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Original Research Article

A Retrospective Assessment of Unenhanced Focused Appendiceal CT and Sonography for the Diagnosis of Acute Appendicitis

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Abstract

Aim: The aim of the present study was to compare the diagnostic performances of Ultrasound (graded compression Sonography) and unenhanced focused CT in patients suspected of having acute appendicitis.

Methods: In this retrospective study, an analysis of 50 consecutive patients who presented in the Department of Radio-Diagnosis, JLNMCH, Bhagalpur, Bihar, India from January 2022 to December 2022 with acute appendicitis was done.

Results: Out of these patients, 23 patients had appendicectomies- 25 as emergency and appendicitis was confirmed by microscopic examination of the surgical specimen. Appendicectomy was not performed in 27 patients. Among these patients, 10 had an alternate diagnosis. 50 patients (35 males and 15 females) aged 7 – 68 years (mean age 29.8 years) clinically suspected with acute appendicitis underwent USG and CT. Of the 28 cases in which USG was negative for appendicitis, 10 cases had alternative diagnosis. The remaining 18 cases were reported as normal, of which 3 had appendicitis, and 1 case had alternate diagnosis (epiploicappendagitis). CT detected all case of acute appendicitis. Of the 26 cases in whom CT was negative for appendicitis, 8 cases had alternate diagnosis by CT. The remaining 18 cases were reported as normal of which 3 had alternate diagnosis (1 pelvic inflammatory disease, 1 inguinal hernia, and 1 duodenal perforation peritonitis). CT had a sensitivity of 100%, specificity of 96.96% and accuracy of 98.34% for the diagnosis of acute appendicitis.

Conclusion: This study showed that both unenhanced focused CT and sonography are accurate imaging modalities in patients with suspected appendicitis. The choice of type of study to perform is likely to depend on the available resources and personnel at various institutions and the clinical features. However, CT was found to be superior to US in evaluating patients suspected of having acute appendicitis.

Keywords: acute appendicitis, focused appendix CT technique, graded compression sonography, sensitivity, specificity

Introduction

Traditionally, the diagnosis of acute appendicitis is mainly based on history, findings at physical examination, and results of laboratory tests. The rate of negative findings for appendicitis at laparotomy or laparoscopy based on these parameters may be as high as 50%. [1-3] On the other hand, a delay in the diagnosis and treatment of appendicitis may increase the potential risk of a complicated clinical course. [4]. Acute appendicitis is the most common surgical emergency of the abdomen, and there are about 250, 000 new cases a year in the United States. The lifetime risk of appendicitis is approximately 8.6% in males and 6.7% in females. [5] Despite the frequency of the disease, the clinical diagnosis of appendicitis remains a diagnostic challenge. [6] Historically, classic physical findings such as pain at McBurney's point or the psoas sign have been used to make the diagnosis, though the discriminative power of classic clinical and even laboratory findings remains low. [7-9] The presence of these signs increases the likelihood of app [10] An imaging study allows an objective confirmation of the diagnosis before an invasive procedure is performed. The two most common modalities in use are abdominal helical computed tomography (CT) and abdominal ultrasound (US). [11-14]

Moreover, the rate of negative findings for appendicitis at laparotomy or laparoscopy based on clinical features may be as high as 50%. [1-3] Ultrasonography (US) and computed tomography (CT) are being used to improve the diagnostic performance and establish an alternative diagnosis of diseases that may mimic acute appendicitis. [15] Although US is widely available and inexpensive, its accuracy is dependent on the skill of the operator. It

has been reported that when patients suspected of having acute appendicitis are examined by experienced operators, the sensitivity of US is 76%–90%, specificity is 86%–100%, positive predictive value is 71%–95%, and negative predictive value is 76%–98%. [16-19]

The aim of the present study was to compare the diagnostic performances of Ultrasound (graded compression Sonography) and unenhanced focused CT in patients suspected of having acute appendicitis.

Materials and Methods

In this retrospective study, an analysis of 50 consecutive patients who presented in the Department of Radio-Diagnosis, JLNMCH, Bhagalpur, Bihar, India from January 2022 to December 2022 with acute appendicitis was done.

