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DIFFERENTIATION OF PERFORATED FROM NONPERFORATED APPENDICITIS WITH CT

Radio-diagnosis

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ABSTRACT

Sixty eight surgically proven appendicitis patients with 41 cases of nonperforated appendicitis and 27 cases of perforated appendicitis were evaluated based on the computed tomography (CT) appearances of phlegmon, abscess, extraluminal air, defect in enhancing appendiceal wall, appendiceal wall enhancement, lateroconal fascial thickening, bowel wall thickening, appendicolith, periappendiceal fluid and omental haziness. The sensitivity (SN), specificity (SP), positive predictive value (PPV), negative predictive value (NPV) and accuracy for each finding is calculated by comparing the predicted outcome to the surgical and pathologic outcome. We concluded that direct and indirect CT appearances can differentiate perforated from nonperforated appendicitis. A dedicated search for indirect signs may be helpful in difficult case.

KEYWORDS

Perforated Appendicitis; Nonperforated Appendicitis; Ct

INTRODUCTION

Acute appendicitis is the most common cause of emergency abdominal surgery, with an estimated lifelong risk of 8.6% in men and 6.7% in women [1]. It is often regarded as a disease of the younger population with a peak incidence in the 2nd and 3rd decades of life [1, 2]. Primary acute appendicitis is the result of the torsion with subsequent ischemia of the appendix or it is caused by spontaneous venous thrombosis without the torsion of the appendix (3). Secondary acute appendicitis is the inflammation of the appendix within adjacent pathological processes such as diverticulitis (4).

In 1986, Alvarado presented a clinical scoring system on the basis of eight predictive clinical factors to enhance the accuracy of physician's clinical assessments in diagnosing acute appendicitis. This scoring system produces a maximum total score of 10 points and includes clinical symptoms (nausea and anorexia), signs (fever, shifting pain, right lower quadrant pain, and rebound tenderness), and laboratory findings (leukocytosis and neutrophilia). Right lower quadrant pain and leukocytosis contribute 2 points each while the rest contributes 1 point [5].

High-resolution sonography and Computed tomography (CT) are frequently used in the evaluation of acute appendicitis. With a stated sensitivity of up to 96.5% and specificity of about 98%, CT plays a major role in the clinical decision making process in acute appendicitis and is considered as a first line imaging modality in the diagnostic work-up for suspected acute appendicitis [6–9].

Appendectomy is generally accepted as a first-line treatment for noncomplicated acute appendicitis. In the absence of surgical intervention, it can lead to perforation resulting in peritonitis. Reports have shown that preoperative radiographic evaluation has helped to decrease negative appendectomy rates from 20% to as low as 5% [10]. The aim of the study was to analyze the direct and indirect CT appearances to differentiate the perforated appendicitis from the nonperforated one.

MATERIALS AND METHODS

The study was carried out retrospectively analyzing demographics, radiologic and pathologic results of the 68 patients who had undergone abdominal CT for clinical diagnosis of acute appendicitis in our tertiary care rural hospital from October 2016 to March 2019.

CT examinations were done on GE Revolution EVO 64 Detector row CT scan machine. The patients were scanned in supine position from the level of the liver dome to the symphysis pubis. 100 ml iodinated contrast medium was injected via the antecubital vein at a rate of 3 ml/second with a delay of 60 seconds between contrast administration and data acquisition. 5 mm thick axial images were obtained. Soft tissue reconstruction increment was 1 mm.

Radiologist blind to the postoperative notes and pathology results analyzed CT images for phlegmon, abscess, extraluminal air, defect in enhancing appendiceal wall, appendiceal wall enhancement, lateroconal fascial thickening, bowel wall thickening, appendicolith, periappendiceal fluid and omental haziness.

Each patient was assigned to either the perforated group or the nonperforated group based on the surgical and pathologic reports. Statistical analysis was carried out using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA) after collecting patient data in a master chart.

OBSERVATIONS AND RESULTS

Table 1: Distribution of patients according to age and gender

	Non-perforated appendicitis (n=41)	Perforated appendicitis (n=27)
Mean Age (years)	29 ± 11	46 ± 16
Range (years)	5 - 72	10 - 67
Male : Female	21 (51.2%) : 20 (48.8%)	11 (40.7%) : 16 (59.3%)

Table 2: Analysis of CT features of appendicitis

	Non-perforated Appendicitis (n=41)	Perforated appendicitis (n=27)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Phlegmon	3	19	70.37	92.68	86.36	82.61	83.82
Abscess	0	18	66.67	100.00	100.00	82.00	86.76
Extraluminal air	0	15	55.56	100.00	100.00	77.36	82.35
Defect in enhancing appendiceal wall	0	21	77.78	100.00	100.00	87.23	91.18
Appendiceal wall enhancement	32	25	92.59	21.95	43.86	81.82	50.00

