Spiral CT Findings in Complicated Appendicitis: Pictorial Essay

M. Sanei Taheri MD[1]
H.R. Haghighatkhah MD[1]
Sh. Birang MD[2]
Y. Moharamzad MD[3]
F. Jamali MD[3]

Acute appendicitis is one of the most common causes of acute abdomen which usually presents with right lower abdominal pain. Although physicians have enough information about this disease, its atypical presentations occasionally become challenging. Nowadays, the role of spiral computed tomography (CT) scan—as a diagnostic modality for lowering the rate of negative appendectomy and ruling out differential diagnoses—is increasing. In this pictorial essay, we describe abdominal spiral CT findings of patients presented with complicated appendicitis to our emergency unit during a two-year period.

Keywords: Appendicitis, Spiral Computed Tomography, Complication

Introduction

Acute appendicitis occurs when the lumen of the appendix is obstructed, leading to fluid accumulation, inflammation and finally perforation of the appendix. Appendicitis is one of the most common causes of acute abdominal pain. It is the most common disease that requires surgical treatment. Diagnosis is made according to both clinical and laboratory findings; including fever, pain and rebound tenderness in the right lower quadrant (RLQ) and leukocytosis.[1] However, atypical symptoms are seen in one-third of the patients and making an accurate diagnosis is difficult in these cases.[2,3] There are abdominal conditions which are considered as differential diagnosis of appendicitis. In contrast to acute appendicitis, some similar presentations do not necessitate surgical intervention.

The negative appendectomy rate has been reported to be up to 29% according to both clinical and laboratory findings.[4-7] Diagnosis of acute appendicitis in children is more challenging than adults, and is often delayed or missed.[8] As a result, complications such as perforation are seen with a higher frequency among children than adults. In addition, some typical presentations of appendicitis such as localized pain in the RLQ, fever or leukocytosis may be absent or minimal in children.[9]

For avoiding an increased rate of morbidity and mortality and decreasing the rate of unnecessary appendectomies in patients with acute abdomen, accurate and quick diagnosis is necessary.[3] The diagnostic accuracy of imaging devices such as ultrasound and CT scan for acute appendicitis is very high in both children and adults. The rate of negative appendectomy has been lowered to below 10% by using these methods.[4]

Ultrasound is a non-invasive and fast technique that is available and cheap and does not have ionizing radiation. However, it is highly operator dependent and requires high levels of experience and skill. It also can be difficult to make diagnosis just according to ultrasound findings in some situations such as severe pain, underlying gas, and in obese patients.[2]

CT scan with oral and intravenous contrast medium has a great effect in non-invasive evaluation of appendicitis. Reported sensitivity and specificity of

1. Associate Professor, Department of Radiology, Shohada Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2. Associate Professor, Department of Radiology, Loghman Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
3. Department of Radiology, Shohada Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Corresponding Author:
Morteza Sanei Taheri
Address:Department of Radiology, Shohada Tajrish Hospital, Tajrish Sq.,Tehran, Iran
Tel: +9821-2271-8003
Fax: +9821-2271-9012
E-mail: saneim@yahoo.com

