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Computed Tomography (CT) Findings of a Diagnostic Dilemma: Atypically Located Acute Appendicitis

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Summary

Background:

Acute appendicitis is an emergent surgically treated disease generally represented by right lower abdominal pain. The most common location of the appendix is descending intraperitoneal. However, it can also show atypical locations such as inguinal canal, femoral canal, subhepatic, retrocecal, intraperitoneal abdominal midline and left side in situs inversus or intestinal malrotation patients. Atypical location can lead to atypical clinical presentations. Ultrasonography is the first choice modality for imaging. However, it can be insufficient for demonstration of the appendix. Therefore, computed tomography (CT) is needed for further examination. We aim to review the CT findings of atypically located acute appendicitis with cases and remind the clinicians and radiologists the importance of the prompt diagnosis.

Case Report:

We presented five atypically-located appendix cases, including four with acute appendicitis that presented to our emergency department with acute abdominal pain. Two of the acute appendicitis cases had normal, the other two had elevated white blood cell count, but all of them had elevated CRP. Ultrasonography imaging was performed as a first-line imaging modality. Because of the inconclusive results of both clinical-laboratory findings and ultrasonography, CT imaging was performed. Abdominal CT demonstrated all of the atypically localised appendices successfully, which were left-sided in a malrotated patient, retrocecal, subhepatic, retrocecal ascending, intraperitoneal abdominal midline localised.

Conclusions:

Atypically located acute appendicitis can show atypical presentation and result in misdiagnosis. If ultrasonography is inconclusive, we suggest abdominal CT in such confusing, complicated cases, because misdiagnosis or delay in the right diagnosis can result in complications and increased morbidity and mortality rates.

MeSH Keywords:

Abdomen, Acute • Appendicitis • Multidetector Computed Tomography

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Background

Acute appendicitis is an emergent surgically treated disease generally represented by right lower abdominal pain [1]. The most common location of the appendix is descending intraperitoneal [2,3]. However, the appendix can also show atypical locations such as inguinal canal, femoral canal, subhepatic, retrocecal, intraperitoneal abdominal midline and left side in situs inversus or intestinal malrotation patients [4]. Atypical location can lead to atypical clinical presentations. Subhepatic, retrocecal ascending appendicitis can present with right upper abdominal pain or right

side pain, and be confused with acute cholecystitis, pyelonephritis, renal/ureter stone, cecal/ascending colon diverticulitis, terminal ileitis, neoplasm and irritable bowel syndrome [5,6]. Left-sided appendicitis generally presents with left lower abdominal pain and is confused with diverticulitis or gynecological pathologies. Inguinal canal and femoral canal-located appendicitis can present with groin pain [1,7]. In such cases ultrasonography (US) is the first-choice modality for diagnosis. However, it can be insufficient for the demonstration of the appendix. Therefore, computed tomography (CT) is needed for further examination. CT imaging plays a crucial role in the rapid and valid

diagnosis in such confusing, complicated cases [8,9]. We aimed to review the CT findings of atypically located acute appendicitis with cases, and remind the clinicians and radiologists the importance of early diagnosis.

Case Report

Patients that presented to our emergency department with acute abdominal pain had C-reactive protein (CRP) and total blood count tests. Then ultrasonography examination was performed as the first-line imaging modality. Because of the inconclusive results of both clinical-laboratory findings and ultrasonography, CT imaging with intravenous (iv) nonionic iodinated contrast material (100 cc, 5 cc/sec through 18 gauge iv catheter) administration acquired in the portal venous phase was performed using 16-sliced MDCT (Siemens Somatom Emotion).

Case 1

A 29-year-old male patient presented to the emergency department with left lower abdominal pain. White blood cell (WBC) count was normal, CRP was elevated (10.5 mg/L). Abdominal CT scan with iv contrast was performed for prediagnosis of diverticulitis. The cecum and ascending colon were on the left side and the jejunal loops were located on the right side, secondary to malrotation. The left-sided appendix was increased in diameter and wall enhancement was detected. CT findings were compatible with acute appendicitis (Figure 1). In retrospective sonography imaging, with the knowledge on the location, left-sided appendicitis was visualised successfully. The pathologic findings of an appendectomy specimen were compatible with suppurative appendicitis.

