ORIGINAL RESEARCH

The efficacy of the Appendicitis Inflammatory Response Score (AIRS) in the accurate diagnosis of acute appendicitis: A single-center prospective study

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ABSTRACT
This prospective observational study of 126 patients with right iliac fossa pain suspected of acute appendicitis compared the Appendicitis Inflammatory Response (AIR) scoring system against contrast-enhanced computed tomography (CECT) and ultrasound (USG) abdomen. Patients underwent emergency open appendicectomy and were evaluated preoperatively using these methods, then compared with postoperative histopathological diagnosis. The AIR score showed a high positive rate (92%) similar to CECT (92.85%), but higher than USG (78.57%). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were notably higher for CECT abdomen and AIR score compared to USG. CECT demonstrated the highest accuracy (96.03%) and diagnostic effectiveness. The study concludes that CECT is the most effective diagnostic tool for acute appendicitis, but in the absence of CECT facilities, the AIR score is a viable alternative, outperforming USG in accuracy, specificity, and diagnostic value. This finding supports the AIR score as a reliable tool for acute appendicitis diagnosis in settings lacking advanced imaging resources.
Key words: Acute appendicitis diagnosis, appendicitis inflammatory response score, c-reactive proteins (CRP), clinical scoring system, negative appendicectomy

INTRODUCTION

The etymology derives from the Latin word vermiform, which means worm-like, which is also its common morphological appearance. The appendix can have a variable length, ranging from 5 to 35cm, with an average of 9cm [1]. The origin is relatively constant and typically arises near the ileocecal valve, from the posteromedial cecal border, or the cecal fundus. From there, the appendix can follow a variable course, with retrocecal being the most common [1]. Alternative routes include retroileal, preileal, pelvic, cross midline, and as far as the hepatorenal recess. The appendix is supplied by the appendicular artery, a branch of the ileocolic artery, and is contained within the mesenteriolum (the mesentery of the appendix). There is additional vascular supply from branches of the anterior and posterior cecal arteries to the base of the appendix. Venous drainage is via the ileocolic and right colic veins. Lymphatic drainage is to the ileocolic lymph nodes adjacent to the superior mesenteric artery.

Acute appendicitis is the most common surgical emergency of the abdomen encountered by surgeons around the world. The primary goal of therapy is early diagnosis and prepared intervention. The male gender is comparatively more predisposed to this condition. The mortality rate of acute appendicitis is declining worldwide, while the incidence is increasing. The peak incidence is found in the 15 to 19-year-old age group [2]. Early surgical intervention is thought to be associated with a lower risk of perforation, and conservative treatment with antibiotics was found to be 18% less effective than surgical treatment [3].

The AIR score has a high sensitivity for complicated appendicitis and identifies subgroups with a low probability of complicated appendicitis or a high

probability of appendicitis. It performs equally well in both sexes [4].

This study was planned to compare the AIRS scoring system, which is purely based on history, clinical, and laboratory findings, versus radiological investigations such as ultrasound (USG) abdomen and pelvis and contrast-enhanced computed tomography (CECT) abdomen, keeping in mind to diagnose earlier in a cost-effective manner at ease and also reduce the negative appendicectomy rates.

MATERIALS AND METHODS

The approval for the study was obtained from the institutional ethical and scientific committee of the Government Vellore Medical College (Reg.No.ECR/1215/Inst/TN/2019). Before enrolment, the study was discussed with the participants and their family members. Written informed consent was obtained.

This is a prospective observational study of 126 patients who presented to Government Vellore Medical College, a tertiary care center in India, between December 2021 and December 2022. Patients with right iliac fossa pain suspected of having acute appendicitis who underwent an emergency open appendicectomy were chosen. Patients were evaluated and operated on at the discretion of the surgeon, a professor in the Department of General Surgery with more than 20 years of experience.

The preoperative assessment was performed in all 126 patients with the AIRscore, CECT abdomen, and USG abdomen, and we proceeded with open appendicectomy. Preoperative reports were compared with postoperative HPE reports in terms of sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV).

Statistical analysis was done with SPSS version 26 software (IBM Corp.). Data were analyzed with a 95% confidence interval, and the P value was calculated using Fisher's exact test, where<0.05 was accepted as statistically significant.

Table1: Appendicitis Inflammatory Response Score

Parameters	Score
Vomiting	1
Pain in right iliac fossa	1
Abdominal Defense	
Light	1
Medium	2
Strong	3
Body temperature ≥38·5°C	1
Proportion polymorphonuclear leucocytes	
70-84%	1
≥85%	2
White blood cell count	
10.0-14.9x109/L	1
≥15.0x109/L	2
C-reactive protein (CRP)	
10-49 mg/l	1
≥50 mg/l	2

AIR Score [4].

0-3= Low probability of appendicitis.

4-8= Medium probability of appendicitis.

9-12 = High probability of appendicitis.

Results

Of the 126 patients we included in the study, there was a predominance of males (61.9%) over females (38.1%).

