Original Article

Effectiveness of Appendicitis Inflammatory Response Score in Diagnosis of Acute Appendicitis

Shahid Nazir Memon[1]*, Rehmat-Urf-Sehrish[2], Anita Kumari[3], Sahrish Sulman[4], Ambreen Munir[1], Anas bin Tariq[5]

ABSTRACT

OBJECTIVE: To determine the diagnostic accuracy of appendicitis inflammatory response (AIR) scores in diagnosing acute appendicitis.

METHODOLOGY: This cross-sectional observational study was conducted at Liaquat University of Medical and Health Sciences Jamshoro from June to October 2019. A total of 500 suspected patients of acute appendicitis according to AIR score were included by consecutive sampling technique. Patients without right iliac fossa pain, pregnant mothers, and patients with previous abdominal surgery or known cases of abdominal malignancy were excluded. The histopathological report was obtained for each patient to confirm acute appendicitis and the diagnostic accuracy of the AIR scoring system.

RESULTS: From 500 patients, the mean age was 21.25±9.12 years, with 310 (62%) males. AIR scoring was done as a total score between 0-4 as low-risk, 5-8 as intermediate-risk, and 9-12 as high risk for appendicitis. 305 (61%) patients complained of vomiting, 480 (96%) pain, 370 (74%) patients had a total leucocyte count (TLC) between 10-14/9 mm^3, 270 (54%) reported fever and CRP level >50 ng/ml in 275 (55%) of patients A significant difference of <0.001 between the clinical and laboratory findings were reported between each category of AIR Rate of negative appendectomies was 08 % while the sensitivity of AIR scoring acute appendicitis patients was 92%.

CONCLUSION: AIR scores were successful in determining the suspected patients with acute appendicitis on a clinical and laboratory basis only without the need for imaging, where intra-operative as well as histopathological diagnosis of acute appendicitis confirmed the highest sensitivities and minimum of negative appendectomies.

KEYWORDS: Appendicitis, diagnostic accuracy, appendicitis inflammatory response, pain, surgery.

INTRODUCTION

One of the most commonly observed surgical emergencies observed in both developed as well as developing worlds is acute appendicitis[1]. Even though increases in the usage of inflammatory mediators and diagnostic interventions have been reported yet missed, delays in diagnosing appendicitis and the rate of negative appendectomies remain high[2]. In addition, the risk of complications perforation of the appendix leading to sepsis and death are also fairly common[2].

Acute appendicitis is a common gastrointestinal disease affecting 5.7–57/per 100.000 individuals each year, with the highest incidence in children and adolescents. The variation in incidence is due to variations in ethnicity, gender, age, obesity, and season of the year[3]. The ultimate diagnostic modality in acute appendicitis is regarded as the routine imaging technique[4]. Nonetheless, using selected imaging modalities is recommended since indiscriminate usage of imaging techniques is related to a high frequency of false-positive and false-negative, resulting in the patient having low or high probabilities of appendicitis, respectively[5]. Computer tomography helps detect acute appendicitis but can expose patients to ionizing radiations that can be managed with or without treatment, leading to higher rates of appendicitis[6].

Diagnosing acute appendicitis in clinical emergencies is pivotal since it sets the base for a further selection of diagnostic workups. In particular, variables demonstrating inflammation have been reported to have vital diagnostic values[7]. Currently, efforts have been put into place to find newer inflammatory markers to help improve the laboratory diagnosis of acute appendicitis. Nevertheless, few studies have compared the diagnostic properties of such newer variables to the conventional diagnostic variables we routinely use.

Clinical signs and symptoms, in addition to routinely measured markers of inflammation, have limitations with their values as a diagnostic tool when solely used; however, these can help in achieving a more

[1]*Department of Surgery, Liaquat University of Medical & Health Sciences, Jamshoro, Sindh-Pakistan.*
[2]*Department of Surgery, Civil Hospital Matli, Sindh-Pakistan.*
[3]*Civil Hospital, Thana Bola Khan, Sindh-Pakistan.*
[4]*Civil Hospital, Shah Bhitai, Hyderabad, Sindh-Pakistan.*
[5]*Department of Medical Education, Al-Tibri Medical College, Karachi, Sindh-Pakistan.*
***Correspondence:** shahidnazir2702003@yahoo.com*
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significant discriminatory role in combination with a clinical score, such as Alvarado or the Appendicitis Inflammatory Response (AIR) score[9]. Such scorings could aid in classifying patients of acute appendicitis with low or high probabilities of acute appendicitis and also help serve as a decision-making clinical diagnostic modality for selecting patients for further workup of appendicitis[10]. Therefore, it can serve as a tool for sorting out patients and reducing the number of negative appendicitis patients or those that can be safely and conservatively managed[11].

