Intraluminal gas in non-perforated acute appendicitis: a CT sign of gangrenous appendicitis

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Authors: D. Plata Ariza¹, E. MARTINEZ CHAMORRO², J. C. Zornoza¹, A. Veitia Sarmiento¹, A. Merina¹, I. Daimiel¹, S. Borruel Nacenta¹; ¹Madrid/ES, ²MADRID/ES
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Purpose

Acute appendicitis is recognized as the most frequent cause of non-traumatic surgical abdominal pain and the CT has an important role as the standard imaging test with a reported sensitivity and specificity of 87% - 99% and 92% - 99% respectively [1].

There are several radiographic signs of acute appendicitis at CT and many studies have focused on identifying signs to difference perforated from non-perforated appendicitis[1-4]. However, few studies have focused on differentiating gangrenous appendicitis from phlegmonous appendicitis at CT and this result could have implications for the management, complications and prognosis of the patient.

Traditionally intraluminal appendicular air in abdominal plain radiography has been identified as a sign indicating a patent lumen and thus a normal finding in most of the cases and some studies described that US-based detection of gas within the appendix helps to rule out acute appendicitis [5]. However, some studies have reported intraluminal appendicular gas at plain radiography and at CT in both, the normal and the inflamed appendix. [6,7]

The purpose of this study is to determine if the presence of gas within the appendix at CT in the context of proven appendicitis correlates with the existence of gangrenous appendix by using surgery and pathologic examination as the reference standard.

Methods and Materials

We retrospectively reviewed 967 medical records from adult patients with proven acute appendicitis. We obtained from our hospital information system a list of all patients who had undergone appendectomy and pathologic examination of the appendix during a 34-month period, between January 2009 and October 2011.

Of the all patients listed 156 underwent MDCT examination. Patients with conservative management (1 case) or with classic perforated appendicitis CT findings (phlegmon, extraluminal air, abscess, extraluminal appendicolith and focal defect in enhancing appendiceal wall) were excluded (77 cases), this in order not to include cases that obviously have gangrene and perforation. This elimination resulted in a final study population of 78 patients who underwent preoperative abdominal multidetector CT and had an appendicitis pathological outcome Fig. 1 on page 3.
All CT examinations were performed using a 16-slice CT scanner. Scanning parameters included slice thickness 3 mm with 1,5 -mm image reconstruction and, in some cases, multiplanar reconstructions were performed.

There was no special preparation before the CT. The use of oral/rectal contrast medium was not routinely administered except in some cases depending on the clinical history provided (oral contrast was administrated to eight patients and rectal contrast to one) and the examinations were performed with intravenous contrast medium unless there were contraindications or technical problems in its administration. Intravenous non-ionic contrast media was administered to sixty-two patients and it was injected at a rate of 3 ml/sec, with image acquisition performed in the portal venous phase with a 70-second scanning delay.

Seventy-eight CT-scans of patients with CT findings and proven appendicitis were reviewed in consensus by two experienced emergency radiologists and one radiology resident and classified in two groups as positive or negative depending on the presence of air in the appendix.

The results were compared to surgical and histopathological reports looking for a gangrenous or phlegmonous appendix. Both surgical and pathology reports combined were considered the reference standard to determine gangrene.

Sensitivity, specificity, positive likelihood ratio and positive and negative predictive values were determined for the diagnosis of gangrenous appendicitis.

The statistical analysis was performed using the Chi-squared test and $p$ value < 0.05 was considered statistically significant.

Images for this section:
**Fig. 1:** Flow diagram of patients exclusions leading to selection of final study group. MDCT: multidetector CT.
Results

Our study population consisted of 78 patients, there were 42 male and 36 female patients and the mean age was 42 (range, 17 - 86 years).

All reviewed images were considered to be of diagnostic quality and all patients had CT signs of non-perforated appendicitis.

Appendix with intraluminal gas was present in 17 patients (21,7%) and on the basis of the surgical and pathologic outcome 14 patients (82,3%) were finally diagnosed of gangrenous appendicitis Fig. 2 on page 5 Fig. 3 on page 6 Fig. 4 on page 7 Fig. 5 on page 8 and 3 had phlegmonous appendicitis Fig. 6 on page 9.

In the remaining group of 61 patients who did not show gas in the appendix, the final outcome was phlegmonous appendicitis in 55 patients (90,2%) and only 6 (9,8%) specimens were gangrenous Fig. 7 on page 10.

By using the presence of appendix with intraluminal gas at CT in patient with other radiological findings of non-perforated acute appendicitis the sensitivity of detecting gangrenous appendicitis was 70% with a specificity of 94,8%.

Positive likelihood ratio was 13,46 and the positive and negative predictive values were 82% and 90% respectively.

The association between intraluminal appendicular gas in patients with proven appendicitis and gangrenous pathologic/surgical outcome was statistically significant (p < 0.01).

Images for this section:
Fig. 2: Appendicitis in a 63-year-old woman. Sagital (a) and axial (b-c) MDCT images with intravenous contrast media show a dilated appendix (red arrowheads) with intraluminal gas (yellow arrows), hyperenhancement of appendicular wall and adjacent fat stranding. Gangrenous appendicitis was the final outcome.
Fig. 3: Coronal (a), sagital (b) and consecutive axial (c-e) MDCT images with intravenous contrast medium in 40 year-old man with non-perforated appendicitis (histopathological report) showing a dilated appendix with intraluminal gas (yellow arrows), fat stranding and a three intraluminal appendicoliths (one is not on the picture) (red arrowheads). The final result was gangrenous appendicitis.
Fig. 4: MDCT with intravenous contrast medium in a 33 year-old man with acute gangrenous appendicitis (histopathological outcome). Coronal (a-b) and axial (c) images of the dilated appendix with intraluminal gas bubbles (yellow arrows), fat stranding and free fluid adjacent to the appendix.
Fig. 5: Appendicitis in a 39 years-old man. MDCT with intravenous contrast medium. Coronal (a), sagital (b) and axial (c-e) images showing a dilated appendix gas filled (yellow arrows) with a minimal adjacent fat affectation. The final outcome was gangrenous appendicitis.
Fig. 6: MDCT images with intravenous contrast medium in two different patients with acute appendicitis. (a-b) Coronal and axial images in 39 years-old woman and (c-d) sagital and axial images in 17 years-old man showing CT signs of acute appendicitis with intraluminal appendicular gas (yellow arrows) and appendicolith (red arrowheads) (c-d). However the histopathological diagnosis was phlegmonous appendicitis in both cases. These are two examples of three false positive cases found in the study.
**Fig. 7:** Graph illustrates the distribution of patients with gangrenous or phlegmonous appendicitis depending on the presence of intraluminal appendicular gas at CT.
Conclusion

In patients with CT signs of non-perforated appendicitis the presence of gas within the appendix suggests a high statistical probability of gangrenous appendicitis.

References


Personal Information