e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2022; 12 (11); 136-142
Original Research Article

Ultrasonography and Computed Tomography's Diagnostic Performance in Acute Appendicitis

Dilip Jha[1], Prashant Nath Gupta[2]

[1]Assistant Professor, Department of Radiology, Krishna Mohan Medical College & Hospital, Pali Dungra, Sonkh Road, Mathura U.P.
[2]Assistant Professor, Department of Radiology, Krishna Mohan Medical College & Hospital, Pali Dungra, Sonkh Road, Mathura U.P.

Received: 25-09-2022 / Revised: 25-10-2022 / Accepted: 30-11-2022
Corresponding author: Dr. Prashant Nath Gupta
Conflict of interest: Nil.

Abstract:

Background: An Appendectomy is type of surgery done for Acute Appendicitis which can be m done as an open surgery or as laparoscopic surgery. This surgical procedure has lower-risk, and has few mortality rates reported ranging between 0.03 and 0.24%. Complications include Infectious cause occurring in some 9–20% of patients, followed by a hospital readmission rate of 6%. Perforation sometimes presents in 30%-75% of children, at the time of diagnosis and particularly common with younger ones are being at higher risk. Perforation rate varies from 16% to 40%, commonly occurring at higher frequency in younger age groups (40–57%) and in 50 years (55–70%) above patients. Basing on the medical condition, the recommendation of treating physician include Appendicitis treatment plan which may include surgery of Appendix removal (Appendectomy), needle drainage, abscess drainage, antibiotics, pain relievers, IV fluids and liquid diet.

Aim: The current study's goal is to compare the diagnostic abilities of computed tomography and ultrasonography in cases of acute appendicitis. To assess the sensitivity and specificity of USG and CT for the diagnosis of acute appendicitis.

Material and Method: The study is non-interventional, analytical, and prospective. The study's goals were to analyze the surgical and histological association of radiological abnormalities in both modalities, as well as the sensitivity and specificity of CT and USG in identifying acute appendicitis. The Department of Radio-Diagnosis was where the study was carried out. The GE Voluson S6 scanner was used to do the ultrasound evaluation. It used a curvilinear probe with a frequency range of 1.6 to 4.6 MHz and a linear high-frequency transducer with a frequency range of 5 to 13 MHz. The GE Optima 660, 64 slice Scanner was used to perform an abdominal CT scan.

Results: All patients with right iliac fossa pain or acute abdomen pain should undergo USG as their primary imaging modality because it is the most accessible, least expensive, and radiation-free option. Therefore, it is favored in patients who are pregnant or children. All individuals with stomach pain who have probing tenderness over the right iliac fossa on a USG should have their appendix thoroughly examined. There are certain technological and operator-dependent limits with USG, as well as concerns with significant abdominal gaseous distension, obesity, and the inability to provide enough compression in cases of acute severe abdominal soreness. In these circumstances, CECT clearly outperforms ultrasound.

Conclusion: In comparison to USG, CECT abdomen and pelvis offers higher sensitivity, specificity, PPV, NPV, and diagnostic accuracy for the diagnosis of acute appendicitis. Additionally, it aids in identifying the various anatomical regions, which aids surgeons in arranging treatments. Therefore, suspected instances of acute appendicitis with negative USG results should have CECT abdomen and pelvis performed for further assessment. A number

of CT's drawbacks include ionizing radiation exposure, a lack of universal accessibility, a higher cost, and the possibility of contrast allergy. Peri Appendiceal fat stranding is the most specific finding amongst different CT features of Acute Appendicitis. Due to higher diagnostic performance of CECT, it should be advocated in cases of high clinical suspicion of Acute Appendicitis, which are inconclusive on USG.

Keywords: Ultrasonography, Multi-Detector Computed Tomography, Computed Tomography, Histopathologic Examination, Positive Predictive Value.

