



SHORT ORIGINAL ARTICLE / *Digestive*

Extraperitoneal ascending appendicitis: Usefulness of the split interfascial plane sign on MDCT



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KEYWORDS

Appendix;
Appendicitis;
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Multidetector
computed
tomography

Abstract

Purpose: To retrospectively evaluate the multidetector computed tomography (MDCT) findings of extraperitoneal ascending appendicitis.

Materials and methods: The MDCT examinations of 10 patients with extraperitoneal ascending appendicitis confirmed by laparoscopic surgery were retrospectively analyzed. Preoperative MDCT examinations were obtained after intravenous administration of iodinated contrast material in all patients. Transverse and coronal reformatted MDCT images were reviewed in consensus by two radiologists. The presence of the extraperitoneal triangle sign, the split interfascial plane sign, and the other classical findings of appendicitis were evaluated.

Results: Luminal dilatation, wall enhancement of the inflamed appendix, and fat infiltration were present in 10/10 patients (100%). The perforation of the inflamed appendix with abscess formation was present in 4/10 patients (40%). The split interfascial plane sign was present in 7/10 patients (70%), and parts of inflamed appendix or periappendiceal abscess were located behind the right extraperitoneal triangle in 8/10 patients (80%).

Conclusion: The split interfascial plane sign and the presence of an appendiceal tip or periappendiceal abscess located in the right extraperitoneal triangle are highly suggestive of extraperitoneal ascending appendicitis on MDCT.

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The location of the vermiform appendix varies according to that of the cecum. The incidence of the retrocecal or retrocolic ascending appendices ranges between 20% to 65% [1,2]. Meyers and Oliphant [2] reported unique radiologic features of ascending retrocecal appendicitis, including an illustration of anatomic variations in this entity according to the various peritoneal relations of the appendix. Contrary to the common misunderstanding that the retrocecal appendix is located in the extraperitoneum, previous studies have reported that the retrocecal ascending appendix may have anatomic variations according to the peritoneal fixation of the appendix [1,3]. The retrocecal ascending appendix included the intraperitoneal and extraperitoneal subgroups [1,4]. The frequency of the extraperitoneal subgroup varies from 2.5% to 24% [1,4]. A few studies have demonstrated CT findings of retrocecal ascending appendicitis along with clinical features [5,6]. However, the aforementioned studies were not analyzed by strict division of the extraperitoneal and the intraperitoneal locations of retrocecal ascending appendicitis. Although a new anatomical nomenclature of the extraperitoneal interfascial plane has been widely accepted by radiologists and surgeons, the literature regarding retrocecal appendicitis based on the plane concept is sparse [7,8]. There is no literature on detailed MDCT findings of extraperitoneal ascending appendicitis from the standpoint of the interfascial plane.

Accordingly, the goal of this study was to evaluate MDCT findings in patients with extraperitoneal ascending appendicitis, with a special focus on the usefulness of the extraperitoneal triangle and split interfascial plane signs.

Materials and methods

Patient groups

After review of the medical records of 553 patients who had undergone preoperative MDCT and subsequent laparoscopic appendectomy from January 2011 and December 2013, 10 patients (median age, 27 years; range, 7–56 years) with extraperitoneal ascending appendicitis were included in our final analysis. Extraperitoneal ascending appendicitis was confirmed by laparoscopic surgery when the surgeon dissected the white line of Toldt to remove the appendix. This retrospective research protocol was approved by the Institutional Review Board of our hospital, and informed consent was waived.

MDCT technique

MDCT was performed using a 128-detector-row CT scanner (definition AS+, Siemens Medical Solutions, Forchheim, Germany) after injection of intravenous contrast material (Iopromide, Ultravist 300®; Bayer Healthcare, Berlin, Germany). The images were acquired during the portal venous phase (70 second after contrast injection; 100 kVp; 220 mAs; pitch, 1.25; and gantry speed, 0.5 second per rotation) and included the area from the dome of the diaphragm to the symphysis pubis. Tube current modulation software (CareDose 4D, Siemens Medical Solutions) was used. The technicians used a computer program (Syngo VB28B, Siemens Medical Solutions) to reconstruct axial and coronal

images at a section thickness and interval of 4 mm. The reconstruction was performed on a commercially available console system (Syngo, Wizard; Siemens Medical Solutions). The entire process was performed by the technicians at the operator's console. The 4-mm-thick axial and coronal images were then transferred to a picture archiving and communications system (M-view; Marotec Medical System, Seoul, Korea) as a separate series of images for subsequent interpretation.

Image analysis

Preoperative contrast enhanced MDCT examinations were retrospectively reviewed and interpreted in consensus by two radiologists (S.L.L. and Y.M.K.) with 7 and 12 years of experience in abdominal imaging, respectively. Transverse and coronal reformatted images were simultaneously evaluated. For all appendiceal lesions, the following features were evaluated: the thickness and enhancement of the appendiceal wall, periappendiceal fat infiltration, the presence of perforation, the split interfascial plane sign, and the extraperitoneal triangle sign. The extraperitoneal triangle is a major part of the ascending mesocolon bound by the medial border of the ascending colon laterally, the horizontal line that extends bilaterally from the level of the gastrocolic trunk superiorly, and ileocolic vessels inferomedially (Fig. 1). The extraperitoneal triangle sign defines that a part of the inflamed appendix including periappendiceal abscess lies dorsal to the ascending mesocolon and extending over the inferomedial border of extraperitoneal triangle (Figs. 1 and 2). The split interfascial plane sign refers to separation of the interfascial plane by part of the inflamed appendix or periappendiceal abscess (Figs. 3 and 4).

Results

Among the 10 patients, 5/10 patients (50%) presented with right lower-quadrant pain, 3/10 (30%) with right flank pain and 2/10 (20%) with periumbilical pain. All patients had leukocytosis ($> 10,000/\text{mL}$). Inflamed appendices were visualized completely in 6/10 patients (60%) and partially in 4/10 (40%) due to perforation and periappendiceal abscess formation. In patients with a completely or partially visualized appendix, mean appendiceal diameter was 12.2 mm (range, 7–19 mm). All patients had additional findings, such as appendiceal wall thickening (wall thickness ≥ 3 mm), wall enhancement, and fat stranding (Table 1).

The split interfascial plane sign was present in 7/10 patients (70%), and the appendiceal tips were located in the right extraperitoneal triangle in 8/10 patients (80%) (Table 1).

Discussion

The interfascial plane refers to the potential space in the multilaminated fasciae. During decades, the concept of the extraperitoneal interfascial plane has been widely accepted to explain the dynamic change and extension of the extraperitoneal lesion [7,9]. Embryologically, during the descent of the cecum and fixation of the ascending mesocolon, if there is incomplete rotation of the

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