

## Acute gangrenous appendicitis-diagnosis by spiral CT

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### SUMMARY

**Aim:** Aim of the study is to demonstrate the usefulness and validity of spiral CT in the evaluation and diagnosis of acute gangrenous appendicitis, a serious complication of acute appendicitis.

**Material-method:** twenty-two patients, aged 22-67 are presented. They were admitted in the outpatient department of our hospital with clinical and laboratory findings suggestive of acute appendicitis. All patients were examined by CT after the oral administration of contrast material. The imaging findings were confirmed intraoperatively. **Results:** a common imaging finding in all patients that were examined by spiral CT, was the enlargement of the appendix with periappendiceal and right paracolic fissure fluid collections. Intraluminal air-bubbles were demonstrated in 19 patients (86.3%) and calcified faecaliths in 16 (72.7%). The wall of the inflamed appendix was demonstrated abnormally thin in 15 patients (68.2%) while thickening of the appendiceal wall was detected in 7 patients. In 15 patients localized peritonitis' imaging findings were demonstrated by hazy periappendiceal and pericaecal fat, as well as stranding of the area. Diffuse peritonitis was demonstrated in 7 patients as diffusely hazy peritoneal fat stranding with fluid collections in the Dou-

glas pouch. In 13 patients spiral CT detected diffuse inflammation of the right colon and terminal ileum, demonstrated by thickening of their walls. Finally, obstructive ileus was demonstrated in 4 patients. **Conclusion:** spiral CT is a valuable method, appropriate for the immediate diagnosis of gangrenous appendicitis, which represents a serious complication of acute appendicitis. The specific imaging findings of spiral CT, make early diagnosis and early operative management possible. These imaging findings are especially taken into account, in order to present some specific imaging diagnostic characteristics for acute gangrenous appendicitis.

**Key words:** Diagnosis, gangrenous, appendicitis, spiral-CT, findings

### INTRODUCTION

Acute appendiceal inflammation is one of the commonest causes of right lower quadrant abdominal pain. Its diagnosis is established mainly by clinical findings, and the patients are operated on immediately, or after a brief clinical follow up, while the use of any imaging methods is considered unnecessary. Recently many surgeons use newly introduced medical technology methods, especially in the field of diagnostic imaging, for a preoperative imaging overview.

A substantial percentage of patients, ranging from 7-25%, operated on with symptoms mimicking acute appendicitis have negative laparotomy results, whereas others, such as the elderly, preschool children and women of reproductive age, present with atypical symptoms. In these cases diagnosis is difficult and imaging of the right lower quadrant necessary.<sup>1-4</sup>

Detailed analysis of CT findings offers the possibility

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of a complete and accurate mapping of all pathological lesions, resulting in a less time-consuming surgical procedure, a smaller surgical wound, the avoidance of major complications and finally a shorter in-hospital stay.<sup>5</sup>

The question that has recently arisen is whether it would be useful for all patients with symptoms suggestive of acute appendicitis to undergo CT-scanning as a common practice.

This study is concerned with the diagnosis of acute gangrenous appendicitis, a complication of acute appendicitis which involves the danger of appendiceal perforation and generalized faecal peritonitis, thus making early diagnosis extremely important for its surgical treatment.

**PATIENTS-METHOD:** Twenty-two patients between 22 and 67 years of age, 14 male and 8 female, were admitted in the outpatient department of our hospital with signs of acute appendicitis.

All patients were examined by spiral CT. A Picker 5000 PQ CT-scanner was used and a classical abdominal examination protocol of 10mm sections, with extra thin sections of 4-5mm at the anatomical area of the right iliac fossa, was performed.

Oral contrast material was administered to all patients before the CT scan.

In 14 patients intravenous contrast material was additionally used.

**RESULTS:** Enlargement of the appendix was the common imaging finding in all patients, with periappendiceal and right colic fissure fluid collections.

Intra-appendiceal air-bubbles were detected in 19 patients (86.3%). In 16 patients (72.7%) calcified faecaliths were found in the appendiceal lumen. In 13 patients a single faecalith was detected and two or three faecaliths at different levels were observed in the rest of the cases.