Introduction

With an estimated lifetime risk of 7-9%, appendicitis is one of the most frequent causes of acute abdomen in children and younger people who require surgical intervention.[1] It typically manifests as an acute disease within 24 hours in around 75% of cases, and it can sporadically manifest as a subacute or chronic syndrome. The typical age of appendicitis onset is 28 years old, but it can occur at any age between 5 and 45 years old. Males are more likely to be afflicted than females; the incidence for men is ~8.9%, while the incidence for women is ~6.7%, with a male to female ratio of ~1.3:1.[2] Appendicitis or appendectomy occur ~100 times per 100,000 people worldwide. The chance of rupture increases by 5% every 12 hours or by 2% after 36 hours. [3]

Abdominal pain migration, right lower quadrant tenderness and increase in white blood cell count are the classic clinical trial of Acute Appendicitis and typically seen in fifty percent of cases. In early onset of Appendicitis physical finding are minimal. [4] Mortality is 0.14% and morbidity rates is 4.6% for removal of a normal Appendix respectively, which increases from 0.24% and 6.1% for Acute Appendicitis and from 1.7% to 19% for perforated Appendicitis.[5] Polyare developed the technique of graded compression method for Appendix visualization on USG.[6] Graded compression technique in USG and MDCT are preferred diagnostic tools, approved globally in cases presenting as right iliac fossa pain/ tenderness to evaluate Appendix. USG is readily accessible, reasonably inexpensive, non-invasive and without any radiation hazards. USG is a major tool in evaluation of suspected Acute abdomen causes in pregnancy. Limitations of USG includes operator-dependency, difficulty in performing in patients presenting with severe abdominal pain or in whom excess bowel gas is seen, in obese patients and also depends upon the type of USG machine used. To overcome these limitations in evaluating cases of Acute Appendicitis CT plays an important role. The CT features of Acute Appendicitis include enlarged diameter of Appendix (> 6mm in diameter), appendicular wall thickening (>2mm), peri-appendicular fat stranding, appendicular wall enhancement which are found in around 25% of patients. [7] As compared to CT the precision and accuracy of USG is lower due to the above said limitations.

The benefits of CT over USG include the lack of constraints like excess intestinal gas, obesity, and in patients with severe abdominal soreness where graded compression technique cannot be used, as well as high sensitivity, specificity (~100%), accuracy, and non-operator dependent. However, ionizing radiation exposure, expense, accessibility, and unpleasant reactions to contrast are the main drawbacks of CT.[8] It is estimated

that around 2% of cancers are related to radiation exposure attributed to CT, hence to minimize this potential issue, clinicians need to address different means to decrease cancers related to radiation. MRI is an alternative diagnostic modality to CT, in pregnant women providing better soft tissues characterization without ionizing radiation exposure. MRI protocol for Acute Appendicitis includes T1 and T2 images. [9] High cost, limited availability, prolonged duration and patient suitability are the major drawbacks of MRI in Acute conditions like Acute Appendicitis. Several studies found that the sensitivity and specificity of CT were 0.94 (95% CI: 0.91 to 0.95) and 0.95 (95% CI: 0.93 to 0.96) and 0.81 (95% CI: 0.78 to 0.84) and 0.81 (95% CI: 0.78 to 0.84) correspondingly for the diagnosis of acute appendicitis in adults, adolescents, and children. [10]

In children, thin young adults including reproductive-age women USG should be the initial modality of choice and no subsequent imaging is needed if the USG findings are conclusive, unambiguous, and coincide clinically. [11] CT is required further if USG findings are inconclusive and in cases of clinco-radiological incoherence, in ambiguity and to nullify the any machine and operator related issues. Histopathology being gold standard in evaluation of Acute Appendicitis cases the findings of USG and CT are compared with HPE for the calculation of sensitivity, specificity, PPV, NPV and diagnostic accuracy of these modalities.

Material and Methods

Study Design: The study was carried out in the Radio-Diagnosis Department. The study has an analytical, non-interventional prospective design. Examining the sensitivity and specificity of CT and USG in the diagnosis of acute appendicitis, as well as the surgical and histological association of radiological findings in both modalities, were the study's main goals.

Study population:

Target Population were the patients with suspected Acute Appendicitis referred for Radiological Imaging to the Department of Radio-Diagnosis. The study population provided formal consent for participating in the study.

