

A Study to Compare the Diagnostic Accuracy of CT and USG in the Diagnosis of Acute Appendicitis

Veeresh Hanchinal¹, S Rutuparna², Priyanka Patil³

¹Associate Professor, Department of Radiology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India, ²Consultant, Department of Radiologist, Columbia Asia Hospital, Bangalore, Karnataka, India, ³Assistant Professor, Department of Radiology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India.

Abstract

Background: Vague abdomen pain is the most commonly encountered symptom in the emergency department at any hospital. The various cause of the abdomen pain may vary from benign to life threatening disease. Appendicitis is the most common cause of abdomen pain in patients admitted at the emergency department. The Aim of the study was to evaluate the accuracy of CT and USG in the diagnosis of acute appendicitis in patients who are taken for appendectomy on clinical basis. **Subjects and Methods:** A Prospective Observational study was conducted at Department of Radiology at Gadag Institute of medical Sciences from June 2019 to December 2019. A total of 200 study subjects during the study period who presented with symptoms of acute abdomen pain and clinical findings highly suspicious of appendicitis were enrolled for the purpose of the study. **Result :** From the study it is concluded that CT is more sensitive, specificity, PPV, NPV. Hence the CT investigation is more accuracy than USG in diagnosing cases of appendicitis. **Conclusion:** Evaluating a case of appendicitis is mainly clinical, depending on the clinical scores and signs. But there is increase in the negative appendectomy rate on depending only on clinical findings. Usually USG is the first primary techniques, considering its easy availability, low cost and reproducible with no radiation but it has its own pitfalls, being operator dependent. CT on the other hand is more specific than USG and hence could rule out appendicitis. Most of the studies including our study has shown that CT has more sensitivity, specificity, Negative predictive value and Positive predictive value in diagnosing appendicitis.

Keywords: Appendicitis, Pain, USG, CT, Diagnostic Accuracy.

Corresponding Author: Veeresh Hanchinal, Associate Professor, Department of Radiology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India.

E-mail: veereshhanchinal@gmail.com

Received: 01 February 2021

Revised: 04 March 2021

Accepted: 12 March 2021

Published: 20 June 2021

Introduction

Appendicitis is a common and frequently made diagnosis. History of appendicitis was made and written in the past two generations.

Appendicitis is the most common cause of abdomen pain in patients admitted at the emergency department. Diagnosing this in young male patient is mostly straight forward, but the same becomes a problem in premenopausal women with similar clinical history and symptoms.^[1]

The three classical sign of pain in the right lower quadrant with fever and chills, and peritonitis was contributed by McBurney in 1889. He also described, what is now the Mc Burney's point, the point of maximum tenderness at the junction of a line drawn from umbilicus to anterior superior iliac spine.^[2]

Alvarado published clinical score for appendicitis in the year 1986. He compared suspected patients with common clinical

and laboratory findings with the pathologically proven acute appendicitis.^[3]

Eight criteria were chosen to be included in the diagnostic score. Most predictive and prevalent was the right lower quadrant pain and a left Shift of WBC count. Each criteria was given 1 point. Right lower quadrant pain and leucocytosis was given 2 points each reaching a total of 10. The score was applied to adults and children, with an age ranging from 4 to 80 years. An Alvarado Score of ≥ 7 was considered high risk for appendicitis with sensitivity of 81% and a specificity of 74%.^[4]

Routine investigation of the patients admitted with right quadrant pain includes the laboratory investigations like complete blood count, c-reactive protein, the urine routine and urine culture examination.

Nearly 70-90% of patients of acute appendicitis have an elevated neutrophil count. It has poor specificity for diagnosing

acute appendicitis.^[5,6]

WBC has been found to be elevated in acute appendicitis which may be due to the mural inflammation of the appendix. Studies have also shown that the WBC count correlates with the severity of appendicitis. CRP is an acute phase reactant that has similar role as that of WBC in appendicitis. There has been a reported sensitivity of 40-90% and specificity of 27-90% in the diagnosis of appendicitis. Another study shows that WBC was found to differentiate normal appendix from the early inflamed appendix, than the CRP level.^[7,8]

Acute abdomen pain is the most common symptom we encounter in most of the emergency department. The abdominal pain is attributed to many cause, of which the appendicitis occupies within the first few of the cause. Evaluating a case of appendicitis is mainly clinical, depending on the clinical scores and signs.