Thinning of the appendiceal wall was detected in 15 cases (68.2%) whereas in 7 cases (31.8%) wall thickening was found. Localized peritonitis with periappendiceal and pericaecal fat haziness and localized stranding was detected in 15 patients. In 7 patients generalized peritonitis was demonstrated by generalized stranding and haziness of the peritoneal fat and intraperitoneal fluid collections extending to the Douglas pouch.

In 13 (59.1%) patients inflammatory spreading involved the caecal and terminal ileum wall and was demonstrated by significant thickening of their walls.

Finally, obstructive ileus was also demonstrated in 4 cases (18.2%).

## DISCUSSION

CT is a non-invasive and safe imaging modality for the diagnosis of acute appendicitis. Currently Spiral and Multi-slice CT have increased the speed of the examination and improved its spatial resolution aiding the radiologist.

Imaging of a normal appendix by CT is possible in 44-51% of the patients that undergo an abdominal CT scan for other reasons.<sup>6-8</sup>

Sensitivity and specificity for the diagnosis of acute appendicitis ranges between 88-98% and 85-100% respectively.<sup>9-12</sup>

The use of 5mm thick sections increases the method's accuracy from 89 to 99%.<sup>13</sup>

The most common imaging finding suggestive of acute inflammation of the appendix is localized peritonitis, demonstrated by haziness of the periappendiceal fat with stranding and small periappendiceal exudates along the right colic fissure. In several studies the percentage of these findings ranges between 68-100%.<sup>14-15</sup>

Enlargement of the appendix is also one of the commonest findings in 47-100% of the patients. An increase of its diameter of more than 6mm is evaluated, whereas other authors elevate this limit to up to 10mm.<sup>8, 16-17</sup>

In the current study the findings of increased appendiceal diameter and localized peritonitis were present in 100% of the cases.

According to the CT findings, the surgeon may recognize preoperatively:

1. the accurate anatomical position of the inflamed appendix especially in ectopic cases.
2. possible complications such as gangrene, perforation, periappendiceal abscess and periappendiceal phlegmons.
3. other clinical entities that clinically mimic acute appendicitis, such as Crohn's disease, malignancy of the caecum and less commonly appendiceal mucocele, dermoid ovarian cyst, endometriosis, perforated extra-uterine pregnancy, caecal inflammation, pseudomembranous colitis and peptic ulcer perforation. Primary appendiceal neoplasms may initially present with symptoms mimicking acute appendicitis.<sup>18-20</sup>

Acute appendiceal inflammation can be obstructive or non-obstructive. A faecalith, anatomical angulations, lymphatic inflammatory hyperplasia of the appendiceal wall and adhesions from previous operations are the main causes of obstruction of the appendiceal lumen.<sup>21</sup>

The steps in the pathogenesis of acute obstructive appendicitis are the creation of a closed enteric loop with inflammatory infiltration and oedema of the mucosa, pseudomembrane formation, ulcerations, vascular thrombosis, haemorrhagic infarction, gangrene, necrosis and finally perforation of the necrotic appendiceal wall.

There is a high risk for gangrenous appendicitis perforation, resulting in spillage of its content in the peritoneal cavity. This is a serious complication, which can lead to periappendiceal abscess formation, periappendiceal phlegmon, generalized peritonitis, paralytic ileus and even systemic sepsis.<sup>21</sup>

Obviously, the diagnosis of gangrenous appendicitis is critical in the choice of treatment, which must be immediate operation, in order to prevent perforation with the previously mentioned possible complications.

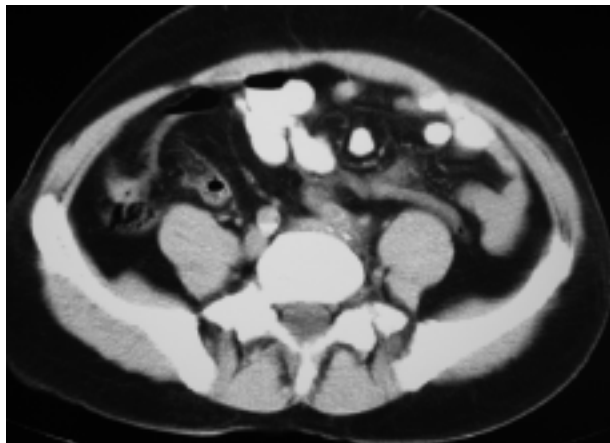
We concluded that the diagnosis of gangrenous appendicitis can be safely established based on the following 4 CT findings:

1. enlargement of the appendix
2. intraluminal air-bubbles
3. intraluminal faecalith
4. thinning of the appendiceal wall

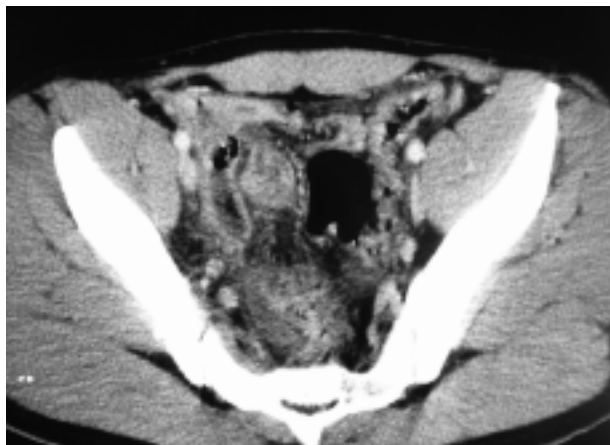
Intraluminal air-bubbles can be found in the obstructed appendiceal lumen due to the presence of anaerobic bacteria. Air-bubbles can be present even in normal appendices, so this finding by its self cannot be a diagnostic one. The presence of intraluminal air-bubbles must be taken into consideration in relation to appendiceal enlargement and thinning or thickening of its wall (fig.1-2).

In our study, an intraluminal faecalith was found in a quite high percentage (86.3%) of the gangrenous appendicitises (fig.3), whereas in a smaller percentage (13.7%) the appendiceal lumen obstruction was caused by lymphatic tissue proliferation.

A faecalith may obstruct the lumen of the appendix, resulting in a closed cavity formation, containing faecal debris, which enables bacterial proliferation. Usually the faecalith is single and oval shaped with a diameter of 1-



**Fig. 1.** Spiral abdominal CT: demonstration of appendiceal enlargement with intraluminal airbubble and wall thinning. Diagnosis: acute gangrenous appendicitis.



**Fig. 2.** Spiral abdominal CT: demonstration of appendiceal enlargement with intraluminal airbubble and wall thickening. Diagnosis: acute gangrenous appendicitis

2cm. Rarely, two or more faecaliths can be found in the appendiceal lumen at different levels (fig.4).

Faecaliths within gangrenous appendices is found in 2/3 of the cases. When a faecalith is demonstrated intraluminally, appendicitis is gangrenous in 77% of the cases.<sup>21</sup>

Evaluation of the inflamed appendiceal wall is often difficult, due to generalized oedema of the region and the nature of the appendiceal content. Intravenous contrast medium administration improves the accuracy of the appendiceal wall imaging.

In our study, thinning instead of thickening of the appendiceal wall was observed in most of the patients and this can be explained by the fact that at the initial

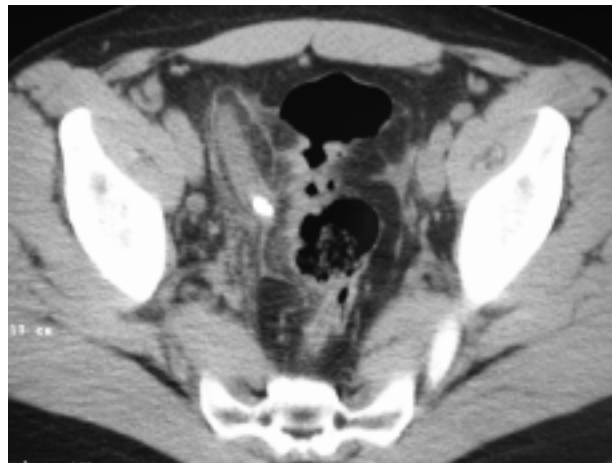


**Fig. 3.** Spiral abdominal CT: demonstration of appendiceal enlargement with intraluminal calcified fecalith. Diagnosis: acute gangrenous appendicitis



**Fig. 4a, b.** Spiral abdominal CT: demonstration of significant enlargement with two calcified intraluminal fecaliths at different levels and air bubbles, as well as generalized pericolic fat sagginess demonstrating peritonitis. Diagnosis: acute gangrenous appendicitis with generalized peritonitis.

inflammatory stages of an obstructive appendicitis inflammation of the mucosa and oedema may progress to atrophy, ulceration and necrosis, leading to thinning in the more advanced stages (fig 5).



