Pelvic Pain: Ultrasound of the Bowel

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KEYWORDS

• Ultrasound • Bowel • Appendicitis • Diverticulitis
• Crohn's disease • Pelvis

RIGHT LOWER QUADRANT PAIN: GASTROINTESTINAL ULTRASOUND

Ultrasound (US) is a useful modality for women of reproductive age presenting with acute or chronic lower quadrant pain. It is superior to CT for the evaluation of the uterus and ovaries, does not involve radiation, and is widely available. The most recent American College of Radiology Appropriateness Criteria for acute pelvic pain in the reproductive age group states that transvaginal US should be used as the initial test when obstetric or gynecologic etiologies are suspected.[1] In the setting of a negative β-hCG result and a clinical suspicion of gastrointestinal (GI) or genitourinary disease, a CT scan is a useful first test.[1] Clinical diagnosis, however, can be especially challenging in reproductive women because gynecologic causes, such as tubo-ovarian abscess, ruptured ovarian cyst, and ovarian torsion, can have a similar presentation to GI tract disease. Pelvic pain, fever, nausea, vomiting, and an elevated white count are nonspecific. When a uterine or ovarian cause for a patient's symptoms is not found on US, a systematic search must be performed for nongynecologic causes, including diseases of the bowel. Correctly diagnosing both gynecologic and nongynecologic causes of pelvic pain on US allows appropriate triaging and correct initiation of medical versus surgical therapy. This avoids unnecessary radiation and laparotomy. An understanding of both transabdominal and transvaginal sonography of the GI tract is, therefore, essential in performing a complete pelvic evaluation of premenopausal women presenting to the US department with pelvic pain. This article includes a review of the anatomy of the GI tract and bowel wall in addition to the techniques used to perform a thorough evaluation of the bowel with US. GI causes of pelvic pain are then discussed, including appendicitis, diverticulitis, inflammatory bowel disease, epiploic appendagitis, omental infarction, and infection.

ANATOMY

The stratified appearance of the normal bowel wall on US reflects its histologic construction (**Fig. 1**). The innermost echogenic line corresponds to the interface between the mucosa and the lumen. The next concentric hypoechoic ring is the muscularis mucosa, followed by the echogenic submucosa and finally by the outermost hypoechoic muscularis propria. Histologically this muscular layer is composed of a longitudinal layer and a circular layer; however, these 2 layers are not resolved on US. The serosa is the outermost thin echogenic line but is not always visible because it blends in with the adjacent echogenic fat. This concentric arrangement is constant throughout the GI tract from the esophagus to the rectum, including the appendix. Of CT, MR imaging, and US, US is the only modality to resolve all 5 layers, which makes it particularly useful in evaluating the bowel.

Understanding the mesenteric attachments is important when evaluating the bowel by any modality. On US, knowledge of which segments are fixed in position and which segments are mobile aids in localizing the segment of interest. A mesentery is a double layer of visceral peritoneum that wraps around a segment of bowel and attaches it to the posterior abdominal wall. The small bowel mesentery attaches along the posterior abdominal wall in a line from the left side of L2 downwards and rightwards toward the