Subject selection procedure:

A total of 65 consecutive subjects were selected based on inclusion and exclusion criteria. With proper consent and fulfilling the inclusion criteria with eligible condition to undergo contrast enhanced CT (after excluding renal dysfunction) are included the study

Inclusion criteria:

Clinically suspected Acute Appendicitis referred for imaging to the department of radio diagnosis and patients undergoing both USG and CT evaluation followed by Surgery and Histopathology in this institution.

Exclusion criteria:

Patients who didn't undergo both USG and CT, Surgery as well as Histopathology. Patients with chronic appendicular lump and Pregnancy were also excluded from the study.

Study methodology:

USG:

The GE Voluson S6 scanner was used to do the ultrasound evaluation. It used a curvilinear probe with a frequency range of 1.6 to 4.6 MHz and a linear high-frequency transducer with a frequency range of 5 to 13 MHz.

CT:

All patients with clinically suspected acute appendicitis got a CT scan after a USG. On a GE Optima 660, 64-slice scanner, a CT scan of the abdomen was performed using the following scan parameters: 5 mm thick contiguous slice, reconstruction at 0.625 to 1.5 mm, 80-120 KVp, variable mA ranging from 250-375 in Helical mode

with a Pitch of 0.984, starting from the upper border of the diaphragm to just below the pubis symphysis.

After gaining informed consent, non-contrast enhanced studies employing oral, rectal, and IV were always followed by contrast-enhanced studies. 1.5 liters of diluted iodinated contrast (30ml of (60%) trazograff mixed with 1.5 liters of water) were used to opacify the bowel. Non-ionic contrast was given intravenously at a rate of 70 ml (1 ml/Kg body weight) at 2.2–2.5 ml/s, followed by 30 ml of normal saline at a rate of 2 ml/s. Prior to administering contrast, pertinent histories were verified, renal parameters were examined, and any allergies to iodinated contrast, prior histories of asthma, diabetes, kidney illnesses, and multiple myeloma were examined. Premedication was given to patients with contrast allergy. After contrast injection or scan was over, the patient was observed for another 40 minutes to see for any late contrast reactions and managed accordingly. Surgical and Histopathological correlation of radiological findings in both modalities were done.

Statistical analysis: MS Excel was used to enter the data. Statistical analysis was carried out using MedCalc 2020 (MedCalc Software) and IBM SPSS Statistics for Windows, version 27.0 (released 2020). To calculate sensitivity, specificity, positive predictive value, negative predictive value, and other variables, descriptive statistics have been used to show the data.

Result

Table 1: USG and histopathology correlation

		Histopthology Examination		
		Inflammed Appendix	Normal	Total
Ultrasound	Negative	07	4	11
		75%	25%	100.0%
	Positive	52	2	54
		98.4%	1.6%	100.0%
Total		59	6	65
		94.6%	5.3%	100.0%

In 8 of the 11 cases where the USG was negative but the HPE was, the CT was positive. 4 of the remaining 6 USG negative cases tested negative for HPE, while 2 tested positive. Out of the 60 positive USG cases, 64 had positive and 1 had negative results for appendicitis after they underwent surgery and HPE.

Table 2: CT diagnosis and Histopathology correlation

		Histopthology Examination		
		Inflammed Appendix	Normal	Total
CT	Negative	1	3	04
		25%	75%	100.0%
	Positive	60	1	61
		98.5%	1.5%	100.0%
Total		61	4	65
		96.0%	4.0%	100.0%

Out of 4 patients who tested negative on the CT scan, 3 also tested negative in the surgery, while the other patient tested positive for HPE. hence, for CT False

positives are 1, false negatives are 1, and true positives are 60. Therefore, it was determined that sensitivity, specificity, PPV, NPV, and diagnostic accuracy were each 98%, 75%, 98%, 75%, and 97%.

Discussion

A tertiary institution served as the site of this study. Patients who presented to the emergency room complaining of fever, abdominal pain, nausea, or vomiting as well as clinically suspected acute appendicitis were examined by the surgeons and referred to the radiology department for USG and CECT abdomen and pelvis to rule out acute appendicitis, followed by surgery and HPE. These patients were considered the study population. Patients who underwent no imaging procedures, such as USG or CECT abdomen and pelvis, were not included in the study. It could be that the patient is averse to having their abdominal and pelvis examined using both USG and CECT. It could be caused by a number of different factors, such as lack of consent, a history of allergy to contrast, pregnancy, or abnormal renal parameters where contrast injection is not advised.