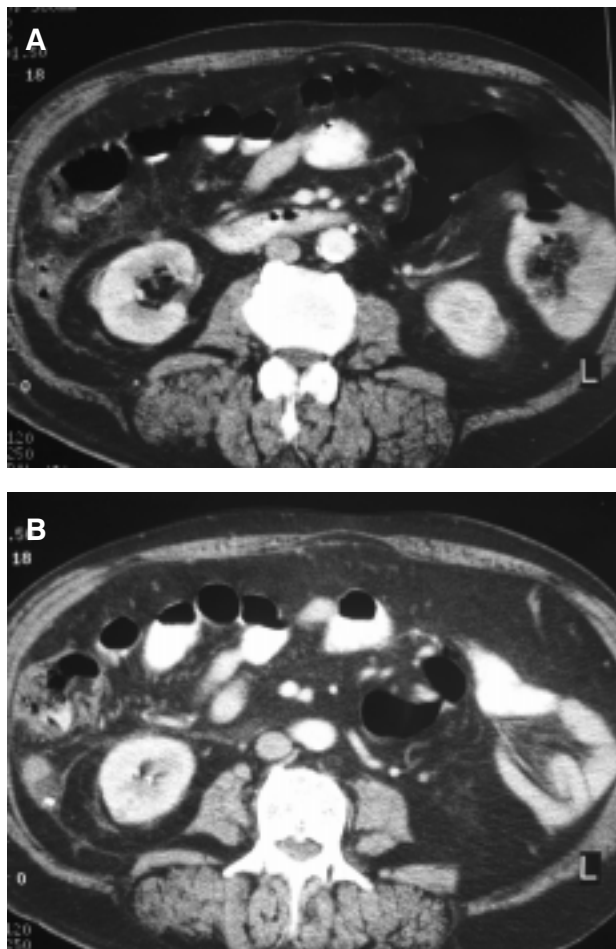
**Fig. 5.** Spiral abdominal CT: demonstration of significant appendiceal enlargement with intraluminal calcified fecalith and wall thinning. Diagnosis: acute gangrenous appendicitis.

In the case of gangrenous appendicitis, the inflammation may spread through tissues to the caecum and terminal ileum and is demonstrated by thickening of their walls. Thirteen of the 22 patients (59%) presented with terminal ileitis and inflammation of the caecum demonstrated by thickening of their walls.

Generalized peritonitis may coexist and is demonstrated by extensive intraperitoneal fluid collections in the Douglas pouch and generalized haziness of the peritoneal fat.

Finally, based upon the imaging findings, it is possible to diagnose the perforation of a gangrenous appendix. Disruption of the appendiceal wall and the possibility of the presence of an extraluminal calcified faecalith, as well as free intraperitoneal air-bubbles at the region and periappendiceal abscess may lead to the possible diagnosis of perforation of a gangrenous appendicitis (fig.6).

In conclusion, Spiral CT is a non-invasive and quick imaging method, which may lead to the possible diagnosis of acute gangrenous appendicitis based upon the following imaging criteria: Enlargement of the appendix, thinning of its wall, demonstration of faecaliths and/or air-bubbles in the appendiceal lumen and these specific imaging findings, can confirm the possible diagnosis of



**Fig. 6a, b.** Spiral abdominal CT: demonstration of appendiceal enlargement which is located at a higher position close to the anatomical region of the right kidney, with an extraluminal fecalith and a small periappendiceal abscess formation. Diagnosis: perforation of acute gangrenous appendicitis with periappendiceal abscess formation.

acute gangrenous appendicitis, leading to immediate operative treatment.

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