

Comparative Study of Diagnostic Accuracy of Pelviabdominal Computed Tomography with Contrast versus Appendicitis Inflammatory Response Score in the Diagnosis of Acute Appendicitis

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Introduction: Acute appendicitis is one of the most common surgical emergencies, with a lifetime prevalence rate of approximately one in seven. A negative appendectomy is taken as a surgery performed for a preoperative diagnosis of appendicitis that results in a normal histopathology specimen. Different techniques have been devised to assist in equivocal cases in attempts to decrease negative appendectomy rates.

Aim of work: To compare the diagnostic accuracy of pelviabdominal computed tomography with oral and intravenous contrast versus appendicitis inflammatory response score in the diagnosis of acute appendicitis.

Patients and methods: This is a cross-sectional study conducted at (The General Surgery Department), Ain Shams University Hospitals between Jan 2023 and June 2023. 64 patients underwent appendectomy based on the decision of the consultant after clinical examinations and investigations including pelviabdominal computed tomography with oral and intravenous contrast. The accuracy of the pelviabdominal computed tomography was compared with the appendicitis inflammatory response score. The evaluation was based on the Histopathology postoperatively in Standardized Pathology laboratory in Ain Shams University Hospital.

Results: Histopathology among the studied patients was found positive in 60 cases (93.8%) negative 4 cases (6.2%). Receiver operating characteristic curve (ROC) showed that the best cut off point of (AIR) score to detect positive cases according to histopathology was ≥ 5 with sensitivity of 85.00%, specificity of 75.00%, PPV of 98.1%, NPV of 25.0% and total accuracy of 84.4.0%. CT scan sensitivity of 98.33%, specificity of 100.00%, PPV of 100.0%, NPV of 80.0% and total accuracy of 99.2%. P value was 0.041 when the cut off value of AIR score was equal or more than 5 in comparison to CT scan.

Conclusion: To conclude, this study validates that the Appendicitis Inflammatory Response score has high discriminating powers and diagnostic accuracy they could aid in selecting patients who require timely surgery or those who require further evaluation. The high probability score can be conclusive without use of CT scan, within intermediate and low probability CT scan could add diagnostic value and decrease negative appendectomies. In case of unavailability of CT scan AIR score can be used with cut off value equal or more 5 with high diagnostic accuracy and sensitivity.

Key words: Appendicitis inflammatory response, Acute appendicitis.

Introduction

Acute appendicitis is one of the most common causes of acute abdomen¹

Appendicitis occurs most often between the ages of 5 and 45, with a mean age of 28. Males have a slightly higher predisposition to developing acute appendicitis than females, with a lifetime incidence of 8.6% and 6.7% for men, and women, respectively.²

Acute appendicitis is traditionally considered a clinical diagnosis. Abdominal pain is a common reason to seek emergency medical attention, it is not uncommon to diagnose acute appendicitis based on clinical profile. Hence, clinical diagnosis reliance leads to over diagnosis and treatment with eventual negative appendectomy.³

Microscopic findings in acute appendicitis include

the proliferation of neutrophils in the muscularis propria. The degree and extent of inflammation are directly proportionate to the severity of the infection and duration of the disease. As this condition progresses, extra appendiceal fat and surrounding tissues become involved in the inflammatory process.⁴

Computerized tomography (CT) scan and Ultrasound (US) imaging are used for making the diagnosis more accurate. CT scan is more sensitive and specific than the US and it is associated with a smaller number of negative appendectomies.⁵

The appendicitis Inflammatory response score (AIR) is based on assigning patients to low, medium or high probability of acute appendicitis. It incorporates CRP as a variable in the score, a widely available laboratory test that has not shown sufficient sensitivity or specificity to be used as a stand-alone test to predict risk of appendicitis.^{6,7}

Aim of work

The aim of this study is to compare the diagnostic accuracy of pelviabdominal computed tomography with oral and intravenous contrast versus appendicitis inflammatory response score in the diagnosis of acute appendicitis.

Patients and methods

Type of study: A cross-sectional study.

