

# Diagnostic Imaging Review

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**FIGURE 1.** Axial CT demonstrates a round structure in the right lower abdomen (arrow), with enhancement of its wall and surrounding mesenteric fat stranding.

## Appendicitis: What helps to make the diagnosis?

### CASE

A 73-year-old female presented to the emergency department with nontraumatic abdominal pain in the right lower quadrant (RLQ). She stated that the pain began several hours earlier and had been almost continuous. She had no significant medical history and took no medications. She had not had a bowel movement since the pain began, but she denied seeing any blood in the stool prior to this. Her WBC count was minimally elevated. She was

afebrile. There was moderate tenderness to palpation in the RLQ. CT of the abdomen was performed with IV, oral, and rectal contrast (see Figure 1 and Figure 2, page 80). **What do these images reveal?**

### DISCUSSION

Figure 1 is an axial CT image demonstrating a round structure in the right lower abdomen, with enhancement of its wall and surrounding mesenteric fat stranding. This structure can be fol-

lowed to the cecum and is compatible with a diagnosis of appendicitis. Figure 2 is a coronal image from the same patient that was reconstructed from the axial images. Notice the tubular structure in the right lower quadrant, with wall thickening and surrounding edema and fat stranding.

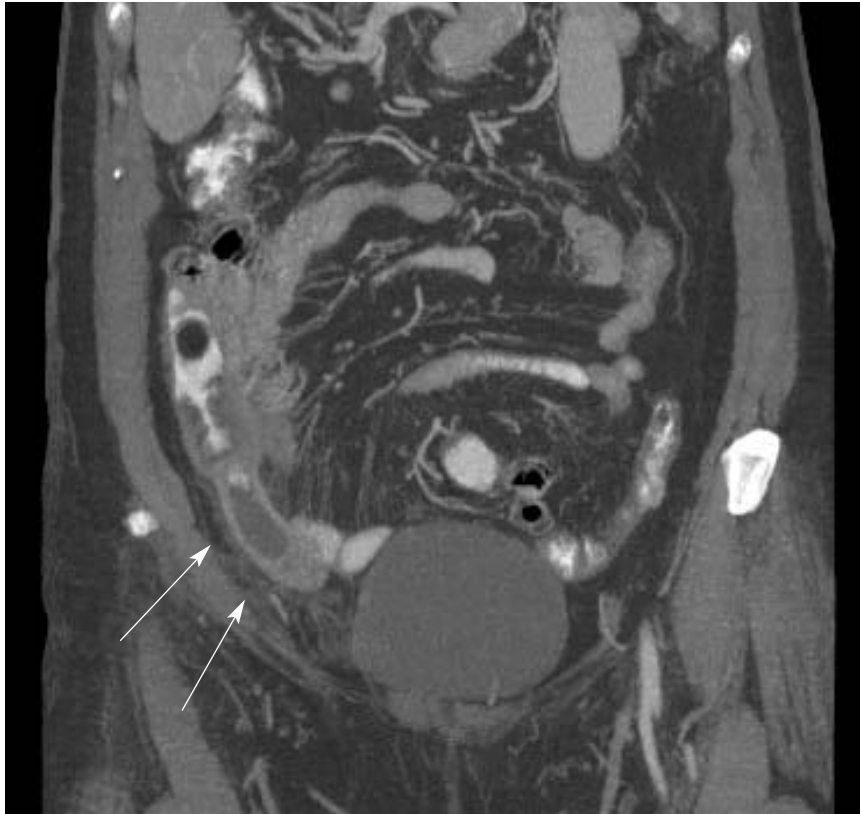
**Appendicitis** is a common cause of abdominal pain. It is the most common cause for abdominal surgery in pediatric patients, but it can develop at almost any age. The diagnosis can be difficult to make because the differential can be extensive and the manifestations are variable. Clinicians must be able to diagnosis appendicitis in a timely manner, as the complications can be devastating and deadly and they can progress rapidly.

Typical symptoms of appendicitis usually include pain in the RLQ of the abdomen. This pain may start in the umbilical region. The patient may complain of decreased appetite, nausea, vomiting, and low grade fever. The patient may move slowly and avoid sudden movements because of the pain. These symptoms, however, can also be seen with other problems, including inflammatory bowel disease, intussusception, mesenteric adenitis, cecal diverticulitis, epiploic appendagitis, carcinoma, omental infarction, urinary tract infection or stones, pancreatitis, cholecystitis, perforated ulcer, or one of several gynecologic conditions such as pelvic inflammatory disease, ovarian torsion, ectopic pregnancy, or ovarian cyst. This wide differential can make the diagnosis difficult. The WBC count may be slightly elevated with appendicitis; however, other infectious/inflammatory processes in the differential diagnosis can also have this effect. A urine pregnancy test is important to exclude ectopic pregnancy in women of reproductive age. A urinalysis may be helpful, if negative, in including a urinary tract infection.

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**FIGURE 2.** Coronal CT reveals a tubular structure in the right lower quadrant, with wall thickening and surrounding edema and fat stranding.