But there is increase in the negative appendectomy rate, depending only on clinical findings. And also in patients with atypical and equivocal clinical findings surgeons are in favour of imaging modalities for arriving at a diagnostic conclusion, rather than to keep the patient in observation.

As the later practice of observation has led to increase in the percentage of perforation rate, here comes the major role of the imaging techniques like CT and USG.

Usually USG is the first primary technique recommended considering it's easy availability, low cost and reproducible with no radiation.^[9]

But it has its own pitfalls, being operator dependent, highly depending on the skill and experience of the radiologist who does the scan. And also other factors like the built of the patient, and the various position of the appendix, makes it difficult for the scanning radiologist to visualise the appendix.

Sometimes USG also gives a equivocal findings were in we are forced to switch over to CT or other modalities. CT on the other hand is more specific than USG and hence could rule out appendicitis .Both the imaging technique could give an alternate diagnosis if appendicitis is ruled out.

Literature shows many studies that have debated over the best modality for diagnosing acute appendicitis. Most of them come up with more or less the same results. Both the technique have definitely reduced the rate of negative appendectomy in recent years.

Objective:

To find the diagnostic accuracy of both the imaging technique in diagnosing acute appendicitis.

Subjects and Methods

A Prospective Observational study was conducted at Department of Radiology at Gadag Institute of medical Sciences from

June 2019 to December 2019.

A total of 200 study subjects during the study period who presented with symptoms of acute abdomen pain and clinical findings highly suspicious of appendicitis were enrolled for the purpose of the study.

Inclusion Criteria:

1. Patients who have undergone both the imaging techniques of CT and USG for diagnosing of Appendicitis

Exclusion Criteria:

1. Patient with inflammatory focus like mesenteric adenitis found through initial USG screening and history
2. PID, nonspecific enterocolitis were excluded
3. Who were in need of immediate surgery and no time for imaging modality?
4. Non consenting patient
5. Patients who had only one imaging done or no imaging done were excluded

Patients who were admitted in the causality surgical emergency ward within the age group of 15-45 who presented with clinical findings and symptoms of acute appendicitis like right iliac fossa pain ,fever and vomiting were enrolled in the study. A total study sample of 200 was selected the clinical history regarding present history was taken in the prescribed proforma. Informed consent was obtained from each participating patient.

The normal appendix when visualized was reported. The CT report was positive, negative, or inconclusive. The criteria for appendicitis is similar to that of USG. Alternative diagnoses, when achieved, were reported.

Results:

Total of 200 study subjects were enrolled and examined during the study period.

The [Table 1] shows the predominance of male patient in the study sample with about 63% and females are 37%. The incidence of Appendicitis was found to be more among the subjects with 21 to 40 years with 60% of subjects.

In the present study nearly 88% of the study subjects were diagnosed to be having appendicitis from CT Examination and 86% were diagnosed as Acute Appendicitis by USG [Table 2].

Among 176 study subjects diagnosed by CT as appendicitis, 174(98.9%) of them were found to be having Acute Appendicitis by Histopathology examination, 2(1.1%) of them were found to be false positive by Histopathology. Out of 24 cases diagnosed normal by CT, 6 (25%) of them were false negative as they had inflamed Appendix by Histopathology. The sensitivity of CT was 96.67%, Specificity was 90.00%, PPV

Table 1: Social profile of the study subjects

		Frequency	Percentage
Age	< 20 Years	74	37
	20 to 40 years	120	60
	More than 40 Years	6	3
Gender	Male	126	63
	Female	74	37

Table 2: Diagnosis of Appendicitis by CT

		Frequency	Percentage
CT	Normal	24	12
	Positive	176	88
USG	Normal	28	14
	Positive	172	86

