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Original Research Article

A study of correlation between clinical, radiological and pathological diagnosis of appendicitis: a retrospective analytic study

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ABSTRACT

Background: Acute appendicitis is the most common cause of acute abdominal pain in young adults requiring emergency surgery. Appendicectomy is the most frequently performed surgery. The diagnosis is often challenging and the decision to operate in an emergency setting is always debatable. A combination of clinical signs and symptoms with laboratory findings in many scoring systems are suggesting the probability of appendicitis and the possible subsequent management pathway. The aim was to evaluate accuracy of the clinical Alvarado scoring system, radiological finding and histopathological examination for the diagnosis of acute appendicitis.
Methods: A retrospective study was conducted in the department of general surgery in a tertiary care centre in South India. Total of 237 patients with acute abdominal pain were included and evaluated with the clinical Alvarado scoring system, radiological finding with (USG/CT abdomen) and histopathological examination for the diagnosis of acute appendicitis. The data was collected and analyzed retrospectively.
Results: Of the 237 patients, 164 patients were male (69.1%) and rest is female. The correlation of the Alvaroda score with histopathological findings in groups with score > 7 and ≤7 the correlation of Alvarado score and the ultrasound findings were comparable between the study groups. The sensitivity of ultrasound in diagnosing acute appendicitis in patients with Alvarado score >7 was 72.99%. The sensitivity of ultrasound in diagnosing acute appendicitis in patients with Alvarado score ≤7 was decreased to 27%.
Conclusions: The diagnostic accuracy of clinical features is far better than radiological investigations in the diagnosis of acute appendicitis. Therefore, it is concluded that it is better to use radiological investigations only to confirm the diagnosis of acute appendicitis rather to diagnose it.

Keywords: Appendicitis, Alvaroda score, Negative appendicectomy, Right iliac fossa pain

INTRODUCTION

Appendicitis is an inflammation of the vermiform appendix. Most common cause is obstruction of the lumen due to hyperplasia of the lymphoid follicles at younger age or by obstruction of the lumen by fecoliths in older patients.[1] Acute appendicitis (AA) is the most common cause of acute surgical emergency in the general population with incidence increasing in Asian countries.[2] Although, the diagnosis is straightforward in most cases, made mostly through clinical examination and appendectomy is procedure of choice. Delayed in diagnosis could result in increased morbidity and mortality and complications like perforation, peritonitis or sepsis.[3,4] Despite its high prevalence, there have been numerous attempts to improve the diagnostic accuracy

and outcome of patients with AA the diagnosis of appendicitis remains challenging. A number of scoring systems for diagnosing acute appendicitis have been suggested to improve accuracy and decrease the negative appendectomy rate the range of 25-30%.[5]

Ultrasound has been widely used tool in the diagnosis of acute appendicitis with certain sonographic criteria. It is common practice in our country to send all appendix specimens for histopathological examinations, the aim of this study to correlate the histopathological findings with clinical and sonological diagnosis. In this study, we evaluated the Alvarado scoring for the diagnosis of acute appendicitis with a sonographic and histopathological correlation.

Conventional appendectomy is a highly effective procedure, but histological examination of appendix specimens is routinely done in our institution hence the need to correlate the histopathological findings with the clinical diagnosis of appendicitis. This study was done to find out the association between clinical, radiological, operative and histopathological finding and thus evaluate clinical diagnostic accuracy and radiological diagnostic accuracy. The study also was done to find out the importance and accuracy of clinical examination and effectiveness of radiological investigation in diagnosing acute appendicitis.

METHODS

A retrospective search was performed for cases that had been operated with a clinical diagnosis of acute appendicitis in a tertiary teaching centre for the period of four years. A total of 237 cases were identified based on the inclusion and exclusion criteria. Study population were characterised by their histopathological reports of appendectomy specimens. The clinical, radiological, surgical and histopathological data were retrieved from previous record and collected from MRD.