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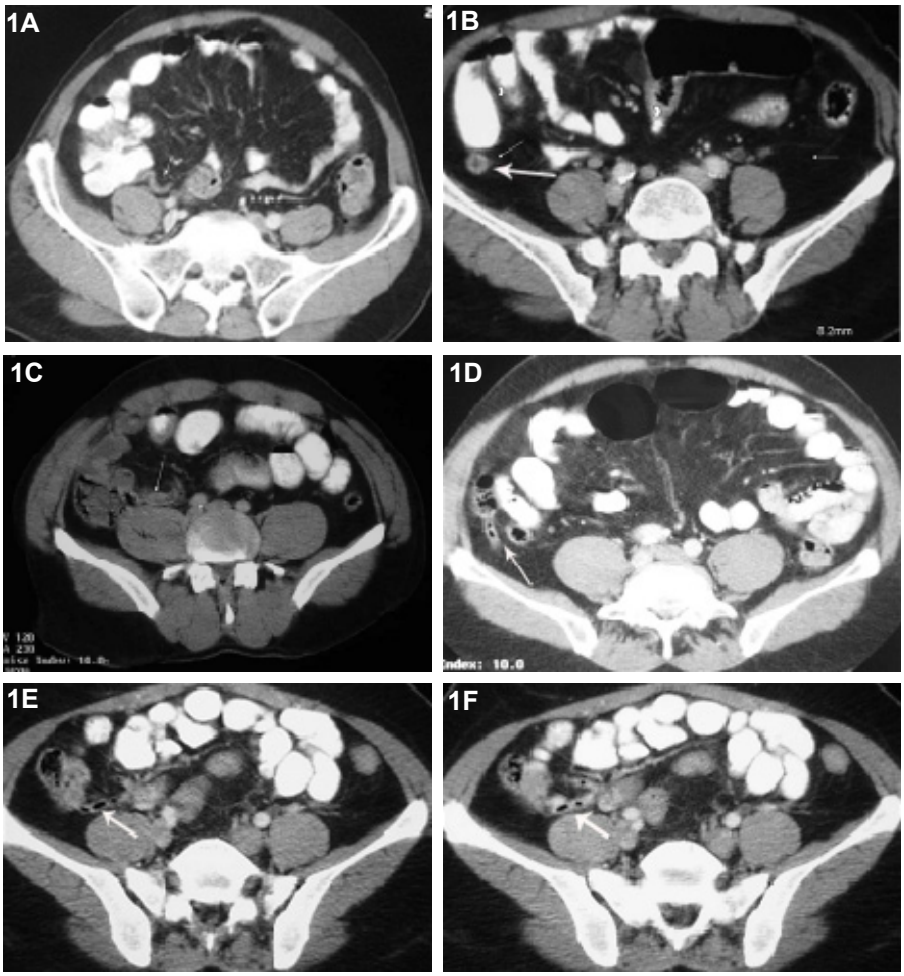


Fig. 1. Presentations of the normal appendix in spiral CT scan.
A. Appendix with normal diameter in a 45-year-old man, contrast media is seen inside the lumen (arrow).
B. Normal appendix (thick white arrow) in a patient with no specific symptoms related to acute appendicitis. Appendix is smooth with no fatty infiltration (thin white arrow). Serous-serous diameter is 8.2 mm (black line). Appendicular wall enhancement is similar to the other parts of small intestinal loops (arrowheads).
C. Fecal materials are visible inside the lumen of the appendix (arrow).
D. Retrocecal appendix (arrow) with a normal diameter and air inside the lumen.
E. Air inside the lumen of a normal appendix (arrow).
F. Air and contrast media (arrow) are seen inside the lumen of a normal appendix.

Fig. 2. A 30 -year-old man with abdominal pain and tenderness in the RLQ. The patient underwent laparotomy and the diagnosis was confirmed by histopathologic examination.
A-C. Serous-serous diameter is 10.8 mm and periappendiculocecal fat stranding is shown. Wall thickening and increased enhancement of the appendicular wall is seen (arrow).

CT are 96% and 89%, respectively. Its accuracy (94%) is higher than ultrasound (91%), and is less operator dependent.[10,11] As a result CT has been chosen as the technique of choice for imaging the evaluation of acute appendicitis in many medical centers in the recent years. The important benefit of CT is that it shows the appendix, periappendiceal tissues and intra abdominal structures with a high resolution. CT considerably affects the management of appendicitis by visualization of the severity and extension of the inflammatory process. It has been shown that the use of thin section collimation CT (5mm) in the RLQ increases the probability of visualization of appendicitis.[10] Wagner et al. showed that with the increased use of CT, a significant decrease was achieved with respect to the negative appendectomy rate, particularly among adult women.[12] In another retrospective study,[13] CT scans and medical records of patients who complained from RLQ pain were reviewed to compare CT scan and the Alvarado score. It revealed that

Fig. 3. Spiral CT image with intravenous contrast material in an 11-year-old boy with malaise, high fever, and severe tenderness in the RLQ. CT-guided abscess drainage was performed.
A&B. A well-defined abscess (50×40 mm) lying at the anterior aspect of the right psoas muscle, inferior to the cecum is seen as a rim enhancement. Air foci (thin black arrow in B) and an extraluminal calcified appendicolith (diameter, 3mm arrow in A) are seen inside the abscess with infiltration of the surrounding retroperitoneal fat (thick black arrow in B).