Case 2

A 29-year-old male patient presented to the emergency department with right lower abdominal pain. He had leukocytosis (14800/ μ L) with neutrophil predominancy (%79.5), and elevated CRP (3.3 mg/L) in his blood tests. Ultrasonography was inconclusive, therefore abdominal CT with iv and oral contrast was performed. CT scan showed a dilated retrocecal located appendix, with a diameter of 7 mm, accompanied by adjacent mesenteric fatty stranding and thickening of the adjacent peritoneum (Figure 2). The pathologic findings of an appendectomy specimen were compatible with suppurative appendicitis.

Case 3

A 29-year-old male patient presented to the emergency department with acute abdominal pain. He had elevated leukocyte level (14100/ μ L) with neutrophil predominancy (%76.4), and elevated CRP (58 mg/L). After nondiagnostic ultrasonography, abdominal CT without iv contrast administration (because of contrast agent contraindications) was performed. On CT images, subhepatic ascending dilated appendix with thickened wall and intraluminal appendicolith, accompanied by mesenteric fatty stranding and intramural air was detected (Figure 3). The pathologic findings of an appendectomy specimen were compatible with gangrenous appendicitis.



Figure 1. Dilated left-sided appendix (arrow) with wall enhancement was detected on axial image of abdominal CT with iv and orally administered contrast material.

Case 4

A 65-year-old female patient presented to the emergency department with right upper abdominal pain. She had normal leukocyte values (7300/ μ L) with neutrophil predominancy (%80), and elevated CRP (300 mg/L). After nondiagnostic ultrasonography, abdominal CT with oral and iv contrast administration was performed. CT scan demonstrated dilated retrocecal subhepatic ascending appendix with wall enhancement and mesenteric fatty stranding (Figure 4). CT findings were compatible with acute appendicitis as the pathology finding was compatible with suppurative appendicitis.

Case 5

A 16-year-old female patient presented to the emergency department with right lower abdominal pain. Her leukocyte level was 6800/ μ L and CRP was 3.3 mg/L. Ultrasonography showed a right ovarian simple cyst, 5.5 cm in diameter, but the appendix was not visualised. Abdominal CT with iv contrast was performed in order to exclude acute appendicitis. The appendix was found to be intraperitoneal and midline-located without inflammation findings (Figure 5).

Discussion

Acute appendicitis generally presents with periumbilical pain radiating to the right lower quadrant, Mc Burney's point. Physical examination shows abdominal sensitivity, defence and rebound tenderness. Laboratory tests show elevated inflammatory indicators such as leukocytosis and elevated CRP [1,9]. In such typical cases no further test or imaging are needed.

Although the most common location of the appendix is descending intraperitoneal, it can also be atypically located. Inguinal canal, femoral canal, subhepatic, retrocecal, intraperitoneal abdominal midline and left side in situs inversus or intestinal malrotation patients are among these localisations [4,6]. This can lead to atypical clinical presentations and cause a diagnostic dilemma. Subhepatic,



Figure 2. Axial (A), sagittal (B) and coronal (C) images of abdominal CT with iv and oral contrast material show a dilated retrocecal appendix, 7 mm in diameter (arrow), accompanied by mesenteric fatty stranding and peritoneal thickening.

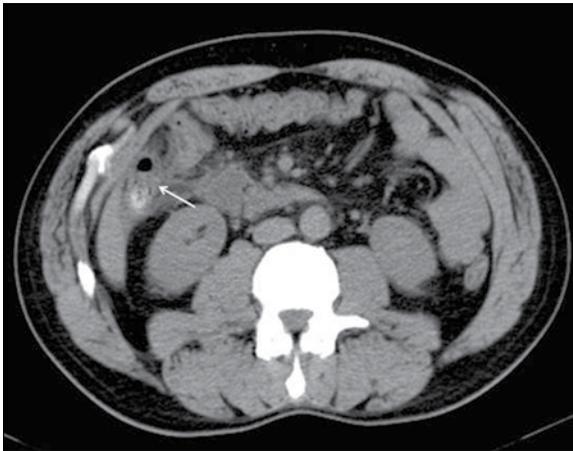


Figure 3. Non-contrast abdominal CT shows subhepatic, dilated appendix with wall thickening, intraluminal appendicolith, intramural air density, mesenteric fatty stranding, and peritoneal fluid (arrow).