Our study has similar observation comparable to a study done by Reich, Betzalel et al. [8] depicting the incidence of Acute Appendicitis, which is 61.3% among males and 38.7% among females. Majority of our patients (50%) belong to 21-30 years' age group and minimum number (4%) of patients belong to 51-60 years' age group. Majority of male patients (66%) were between 21-30 years and (2%) were between 51-60 years. Majority of female patients (42%) were less than 20 years and (3%) were between 41-50 years. Over all second common age group belongs to less than 20 years (27%). From this study, we observed that Acute Appendicitis is more common among males in 21-30 years' age group and <20years in females.

A study by Mostbeck G et al. [12] found that USG had identical results to those of our study, with the exception of NPV, for sensitivity, specificity, positive predictive value, and negative predictive value in the diagnosis of acute appendicitis. The non-visualization of the appendix in USG, making it impossible to rule out acute appendicitis in the majority of cases, is one explanation for the study's much lower negative predictive value. Numerous factors, including overlapping bowel gases, obesity, operator dependence, and extreme soreness over the RIF that prevents compression in the RIF, may contribute to the non-visualization of the appendix. In a study by Yu SH et al. [13], they discovered that the sensitivity and specificity of USG were, respectively, 86.7% and 90.0%. In a study, Kaiser et al. [14] discovered that the sensitivity and specificity of USG were 80% and 94%, respectively, whereas those of CT were 97% and 93%.

According to Paulson EK et al. [15] the sensitivity, specificity and positive predictive values of 90-100%, 91-99%, 95-97% respectively. According to them USG had a sensitivity, specificity and positive predictive value of 75- 90%, 86-100%, and 89-93% respectively. According to a study done by Hlibczuk V et al. [16] the sensitivity, specificity of CT in diagnosis of Acute Appendicitis was 92.7% (95% CI 89.5%-95.0%) and 96.1% (95% CI 94.2%-97.5%) respectively which is similar to our study

According to study by C J Sivit et al. [17] on 386 children and younger adults with suspected Appendicitis who were subjected to either USG or CT and both. Out of 386 patients, 233 underwent only USG, 71 underwent only CT and 82 examined by both modalities. CT and USG findings were compared with surgical and histopathologic findings or clinical follow-up. In order to compare the results with graded USG, Lisa H. Lowe [18] sought to establish the sensitivity, specificity, and

accuracy of unenhanced abdominal minimum CT in children with suspected appendicitis. Over an 11-month period, 76 children with suspected appendicitis underwent unenhanced, minimum CT, and 86 consecutive kids exhibited graded USG compression. For unenhanced small CT, sensitivity, specificity, and accuracy were 97%, 100%, and 99% respectively; for USG, they were 100%, 88%, and 91%. According to study by Betzalel Reich et al.(8) in which efficiency of CT vs USG was evaluated for Acute Appendicitis. Out of 136 patients with a diagnosis of Appendicitis, 79 met the criteria for inclusion in the CT cohort. CT was 100 per cent sensitive based on pathology.

Gamanagatti et al. [19] with an aim to compare the graded compression USG with unenhanced CT in Acute Appendicitis and then the results were compared with operative findings and clinical follow-up. Found that out of the 58 patients (90% were adults) 52 had Appendicitis as proved by surgical finding and remaining six patients were managed conservatively. [20]

Conclusion:

For the diagnosis of acute appendicitis, CECT abdomen and pelvis provides greater sensitivity, specificity, PPV, NPV, and diagnostic accuracy compared to USG. It also helps to distinguish the various anatomical sections, which helps surgeons plan out therapies. In cases of suspected acute appendicitis with negative USG results, CECT abdomen and pelvis should be conducted for additional examination. Ionizing radiation exposure, a lack of universal accessibility, a higher price, and the potential for contrast allergy are only a few of CT's disadvantages. Peri Appendiceal fat stranding is the most specific finding amongst different CT features of Acute Appendicitis. Due to higher diagnostic performance of CECT, it should be advocated in cases of high clinical suspicion of Acute Appendicitis, which are inconclusive on USG.