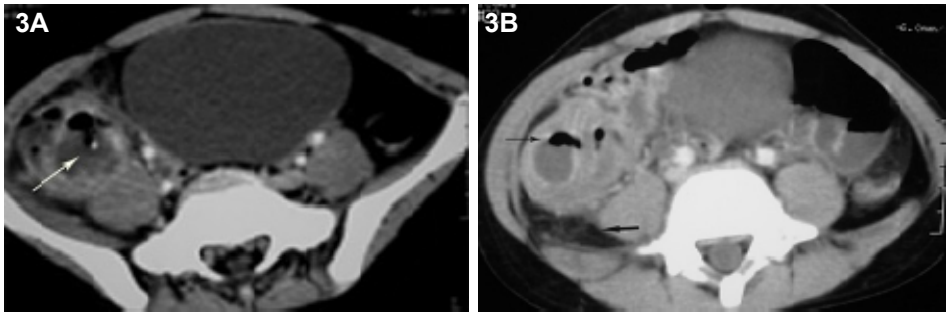
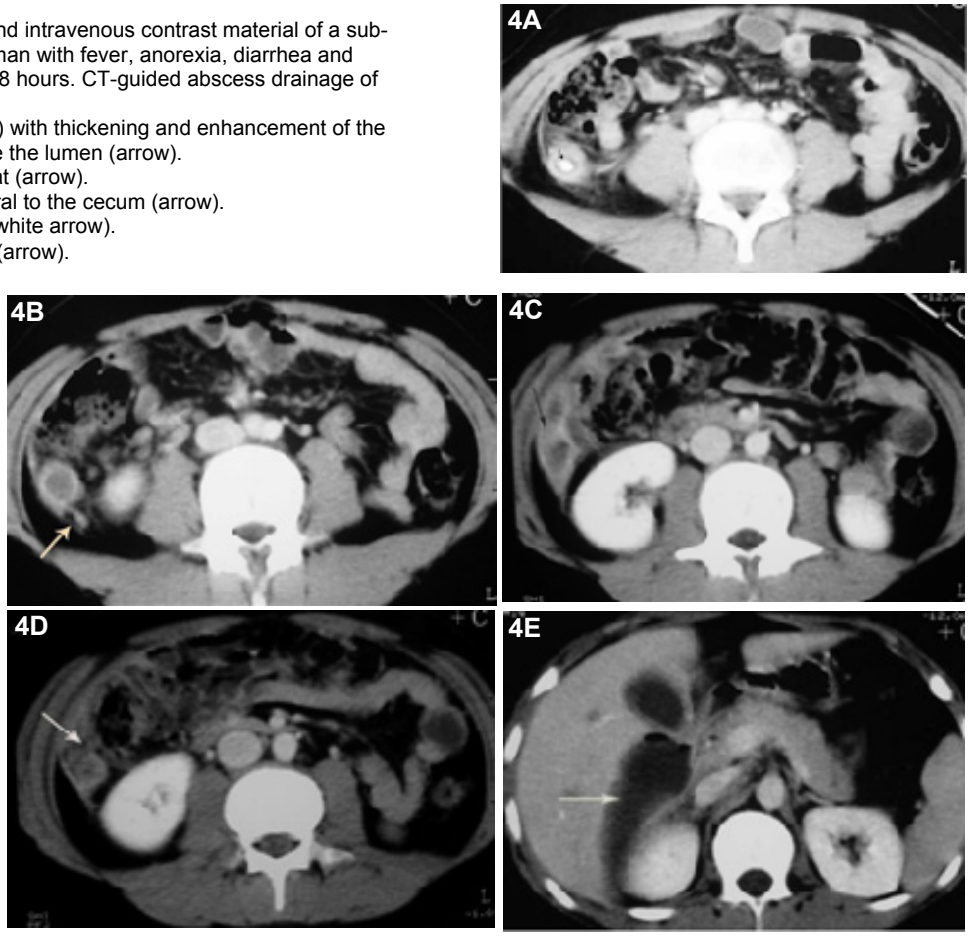


Fig. 4. CT scan with gastrointestinal and intravenous contrast material of a subhepatic abscess in an 18-year-old woman with fever, anorexia, diarrhea and vague abdominal pain that lasted for 48 hours. CT-guided abscess drainage of 80 cc infected fluid was performed.
A. Dilated appendix (diameter>10 mm) with thickening and enhancement of the appendicular wall. Appendicolith inside the lumen (arrow).
B. Infiltration of the periappendicular fat (arrow).
C. The appendicular tip is located lateral to the cecum (arrow).
D. Focal defect in the enhanced wall (white arrow).
E. Subhepatic infected fluid collection (arrow).