The study included only patients undergoing surgery were included among all age group of both sexes. The study excluded patients admitted with recurrent appendicitis for interval appendicectomy, appendicular abscess, appendicular mass previously treated conservatively.

In this study, clinical Alvarado scoring system was done on the eight predictive clinical factors. This scoring system has maximum score of 10 points including:

- Clinical symptoms (nausea and anorexia);
- Signs (fever, shifting pain, right lower quadrant pain, and rebound tenderness);
- Laboratory findings (leukocytosis and neutrophilia).

Right lower quadrant pain and leukocytosis carries 2 points each while the rest contributes 1 point.[1] CT evaluation of the appendix was based on the diameter of the appendix (the cut-off value for appendiceal diameter was found to be 6.5 mm with very high-class prediction) and peri appendiceal inflammation. The presence or absence of peri-appendiceal inflammation was analysed. If it was present the degree of inflammation was categorized visually into mild to moderate and severe. Peri-appendiceal fat stranding which is present in up to one centimeter periphery of the appendix for mild to moderate inflammation if area is larger it was termed severe inflammation. Presence of extraluminal fluid collection around the appendix (free fluid) is assessed based on its presence or absence, which is suggestive of perforation and abscess formation, was evaluated. Appendicolith is a high attenuation structure of any size within the appendix. Presence or absence of appendicolith was noted.

Patients were divided into four groups like Group 1 (Alvarado score >7 with positive sonographic findings), Group 2 (Alvarado score >7 with negative sonographic findings), Group 3 (Alvarado score ≤7 with positive sonographic findings) and Group 4 (Alvarado score ≤7 with negative sonographic findings). The four groups were correlated with the histopathological diagnosis.

Statistical analysis

Data were analysed using SPSS version 14.0 software (SPSS Inc., Chicago, IL). Categorical variable was compared using Pearson's Chi-square test and Fisher exact probability test. Mann-Whitney U test was used for ordinal data. The sensitivity, specificity, Positive predictive value (PPV) and Negative predictive value (NPV) were calculated for individual investigation and investigations in combination. P value of <0.05 was considered significant for all tests.

RESULTS

Demographic parameters

This study had 164 male (69.1%) and 73 females (30.8%). There was male preponderance over females. Distribution of comorbidities was comparable between the study groups (Table1).

Table 1: Baseline demographic parameters.

Demographic parameters	Study patients (n = 237)
Mean age (years)	37.8
Gender	
Male	164 (69.1%)
Female	73 (30.8%)
Comorbidities	
DM (n)	65 (27.42%)
Hypertension (n)	76 (32.06%)

The distribution of CT signs was comparable between the groups. Severe inflammation was equally noted in both

groups. Appendicular diameter (mm) was high in appendicitis group. Appendicolith was not noted in normal appendix group (Table 2).

Table 2: The distribution of CT signs in study patients.

CT findings	Normal appendix (n = 46)	Acute appendicitis (n = 191)
Appendiceal diameter (mm)	3.1±0.8 (2-5)	8.5±2.7 (6-16)
Mild-moderate inflammation	54% (n = 25)	60% (n = 115)
Severe inflammation	24% (n = 11)	26% (n = 50)
Free fluid	22% (n = 10)	12% (n = 22)
Appendicolith	0	2% (n = 4)

Intra operative findings of study patients

Appendicectomy done by either Laparoscopic or Open method by muscle splitting, transverse skin incision shows following findings, the appendix was seen in different positions. In present series' most of appendix 76% were retrocaecal in position and in 15% of cases it was pelvic in position and others is 9%.

Table 3: Intra operative findings of study patients.

Intra Operative findings	Total study patients (n = 237)
Thickened, fibrotic	24 (10%)
Congested, edematous	58 (24%)
Gangrenous	23 (9%)
Perforated	86 (36%)
Normal appendix	46 (19%)

On gross examination of the appendix it was congested and edematous in 24% of cases. In 36% cases it was perforated and in 19% cases appendix was normal. Twenty-three cases of gangrene were reported in this study (Table 3).