Inclusion Criteria

• Patients with clinical suspicion of appendicitis.

Exclusion Criteria

• Pregnant patients

• patients with previous history of appendicectomy

• unwilling patients

CT Examination

CT examination was performed with four slice helical CT scanner (Asteion, Toshiba) by means of a rapid thin- scanning technique. A single breath hold helical scan from the top of the L2 vertebral body to the pubic symphysis was obtained in supine position. The technical parameters were as follows: collimation of 4x5 mm, table speed of 17.5 mm per rotation, pitch of 0.825, rotation time of 0.75seconds, 120 kVp, and 100-240 mA. The axial section data were reconstructed with a 5-mm thickness at 5-mm intervals and viewed using different soft-tissue window settings (width, 450 HU; level, 50 HU). No oral, rectal, or IV contrast material was administered. CT scan images were analyzed both at a workstation and on hard copy.

The following observations were made on CT examinations:

• Whether appendix was visible, if seen its maximal outer transverse diameter, and

• The presence or absence of following findings:(a) gas in the appendiceal lumen, (b) Appendicolith, (c) peri appendiceal fat stranding, (d) cecal wall thickening, and (e) abscess or phlegmon in the right iliac fossa. Each finding was separately coded.

• If the above findings were absent, a general survey of visualized parts of abdomen to find an alternative diagnosis that could explain the patient's symptoms was done.

CT findings were diagnostic of appendicitis if the outer transverse diameter of appendix is> 6 mm with or without appendicolith. If the appendix was not visualized then the presence of abscess or phlegmon is taken as a positive criteria. The presence of gas in the appendiceal lumen was considered as a possible negative criterion for acute appendicitis.

US Examination

Ultrasonography was performed using Nemio Toshiba machine. A general survey of entire abdomen, including the pelvis, was performed in all patients by using a 4.2- MHz convex-array transducer. In all the patients a targeted scan of right lower quadrant was done after emptying the bladder, with a 6-9 MHz linear-array transducer with use of the graded compression technique described by Puylaert8. Before the study the patients was asked to point to the site of maximal pain in the right lower quadrant with a single finger. The examination was initiated by scanning in the transverse plane in the right lateral and mid abdomen just above the level of umbilicus. The examination was continued caudally to the right lower quadrant with gradually increasing compression. Compression was increased until all bowel gas and fluid could be expressed from the ascending colon and caecum. The normal caecum could be compressed by moderate pressure. Care was taken so that transducer pressure was gradually increased. The inflamed appendix was most often visualized at the base of the caecum during maximal graded compression as a tubular blind ending non-peristaltic structure with bowel signature. The examination was continued caudally with identification of psoas and iliacus muscles, and the external iliac vessels. Longitudinal and oblique scans were also obtained, again with graded compression.

The following observations were made on US examinations:

• Whether appendix was visible , if seen its maximal outer transverse diameter

• Presence or absence of following findings:

(a) fluid-filled appendix, (b) lack of compressibility of the appendix, (c) appendicolith, (d) peri cecal fluid, (e) hyperechoic peri appendiceal tissue, (f) abscess or phlegmon, and (g) maximal tenderness at the site of the appendix.

• If the above findings were absent, a general survey of abdomen to find an alternative diagnosis that could explain the patient's symptoms was done.

The appendiceal diameter of > 6 mm in a noncompressible appendix, with or without appendicolith was considered as positive criteria. If the appendix is not visualized then the presence of abscess or phlegmon was taken as a positive criteria.

Final Diagnosis

The CT and US findings was independently reported as (a) suggestive of appendicitis, (b) no evidence of appendicitis, or (c) An alternative diagnosis

Definite diagnosis

In all patients who underwent surgery, definite diagnosis was made on the basis of operative findings and/or from histopathological examination of specimen. In the group that did not undergo surgery, the standard of reference was the clinical consensus based on follow-up over a period ranging from six to eight weeks.

Statistical Analysis

All the data was processed SPSS statistical packages. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated for each of the findings and also the overall diagnosis in CT and USG.