the overall area under the receiver operating characteristic curves for CT and the Alvarado score was 0.965 (highly accurate) and 0.732 (moderately accurate), respectively. The authors concluded that the Alvarado score should be supplemented with CT examination for the accurate diagnosis of acute appendicitis. However, CT has some limitations, of which the most important is the ionizing radiation.[2]

Normal appendix has variable appearances on CT scan. It typically originates from the tip of the cecum in the posteromedial direction, one to four centimeters below the ileocecal valve.[2,10] When the cecum is mobile, the appendix may rarely originate from lateral locations.[8] It ranges from 4 to 25 centimeters, with a diameter of 6 mm in the outer wall.[11]

Generally, presence of fluid, air, fecal materials, and contrast medium inside the lumen of the appendix is considered non-pathogenic.

In case of acute appendicitis, CT findings are mainly divided into three categories as follows: appendicular,

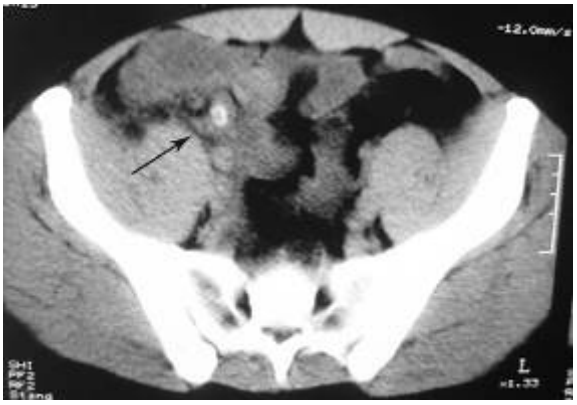


Fig. 5. Spiral CT image without contrast medium in a 27-year-old man shows an appendicolith (diameter, 10 mm) inside the appendicular lumen (black arrow), fatty infiltration, and a fluid collection (50 × 30 mm).

Fig. 6. Spiral CT image with enteric and intravenous contrast material from a 31-year-old woman shows a phlegmon without rim enhancement at the right side of the pelvis (arrow).

Fig. 7. An ill-defined heterogeneous enhancement at the right side of the pelvis, anterior aspect of psoas muscle (white bidirectional arrow), adjacent to the right and anterior parts of the uterine(black bidirectional arrow) is seen on the spiral CT of a 30-year-old female indicating a phlegmon with fatty infiltration (white arrow) –enteric and intravenous contrast materials were used.

cecal, and periappendicular.

1. Appendicular findings include: increased thickness of the appendix more than 10 mm (a hallmark), increased thickness of the appendicular wall (>3 mm), enhancing wall, stratification of the wall, appendicolith within the lumen of the appendix (especially in asymptomatic patients), and intramural air.

2. Cecal findings include increased cecal-apical thickness, the arrowhead sign (cecal wall thickening centered on the appendicular orifice), and enteric contrast material in the cecal lumen which refers to the abnormal appendix and assumes a triangular configuration. The cecal bar sign is indicative of an inflammatory process of soft tissues at the base of the appendix that separates the appendix from the contrast-filled cecum.

3. Inflammatory findings are fat stranding, thickening of the lateroconal fascia, extraluminal fluid, phlegmon, mild lymphadenopathy and inflammatory thickening of contiguous structures.

Abdominal CT also has an outstanding role in perforated appendicitis. Five specific signs on the CT suggestive of perforation are extraluminal air, extraluminal appendicolith, abscess, phlegmon and a defect in the enhanced wall.[11] Tsai et al.[14] showed that among patients with perforated appendicitis, CT findings of either fat stranding with remarkable fluid content or abscess would suggest the presence of severe inflammation and is accompanied by adverse surgical outcomes. In addition, extraluminal appendicolith was more frequently reported on the CT scans of patients who developed complications after appendectomy.