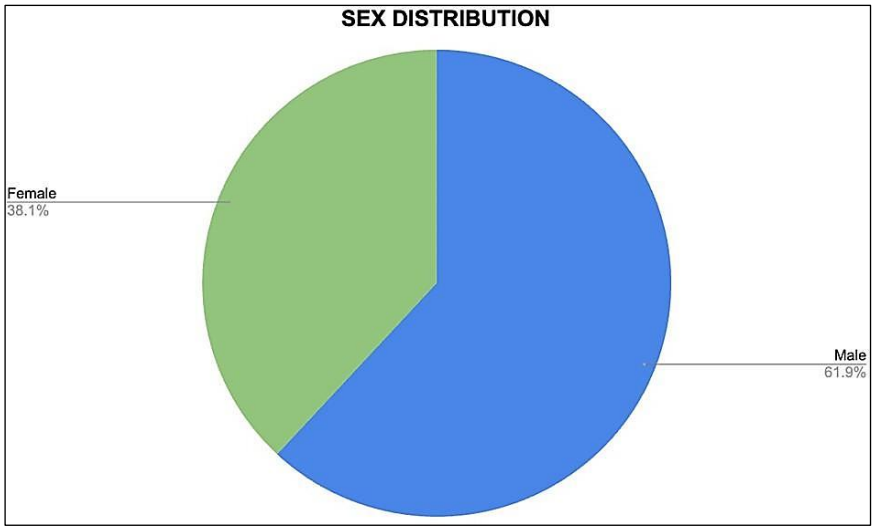

Figure1: Sex Distribution

Table 2: Sex Distribution

	Number of Patients	Percentage
Male	78	62%
Female	48	38%
Total	126	100%

Most belonged to the age group of 21-40 years of age (58%), and the least belonged to the >60 years of age group (10%).

Table 3: Age Distribution

Age	Number of Patients	Percentage
13-20	24	19%
21-40	73	58%
41-60	16	13%
>60	13	10%
Total	126	100%

Regarding the aspect of the evolutionary stages of appendicitis, it was considered stage 1 catarrhal, stage 2 suppurated, stage 3 gangrenous, and stage 4 perforated. When the AIR score was connected to the appendicitis evolutionary stage, it was noticed that a mild score was related to the initial stages 1 and 2, while the high probability score was related to the developed stages 3 and 4 [5].

In this study, the AIR score was >9 (high probability) in 116 patients (92%) and <9 (medium and low probability) in 10 patients (8%).

Table 4: Results of the AIR score

IR Score	Number of Patients	Percentage
>9	116	92%
<9	10	8%
Total	126	100%

AIR SCORE: Appendicitis inflammatory response score.

Preoperative AIR scores were compared with postoperative HPE reports, and sensitivity of 96.58%, specificity of 66.67%, PPV of 94.41%, NPV of 60.00%, and accuracy of 94.4% were obtained (Table 5).

Table 5: Correlation of AIR score with histopathology

		Histopathology Report		Total	P value
		Positive	Negative		
AIR score	>9	113	3	116	
	<9	4	6	10	
Total		117	9	126	<0.0001

Sensitivity	Specificity	PPV	NPV	Accuracy	
96.58%	66.67%	94.41%	60.00%	94.4%	

AIR SCORE:appendicitis inflammatory response score, PPV: positive predictive value, NPV: negative predictive value.

Of 126 patients, the USG abdomen was positive in 78.57% (n=99). An enlarged, non-compressible appendix of diameter greater than 6 mm is the most accurate USG finding with a high positive predictive value for the diagnosis of acute appendicitis [6].

Table6: Results of the USG abdomen

USG Abdomen	Number of Patients	Percentage
Positive	99	78.57%
Negative	27	21.43%
Total	126	100%

Preoperative USG reports were compared with postoperative histopathology reports, and sensitivity of 79.31%, specificity of 30%, PPV of 92.93%, NPV of 11.11% and accuracy of 75.40% were obtained (Table7).

Table 7: Correlation of USG abdomen with histopathology reports

		Histopathology Report		Total	P value
		Positive	Negative		
USG	Positive	92	7	99	
	Negative	24	3	27	
Total		116	10	126	0.36
Sensitivity	Specificity	PPV	NPV	Accuracy	
79.31%	30.00%	92.93%	11.11%	75.40%	

PPV: positive predictive value, NPV: negative predictive value.

We used Fisher's exact test to examine the association between USG and postoperative HPE reports in predicting outcome variables. The analysis yielded a P value of 0.36, indicating a less significant association between USG and HPE reports.

CECT findings suggestive of acute appendicitis include a dilated appendix greater than 6 mm in diameter, wall thickening greater than 2 mm, adjacent mesenteric fat stranding, mesenteric lymph nodes, appendicolith, and peri-intestinal fluid [7]. An increase in diameter alone may be considered an early finding, but it may also be misleading. Therefore, it should be supported by clinical or laboratory findings or iv/oral contrast-enhanced imaging [8].