Results

Table 1: Summary of number of cases confirmed

	N	%
Confirmation of appendicitis in suspected cases	23	46
No appendicitis in clinically suspected cases	27	54
Alternative diagnosis established	10	20
Gender		
Male	35	70
Female	15	30

Out of these patients, 23 patients had appendicectomies. Appendicectomy was not performed in 27 patients. Among these patients, 10 had an alternate diagnosis. 50 patients (35 males and 15 females) aged 7 – 68 years (mean age 29.8 years) clinically suspected with acute appendicitis underwent USG and CT.

Table 2: USG diagnosis vs Final diagnosis

Final diagnosis	**Alternative**				
USG diagnosis	**Normal**	**Appendicitis**	**Diagnosis**	**Total**	**%**
Normal	14	3	1	18	36
Appendicitis	2	19	1	22	44
Alternate diagnosis	0	0	10	10	20

Of the 28 cases in which USG was negative for appendicitis, 10 cases had alternative diagnosis. The remaining 18 cases were reported as normal, of which 3 had appendicitis, and 1 case had alternate diagnosis (epiploicappendagitis).

Table 3: CT versus Final diagnosis

Final diagnosis	Alternative				
	Normal	Appendicitis	Alternate diagnosis	Total	%
Normal	15	0	3	18	36
Appendicitis	1	23	0	24	48
Alternate diagnosis	0	0	8	8	16
Total	16	23	11	50	100

CT detected all case of acute appendicitis. Of the 26 cases in whom CT was negative for appendicitis, 8 cases had alternate diagnosis by CT. The remaining 18 cases were reported as normal of which 3 had alternate diagnosis (1 pelvic inflammatory disease, 1 inguinal hernia, and 1 duodenal perforation peritonitis).

Table 4: Performances of US and CT in the overall diagnosis of acute appendicitis

Modality	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**Accuracy**
Ultrasound	84.72	90.92	89.82	89.34	89.41
CT	100	96.96	96.55	100	98.34

CT had a sensitivity of 100%, specificity of 96.96% and accuracy of 98.34% for the diagnosis of acute appendicitis.

Discussion

An imaging study allows an objective confirmation of the diagnosis before an invasive procedure is performed. The two most common modalities in use are abdominal helical computed tomography (CT) and abdominal ultrasound (US). [20-23] Both are considered to have acceptable sensitivities, specificities, and positive and negative predictive values, though CT has been shown to be superior in numerous studies. [20-24] The introduction of CT

has led to a marked decrease in the rate of negative appendectomy, as much as 48% in one institution. [25] Compared with clinical and laboratory findings alone, the addition of CT increased diagnostic sensitivity from 91.6% to 98.3%. [26]

Out of these patients, 23 patients had appendicectomies- 25 as emergency and appendicitis was confirmed by microscopic examination of the surgical specimen. Appendicectomy was not performed in 27 patients. Among these patients, 10 had an alternate diagnosis. 50 patients (35 males and 15 females) aged 7 – 68 years (mean age 29.8 years) clinically suspected with acute appendicitis underwent USG and CT. Of the 28 cases in which USG was negative for appendicitis, 10 cases had alternative diagnosis. The remaining 18 cases were reported as normal, of which 3 had appendicitis, and 1 case had alternate diagnosis (epiploicappendagitis). CT detected all case of acute appendicitis. 10The study by Ege G et al [27] who used similar CT protocol for imaging patients reported a sensitivity of 96%, specificity of 98%, positive predictive value of 97%, negative predictive value of 98% and accuracy of 97%.This is comparable to the present study. In this study, the unenhanced focused CT showed better diagnostic performances compared to graded compression sonography for the diagnosis of appendicitis but there was no significant difference in sensitivity, specificity, predictive values or accuracy between these imaging techniques. The results of present study are similar to that of Poortman et al [28] who, when comparing the graded compression technique of US with focused unenhanced CT, reported no significant difference in sensitivity, specificity, or accuracy between these imaging techniques. In this study, discordance between CT and sonographic findings occurred in 11 (16%) of 61 cases undergoing both examinations.