Study setting: This study was conducted at (the General surgery department), Ain Shams University Hospitals. Approval of the Ethical Committee and written informed consent from all participants were obtained.

Study period: Between Jan 2023 and June 2023.

Study population

Inclusion criteria: Male and Female patients. 14 to 75 years of age. Fit for surgery.

Exclusion criteria: High-risk patients unfit for surgery. old age (Over 75 years old). young age (Below 14 years old). Patient refusal to enroll in the study.

Sampling:

Sample size: 64 patients.

Sampling method: 64 Patients who were underwent appendectomy based on the decision of the consultant after clinical examinations and investigations including pelviabdominal computed tomography with oral and intravenous contrast. The accuracy of the pelviabdominal computed tomography was compared with the appendicitis inflammatory response score.

Ethical considerations: Informed consent: Informed consent was taken from patients who are invited to participate in the research. Confidentiality: All patients' data are confidential, and they was not be mentioned by name at any published paper. Right to refuse or withdraw: Patients have the right to refuse joining the research or withdraw at any time without affecting their chances to receive the required surgical care at any time.

Preoperative assessment: Full clinical history; personal history, present history, past history. Full clinical examination; vital signs, body examination. Routine preoperative investigations including, complete blood count, random blood sugar, liver function test, kidney function test, coagulation profile, serum electrolytes. Pelviabdominal sonography. Pelviabdominal computed tomography. Electrocardiography, Echocardiography, pulmonary function test, if indicated. Preoperative co-morbid factors such as hypertension, Diabetes mellitus and electrolyte disturbance was controlled when possible before surgery.

Data collection: Data was collected from medical files, and interviews.

Outcome measures: The evaluation was depended on the in Histopathology postoperatively in Standardized Pathology laboratory in Ain Shams University Hospital.

Some notes: Decision on appendectomy was solely based on surgeon's clinical judgment after taking into consideration all the findings of clinical, laboratory and radiological investigation. Patients were monitored following admission, surgery and till discharge from the Hospital. Daily follow up included monitoring vital data. Gross findings during operation and histopathology findings of the operated case were collected and correlated with either score as histopathology is the gold standard for diagnosis of acute appendicitis).

Statistical analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 20. The qualitative data were presented as number and percentages while quantitative data were presented as mean, standard deviations and ranges when their distribution found parametric. The comparison between two groups with qualitative data were done by using Chi-square test and/or Fisher exact test was used instead of Chi-square test when the expected count in any cell was found less than 5. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: $P > 0.05$ = non-significant (NS). $P < 0.05$ = significant (S). $P < 0.001$ = highly significant (HS).

Results

Table 1: Demographic data and characteristics of the studied patients

		Total no. = 64
Gender	Female	36 (56.2%)
	Male	28 (43.8%)
Age	Mean ± SD	35.61 ± 11.60
	Range	18 – 58
	<40	39 (60.9%)
	≥ 40	25 (39.1%)

Table 2: Distribution of studied cases according to AIR score

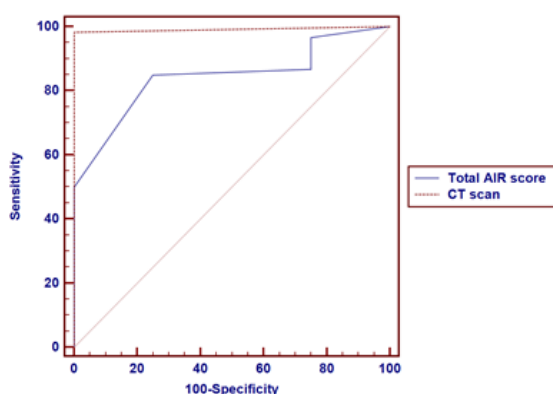
		Total no. = 64
Vomiting	No	25 (39.1%)
	Yes	39 (60.9%)
Right iliac fossa pain	No	0 (0.0%)
	Yes	64 (100.0%)
Temperature >38.5	No	30 (46.9%)
	Yes	34 (53.1%)
Right iliac fossa rebound tenderness	Strong	10 (15.6%)
	Medium	13 (20.3%)
	Light	25 (39.1%)
	No	16 (25.0%)
WBC	<10	22 (34.4%)
	(10 - 14.9)	31 (48.4%)
	≥ 15	11 (17.2%)
Poly morph nuclear leucocytes	<70	13 (20.3%)
	(70 – 84)	43 (67.2%)
	≥85	8 (12.5%)
CRP	<10	27 (42.2%)
	(10 - 49.9)	31 (48.4%)
	≥50	6 (9.4%)
Probability	High	12 (18.8%)
	Intermediate	40 (62.5%)
	Low	12 (18.8%)
Total AIR scoreAIR score	Median (IQR)	5 (5 – 8)
	Range	1 – 11
	<5	12 (18.8%)
	≥ 5	52 (81.2%)