Scoring systems are a valid and valuable diagnostic tool to discriminate between acute appendicitis and abdominal pain of nonspecific variety. The AIR scoring has been formulated recently to serve diagnosis, which uses seven score variables to stratify patients into low, intermediate, and high-risk groups[12]. AIR scores have been reported to be valid and outperform the previously used Alvarado score; this might be possible because the AIR score relies on fewer subjective symptoms like nausea or anorexia and incorporates C-reactive protein[13].

This study aimed to determine the diagnostic accuracy of appendicitis inflammatory response (AIR) score in the diagnosis of acute appendicitis.

METHODOLOGY

This cross-sectional observational study was designed to be conducted at the Department of Surgery, Liaquat University of Medical and Health Sciences Jamshoro, from June to October 2019. Five hundred patients of either age presented with sudden-onset, non-traumatic Right Iliac Fossa (RIF) pain suspected to be acute appendicitis were included in the study by consecutive sampling technique. In contrast, patients without RIF pain, pregnant women, patients with previous abdominal surgery or known cases of abdominal malignancy were excluded from the study. Consecutive sampling technique was used to select patients. A detailed medical history of each patient was obtained. The AIR score sheet was filled for each patient. The histopathological report was obtained for each patient to confirm acute appendicitis and the diagnostic accuracy of the AIR scoring system. Using the AIR score for acute appendicitis proforma, the scoring of the patients was recorded. The total score was calculated at 12. A score between 0-4 was regarded as a low risk for acute appendicitis, while a score between 5-8 was termed intermediate risk for acute appendicitis, while a score between 9-12 was classified as a high risk for acute appendicitis.

All the information was analyzed using a statistical package for social science (SPSS) version 22. Qualitative data were represented as the frequency in percentages, while quantitative data were expressed as mean and standard deviation. The chi-square test was applied to test for significance, keeping a P-value of <0.05 as statistically significant.

RESULTS

A total of 500 patients suspected of acute appendicitis were included in the study during the study period. The mean age of patients was 21.25±9.12 years, with 310(62%) males and 190(38%) females. Diagnosis of acute appendicitis was made on a clinical and laboratory basis. Scoring was done according to the AIR scores, with a total score between 0-4, classified as low-risk for appendicitis, 5-8 as intermediate-risk, and 9-12 as high risk. 305(61%) of patients complained of vomiting, 480(96%) complained of pain, 195(39%) patients were observed to have light rebound tenderness, while 280(56%) had medium and 25(5%) strong rebound tenderness. 270(54%) were found to have a fever. 370(74%) patients had a total leucocyte count (TLC) between 10-14/9 mm^3, TLC of >15 mm^3 in 100 (20%) and TLC of <10 mm^3 in 30(6%) of patients. A CRP level between 10-49 ng/ml was reported in 225(45%) patients, while >50 ng/ml in 275 (55%) patients **Table I**.

After applying AIR scorings, 05 patients were classified into the low-risk category, 375 in the intermediate category, and 120 in the high-risk category **Figure I**.

Among the low-risk patients according to AIR score, the findings among the patients recorded were vomiting, pain, light rebound tenderness, a TLC <10 mm^3, leucocytes below <70 %, and CRP in-between 10-49. Amongst the intermediate-risk patients according to AIR score, 180 patients experienced vomiting, 355 pain, in 170 patients light, in 195 patients medium and 10 patients, a strong rebound tenderness, fever in 165 patients, TLC in-between 10-14.9 mm^3 in 285 patients, TLC >15 mm^3 in 65 patients and TLC <10 mm^3 in 25 patients, leucocytes in-between 70-84 % in 275 patients, >85 % in 70 patients and <70 in 30 patients and CRP in-between 10-49 in 205 patients and 170 patients, >50. Among the 120 high-risk patients, all patients had vomiting pain, 20 had light, 85 had medium, 15 had strong rebound tenderness, and 105 were observed to have a fever. In 85 patients, TLC was in-between 10-14.9 mm^3, >15 mm^3 in 35 patients, 70-84 % leucocytes in 70 patients and >85 % in 50 patients. CRP between 10-49 ng/ml was reported in 15 patients, while 105 patients had a CRP >50 ng/ml. A significant difference of <0.001 between the clinical and laboratory findings was reported between each category of AIR scoring **Table II**. An intra-operative diagnosis of appendicitis was made in 479(95.8%) patients, while 21(4.2%) of cases were intra-operatively reported to be negative for appendicitis. Similarly, histo-pathologically 460 (92%) cases were reported as acute appendicitis, while 40(08%) were negative for appendicitis. All negative appendicitis cases were from the intermediate air risk group. Therefore, the rate of negative appendectomies in the study was 08%, while the sensitivity of AIR scoring in cases of acute appendicitis was 92% **Figure II**.