Histopathological findings of study patients

Acute appendicitis on histopathological examination includes acute suppurative appendicitis, transmural inflammation of the appendix with or without presence of fecolith and gangrenous perforated appendix. Thirty-six cases were reported to have fibrous obliteration of appendix lumen. Around 4% of patients had unusual findings on histopathology as shown in table II. Two cases that reported mucinous cystadenoma had a nodule of 6 mm in maximum dimension measured. Two case of Focal dilatation of appendix lumen and mild atypical epithelium seen. Three case of extravasation of mucin with a single gland suggestive of cystadenoma with low grade dysplasia associated with inflammation. Two cases found to have carcinoid at tip of appendix with positive staining. All these patients had appendectomy as treatment of choice. Negative appendectomy rate was 9.46% and patients greater than 16 years of age represent 85.71% of it. Unusual findings like Carcinoid tumor, mucinous cystadenoma, and granulomatous lesion with Crohn's diseases were noted in 4% of the study population (Table 4).

Table 4: Histopathological findings of study patients.

Histopathological findings	Total study patients (n = 237)
Acute appendicitis	65% (n = 154)
Normal appendix	19% (n = 46)
Fibrous Obliteration	12% (n = 28)
Unusual findings	4% (n = 9)

Alvarado scoring in study patients

According to Alvarado scoring among 237 cases 173 patients have scoring of >7 and 64 of them have scored <7. The scoring is done among both sexes (Table 5).

Table 5: Alvarado scoring in study patients.

Alvarado score	>7	<7
	173 (73%)	64 (27%)

Correlation of Alvarado score with histopathological finding

Correlation of alvaradon score with histoplathological finding is done. This shows among pathiens who have scores >7 has positive histopathological finding 0f 86% and negative findings of 13%. The patients who have scored<7 has positive finding of 78% and negative findings of 22% (Figure 1)

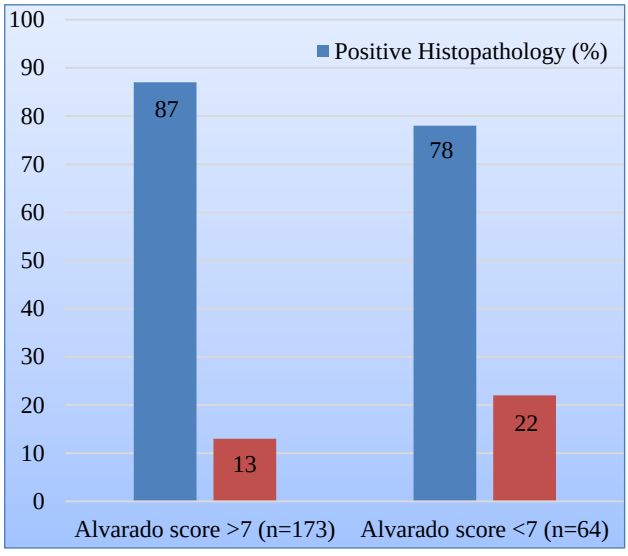

Figure 1: Correlation of Alvarado score with histopathological findings.

Correlation ultrasound findings with histopathological findings

According to Table 3 correlation with ultrasound, histopathological and Alvarado scoring >7 on USG finding 71% are positive 29% negative and Alvarado scoring <7 on USG finding 54% positive and 16% negative (Table 6).

Table 6: Correlation ultrasound findings with histopathological findings.