Of the 26 cases in whom CT was negative for appendicitis, 8 cases had alternate diagnosis by CT. The remaining 18 cases were reported as normal of which 3 had alternate diagnosis (1 pelvic inflammatory disease, 1 inguinal hernia, and 1 duodenal perforation peritonitis). CT had a sensitivity of 100%, specificity of 96.96% and accuracy of 98.34% for the diagnosis of acute appendicitis. This is comparable to the study by Sivit CJ et al [29] in which CT was correct in 98% cases.

Thus, CT is more likely to be correct when there is a discordant diagnosis. An important issue to be addressed while evaluating the positive impact of an imaging examination on the assessment of patients with suspected appendicitis is the value of normal findings on an examination using a modality. The higher the sensitivity of the imaging examination, the lower the number of false- negative examinations, and, consequently, more trust can be placed on normal findings from that examination by caregivers. According to Malone AJ [30] the identification of inflammatory changes in the pericecal and periappendiceal fat are the most important findings when the diagnosis of acute appendicitis is done by unenhanced CT. Balthazar et al [31] found that lack of visualization of an abnormal appendix in contrast- enhanced CT scans, even in the presence of obvious inflammatory changes in the right lower quadrant, is a nonspecific finding and is an insufficient basis for the diagnosis of acute appendicitis. In the present study, periappendiceal inflammatory changes were taken as supportive evidence of appendicitis.

Conclusion

This study showed that both unenhanced focused CT and sonography are accurate imaging modalities in patients with suspected appendicitis. The choice of type of study to perform is likely to depend on the available resources and personnel at various institutions and the clinical features. However, CT was found to be superior to US in evaluating patients suspected of having acute appendicitis.

References

1. Birnbaum BA, Wilson SR. Appendicitis at the millennium. Radiology. 2000 May;215(2):337-48.
2. Pieper R, Kager L, Nasman P. Acute appendicitis: a clinical study of 1018 cases of emergency appendectomy. *Acta Chir Scand* 1982; 148:51 –62
3. Bogstein PJ. Acute appendicitis-a clear-cut case in men, a guessing game in young women: a prospective study on the role of laparoscopy. Surg Endsc. 1997;11:923-7.
4. Eldar S, Nash E, Sabo E, Matter I, Kunin J, Mogilner JG, Abrahamson J. Delay of surgery in acute appendicitis. The American journal of surgery. 1997 Mar 1;173(3):194-8.
5. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. American journal of epidemiology. 1990 Nov 1;132 (5) :910-25.
6. Sternbach G, Rosen P. Appendicitis: a continuing diagnostic challenge. The Journal of Emergency Medicine. 1995 Jan 1;13(1):95-6.
7. Laméris W, Van Randen A, Go PM, Bouma WH, Donkervoort SC, Bossuyt PM, Stoker J, Boermeester MA. Single and combined diagnostic value of clinical features and laboratory tests in acute appendicitis. Academic Emergency Medicine. 2009 Sep;16 (9):835-42.
8. Cardall T, Glasser J, Guss DA. Clinical value of the total white blood cell count and temperature in the evaluation of patients with suspected appendicitis. Academic emergency medicine. 2004 Oct;11(10):1021-7.