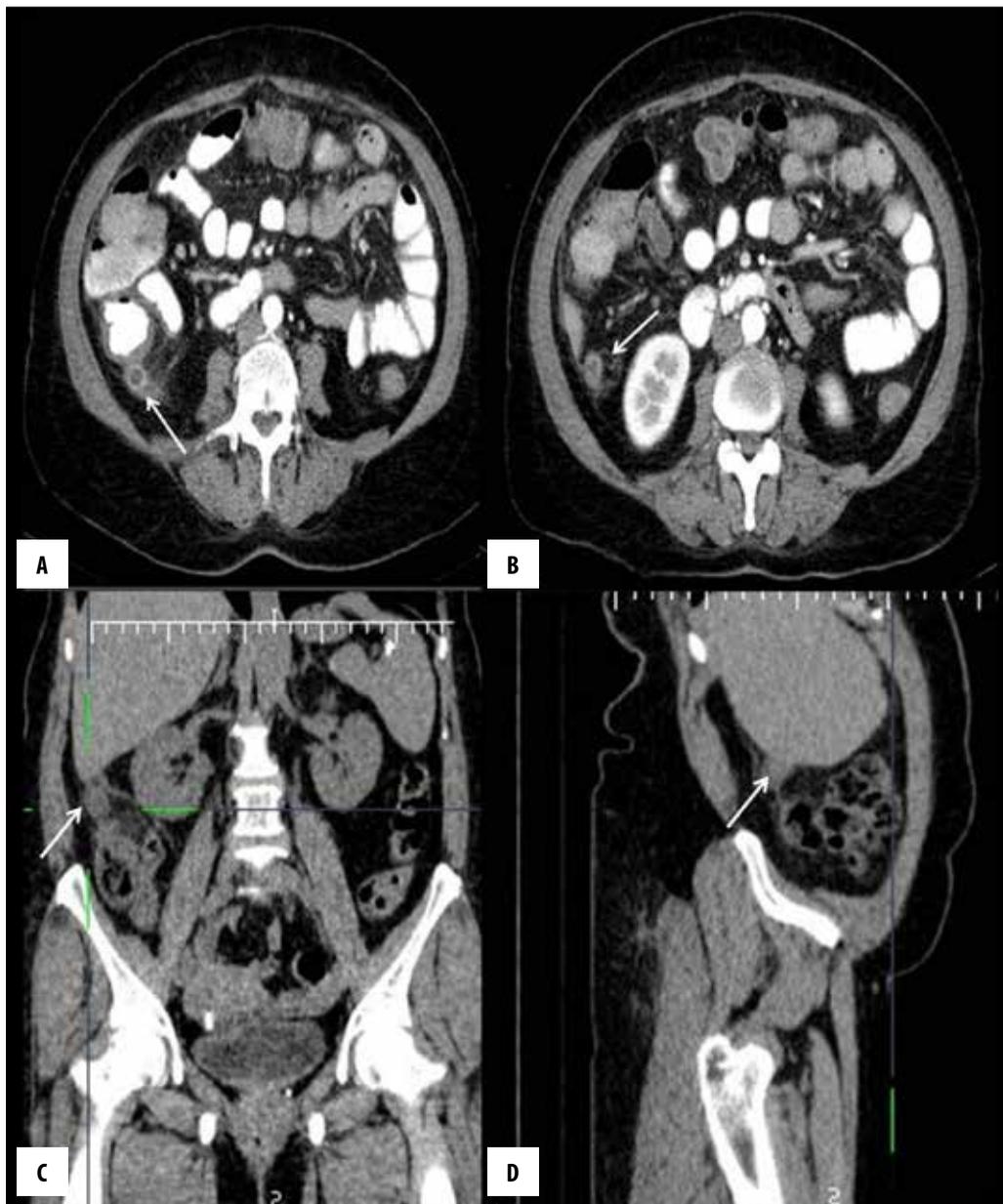


Figure 4. Axial image of abdominal CT with iv and oral contrast material demonstrates dilated retrocecal (A) subhepatic ascending (B) appendix with wall enhancement, mesenteric fatty stranding. Coronal (C) and sagittal (D) images of subhepatic ascending appendicitis.