In this pictorial essay, we have first shown some presentations of the normal appendix in spiral CT scan. Then, various findings of perforated and non-

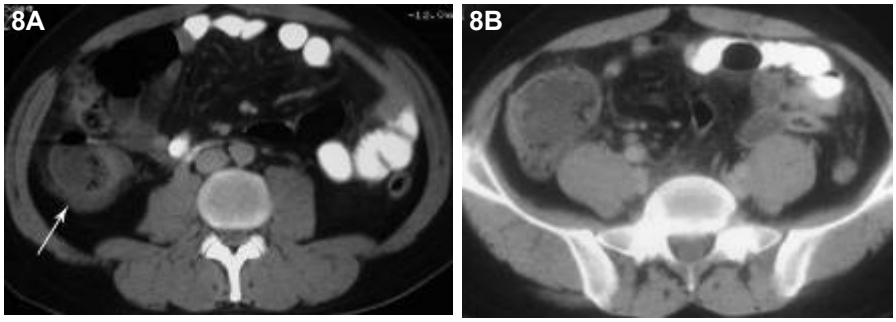


Fig. 8. Spiral CT of a 40-year-old man with generalized guarding and tenderness of the abdomen. Perforated appendix was confirmed by laparotomy.

A&B. Dilatation of the cecum and terminal ileal loops with infiltration of the pericecal fat (arrow).

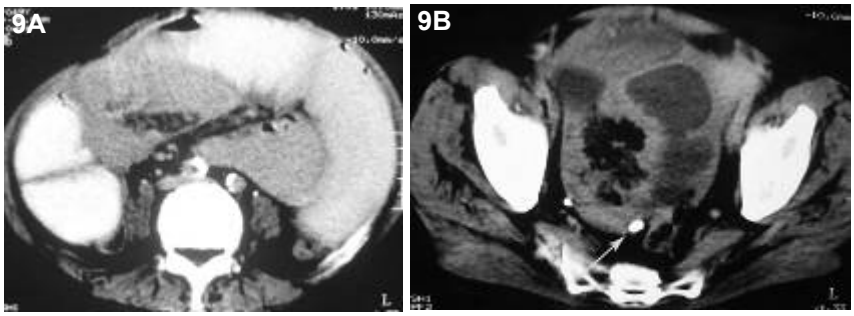
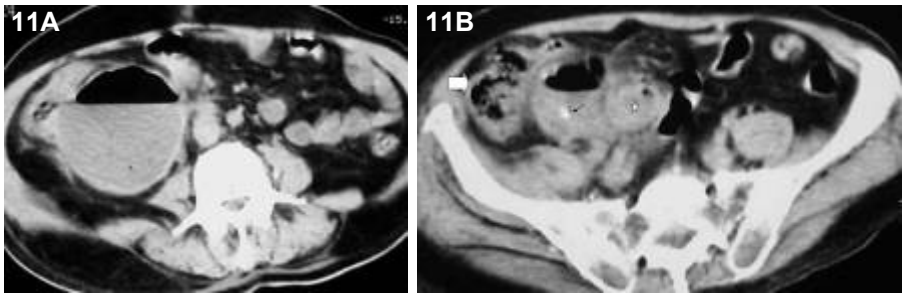


Fig. 9. Spiral CT with gastrointestinal and intravenous contrast medium in a 40-year-old man presented with nausea and vomiting, and abdominal distension since 11 days earlier. The patient underwent laparotomy with the diagnosis of complicated pelvic appendicitis.

A&B. Severe dilatation of the small intestinal loops. Diameter of the colon is normal. At the right side of the pelvis, an air density outside the lumen is seen that has been walled off by intestinal loops. A hyperdense oval-shaped density with 10 mm length is seen, suggesting an extraluminal appendicolith (arrow in B).

Fig. 10. Retrocecal appendicitis with phlegmon on the spiral CT of a 50-year-old man with abdominal pain and positive rebound tenderness. The patient underwent laparotomy, in which retrocecal appendicitis with phlegmon was confirmed.
Cecal deformity (long arrow) and severe infiltration of pericecal fat at the lateral side which is continued to the psoas muscle (arrowhead). Short arrow shows the arrowhead sign.



Figs. 11. A 40-year-old man with fluid collection in the abdomen.

A&B. Fluid collection is seen at the medial side of the cecum measuring 80 × 70 mm with an air-fluid level. Inferior to the collection, a hyperdense lesion (diameter, 6 mm) compatible with extraluminal appendicolith is seen (black arrow). Walled off intestinal loop (star) is presented. Thick arrow displays the cecum.

perforated appendicitis with or without complications are depicted. These images were gathered from patients with atypical symptoms of appendicitis who presented to our emergency department during a two-year period. Abdominal CT, using thin section collimation with oral and intravenous contrast materials, was performed. Following the primary diagnosis, laparotomy or percutaneous interventions were done. All diagnoses were confirmed by histopathologic examination of the removed specimens during the performed procedures.

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