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Appendicitis Inflammatory Response Score in Comparison to Alvarado Score in Acute Appendicitis

Bushra Liaqat[1], Prof Dr Mahmood Ayyaz[2], Zehra Rizvi[1], Muhammad Sohail[1]

[1]Department of General Surgery, National Hospital and Medical Centre, Lahore, Punjab, Pakistan.
[2]Vice Chancellor, King Edward Medical University, Lahore, Punjab, Pakistan.

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Correspondence to: Bushra Liaqat, Department of General Surgery, National Hospital and Medical Centre, Lahore, Punjab, Pakistan.
Email: bliaqat777@gmail.com

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ABSTRACT

Introduction: In resource-constrained environments like Pakistan, scoring systems are essential. When radiography is unavailable or ambiguous, these grading systems can be useful for clinical diagnosis, prompt transfer from primary care institutions, and surgical decision-making. The purpose of the current study was to validate the Alvarado-based appendicitis inflammatory response score in patients having appendicectomies for suspected acute appendicitis. **Study design:** Cross-sectional (validation) study. **Settings:** Department of Surgery, National Hospital, Lahore. **Methodology:** The study comprised 213 patients, aged 18 to 60 years presenting with suspected acute appendicitis undergoing appendectomy. Patients with known malignancies, pregnant women, and those with a sonographic diagnostic of an appendicular mass, abscess, or perforation were excluded. The AIR score was determined following a thorough history, examination, and basic laboratory testing. The Alvarado Score was used to make a clinical diagnosis of suspected cases of acute appendicitis. Results were compared with histopathology report. **Results:** 94.67% AIR score sensitivity, 79.37% specificity, 91.61% PPV, 86.21% NPV, and 90.14% diagnostic accuracy were used to diagnose acute appendicitis. 94.67% AIR score sensitivity, 79.37% specificity, 91.61% PPV, 86.21% NPV, and 90.14% diagnostic accuracy were used to diagnose acute appendicitis. **Conclusion:** For the precise diagnosis of acute appendicitis, the appendix inflammatory response score offers higher sensitivity and specificity.

INTRODUCTION

Bacterial translocation as a result of appendiceal luminal blockage and increased intraluminal pressure of the appendiceal lumen cause acute appendicitis (AA), an inflammation of the appendix.[1] It is one of the most frequent surgical emergencies in the world.[2,3] Throughout their lives, 7–12% of the general population is impacted. As a result, the incidence is roughly 1.5–1.9 per 1000.[4]

When acute appendicitis is not diagnosed in a timely manner, its symptoms can match those of other illnesses, making conditions like perforation more difficult. Conversely, the negative appendectomy rate is approximately 10–15%.[5] The aforementioned consequences can be prevented with the use of diagnostic auxiliary tools such as signs and symptoms, clinical, laboratory, and radiological examinations.[6]

Computed tomography (CT) has a 94% sensitivity and a 95% specificity for acute appendicitis.[7] But it's expensive. As a result, clinical scoring systems like AIR score, Tzanakis, RIPASA, and Alvarado have lately shown their value.[8] By employing eight clinical variables, the Alvarado score improves the precision of acute appendicitis diagnosis. However, the appendicitis inflammatory response (AIR) score uses seven factors, such as anorexia or nausea and C-reactive protein (CRP).[8]

In resource-constrained environments like Pakistan, scoring systems are essential. When radiography is unavailable or ambiguous, these grading systems can be useful for clinical diagnosis, prompt transfer from primary care institutions, and surgical decision-making. The purpose of the current study was to validate the Alvarado-based appendicitis inflammatory response score in patients having appendicectomies for suspected acute appendicitis.

METHODOLOGY

The two rating methods for suspected acute appendicitis were validated in this cross-sectional investigation. Approval from the Ethical Review Board was obtained. after the summary was approved by the College of Physicians and Surgeons of Pakistan, the data were gathered from the Emergency Department of General Surgery at National Hospital in Lahore between February and May of 2025. Using a 95% confidence level, an 11% intended accuracy, a population percentage of 69%[9], a sensitivity of 72.6% for the AIR score, and a specificity of

29.41%, the sample size was determined to be 213.[10] Consecutive patients of either sex, ages 18 to 60, who had been brought in surgical emergency with probable acute appendicitis and had complained of right iliac fossa discomfort for seven days or fewer were taken into consideration for inclusion. Patients with known malignancies, pregnant women, and those with a sonographic diagnostic of an appendicular mass, abscess, or perforation were not included in this study. The patients gave their informed permission. The researcher created a questionnaire and pre-tested it before finalizing it. Patients were included in this trial after providing basic demographic information and contact details. Every diagnosed case's sex, age, residence, and contact information were collected. The AIR score was determined following a thorough history, examination, and basic laboratory testing. The Alvarado Score was used to make a clinical diagnosis of suspected cases of acute appendicitis. Every surgery was carried out by a senior registrar, registrar, or senior post-graduate resident. CRP levels were sent prior to surgery, and they were thereafter tracked along with the specimen's biopsy report, which was sent following surgery. The histopathology report served as the basis for the ultimate diagnosis of acute appendicitis. The Alvarado and AIR scores were computed and compared to the histopathological report. Each scoring system was then evaluated independently for specificity, sensitivity, positive and negative predictive values, and diagnostic accuracy. SPSS 23.0 was utilized to input and analyze all of the collected data. Effect modifiers were taken into consideration by stratifying the data by age, gender, and BMI. Using a post-stratification Chi-square test, a significant p-value was defined as less than 0.05. Diagnostic accuracy was assessed using the Alvarado and AIR scores.