Table 3: Histopathology among the studied patients

		Total no. = 64
Histopathology	Negative	4 (6.2%)
	Positive	60 (93.8%)

Table 4: CT scan, diameter, appendicolith, periappendicular fluid, fat stranding and right iliac fossa reactionary LN among the studied patients

		Total no. = 64
CT scan	Negative	5 (7.8%)
	Positive	59 (92.2%)
Diameter	<6	5 (7.8%)
	>6	59 (92.2%)
Appendicolith	No	48 (75.0%)
	Yes	16 (25.0%)
Periappendicular fluid	Presented	43 (67.2%)
	Not presented	21 (32.8%)
Fat stranding	Presented	27 (42.2%)
	Not presented	37 (57.8%)
Right iliac fossa reactionary LN	Presented	32 (50.0%)
	Not presented	32 (50.0%)



	Cut off point	AUC	Sensitivity	Specificity	+PV	-PV	P-value
Total AIR score	≥5	0.844	85.00	75.00	98.1	25.0	0.041
CT scan		0.992	98.33	100.00	100.0	80.0	

Fig 1: ROC curve to assess total AIR score to detect histopathology finding.

Discussion

Acute appendicitis (AA) is the one of the commonest reasons for emergency admission to general surgical wards. Acute appendicitis is still a difficult diagnostic entity and the management often involves complex decision making as it involves surgical exploration which utilises technical, financial and human resources. A quick and correct diagnosis of acute appendicitis with subsequent early appendicectomy can avoid complications arising from perforation. Though radiological examinations including Ultrasound and Computed Tomography (CT) scan can further aid in making a definite diagnosis and have been reported to have high sensitivity and specificity, it will inflate the cost to the patient and

also the reporting time may further delay emergency appendicectomy. Another worry is regarding the harmful effects of radiation involved in CT scan.⁸

Prompt and accurate diagnosis with timely appropriate treatment is crucial for the successful management of acute appendicitis in spite of advances in diagnostic tools. The decision to proceed to appendicectomy or not remains a surgical dilemma, especially in patients with atypical symptoms, which could be met in small children, the elderly, young females, and when the appendix is in an unusual position.¹⁰ The main goal in the management of atypical cases of acute appendicitis is to decrease the rate of negative appendicectomies without increasing the rate of complications such as

perforation and sepsis.¹¹

With this purpose in mind, various scoring systems have been developed to aid in the clinical diagnosis of acute appendicitis.

Alvarado scoring system, which was first described in 1986, has remained the most popular scoring system in acute appendicitis for many decades. The scoring system remains popular as this scoring system has been proven to have very good sensitivity and specificity.^{1,9} The Modified Alvarado Scoring System (MASS) is the system widely used globally. The Appendicitis inflammatory response (AIR) score is a newer scoring system used in suspected appendicitis, first reported in 2008. In previous studies, AIR scoring system has been found to outperform Alvarado scoring system as AIR score utilises more objective symptoms while Alvarado takes more subjective symptoms.¹¹ Also, many studies have independently shown the importance of C-reactive protein (CRP) in the assessment of patients with appendicitis. The AIR score has incorporated CRP also as a variable whereas the Alvarado does not.¹³

The aim of our study was to compare (AIR) score and pelviabdominal CT with IV and oral contrast, in order to identify which one is the best in sensitivity, specificity, positive predictive value, negative predictive value and accuracy, so which one leads to the most accurate diagnosis of acute Appendicitis.