Alvarado score	Histopathological positive	Histopathological negative
Alvarado score >7 (n = 173)		
USG positive	69 (40%)	53 (31%)
USG negative	25 (14%)	26 (15%)
Alvarado score <7 (n = 64)		
USG positive	32 (50%)	22(34%)
USG negative	9 (14%)	1(2%)

Appendiceal diameter and white blood cell (WBC) were correlated to the inflammation of the appendix. The patients with acute appendicitis had a mean appendiceal diameter of 8.5mm (range, 6-16; SD, 2.7) and a mean WBC count of 14.4 × 109/L (range, 5.8-30.3; SD, 5) whereas the patients with normal appendix had a mean appendix diameter of 3.1mm (range, 2-5; SD, 0.8) and a mean WBC count of 6.6 × 109/L (range, 3.5-13; SD, 1.6). The mean Alvarado score of the patients with acute appendicitis was 6.6 (range, 4-10; SD, 1.7).

Correlation of Alvarado score with CT findings

According to table 4 correlation of Alvarado score with CT finding is done. This shows among patients who have scores >7 has positive CT finding of 92% and negative findings of 8%. The patients who have scored <7 has positive finding of 84% and negative findings of 16% (Figure 2).

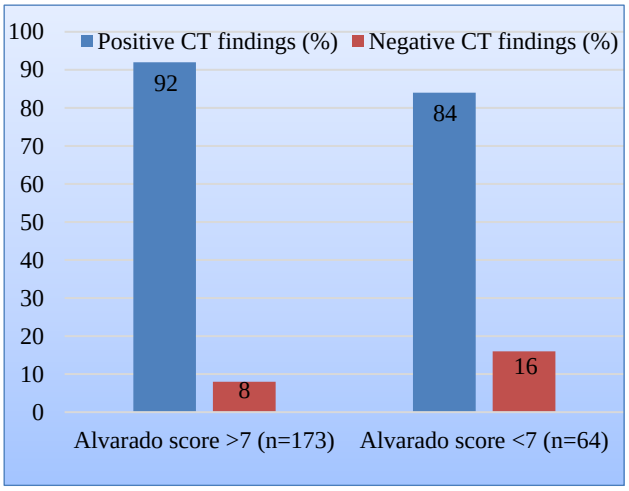

Figure 2: Correlation of Alvarado score with CT findings.

CT has a sensitivity of 90-100%, specificity of 91-99% and positive predictive value of 95-97%. CT has also proven to be superior to USS in the diagnosis of suspected appendicitis and this observation is consistent with the findings of this study which suggests that USS negative.[3] USG finding of acute appendicitis is blind ended, non-compressible aperistaltic tubular structure with gut signature arising from base of caecum with diameter greater than 6 mm.

DISCUSSION

Vermiform appendix is a narrow worm shaped vestigial organ, located in the poster medial wall of caecum and is a favourite site of various disease processes. The human appendix averages 9cm in length and diameter usually between 7 and 8m. The term Appendix vermiform is was coined by Verlyan P in 1735. The word appendicitis was coined by Fitz R in 1886, whereas Mc Burney outlined grid iron incision and also named his Mc Burney's point in 1894. In 1902 Oschner and Sherren suggested conservative regime to treat appendicular lump. During 1880 and 1903, Murphy suggested the concept of internal appendectomies. First laparoscopic appendectomy was done by Semm KKS of Germany in 1983. Acute appendicitis is the most common cause of an acute abdomen in young adults and thus appendicectomy is the widely performed urgent abdominal operation.[1-6]

Marudanayagam et al reported neutrophil shift to left and TLC are useful markers for diagnosing acute appendicitis.[7] Similarly, Sushruth et al also found TLC count of more than 10, 000/cumm suggesting 80-85% of acute appendicitis patients.[8,9] Zoarets et al concluded that increased TLC is a sensitive test for diagnosis of Appendicitis but is less specific. The increasing rates of negative appendectomy results in missing cases of appendicitis such as peritonitis, perforation, abscess and finally sepsis.[10]

Various scoring system are used now a days with varying sensitivity and specificity for diagnosing acute appendicitis. Alvarado scoring system is the widely used method in the diagnosis of appendicitis.[2,11] Prompt diagnosis is required to prevent negative appendectomies and ruptures. Webb et al. established that Alvarado scoring was very useful. Love et al observed patients with Alvarado score <5, 6-8, 9-10, have an accuracy rate of 62%, 86%, 88% respectively. Some authors suggested that score 6 was correlated well with the presence of appendicitis and score 4 was correlated well with the absence of appendicitis. They suggested that radiological investigations (i.e., ultrasound or CT) should be used only in the case of a score between 4 and 6 .[11]