RESULTS

Participants in the study were between the ages of 18 and 60, with a mean age of 39.76 ± 7.12 years. 109 (51.17%) of the patients were between the ages of 41 and 60, according to Table I. Of these 213 individuals, 91 (57.28%) were male and 122 (42.72%) were female, resulting in a male to female ratio of 1.3:1. Mean BMI was 27.04 ± 3.38 kg/m^2. Table I displays the distribution of patients with different factors.

Thirteen patients (False Positive) had no acute appendicitis based on histopathology, while 142 patients (True Positive) had acute appendicitis among those who tested positive for AIR score. 50 (True Negative) and 08 (False Negative) of the 58 patients with negative AIR score exhibited acute appendicitis on histopathology, respectively (p=0.0001), as indicated in Table II. 94.67% AIR score sensitivity, 79.37% specificity, 91.61% PPV, 86.21% NPV, and 90.14% diagnostic accuracy were used to diagnose acute appendicitis.

17 patients (False Positive) had no acute appendicitis based on histopathology, while 137 patients (True Positive) had acute appendicitis among those who tested positive for alvardo score. 46 (True Negative) and 13 (False Negative) of the 59 patients with negative alvardo score exhibited acute appendicitis on histopathology, respectively (p=0.0001), as indicated in Table III. 94.67% AIR score sensitivity, 79.37% specificity, 91.61% PPV, 86.21% NPV, and 90.14% diagnostic accuracy were used to diagnose acute appendicitis. Table IV & V displays the diagnosis accuracy of AIR score and alvardo score stratification by age, gender, and BMI.

Table I

Distribution of patients with variables (n=213)

		Frequency	%age
Age (years)	18-40	109	51.17
	41-60	104	48.83
Gender	Male	91	42.72
	Female	122	57.28
BMI (kg/m^2)	≤30	167	78.40
	>30	46	21.60

Table II

Diagnostic accuracy appendicitis inflammatory response score among patients undergoing appendectomy for suspected acute appendicitis.

	Histopathology (+ive)	Histopathology (-ive)	P-value
AIR score (+ive)	142 (True positive)	13 (False Positive)	0.0001
AIR score (-ive)	08 (False negative)	50 (True Negative)	

Sensitivity: 94.67%
Specificity: 79.37%
Positive Predictive Value (PPV): 91.61%
Negative Predictive Value (NPV): 86.21%
Diagnostic Accuracy: 90.14%

Table II

Diagnostic accuracy Alvardo score among patients undergoing appendectomy for suspected acute appendicitis.

	Histopathology (+ive)	Histopathology (-ive)	P-value
AIR score (+ive)	137 (True positive)	17 (False Positive)	0.0001
AIR score (-ive)	13 (False negative)	46 (True Negative)	

Sensitivity: 91.33%
Specificity: 73.02%
Positive Predictive Value (PPV): 88.96%
Negative Predictive Value (NPV): 77.93%
Diagnostic Accuracy: 85.92%

Table IV

Stratification of diagnostic accuracy of AIR score with respect to age, gender and BMI.

		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	**18-40**	98.57%	82.05%	90.79%	96.97%	92.66%	0.001
	41-60	91.26%	75.0%	92.41%	72.0%	87.50%	0.001
Gender	**Male**	90.91%	92.0%	96.77%	79.31%	91.21%	0.001
	Female	97.62%	71.05%	88.17%	93.10%	89.34%	0.001
BMI (kg/m^2)	**≤30**	94.35%	74.42%	91.41%	82.05%	10.64%	0.001
	>30	96.15%	90.0%	92.59%	94.74%	93.48%	0.001

Table V

Stratification of diagnostic accuracy of alvardo score with respect to age, gender and BMI.

		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	18-40	95.0%	82.86%	92.68%	87.68%	91.30%	0.001
	41-60	88.75%	70.83%	91.03%	65.38%	84.62%	0.001
Gender	Male	87.88%	92.0%	96.67%	74.19%	89.01%	0.001
	Female	94.05%	60.53%	84.04%	82.14%	83.61%	0.001
BMI (kg/m²)	≤30	91.13%	72.09%	90.40%	73.81%	86.23%	0.001
	>30	92.31%	75.0%	82.76%	88.24%	84.78%	0.001