This was a cross-sectional study. That was conducted at (the General surgery department), Ain Shams University Hospitals. Between Jan 2023 and June 2023. 64 Patients who underwent appendectomy based on the decision of the consultant after clinical examinations and investigations including pelviabdominal computed tomography with oral and intravenous contrast. The accuracy of the pelviabdominal computed tomography was compared with the appendicitis inflammatory response score. The evaluation was based on the Histopathology postoperatively in Standardized Pathology laboratory in Ain Shams University Hospital.

Our study included 28 (43.8%) male cases and 36 (56.2%) female cases with age ranging from 18 to 58 years (mean 35.61 ± 11.60years)

In our study there were 39 (60.9%) cases with Vomiting, 64 (100.0%) cases with right-lower-quadrant pain, 34 (53.12%) cases with Temperature (> 38.5 C), 25 (39.0%) cases with Light Rebound tenderness, 13 (20.31%) cases with moderate rebound tenderness, 10 (15.62%) cases with strong rebound tenderness, 31 (48.43.0%) cases with WBC count 10: 14.9, 11 (17.2%) cases with WBC count ≥ 15, 43 (67.2%) cases with

polymorphonuclear leucocytes 70:84, 8 (12.5%) cases with Polymorphonuclear leucocytes ≥ 85 and 31 (48.4%) cases with CRP 10:49, 6 (9.4%) cases with CRP ≥ 50.

The (AIR) score ranged from 1 to 11 with mean 5. High probability cases were 12 (18.8%) all of them were with proven histopathology of acute appendicitis 20% of the positive cases. intermediate probability cases were 40 (62.5%) 39 of them were with proven histopathology of acute appendicitis. low probability cases were 12 (18.8%) 9 of them were with proven histopathology of acute appendicitis 15 % of the positive cases.

In Gupta et al which was a cross-sectional study was conducted at a tertiary care center in North India. All patients presenting with right iliac fossa pain and provisional clinical diagnosis of acute appendicitis were enrolled in this study. A diagnosis of acute appendicitis was confirmed by histopathological assessment of the appendectomy specimen. A total of 64 patients were included and majority were males (76.56%) as compared to females (24.43%). The mean age of presentation in males and females was 36.95 years and 34.66 years, respectively. The overall mean age for occurrence of appendicitis was 36.42 years. On the basis of AIR score, maximum number of patients in our study (68.75%) were categorized into the intermediate-risk group, while 20.31% in the low-risk group and 10.93% in the high-risk group. On histopathological correlation, we observed that the rate of negative appendectomy was higher (46.15%) in the low-risk group, as compared to 9.09% in the intermediate-risk group and 0% in the high-risk group.¹⁴

In our study Receiver operating characteristic curve (ROC) shows that the best cut off point of (AIR) score was found ≥5 the sensitivity was 85.00%, specificity of 75.00%, PPV of 98.1%, NPV of 25.0% and total accuracy of 84.4.0%. Which supported with the finding in Gupta V et al study in which the optimum cutoff point for AIR score was ≥5, which had a sensitivity of 87.04%, specificity of 60. The probability of having appendicitis with AIR score ≥5 was 92.16% (positive predictive value) with a diagnostic accuracy of 82.81%.¹⁴

In our study CT scan shows appendicitis in 59 (92.2%) cases and it was negative in 5 (7.8%) cases. The appendicular diameter was more than 6 mm 59 cases, appendicolith was found in 16 (25.0%) cases, periappendicular fluid was found in 43 (67.2%), fat stranding was found in 27 (42.2%) and right iliac fossa reactionary mesenteric lymph nodes was found in 32 (50.0%) among the studied patients.