9. Wagner JM, McKinney WP, Carpenter JL. Does this patient have appendicitis?. Jama. 1996 Nov 20;276(19):1589-94.
10. Yeh B. Does this adult patient have append icitis?. Annals of emergency medicine. 2008 Sep 1;52(3):301-3.
11. Terasawa T, Blackmore CC, Bent S, Kohlwes RJ. Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents. Annals of internal medicine. 2004 Oct 5;141(7):537-4 6.
12. van Randen A, Bipat S, Zwinderman AH, Ubbink DT, Stoker J, Boermeester MA. Acute appendicitis: meta-analysis of diagnostic performance of CT and graded compression US related to prevalence of disease. Radiology. 2008 Oct;249(1):97-106.
13. Keyzer C, Zalcman M, De Maertelaer V, Coppens E, Bali MA, Gevenois PA, Van Gansbeke D. Comparison of US and unenhanced multi–detector row CT in patients suspected of having acute appendicitis. Radiology. 2005 Aug;236(2):527-34.
14. Weston AR, Jackson TJ, Blamey S. Diagnosis of appendicitis in adults by ultrasonography or computed tomography: a systematic review and meta-analysis. International journal of technology assessment in health care. 2005 Jul;21(3):368-79.
15. Eldar S, Nash E, Sabo E, et al. Delay of surgery in acute appendicitis. Am J Surg 1997; 173:194–198.
16. Keyzer C, Zalcman M, De Maertelaer V, Coppens E, Bali MA, Gevenois PA, Van Gansbeke D. Comparison of US and unenhanced multi–detector row CT in patients suspected of having acute appendicitis. Radiology. 2005 Aug;236(2):527-34.
17. Birnbaum BA, Jeffrey RB. CT and sonographic evaluation of acute right lower abdominal pain. AJR Am J Roentgenol 1998; 170:361–371.
18. Jeffrey RB Jr, Laing FC, Townsend RR. Acute appendicitis: sonographic criteria based on 250 cases. Radiology 1988; 167: 327–329.
19. Rioux M. Sonographic detection of the normal and abnormal appendix. AJR Am J Roentgenol 1992; 158:773–778.
20. Terasawa T, Blackmore CC, Bent S, Kohlwes RJ. Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents. Ann Intern Med. 2004 Oct 5;141(7):537-46.
21. van Randen A, Bipat S, Zwinderman AH, Ubbink DT, Stoker J, Boermeester MA. Acute appendicitis: meta-analysis of diagnostic performance of CT and graded compression US related to prevalence of disease. Radiology. 2008 Oct;249(1):97-106.
22. Keyzer C, Zalcman M, De Maertelaer V, Coppens E, Bali MA, Gevenois PA, Van Gansbeke D. Comparison of US and unenhanced multi-detector row CT in patients suspected of having acute appendicitis. Radiology. 2005 Aug;236(2):527-34.
23. Weston AR, Jackson TJ, Blamey S. Diagnosis of appendicitis in adults by ultrasonography or computed tomography: a systematic review and meta-analysis. Int J Technol Assess Health Care. 2005 Summer;21(3):368-79.
24. Doria AS, Moineddin R, Kellenberger CJ, Epelman M, Beyene J, Schuh S, Babyn PS, Dick PT. US or CT for Diagnosis of Appendicitis in Children and Adults? A Meta-Analysis. Radiology. 2006 Oct;241(1):83-94.
25. Guss DA, Behling CA, Munassi D. Impact of abdominal helical computed tomography on the rate of negative appendicitis. J Emerg Med. 2008 Jan;34(1):7-11.
26. Gwynn LK. The diagnosis of acute appendicitis: clinical assessment versus computed tomography evaluation. J Emerg Med. 2001 Aug;21(2):119-23.
27. Hermans JJ, Hermans AL, Risseeuw GA, Verhaar JC, Meradji M. Appendicitis caused by carcinoid tumor. Radiology. 1993 Jul;188 (1):71-2.
28. Zebrowska G, Walsh NM. Human immunodeficiency virus-related Kaposi's sarcoma of the appendix and acute appendicitis. Report of a case and review of the literature. Archives of pathology & laboratory medicine. 1991 Nov 1;115(11) :1157-60.
29. Wilcox RT, Traverso LW. Have the evaluation and treatment of acute appendicitis changed with new technology?. Surgical Clinics. 1997 Dec 1;77(6):1355-70.
30. Malone Jr AJ, Wolf CR, Malmed AS, Melliere BF. Diagnosis of acute appendicitis: value of unenhanced CT. AJR. American journal of roentgenology. 1993 Apr;160(4):763-6.
31. Buschard K, Kjaeldgaard A. Investigation and analysis of the position, fixation, length and embryology of the vermiform appendix. Acta Chirurgica Scandinavica. 1973 Jan 1;139(3): 293-8.