**Radiology** can be helpful in diagnosing appendicitis, particularly when the manifestations are atypical. Abdominal radiographs are of limited value. They may demonstrate an appendicolith (a calcification within the appendix), and although this has a high association with appendicitis, it is only seen in a small percentage of patients. If the bowel is perforated, pneumoperitoneum may be seen on the upright projections, but this is not specific for appendicitis. The bowel gas pattern can vary.

Ultrasound has been used to evaluate for appendicitis. This is a rapid, noninvasive study and does not involve ionizing radiation. However, it is highly operator dependent and can be of limited usefulness in obese patients. Also, a normal appendix usually cannot be demonstrated with ultrasound. When positive, the ultrasound may

demonstrate a tender tubular or round structure with a transverse diameter of greater than 6 mm in the expected location of the appendix.

**CT** is able to accurately diagnose 94% to 98% of cases of appendicitis.<sup>1,3</sup> The technique used, however, differs by location and by radiologist preference. The disadvantages and advantages of utilizing CT in the diagnosis of appendicitis vary, depending on technique. One disadvantage of CT, in general, is the use of ionizing radiation. This is especially important because most patients with appendicitis are young and may not yet have had children.

Radiologists disagree about the best technique to evaluate for appendicitis with CT.<sup>2</sup> The points of controversy include whether IV contrast should be given; whether enteric contrast should be given, and if so, by what route; and whether the entire abdomen and pelvis

should be scanned or just the area of concern. Covering only the area of concern does reduce the patient's radiation exposure; however, it also increases the risk of missing what is causing the patient's symptoms. Therefore, most imaging centers will scan the entire abdomen and pelvis.

In **unenhanced CT**, no IV, oral, or rectal contrast is given. This approach has the advantages of both avoiding any delay in scanning and avoiding any of the risk associated with IV contrast. Interpreting the images can be challenging, however, particularly if the patient has little peritoneal fat. When the patient is thin and contrast is not used, the lack of fat can make it difficult to differentiate between bowel and adjacent structures, such as vessels, ovaries, or ureters.

The use of **enteric contrast** can decrease the number of false-negative CT studies. With rectal contrast administration, 800 to 1,500 mL of water-soluble contrast is given to fill the colon to the cecum. This allows the radiologist to evaluate for wall thickening in the cecum or filling of a nonobstructed appendix. Rectal contrast administration permits the examination to be completed in a timely manner. The disadvantages of this method are patient discomfort and the inconsistent opacification of the cecal region.

Giving **oral contrast** delays imaging by at least 1 to 2 hours. This, of course, can delay diagnosis and treatment. In addition, the transit time of contrast through the bowel is variable, which can result in scanning the patient too early or too late, when the cecal area is not optimally opacified with contrast. This potentially exposes the patient to additional radiation. Also, the patient may not be able to tolerate oral contrast.

The administration of **IV contrast** can be helpful in many ways when evaluating for appendicitis with CT. An inflamed appendix may show enhancement of its wall, which can be particularly helpful in thin patients. Complications associated with appen-

dicitis, such as perforation, abscess, or septic seeding of the mesenteric-portal venous system, may be better identified. Other causes of abdominal pain, including pancreatitis, pyelonephritis, or inflammatory bowel disease may be better visualized. The disadvantages of IV contrast include cost and the risks associated with administration of contrast, including the possibility of an allergic reaction.

**Several findings on CT** can suggest or confirm appendicitis. The appendix may appear thickened. Typically, an outer-wall to outer-wall diameter of greater than 6 mm is considered diagnostic; however, some radiologists consider a measurement of 6 to 10 mm to be indeterminate, and greater than 10 mm to be compatible with appendicitis. The wall of the appendix should not be greater than 3 mm thick. If IV contrast is used, enhancement of the appendiceal wall is compatible with

appendicitis. An appendicolith may be present; however, this is not diagnostic. Periappendiceal fat stranding, fluid collections, phlegmon, or ileocecal lymphadenopathy may be noted. The lateral conal fascia may appear thickened. The cecal wall may also appear thickened. The *arrowhead sign* may be present, which is thickening of the cecal wall, centered at the origin of the appendix. This finding is only applicable when there is contrast within the cecum. The contrast may appear to resemble an arrowhead, pointing toward the appendix. The *cecal bar sign*, which describes the appearance of the inflamed soft tissue at the base of the appendix that separates the contrast-filled cecum from the appendix, is another indicator of appendicitis.

Complications of appendicitis can include bowel obstruction, septic seeding of the mesenteric-portal venous system, appendiceal ischemia with result-

ant necrosis and possible perforation, abscess formation, and peritonitis. CT can identify abscesses, but the source may not be readily apparent. Septic seeding of the mesenteric-portal venous system can be seen if IV contrast is utilized. The use of IV contrast can help differentiate bacterial peritonitis from ascites. Perforation can be detected as free air within the abdomen, but again, the site of perforation may not be evident. These complications, of course, greatly increase the patient mortality, making prompt diagnosis all the more important. [JAAPA](#)

#### REFERENCES

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3. See TC, Ng CS, Watson CJE, Dixon AK. Appendicitis: spectrum of appearances on helical CT. *Br J Radiology*. 2002;75(897):775-781.