Various imaging modalities like ultrasound and computed tomography scan are widely used in the diagnosis and assessing the severity of acute appendicitis. Ultrasound is mainly useful due to its wide availability as well as can be performed in children and pregnant women with no

risk of radiation.[4,5,12] As appendectomy is the common performed surgical procedure, negative appendectomy rate varies from 6% to 40% where acceptable rate for institution worldwide is around 20%.[8-10,13] The result of this study is negative appendectomy rate is 19%.

The classic presentation of appendicitis involving the triad of fever, leucocytosis, and right lower quadrant pain is present in 10-26% of patients over 60 years of age.[14] The typical signs and symptoms of appendicitis may not be seen in all cases. But in children, atypical features were seen with generalized abdominal pain. Treating elderly patients may pose a challenge because they are more prone to have relevant comorbidities and increased risk of complications. Some studies suggest mortality rate for elderly patients with appendicitis is about 15%.[15] The diagnosis of acute appendicitis might also be delayed in the elderly where some of the differential diagnosis should also be considered. These include right-sided diverticulitis, caecal carcinoma, Crohn's colitis, mesenteric inflammation, complicated ovarian cysts, endometriosis, ectopic pregnancy, local lymphadenopathy, fibrofatty proliferation, Tuboovarian abscess, epiploic appendicitis, biliary colic and urinary tract infection.[14, 16]

USG inconclusive reports are not reliable. The contributory role of imaging in the low incidence of NAR has been further supported by the findings of Raja et al. in an 18-year review. In the present study, total of 19 % positive Appendicectomy was seen. Levine et al reported CT was found to have higher specificity and sensitivity than Alvarado score and USG which are not sufficient on their own for taking the decision for surgery and CT scan has lower negative laparotomy rate when compared with other modalities. Radiologic diagnosis of acute appendicitis can be missed, especially when the patients have equivocal CT findings.[17] Appendicitis is present in up to 30% of patients with equivocal CT findings.[18] As a result, in spite of the progress in CT techniques, negative appendectomy and delayed diagnosis may still occur. The role of ultrasonography should also be emphasized in the diagnosis of acute appendicitis since it is a widely available, affordable modality which does not utilize ionizing radiation. It has been reported to have sensitivity between 55 and 98% and specificity of 78-100% in the literature. The limitations of this technique are the user dependency and the difficulty to obtain good image quality in some patients.[19-21] This study shows that Alvarado scoring system used in conjunction with ultrasonography could significantly decrease the negative appendectomy rate similar to few previous studies.[2,7,8] In some cases, a conservative approach should be considered with normal USG findings not suggestive of acute appendicitis and with Alvarado score less than 7.

There are several limitations in this study. Firstly, this study is a retrospective study and secondly all the USG study was not performed by single operator. The level of competence of the operator will therefore be crucial in the diagnosis and exclusion of acute appendicitis.

CONCLUSION

Acute appendicitis is a clinical diagnosis case. Although the radiological, biochemical and pathological evaluation is important, the history, clinical examination and Alvarado score is more significant to treat and manage the cases of acute appendicitis. The diagnostic accuracy of clinical features is far better than radiological investigations in the diagnosis of acute appendicitis. Therefore, it is concluded that it is better to use radiological investigations only to confirm the diagnosis of acute appendicitis rather to diagnose it. We believe that use of Alvarado scoring system with sonography as an aiding tool performed by skilled operator would further help in decreasing the negative appendectomy rate.