In this study, CECT was positive for acute appendicitis in 117 patients (92.85%) and negative in 9 patients (7.15%).

Table 8: Results of the CECT abdomen

CECT ABDOMEN	Number of Patients	Percentage
Positive	117	92.85%
Negative	9	7.15%
Total	126	100%

CECT: Contrast-enhanced computed tomography.

Comparison of CECT reports with postoperative histopathology reports revealed a sensitivity of 97.46%, specificity of 75%, PPV of 98.29%, NPV of 66.67%, and an accuracy of 96.03% (Table 9).

Table9: Correlation of CECT abdomen with histopathology report

		Histopathology Report		Total	P Value
		Positive	Negative		
CECT	Positive	115	2	117	
	Negative	3	6	9	
Total		118	8	126	<0.0001
Sensitivity	Specificity	PPV	NPV	Accuracy	
97.46%	75%	98.29%	66.67%	96.03%	

CECT: contrast-enhanced computed tomography, PPV: positive predictive value, NPV: negative predictive value

DISCUSSION

Although appendicitis is a very common disease, its etiology is still poorly understood, and the clinical presentation is very heterogeneous, ranging from simple uncomplicated appendicitis to generalized peritonitis due to perforation. For each clinical presentation, the same treatment is proposed: appendectomy, leading to overtreatment, with a described rate of negative appendectomy (a histopathological diagnosis of a normal appendix) ranging from 6% to 20% [9, 10]. Several reports described spontaneous recovery of uncomplicated appendicitis without the need for surgery, and given the high rate of negative appendectomies and the significant complication rate, some authors suggested conservative treatment of uncomplicated appendicitis [11, 12].

In recent years, several clinical scores have been developed and proposed to help surgeons diagnose acute appendicitis, such as the AIR scoring system to rule out unnecessary surgical intervention. Even then, the diagnosis can often be misleading and lead to unnecessary surgical intervention (a negative appendectomy).

This study was conducted to compare the AIR scoring system with radiological investigations such as USG abdomen and CECT abdomen to predict whether the AIR score can be a better diagnostic tool. This study included a total of 126 patients who underwent surgery for acute appendicitis at the surgeon's discretion over a 12-month period. In these patients, preoperative evaluation was performed with the AIR score, USG abdomen, and CECT abdomen and compared with postoperative histopathology reports.

Table 10: Comparison of AIR score vs. CECT abdomen vs. USG abdomen

	AIR Score	CECT abdomen	USG abdomen
Sensitivity [TP/(TP+FP)]	96.58%	97.46%	79.31%
Specificity [TN/(TN+FN)]	66.67%	75.00%	30.00%
PPV [TP/(TP+FN)]	94.41%	98.29%	92.93%
NPV [TN/(TN+FP)]	60%	66.67%	11.11%
Accuracy	94.4%	96.03%	75.40%

AIR Score: Appendicitis inflammatory response score, CECT abdomen: contrast-enhanced computed tomography abdomen, USG abdomen: ultrasound abdomen, TP: true positive, FP: false positive, TN: true negative, FN: false negative.

The Pvalues were <0.0001 for the AIR score and the CECT abdomen, indicating a significant association. For USG abdomen, the P value was 0.36, indicating no statistically significant association.

AIR score,CECT abdomen, and USG abdomen were compared using various statistical parameters as shown in Table 10. Sensitivity was 96.58% vs. 79.31% vs. 97.46%, specificity was 66.78% vs. 30% vs. 75%, positive predictive value (PPV) was 94.41% vs. 92.93% vs. 98.29%, negative predictive value (NPV) was 60% vs. 11.11% vs. 66.67%, and accuracy was 94.4% vs. 75.40% vs. 96.03% in AIR SCORE vs. USG ABDOMEN vs. CECT ABDOMEN, respectively. Thus, it is evident that the CECT abdomen has a better predictive value than the AIR score and the USG abdomen.

CONCLUSION

In the present study, contrast-enhanced computed tomography (CECT) abdomen is highly effective and statistically significant in the diagnosis of acute appendicitis as compared with appendicitis inflammatory response (AIR) score and ultrasound (USG) abdomen. However, in centers not provided with a CECT facility, the appendicitis inflammatory response (AIR) score can be used to aid in the diagnosis of acute appendicitis, which is more accurate, specific, and has better diagnostic value than the USG abdomen.

ADDITIONAL INFORMATION

DISCLOSURES

HUMAN SUBJECTS: Consent was obtained or waived by all participants in this study. Institutional ethical and scientific committee, Vellore Government Medical College issued approval Reg.No.ECR/1215/Inst/TN/2019.

ANIMAL SUBJECTS: All authors have confirmed that this study did not involve animal subjects or tissue.

CONFLICTS OF INTEREST: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

PAYMENT/SERVICESINFO: All authors have declared that no financial support was received from any organization for the submitted work.

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