Table 3: Diagnostic Evaluation of CT Findings with Histopathology Report

		Histopathology Examination		Total
		Normal	Inflamed Appendix	
CT	Normal	18 (75%)	6 (25%)	24 (100%)
	Positive	2 (1.1%)	174 (98.9%)	176(100%)
Total		20	180	200
Sensitivity		96.67%		
Specificity		90.00%		
Positive Predictive Value		98.86%		
Negative Predictive Value		75.00%		
Diagnostic Accuracy		96.00%		

Table 4: Diagnostic Evaluation of USG Findings with Histopathology Report

		Histopathology Examination		Total
		Normal	Inflamed Appendix	
USG	Normal	14 (50%)	14 (50%)	28(100%)
	Positive	6 (3.4%)	166(96.6%)	172(100%)
Total		20	180	200
Sensitivity		92.22%		
Specificity		70.00%		
Positive Predictive Value		90.00%		
Negative Predictive Value		50.00%		
Diagnostic Accuracy		90.00%		

was 98.86%, NPV was 75.0% and Diagnostic Accuracy was 96.00% [Table 3].

Among 172 study subjects diagnosed by USG as appendicitis, 166(96.6%) of them were found to be having Acute Appendicitis by Histopathology examination, 2(1.1%) of them were

found to be false positive by Histopathology. Out of 28 cases diagnosed normal by USG, 14(50%) of them were false negative as they had inflamed Appendix by Histopathology. The sensitivity of CT was 92.22%, Specificity was 77.00%, PPV was 96.51%, NPV was 50.00% and Diagnostic Accuracy was

90.00% [Table 4].

Discussion

The study was done in a tertiary institution. Patient admitted in emergency department with abdominal pain and classical symptoms of acute appendicitis like a fever, right quadrant pain and vomiting, who were examined by the surgeons and taken for surgery based on clinical symptoms were taken in to study

In the present study middle aged study subjects between 20 to 40 years were affected by Appendicitis and it was also seen more among Male when compared with Females. The study findings of our study was found to be comparable and similar to the study findings of Sartelli M et al and Mishra R K et al also had majority of the study subjects aged less than 40 years.^[10,11]

The Increased Male gender predominance in the present study was found to be in comparable to the study findings of Singh I et al and Kalem M et al.^[12,13]

In the present study the diagnosis of Acute Appendicitis was confirmed with the Histopathology examination of the appendix which was removed post-surgery. The histopathological examination findings of inflamed appendix was used as a gold standard test in the diagnosis.

The Ultrasound and Computed Topography were used to diagnose the Acute Appendicitis and were evaluated with HPE to obtain the sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic Accuracy

The CT was found to be having a sensitivity of 96.67% and USG had a sensitivity was 92.2%. The Specificity of CT was found to be 90% and USG it was 70%.

The Findings of the CT Scan in Diagnosing Acute Appendicitis in our study was found to be comparable with the studies done by Balthazar EJ et al.^[14] The Ultrasound findings of our study in diagnosing Acute Appendicitis was similar and comparable to the findings of Puylaert et al,^[15] Terasawa and Coworkers et al.^[16] Even the Korean meta-analysis findings were found to be similar to our study findings.^[17]

Conclusion

Literature shows many studies that have debated over the best modality for diagnosing acute appendicitis. Most of them come up with more or less the same results. Both the technique have definitely reduced the rate of negative appendectomy in recent years. Weighing the cost versus the radiation and the real need to rule out appendicitis, and the dire need in search of alternate diagnosis should be considered before deciding over which imaging modality to choose. But CT without doubt has definitely more diagnostic performance than USG in acute appendicitis and our study also proves the same.