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REFERENCES

1. Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado scores for predicting acute appendicitis: a systematic review. BMC Med. 2011;9(139).
2. Hale DA, Molloy M, Pearl RH. Appendectomy: a contemporary appraisal. Ann Surg. 1997;225:252-61.
3. Kevin PL, Charles SC, Richard JA. Appendix: Sabiston DC. Textbook of Surgery 15th ed. Philadelphia, Pennsylvania: WB Saunders; 1997:965-966.
4. Lehnert BE, Gross JA, Linnau KF, Moshiri M. Utility of ultrasound for evaluating the appendix during the second and third trimester of pregnancy. Emergency Radiol. 2012;19(4):293-9.
5. Garcia K, Hernanz-Schulman M, Bennett DL, Morrow SE, Yu C, Kan JH. Suspected appendicitis in children: diagnostic importance of normal abdominopelvic CT findings with non-visualized appendix. Radiology. 2009;250(2):531-7.
6. Kaiser S, Frenckner B, Jorulf HK. Suspected appendicitis in children: US and CT: a prospective randomized study. Radiol. 2002;223(3):633-8.
7. Marudanayagam R, Williams GT, Rees BI. Review of the pathological results of 2660 appendicectomy specimens. J Gastroenterol. 2006;41:745-9.
8. Slotboom T, Hamminga JT, Hofker HS. Intraoperative motive for performing a laparoscopic appendectomy on a postoperative histological proven normal appendix. Scand J Surg. 2014;103:245-8.
9. Shetty S, Vijayakumar C, Srinivasan K. Role of C-reactive protein, white blood cell counts, bilirubin

levels, and imaging in the diagnosis of acute appendicitis as a cause of right iliac fossa pain. Cureus. 2018;10(1).
10. Zoarets I, Poluksht N, Halevy A. Does selective use of computed tomography scan reduce the rate of "white" (negative) appendectomy? Isr Med Assoc J. 2014;16:335-7.
11. Webb EM, Nguyen A, Wang ZJ. The negative appendectomy rate: who benefits from preoperative CT? AJR Am J Roentgenol. 2011;197:861-6.
12. Pouget-Baudry Y, Mucci S, Eyssartier E. The use of the Alvarado score in the management of right lower quadrant abdominal pain in the adult. J Visceral Surg. 2010;147(2):40-4.
13. Storm-Dickerson TL, Horattas MC. What have we learned over the past 20 years about appendicitis in the elderly? Am J Surg. 2003;185(3):198-201.
14. Brunicardi C, Andersen D, Billiar TR. Schwartz's Principles of Surgery. 8th edition. McGraw-Hill Professional, New York, NY, USA; 2005.
15. Duran JC, Beidle TR, Perret R, Higgins J, Pfister R, Letourneau JG. CT imaging of acute right lower quadrant disease. Am J Roentgenol. 1997;168(2):411-6.
16. Mariadason JG, Wang WN, Wallack MK, Belmonte A, Matari H. Negative appendicectomy rate as a quality metric in the management of appendicitis: impact of computed tomography, Alvarado score and the definition of negative appendicectomy. Ann Royal Coll Surg Eng. 2012;94(6):395-401.
17. Levine CD, Aizenstein O, Lehavi O, Blachar A. Why we miss the diagnosis of appendicitis on abdominal CT: evaluation of imaging features of appendicitis incorrectly diagnosed on CT. Am J Roentgenol. 2005;184(3):855-9.
18. Daly CP, Cohan RH, Francis IR, Caoili EM, Ellis JH, Nan B. Incidence of acute appendicitis in patients with equivocal CT findings. Am J Roentgenol. 2005;184 (6):1813-20.
19. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med. 1986;15(5):557-64.
20. Incesu L, Coskun A, Selcuk MB, Akan H, Sozubir S, Bernay F. Acute appendicitis: MR imaging and sonographic correlation. Am J Roentgenol. 1997;168(3):669-74.
21. Flum DR, Koepsell T. The clinical and economic correlates of misdiagnosed appendicitis: nationwide analysis. Arch Surg. 2001;137(7):799-804.

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