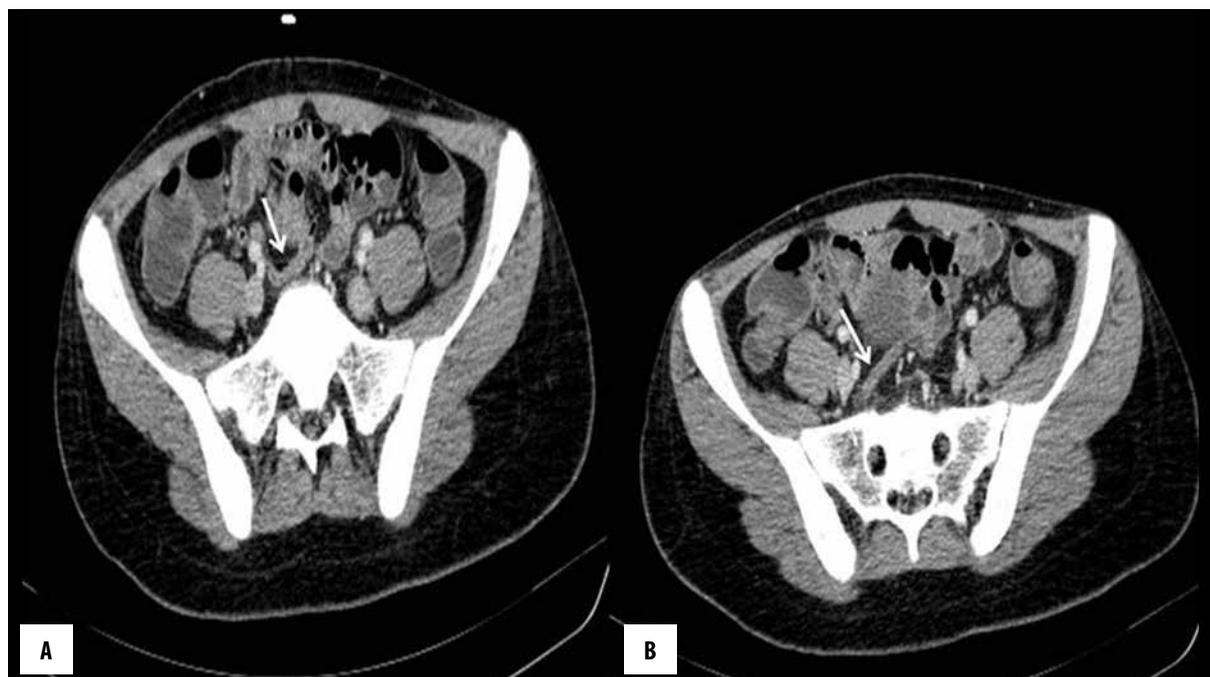


Figure 5. Abdominal CT with iv contrast shows intraperitoneal abdominal midline (B) appendix (arrow) descending back to the right lower quadrant (A) without inflammation findings.

retrocecal ascending appendicitis can present with right upper abdominal pain, right-side pain and confused with acute cholecystitis, pyelonephritis, renal/ureter stone, cecal/ascending colon diverticulitis, terminal ileitis, neoplasm and irritable bowel syndrome [5,6]. Left-sided appendicitis generally presents with left lower abdominal pain and is confused with diverticulitis or gynecological pathologies. Also, groin pain can be a sign of inguinal or femoral canal appendicitis [1,7].