References

1. Humes DJ, Simpson J. Acute appendicitis. BMJ. 2006;9;333(7567) :530-4.
2. Jones MW, Lopez RA, Deppen JG. Appendicitis. In: Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2020.
3. Bickell NA, Aufses AH, Rojas M, Bodian C. How time affects the risk of rupture in appendicitis. J Am Coll Surg. 2006;202(3):401-6.
4. Omari AH, Khammash MR, Qasaimeh GR, Shammari AK, Yaseen MK, Hammori SK. Acute appendicitis in the elderly: risk factors for perforation. World J Emerg Surg. 2014;9(1):6.
5. Khairy G. Acute appendicitis: is removal of a normal appendix still existing and can we reduce its rate? Saudi J Gastroenterol. 2009;15(3):167-70.
6. Worrell JA, Drolshagen LF, Kelly TC, Hunton DW, Durmon GR, Fleischer AC. Graded compression ultrasound in the diagnosis of appendicitis. A comparison of diagnostic criteria. J Ultrasound Med. 1990;9(3):145-50.
7. Sharma M, Agrawal, A. Pictorial essay: CT scan of appendicitis and its mimics causing right lower quadrant pain. Indian J Radiol Imaging. 2008; 18(1):80- 9.
8. Reich B. An international evaluation of ultrasound vs. computed tomography in the diagnosis of appendicitis. International journal of emergency medicine. 2011;4(1):68.
9. Dewhurst C, Beddy P, Pedrosa I. MRI evaluation of acute appendicitis in pregnancy. Journal of Magnetic Resonance Imaging. 2013;73(3):566-75.
10. Kinner S, Pickhardt PJ, Riedesel EL, Gill KG, Robbins JB, Kitchin DR, et al. Diagnostic accuracy of MRI versus CT for the evaluation of acute

appendicitis in children and young adults. American Journal of Roentgenology. 2017;209(4):911-9.
11. Debnath J, George RA, Ravikumar R. Imaging in acute appendicitis: What, when, and why? Medical journal armed forces India. 2017;73(1):74-79.
12. Mostbeck G, Adam EJ, Nielsen MB. How to diagnose acute appendicitis: ultrasound first. Insights Imaging. 2016;7(2):255-263.
13. Yu SH, Kim CB, Park JW. Ultrasonography in the diagnosis of appendicitis: evaluation by meta-analysis. Korean J Radiol. 2005; 5:267–277.
14. Kaiser S, Frenckner B, Jorulf HK. Suspected appendicitis in children: US and CT - a prospective randomized study. Radiology. 2002;223(3):633-8.
15. Paulson EK, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis z. N Engl J Med. 2003; 348:236-42.
16. Hlibczuk V, Dattaro JA, Jin Z, Falzon L, Brown MD. Diagnostic accuracy of non-contrast computed tomography for appendicitis in adults: asystematic review. Ann Emerg Med. 2010; 55:51-59.
17. Sivit CJ, Newman KD, Boenning DA, Nussbaum-Blask AR, Bulas DI, Bond SJ, et al. Appendicitis: usefulness of US in diagnosis in a pediatric population. Radiology. 1992;185(2): 549-52.
18. Lowe LH, Penney MW, Stein SM, Heller RM, Neblett WW, Shyr Y, et al. Unenhanced limited CT of the abdomen in the diagnosis of appendicitis in children: comparison with sonography. American Journal of Roentgenology. 2001;176(1):31-5.
19. Gamanagatti S, Vashisht S, Kapoor A, Chumber S, Bal S. Comparison of graded compression ultrasonography and unenhanced spiral computed tomography in the diagnosis of acute appendicitis. Singapore medical journal. 2007;48(1):80.
20. Smith, G. A. Essential Treatment of Covid19 Patients. Journal of Medical Research and Health Sciences, 2020; 3(12): 1118–1119.