References

1. Birnbaum BA, Wilson SR. Appendicitis at the Millennium. *Radiology*. 2000;215(2):337–348. Available from: <https://dx.doi.org/10.1148/radiology.215.2.r00ma24337>.
2. Jain RK, Jain M, Rajak CL, Mukherjee S, Bhattacharyya PP, Shah MR. Imaging in acute appendicitis: A review. *Indian J Radiol Imaging*. 2006;16(4):523. Available from: <https://dx.doi.org/10.4103/0971-3026.32261>.
3. Ohle†R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: a systematic review. *BMC Med*. 2011;9:139.
4. Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann Emerg Med*. 1986;15(5):557–564. Available from: [https://dx.doi.org/10.1016/s0196-0644\(86\)80993-3](https://dx.doi.org/10.1016/s0196-0644(86)80993-3).
5. Hale DA, Molloy M, Pearl RH, Schuttde, Jaques DP. Appendectomy: a contemporary appraisal. *Ann Surg*. 1997;225:252–261. Available from: <https://dx.doi.org/10.1097/0000658-199703000-00003>.
6. Lewis FR, Holcroft JW, Boey J, Dunphyje. Appendicitis: a critical review of diagnosis and treatment in 1,000 cases. *Arch Surg*. 1975;110(5):677–684. Available from: <https://doi.org/10.1001/archsurg.1975.01360110223039>.
7. Yang HR, Wang YC, Chung PK, Chen WK, Jeng LB, Chenrj. Laboratory tests in patients with acute appendicitis. *ANZ J Surg*. 2006;76:71–75. Available from: <https://doi.org/10.1111/j.1445-2197.2006.03645.x>.
8. Hallan S, Åsberg A. The accuracy of C-reactive protein in diagnosing acute appendicitis—a meta-analysis. *Scand J Clin Lab Invest*. 1997;57(5):373–380. Available from: <https://dx.doi.org/10.3109/00365519709084584>.
9. Larsson PG, Henriksson G, Olsson M, Boris J, Ströberg P, Tronstad SE, et al. Laparoscopy reduces unnecessary appendectomies and improves diagnosis in fertile women. *Surg Endosc*. 2001;15(2):200–202. Available from: <https://dx.doi.org/10.1007/s004640000255>.
10. Sartelli M, Baiocchi GL, Saverio SD. Prospective Observational Study on acute Appendicitis Worldwide (POSAW). *World J Emerg Surg*. 2018;13(19):1–10. Available from: <https://doi.org/10.1186/s13017-018-0179-0>.
11. Mishra RK, Goel P, Sharma R, Sharma AC. The Epidemiology of Appendicitis and Appendectomy in India: An Observational Study. *Int J Med Res Prof*. 2017;3(5):381–87.
12. Singh I. *Textbook of human histology 6th revised edition*. vol. 188. Delhi, India: Jaypee Brothers Medical Publishers; 2001.
13. Kalem M, Rich AJ, Talbot DR, Canlitie WJ. Evaluation of modified Alvarado score in diagnosis of acute appendicitis: A Prospective study. *Ann R Coll Surg*. 1994;76:418–427.
14. Balthazar EJ, Megibow AJ, Siegel SE, Birnbaum BA. Appendicitis: prospective evaluation with high-resolution CT. *Radiology*. 1991;180(1):21–24. Available from: <https://dx.doi.org/10.1148/radiology.180.1.2052696>.
15. Puylaert JB. Acute appendicitis: US evaluation using graded compression. *Radiology*. 1986;158(2):355–360. Available from: <https://dx.doi.org/10.1148/radiology.158.2.2934762>.

16. 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;141(7):537. Available from: <https://dx.doi.org/10.7326/0003-4819-141-7-200410050-00011>.
17. Yu SH, Kim CB, Park JW. Ultrasonography in the diagnosis of appendicitis: evaluation by meta-analysis. *Korean J Radiol.* 2005;6:267–277. Available from: <https://doi.org/10.3348/kjr.2005.6.4.267>.

Copyright: © the author(s), 2021. It is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits authors to retain ownership of the copyright for their content, and allow anyone to download, reuse, reprint, modify, distribute and/or copy the content as long as the original authors and source are cited.

How to cite this article: Hanchinal V, Rutuparna S, Patil P. A Study to Compare the Diagnostic Accuracy of CT and USG in the Diagnosis of Acute Appendicitis. *Asian J. Med. Radiol. Res.* 2021;9(1):76-80.

DOI: dx.doi.org/10.47009/ajmrr.2021.9.1.14

Source of Support: Nil, **Conflict of Interest:** None declared.