CT scan sensitivity of 98.33%, specificity of 100.00%, PPV of 100.0%, NPV of 80.0% and total

accuracy of 99.2%. P value is 0.041 when the cut off value of AIR score was more than or equal 5 in comparison of CT scan.

Not many studies have been conducted to compare AIR scoring system and pelviabdominal CT with contrast in the diagnosis of acute appendicitis.

In Noori et al.¹⁴ study which was a prospective randomized controlled study in which a total of 286 consecutive young and adult patients (166 males, 58% and 120 females, 42%) with a presumptive diagnosis of acute appendicitis were enrolled a total of 286 consecutive adult patients with suspected acute appendicitis were included. The clinical scores, including Alvarado and AIR scores and ultrasound, were done for all patients. Abdominal and pelvic CT scans were done for 192 patients to resolve the diagnosis of acute appendicitis. The sensitivity, specificity, positive and negative predictive values, and accuracy rate of both clinical scores and imaging (ultrasound and CT scan) were compared. The final histopathology was used as the gold standard for which the diagnostic feasibility of the clinical score and imaging were compared.¹⁵

In our study 60 (93.75%) cases were Positively Confirmed by histology and 4 (6.25%) cases were Negative appendectomies with negative histopathology.

Out of 286 total patients who presented with right lower quadrant abdominal pain, a presumptive diagnosis of acute appendicitis was made in 211 patients (123 males and 88 females) after thorough clinical evaluation, clinical scores, and imaging, and they were submitted to appendectomy. The overall prevalence of acute appendicitis proved by histopathology as a gold standard was 89.1% (188 patients) with a negative appendectomy rate of 10.9%.¹⁵

For clinical scores, a cutoff point of at least 8 for AIR was considered diagnostic for acute appendicitis. The overall sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy rate of the and those for the AIR score were 93.3%, 84.1%, 88.4%, 78.8%, and 88.6%, respectively. The diagnostic feasibility of AIR scores was significantly higher than the Alvarado score, and the clinical scores were associated with significantly higher diagnostic accuracy than ultrasound. CT scan is unlikely to be needed and will add little to the diagnosis of acute appendicitis for patients with high clinical scores (≥ 7). The use of CT scans for query cases did not change the negative appendectomy rate.¹⁵

In Noori et al. study CT scan, which was requested for 192 out of 286 patients, was diagnostic for acute appendicitis in 156 patients giving a

sensitivity, specificity, PPV, NPV, and accuracy rate of 93.2%, 88.7%, 72.2%, 90.3%, and 92.3%. Definite diagnosis of acute appendicitis approved by intraoperative findings and histopathology as a gold standard was approved in 144, giving an accuracy rate of 92.3%.¹⁵

Our study showed that, there were highly statistically significant difference between Negative Confirmed histology and Positive Confirmed histology regarding pelviabdominal CT with contrast and (AIR) score on the best cut off value of AIR score more than or equal 5 and the use of CT can decrease the negative appendectomy rate in low and intermediate probability cases. Sensitivity, specificity and diagnostic accuracy of AIR score were higher in In Noori IF et al study than our study and Sensitivity, specificity and diagnostic accuracy of CT scan in Noori IF et al were less than our study

In our study cases of high probability were all with proven acute appendicitis by histopathology and less likely to benefit from CT scan.

In Noori IF et al¹⁴ study patients with clinical scores of 7 and above are less likely to benefit from CT scan examination because the sensitivity, specificity, predictive values, and accuracy rate of clinical scores, especially AIR scores within these score ranges, were not significantly different from those of CT scan. CT scan only for those patients with atypical presentations and equivocal clinical scores, for whom a CT scan is usually the imaging modality of choice.¹⁵

Conclusion

To conclude, this study validates that the Appendicitis Inflammatory Response score has high discriminating powers and diagnostic accuracy they could aid in selecting patients who require timely surgery or those who require further evaluation. The high probability score can be conclusive without use of CT scan, within intermediate and low probability CT scan could add diagnostic value and decrease negative appendectomies. In case of unavailability of CT scan AIR score can be used with cut off value equal or more 5 with high diagnostic accuracy and sensitivity.

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