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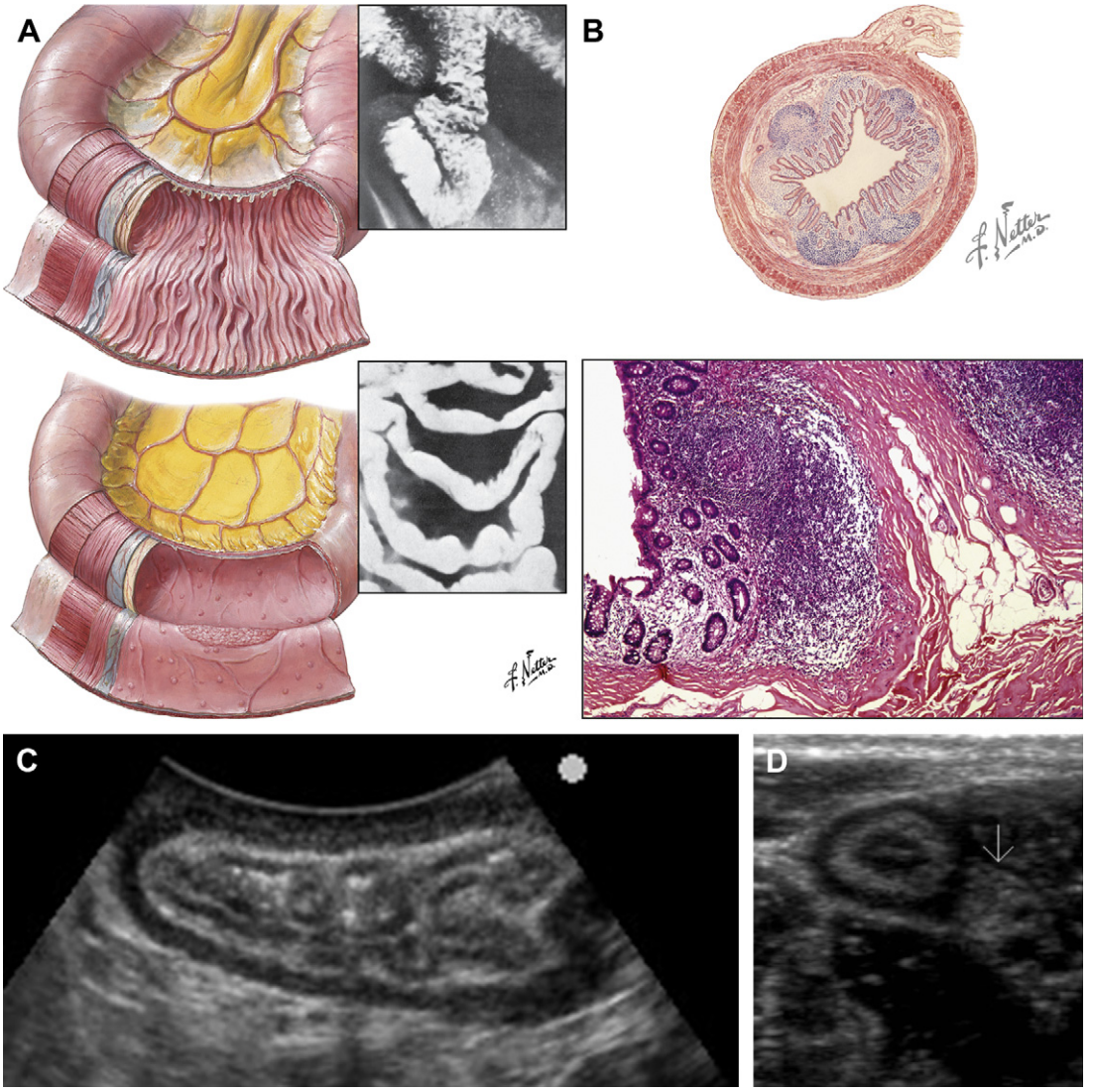

Fig. 1. (*A*) Netter diagram illustrating the layers of the bowel wall. (*upper panel*) Jejeunum with correlation on a barium study, (*lower panel*) ileum with correlation on a barium study. (*B*) Netter diagram illustrating the histologic arrangement of the bowel wall layers; shown both as a schematic (*upper illustration*) and on a histologic specimen (*lower illustration*). (*C*) US image of the normal stomach in cross section demonstrating the concentric echogenic and hypoechoic rings. (*D*) Abnormal appendix in cross section demonstrating the rings and adjacent mesoappendix (*white arrow*). ([*A, B*] Netter illustration from www.netterimages.com.)

right sacroiliac joint. This is the root of the small bowel mesentery. The superior mesenteric artery and superior mesenteric vein run between the 2 layers of peritoneum entering at the root. This posterior line of attachment is short but fans out to the free edge of the small bowel mesentery where the small bowel is located. The free edge of the small bowel mesentery is, therefore, essentially the length of the entire small bowel (approximately 6 m). This allows the small bowel to be mobile, making it difficult on US to be precise about location along the small bowel.

The cecum is the segment of large bowel inferior to the ileocecal valve. This valve is a landmark on US. The cecum does not have its own mesentery and has a variable attachment to the posterior abdominal wall. This accounts for the anatomic variability in position and mobility of the cecum observed in normal individuals (**Fig. 2**). This is an important point to understand when trying the find the cecum, terminal ileum, and appendix on US.

The appendix arises from the cecum posteromedial to the ileocecal valve and approximately 2.5 cm inferior. The length of the appendix is