If the clinical presentation is atypical or laboratory tests are normal, imaging methods are suggested, because delay in diagnosis of acute appendicitis can cause complications such as abscess and perforation, resulting in severe consequences or increased morbidity-mortality rates. Ultrasonography is the first imaging modality to be performed in order to visualise appendicitis and its complications, if present. US is also used to exclude the differential diagnoses such as acute cholecystitis, ureteral/renal stone, acute inflammatory bowel disease and pelvic inflammatory disease or ovarian cyst in female patients. On the other hand, due to its being an operator- and patient-dependent technique, US can be inconclusive, and therefore abdominal CT is performed. However, US still remains the first-line modality in the diagnostics of acute appendicitis because of its being a radiation-free, easily-performed and cost-efficient imaging method [9]. Abdominal CT is superior at demonstrating the atypically located appendix and appendicitis mimickers, such as diverticulitis, neoplasm, epiploic apandigitis, appendiceal mucocoeles, and terminal ileitis [4,10]. The previous studies have shown that CT has higher sensitivity and specificity than US (91 and 90%, 78 and 83%, respectively) [8,9,11].

Abdominal CT scan can be utilized with or without intravenous, oral/rectal contrast material administration.

Nonenhanced CT needs no patient preparation and is suggested by some authors. CT findings of acute appendicitis are dilated appendix with a diameter of more than 6 mm, wall thickening more than 2 mm, adjacent mesenteric fatty stranding, mesenteric lymph nodes, appendicolith, and periintestinal fluid [9]. Increase in diameter alone can be seen as an early finding, but it can also mislead. Therefore, it should be supported by clinical/laboratory findings or iv/oral contrast-enhanced imaging [4].

Intravenous contrast administration is preferred for wall enhancement visualisation and the evaluation of complications. Abscess and perforation are better visualised in iv contrast-enhanced images. Oral/rectal contrast administration is used to demonstrate the obstruction of the appendix which is the main cause of inflammation in appendicitis cases. Some authors suggest that using enteric contrast material is unnecessary, because it does not increase sensitivity or specificity in acute appendicitis diagnosis [9]. Recent advances in CT imaging with multidetector devices, multiplanar reconstructions and volume rendering by using isotropic voxels, have improved the image quality and eased the visualisation of the appendix and inflammation [8].

We presented five atypically-located appendix cases, including four with acute appendicitis. Two of the acute appendicitis cases had normal white blood cell count, but all of them had elevated CRP. Acute appendicitis was not considered by the clinician for the patients who presented with right upper abdominal pain and left lower abdominal pain because of atypical clinical presentation. Acute cholecystitis, pyelonephritis or renal-ureteral stone and diverticulitis or gynecological pathologies were the prediagnosis of those two patients before imaging, respectively. Ultrasonography was unsuccessful in demonstrating the appendix in all of the cases. In addition, sonographic

imaging findings of other differential diagnoses were not detected in the acute appendicitis cases either. Only the ultrasonography of the patient with uninflamed intraperitoneal midline appendix demonstrated a simple ovarian cyst. Abdominal CT was performed for our cases and demonstrated all of the atypically located appendices successfully, which were left-sided in a malrotated patient, retrocecal, subhepatic, retrocecal ascending, intraperitoneal abdominal midline localised.

According to ALARA (as low as reasonably achievable) principle, MRI is preferred as an alternative to abdominal CT after inconclusive ultrasonography, especially in a pregnant and pediatric population. MRI reduces radiation exposure and can also be diagnostic without intravenous contrast material injection, which is contraindicated in pregnancy [12,13]. Previous studies showed high sensitivity and specificity for MRI (100%, 96%, respectively) [13]. However, MRI has also some disadvantages such as being more expensive, time-consuming and prone to artifacts, compared to CT [12]. Because of these reasons, clinicians in our emergency department did not prefer MRI in our cases.

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Conclusions

Atypically located acute appendicitis can show atypical presentation and result in misdiagnosis. Therefore, clinicians and radiologists should keep in mind that appendix can show atypical location and they consider the prediagnosis of acute appendicitis in patients with abdominal pain, even if there are no typical signs. If ultrasonography is inconclusive and there is no contraindication to CT imaging, we suggest abdominal CT in such confusing, complicated cases, because misdiagnosis or delay in the right diagnosis can result in complications and increased morbidity, mortality rates.

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