TABLE I: BASELINE DEMOGRAPHICS OF STUDY PATIENTS

		Mean ± SD
Age (years)		21.25 ± 9.12
		Frequency (%)
Gender	Male	310 (62)
	Female	190 (38)
Vomiting	Yes	305 (61)
	No	195 (39)
Pain	Yes	480 (96)
	No	20 (04)
Rebound Tenderness	Light	195 (39)
	Medium	280 (56)
	Strong	25 (05)
Temperature	Yes	270 (54)
	No	230 (46)
Total Leucocyte Count mm^3	10-14.9	370 (74)
	>15	100 (20)
	<10	30 (06)
Leucocytes %	70-84	345 (69)
	>85	120 (25)
	<70	35 (07)
CRP ng/ml	10-49	225 (45)
	>50	275 (55)

TABLE II: AIR SCORING ACCORDING TO SYMPTOMS

Variables		AIR scoring			
		Low-Risk n=05	Intermediate-Risk n= 375	High-Risk n=120	p-value
Vomiting		05	180	120	<0.001
Pain		05	355	120	0.031
Rebound Tenderness	Light	05	170	20	<0.001
	Medium	00	195	85	
	Strong	00	10	15	
Temperature		00	165	105	<0.001
Total Leucocyte Count mm^3	10-14.9	00	285	85	<0.001
	>15	00	65	35	
	<10	05	25	00	
Leucocytes %	70-84	00	275	70	<0.001
	>85	00	70	50	
	<70	05	30	00	
CRP ng/ml	10-49	05	205	15	<0.001
	>50	00	170	105	

FIGURE I: GRAPHICAL REPRESENTATION OF AIR SCORES OF PATIENTS

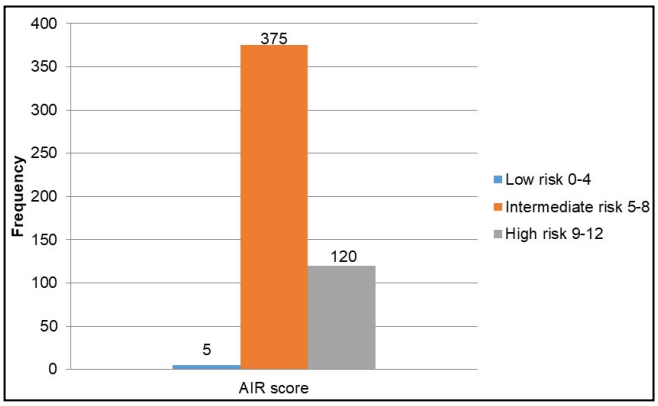
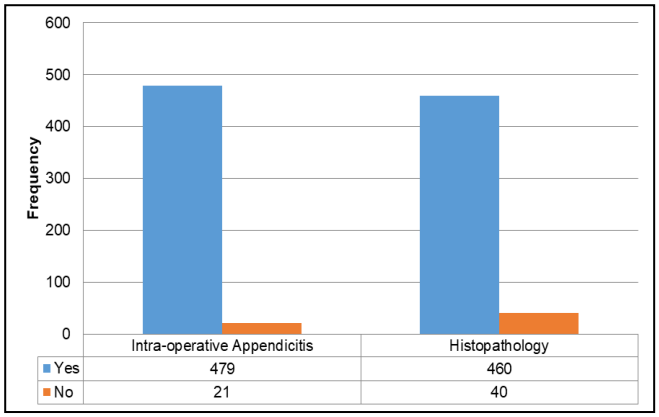


FIGURE II: GRAPHICAL REPRESENTATION OF APPENDICITIS DIAGNOSED ON INTRA-OPERATIVE AND HISTOPATHOLOGICAL BASIS



DISCUSSION

For the evaluation of patients complaining of abdominal pain and for identifying the patients having suspected acute appendicitis, the diagnostic strategies ought, to begin with a complete history along with a physical examination[14]. The Infectious Diseases Society of America(IDSA) and Surgical Infection Society(SIS) recommend establishing the following pathways in diagnosing and managing acute appendicitis[15]. The recommendations include clinical and laboratory findings, including pain in the abdomen, localized and rebound tenderness, and evident inflammatory changes in laboratory investigation16. These shall help in the identification of the most acute appendicitis suspected patients. Some other diagnostic pathways might add radiological imaging with or without other computer support systems[17].