Lateroconal fascial thickening	7	14	51.85	82.93	66.67	72.34	70.59
Bowel wall thickening	9	22	81.48	78.05	70.97	86.49	79.41
Appendicolith	13	20	74.07	68.29	60.61	80.00	70.59
Periappendiceal fluid	15	19	70.37	63.41	55.88	76.47	66.18
Omental haziness	5	16	59.26	87.80	76.19	76.60	76.47

Figure 1: Normal appendix

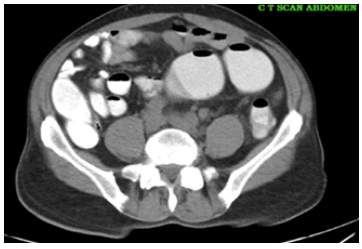


Figure 2: Nonperforated appendicitis

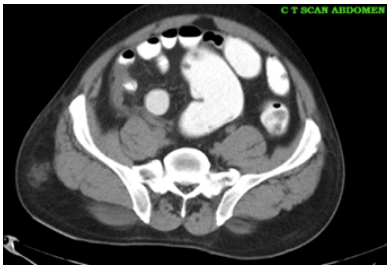
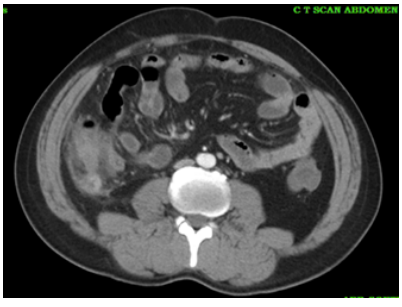


Figure 2: Perforated appendicitis



DISCUSSION

Preoperative knowledge of whether the appendix is perforated has clinical relevance. Once perforation has occurred, the complications, which include reoperation and intra-abdominal sepsis, increase [11]. Perforated appendicitis may be treated first by conservative treatment or percutaneous abscess drainage with great improvement of the clinical symptoms and with or without interval appendectomy. This is in contrast to the nonperforated appendicitis, which requires operation as early as possible in order to reduce the morbidity of the patient.

Our results demonstrate 66.67%, 55.56% and 77.78% sensitivity for the diagnosis of perforated appendicitis when using the three classic CT findings: abscess, extraluminal air and defect in enhancing appendiceal wall respectively.

Few authors have studied the ability of CT to distinguish perforated from nonperforated appendicitis.

Table 3: Comparison of sensitivity and specificity of our study with international literature

CT Findings	Horrow et al [12]		Our study	
	Sensitivity	Specificity	Sensitivity	Specificity
Abscess	36	100	66.67	100.00
Phlegmon	46.2	94.5	70.37	92.68
Defect in enhancing appendiceal wall	64.3	100	77.78	100.00
Extraluminal air	36	100	55.56	100.00

Oliak et al reviewed the CT scans of 84 patients with proven appendicitis, 59 of whom had gangrenous and/or perforated appendicitis proven pathologically. The presence of any one of three findings - abscess, phlegmon, or extraluminal air had a sensitivity of 92%, a specificity of 88%, and a positive predictive value of 96% for perforated or gangrenous appendicitis [13].

Graded-compression ultrasonography of the right lower quadrant is alternate imaging modality for appendicitis, with sensitivities ranging from 75 to 90%. US criteria for perforation include loculated pericecal fluid, prominent pericecal fat greater than 10 mm, and circumferential loss of the echogenic submucosal layer. For perforation, the reported sensitivities vary from a low of 29% to a high of 84%. Not surprisingly, CT should be more sensitive than US for perforated appendicitis, since extraluminal air, extraluminal appendicoliths, and interloop abscesses are more easily detected with use of CT.

Patients with perforated appendicitis are older than patients without perforated appendicitis. The appendix was visualized in all patients with nonperforated appendicitis but in only 68% of patients with perforated appendicits. The detection of appendicolith in our study (48.5%) is comparable to the report by Lane et al (46%), lower than that by Lowe et al (65%), but higher than that by Horrow et al (36%) [13,16,17].

CONCLUSION

In conclusion, we found that a dedicated search for specific CT findings e.g. extraluminal air, abscess, phlegmon, and a defect in the enhancing appendiceal wall allows excellent sensitivity and specificity for the diagnosis of perforated appendicitis when evaluated in a group of patients with known appendicitis.

Factors such as CT protocol and patient habitus may affect the sensitivities and specificities of our CT findings. Thinner collimation can improve visualization of both the appendix and an appendicolith. In addition, in patients with very little adipose tissue it is more difficult to appreciate and quantify the extent of inflammation. Thus, if there is considerable pericecal inflammatory change or a right lower quadrant abscess without visualization of the appendix, one must consider perforated appendicitis in the differential diagnosis. We justify the use of intravenous contrast medium because the resulting wall enhancement makes it easier to identify the appendix, particularly in patients with minimal fat.

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