DISCUSSION

About half of all cases of acute appendicitis have ambiguous and uncommon symptoms. Common symptoms of AA include guarding, anorexia, increased temperature, and pain that radiates from the umbilical region to the right iliac region.[11] This could make it more difficult to provide an appropriate diagnosis and lead to issues like perforation. In the past, a 20% negative appendectomy rate was considered appropriate in certain situations to avoid a delay in diagnosis. However, this came at a significant expense to the patient and healthcare system.[12] Only antibiotics can be beneficial in simple cases of acute appendicitis, as long as the right diagnosis is made.[13] Scoring systems are used in certain situations. With its emphasis on symptoms and indicators, the Alvarado score could help with precise diagnosis.[14] However, the AIR score is also often utilized.[15]

The mean age of the patients in our sample was 39.76 ± 7.12 years, which was nearer the median age of 39 [27–54] in a Meier et al. survey conducted in the United States.[16] Nonetheless, 29,948 [51.3%] female patients received an appendicitis diagnosis, which was similar to our findings of 122 (57.28%) female patients. This could be because men have easier access to treatment while women in the West suffer pain for longer due to socioeconomic disparities.

In the current study, the sensitivity of the AIR score was 94.67%, whereas the sensitivity of the Alvarado score was 91.33%. The AIR score had a specificity of 79.37%, whereas the Alvarado score had a specificity of 73.02%. The AIR score had a positive predictive value of 91.61%, but the Alvarado score had a positive predictive value of 88.96%. The negative predictive value for the AIR score was 86.21%, whereas the negative predictive value for the Alvarado score was 77.93%. The AIR score had a diagnostic accuracy of 90.14%, but the Alvarado score had an accuracy of 85.92%. The Alvarado score exhibited 88.4% sensitivity, 63.6% specificity, a 96.4% PPV, a 33.3% NPV, and an accuracy of 86.3%, according to a previous study conducted in Pakistan. The AIR score showed a diagnostic accuracy of 78.03%, a sensitivity of 77.7%, a specificity of 81.8%, a PPV of 97.9%, and a 25% NPV.[17] More sensitivity and specificity were demonstrated by the AIR score and Alvarado. In contrast, our study's AIR score had a higher sensitivity.

Using histology as the gold standard, Tariq et al.[9] examined the diagnostic accuracy of the Alvarado score and AIR for the diagnosis of acute appendicitis in the Pakistani population. The Alvarado score has an accuracy of 81.7%, specificity of 92.3%, and sensitivity of 80.1%. Conversely, the AIR score showed a 75.5% accuracy rate, 94.2% specificity, and 72.6% sensitivity. According to an Indian study by Jose and Rajesh[7] when the score is higher than 6, the Alvarado score has a 72% sensitivity and a 79% specificity. When the score was assumed to be higher than 7, the specificity rose to 93% while the sensitivity dropped to 46%. For scores higher than 5, the AIR score had a sensitivity of 98% and a specificity of 36%. When the score was higher than 6, the specificity rose to 97%.

In males, 90% of patients with a positive Alvarado score had positive histology ($p < 0.001$), and nearly 94% of patients with positive histopathology also had a positive AIR score ($p < 0.001$). Females likewise showed similar results. In this study, 92% of patients with symptoms lasting less than 24 hours had a positive Alvarado score, and 97% of patients with symptoms lasting less than 24 hours have a positive AIR score. When histology was also positive in obese individuals, the AIR score was positive 97% of the time, and it also demonstrated 97% sensitivity in obese patients. On the other hand, when histology was positive, Alvarado was positive in 86% of patients. In the UK, Hassan et al[18] found that AA was present in the histology of 59 out of 73 individuals (80.8%). Histopathology reports were shown to be significantly correlated with both the Alvarado score ($P = 0.011$) and the AIR score ($P = 0.000$). The Alvarado score has 67.80% sensitivity and 78.57% specificity, but the AIR score has 77.97% sensitivity and 85.71% specificity, they added. According to an Iranian study, the Alvarado score had an 89.3% sensitivity, 23.5% specificity, 35.2% NPV, and 89.3% PPV in individuals with acute appendicitis. According to the AIRS, the AIR score had a sensitivity of 96.1%, a specificity of 82.3%, an NPV of 77.7%, and a PPV of 97%.[19] Poillucci et al[20], who found that the sensitivity of the AIR score was 19.7%, disputed this study. However, they employed an 8 as the cutoff value. The corresponding specificity was 15.5% NNV, 96.9% PPV, and 95.9%.

According to the aforementioned results, the AIR score has a superior diagnostic profile than the Alvarado score. The high sensitivity and specificity rates showed that it can reliably detect true negatives as well as real positive instances, allowing for prompt action and avoiding needless procedures. As a result, it may also be useful for unusual presentations.[17] Because they are simple to use, especially in environments with limited resources like ours, the Alvarado and AIR scores are both useful diagnostic tools. When used, both of these scoring systems can reduce the need for needless surgeries and imaging examinations.[21]

CONCLUSION

For the precise diagnosis of acute appendicitis, the appendix inflammatory response score offers higher sensitivity and specificity. Therefore, it can be regularly used for this purpose by surgeons who work in the emergency department. Additionally, it can do away with the requirement for radiological tests to confirm the diagnosis.

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