Most importantly, a gold standard criterion for suspected acute appendicitis is the histopathological confirmation of appendicitis, even though the pre-operative diagnostic criteria lack standardization. Confirmation of negative appendectomy is either done as an intra-operative finding or at the histopathological confirmation[18]. The Alvarado score is the most commonly used scoring system in diagnosing acute appendicitis. Nonetheless, it can over-predict acute appendicitis, especially in children, and so contribute to higher rates of negative appendectomies, thereby leading to an increase in morbidity[19]. The Appendicitis Inflammatory Response (AIR) score is reported to

outperform the Alvarado score among the adult population[20].

According to the results of this study, incidences of acute appendicitis were reported more frequently in males (62%) in comparison to females (38%). The finding is seen to be consistent with other studies done by Saha DA 2018[21] and Barlas SU 2010[22], where appendicitis was more commonly observed among males (68.5% and 53.5%) in comparison to females (31.5% and 46.5%) respectively. The mean age reported in our study was 21.25 ± 9.12 years, again in line with other studies where the maximum ages of patients were below 30 years (78.6%)[21]. In another study, the mean age of appendicitis patients reported was 27 years[23].

Other than pain, observed in 96% of patients, the most common symptom was vomiting, reported in 61% of patients in this study. Similarly, a study reported a maximum of 62% of patients presented with vomiting[24]. In line with our study, another study reported a higher frequency of vomiting among the patients, i.e. 77.5% [21]; in our study, 54% had a fever. Likewise, other studies also reported the same high rate of fever among appendicitis patients[25]. In line with other studies, rebound tenderness was reported in all of the patients. However, it was classified as light, medium and strong, whereas most patients reported medium rebound tenderness[26]. Leukocytosis was reported in 69% of patients in our study, similar to other studies that reported the samex[27]. A high CRP was seen in 55% of patients, while a study reported higher CRP levels than our study[28].

The sensitivity of the AIR score was reported in 9% of patients in our study, while the rate of negative appendectomy on histopathological diagnosis was 08% (p=<0.001). The diagnostic accuracy of the AIR score has been observed between 71% and 97%. In comparison, the rate of negative appendectomies between 14% and 75% [29,30] AIR scoring has been validated by studies indicating it as accurate for screening patients for suspecting acute appendicitis. It is ideal for a scoring system to be clinically effective for increasing diagnostic accuracy for making decisive actions for suspected acute appendicitis, also helping to reduce the unnecessary need for patients to be exposed to radiation imaging and/or increasing the precious time before undergoing surgical intervention for preventing perforation of the appendix. AIR scores have been considered superior in terms of being easy to use in clinical setups, especially in under-resourced areas[31].

Even though the study covered all the bases of AIR scoring for suspected appendicitis, the study might not be immune from selection or observer bias similarly since the study was conducted at a single center with a limited sample size. Overlapping of symptoms might also have taken place. Therefore, in stratifying patients of acute appendicitis, especially among the high-risk category, where even the need for imaging modality or further workup should not be necessary, must be treated as acute appendicitis surgically until proven otherwise. Further, multi-centred studies with more extensive surgical expertise and sample size would be enlightening in determining further diagnostic accuracy of AIR score and comparing AIR scoring with other scoring systems used for acute appendicitis.

CONCLUSION

According to the results of the study, AIR scores were successful in determining the suspected patients with acute appendicitis on a clinical and laboratory basis only without the need for imaging, where intra-operative as well as histopathological diagnosis of acute appendicitis confirming the highest sensitivities and minimum of negative appendectomies.

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AUTHOR CONTRIBUTION

Nazir S:	Concept, manuscript writing
Sehrish R:	Abstract writing, data analysis
Kumari A:	Discussion Writing, data collection
Sulman S:	Reference collection, data collection
Munir A:	Proofreading and final approval
Tariq AB:	Discussion Writing, data collection

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