study found that the rate of normal appendix appendectomies was highest during the menstrual and ovulation phases of the menstrual cycle.[16] Another article reports that 75% of women with PID have initial symptoms during the first 7 days of the menstrual cycle.[10] It is theorized that PID symptoms occur during the menstrual phase because organisms are transferred upward in the genital tract when there is less cervical mucus.[8]

When you palpate a mass on bimanual exam that is consistent with a tubo-ovarian abscess or pelvic abscess, order a transvaginal ultrasound rather than an abdominal ultrasound, since it allows better visualization of pelvic organs and may help stage PID.[8]

The gold standard for diagnosis of PID is laparoscopy, but it should remain the last resort due to its invasiveness. It is not readily available and is usually too expensive to justify with vague symptoms.[8] A gynecology consult may be necessary in suspected severe cases of PID.

Observation Key to Diagnosis

Abdominal pain in women of childbearing age can be difficult to diagnose. In attempting to differentiate between appendicitis and PID, many aspects of the history, physical examination and clinical data can help clarify the diagnosis. However, some of the data historically used in differentiating appendicitis and PID have not proven useful in studies. Due to the established safety associated with emergency department observation units, observation should be utilized when you are undecided about the diagnosis after performing a thorough history and physical exam.

Several studies have attempted to identify a radiologic imaging study that is more definitive for PID or appendicitis, but so far no readily available test has adequate specificity or sensitivity.[9,15,17,22] No diagnostic tools used in history taking or the physical exam have elicited adequate sensitivity or specificity either. Therefore, rely on the clues discussed in this article to establish the best diagnosis.

The studies reviewed for this article used adequate methods to develop information relating to women with lower abdominal pain. However, the health care settings where patients presented for treatment tended to be similar. The emergency department was the major focus for all studies. Most disappointing is that several of the most interesting studies are outdated and need to be replicated. For example, a 1985 retrospective study that compared women with PID and appendicitis discovered the pain responses of women placed in Trendelenburg position.[16] If verified, this information could be helpful in differentiating these two conditions.

Retrospective study of the diagnostic process used to correctly diagnose appendicitis or PID in women with atypical symptom presentation could prove useful. Further, chart review of misdiagnosed cases might identify common problem areas in the diagnostic process. Improved imaging techniques will provide more definitive diagnostic tests for PID and appendicitis. Finally, while it is appropriate to focus most research on presentations of appendicitis and PID in the emergency departments of hospitals, more research about presentations in primary care settings is needed to determine whether differences exist.

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References

1. Pisarra VH. Recognizing the various presentations of appendicitis. *The Nurse Practitioner*. 1999;24:42,44,49,52,53.
2. Baines PA, Allen GM. Pelvic pain and menstrual related illness. *Emerg Med Clin North Am*. 2001;19:763-780.
3. Graffeo CS, Counselman FL. Appendicitis. *Emerg Med Clin North Am*. 1996;14:653-671.
4. American College of Emergency Physicians. Clinical policy: critical issues for the initial evaluation and management of patients presenting with a chief complaint of nontraumatic acute abdominal pain. *Ann Emerg Med*. 2000;36:406-415.
5. Graff LG, Robinson D. Abdominal pain and emergency department evaluation. *Emerg Med Clin North Am*. 2001;19:123-136.
6. Rothrock SG, Green SM, Dobson M, Colucciello SA, Simmons CM. Misdiagnosis of appendicitis in nonpregnant women of childbearing age. *J Emerg Med*. 1995;13:1-8.
7. Hewitt GD, Brown RT. Acute and chronic pelvic pain in female adolescents. *Med Clin North Am*. 2000;84:1009-1025.
8. Lawson MA, Blythe MJ. Pelvic inflammatory disease in adolescents. *Pediatr Clin North Am*. 1999;46:767-782.
9. Rypins EB, Kipper SL, Weiland F, Neal C, Line B, McDonald R, et al. 99mTc Anti-CD monoclonal antibody (LeuTech) imaging improves diagnostic accuracy and clinical management in patients with equivocal presentation of appendicitis. *Ann Surg*. 2002;235:232-239.
10. Paradise JE, Grant L. Pelvic inflammatory disease in adolescents. *Pediatr Rev*. 1992;13:216-223.
11. Quan M. Diagnosis of acute pelvic pain. *J Fam Pract*. 1992;35:422-431.
12. Silver BE, Patterson JW, Kulick M, Schadt ME, Heller MB. Effect of CBC results on ED management of women with lower abdominal pain. *Am J Emerg Med*. 1995;13:304-306.

13. Bongard F, Landers DV, Lewis F. Differential diagnosis of appendicitis and pelvic inflammatory disease: A prospective analysis. *Am J Surg*. 1985;150:90-96.
14. Hardin DM. Acute appendicitis: review and update. *Am Fam Physician*. 1999;60:2027-2034.
15. Wilcox RT, Traverso LW. Have the evaluation and treatment of acute appendicitis changed with new technology? *Surg Clin North Am*. 1997;77:P1355-P1370.
16. Najem AZ, Barillo DJ, Spillert CR, Kerr JC, Lazaro EJ. Appendicitis versus pelvic inflammatory disease: A diagnostic dilemma. *Am Surg*. 1985;51:217-222.
17. Douglas CD, Macpherson NE, Davidson PM, Gani JS. Randomised controlled trial of ultrasonography in diagnosis of acute appendicitis, incorporating the Alvarado score. *BMJ*. 2000;321:1-6.
18. Jack DB. Diagnosis of appendicitis: getting it right every time? *Lancet*. 1997;349:1076.
19. Wolfe YL. Just say no: test reduced need for appendix removal. *Prevention*. 1997;49:62.
20. Graff L, Radford MJ, Werne C. Probability of appendicitis before and after observation. *Ann Emerg Med*. 1991;20:503-507.
21. Paavonen J. Pelvic inflammatory disease: from diagnosis to prevention. *Dermatol Clin*. 1998;16:747-756.
22. Chen SC, Wang HP, Hsu HY, Huang PM, Lin FY. Accuracy of ED sonography in the diagnosis of acute appendicitis. *Am J Emerg Med*. 2000;18:449-452.