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A Comparative Study of Adult Appendicitis Score with Alvarado Score in the Diagnosis of Acute Appendicitis

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ABSTRACT

Introduction: For individuals suspected of having acute appendicitis, clinical evaluation based on a history and physical examination has been the main diagnostic approach. Although a number of diagnostic methods, such as imaging modalities and biochemical assays, have been developed, advanced diagnostic testing has not improved the detection of acute appendicitis. This diagnostic difficulty has led to the need for objective techniques of using scoring systems to evaluate those who may have acute appendicitis. **Methodology:** The study comprised 180 patients, aged 20 to 60 years presenting with suspected acute appendicitis undergoing appendectomy. Participants in this study were excluded if they had an appendicular mass or abscess, were pregnant, had undergone a laparotomy, had had an appendectomy, or had Koch's abdomen or inflammatory bowel disease. The cutoff point for a higher risk or probability/positive test of acute appendicitis was defined as an Alvarado scale score of ≥ 7 or higher. The cutoff point for a high risk or probability/positive test of acute appendicitis was defined as an Adult Appendicitis Score of ≥ 11 or above. The diagnostic accuracy of Alvarado and AAS was computed by comparing the histopathological results with the preoperative scores. **Results:** Acute appendicitis was diagnosed with a sensitivity of 93.85% Adult Appendicitis Score, a specificity of 80.0%, a PPV of 92.42%, an NPV of 83.33%, and a diagnostic accuracy of 90.0%. Acute appendicitis was diagnosed with a sensitivity of 90.72% alvardo score, a specificity of 72.0%, a PPV of 89.31%, an NPV of 73.47%, and a diagnostic accuracy of 85.0%. **Conclusion:** For the precise diagnosis of acute appendicitis, the Adult Appendicitis Score offers higher sensitivity and specificity.

INTRODUCTION

Hospitalization and emergency surgery are the most common outcomes of acute appendicitis (AA), a common surgical disease.[1] The incidence rate is still rising; in 2019, it rose by about 39% since 1990. Acute appendicitis has a morbidity and mortality rate of around 0.43/100,000, with over 33400 recorded deaths in 2019. The condition is most common in those aged 15 to 19, and the lifetime risk is 6.7% for women and 8.6% for men.[2] Although the exact origins of appendicitis are unknown, it may be linked to bacterial infections, which are more frequently found in cases of acute appendicitis. Acute appendicitis can also be caused by viruses and other microorganisms.[3]

For individuals suspected of having acute appendicitis, clinical evaluation based on a history and physical examination has been the main diagnostic approach. Numerous diagnostic tools, such as imaging modalities and biochemical assays, have been developed, but advanced diagnostic testing has not improved the detection of acute appendicitis.[4] Due to this diagnostic challenge, objective methods of assessing individuals with suspected acute appendicitis through the use of scoring systems have become necessary. To date, the literature has detailed over ten scoring systems for the diagnosis of acute appendicitis, with varying outcomes depending on the setup.[5]

The most popular and well-described score is Alvarado's, which employs eight predicting elements for a total score of ten. Previous research on the sensitivity of Alvarado's score has shown inconsistent and variable findings, with ethnic differences being identified as one contributing factor to the discrepancy in acute appendicitis diagnosis. According to certain research, it has a high sensitivity and should be used regularly, although the majority of the literature indicated the opposite.[6,7] The duration between the onset of symptoms and diagnosis, as well as the unique difficulties in diagnosing women in their reproductive years, are taken into consideration by the Adult Appendicitis Score (AAS) for adult patients with suspected acute appendicitis. With

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more but targeted imaging, the scoring is used to lower the negative appendectomy rate.[8] According to a study, the Alvarado score's sensitivity and specificity were 56.8% and 91.7%[10], whereas the AAS score's were 84.04% and 83.33%.[9] Using histopathological findings as the gold standard, the AAS found that 69.57% of patients with complaints of right iliac fossa pain, tenderness, and nausea had acute appendicitis, with a score of ≥ 7 or higher on the Alvarado scale and an A score of ≥ 11 or higher on the Adult Appendicitis Score.

This study compares the Adult Appendicitis Score with Alvarado's diagnostic accuracy in identifying acute appendicitis. The findings of this study, which is the first being carried out locally, will be utilized to inform future investigations and policy suggestions pertaining to the diagnosis of acute appendicitis. Additionally, this study will assist in determining the optimal score for a timely and accurate clinical diagnosis, which will help lower these patients' morbidity.

METHODOLOGY

This cross-sectional study validated the two rating systems for suspected acute appendicitis. The Ethical Review Board gave their approval. Between April 2025 and July 2025, information was collected from the Department of Surgery at the Allied-II Hospital (DHQ), Faisalabad Medical University, Faisalabad. To determine sensitivity and specificity, use a sample size calculator. AAS score expectations are as follows: expected sensitivity = 84.04%[9], expected specificity = 83.33%[9], illness prevalence as measured by AAS (p) = 69.57%[11], acceptable precision = 10.00%, 95% confidence level, and sample size (including dropout) = 180. Patients of either sex who were consecutive, between the ages of 20 and 60, and who had been brought in with symptoms of acute appendicitis on clinical evaluation—such as pain in the right iliac fossa, tenderness in the right lower quadrant, nausea and vomiting, anorexia, and a body temperature greater than 37.3º—were considered for inclusion. Participants in this study were excluded if they had an appendicular mass or abscess, were pregnant, had undergone a laparotomy, had had an appendectomy, or had Koch's abdomen or inflammatory bowel disease.

The patients consented after being fully informed. A consultant surgeon performed a clinical examination on each patient, and the Allied-II Hospital's laboratory performed routine biochemical laboratory tests (complete blood count and CRP). A history of nausea, anorexia, and migrating discomfort was taken. Tenderness, guarding, temperature, and rebound tenderness were recorded during inspection. CRP, the percentage of neutrophils, the shift to the left of white blood cells, and the total leucocyte count were all measured during the inquiry. Alvarado and AAS scores were collected prior to surgery based on the patient's history, examination, and laboratory results. The cutoff point for a higher risk or probability/positive test of acute appendicitis was defined as an Alvarado scale score of ≥ 7 or higher. The cutoff point for a high risk or probability/positive test of acute appendicitis was defined as an Adult Appendicitis Score of ≥ 11 or above. Every surgery was carried out by a consultant surgeon. Histopathology was performed on the specimen. The diagnostic accuracy of Alvarado and AAS was computed by comparing the histopathological results with the preoperative scores. A specially created Performa was used to record all of the data.

SPSS version 25 was used to transfer and analyze all of the gathered data. Every quantitative measure, including age, symptom duration, and Alvarado and AAS scores, had its mean and standard deviation determined. For every qualitative variable, including gender and acute appendicitis symptoms, frequency and percentage were computed. A 2x2 table was used to calculate the diagnostic accuracy for both scores. Stratification was used to adjust for effect modifiers such age, gender, and symptom duration. Diagnostic accuracy after stratification was computed. To calculate sensitivity, specificity, PPV, NPV, and diagnostic accuracy, a 2x2 table was constructed as follows: Additionally, diagnostic accuracy was computed.

ANNEXEURE-I

Table 1
Alvarado score.

Feature	Score
Migratory Pain	1
Anorexia	1
Nausea	1
Tenderness in right lower quadrant	2
Rebound Tenderness	1
Elevated Temperature	1
Leukocytosis	2
Shift of white blood cells to left	1
Total	**10**

Sum of Score <5: Appendicitis unlikely.
Sum of Score 5 or 7: Suspected Appendicitis.
Score >7: Appendicitis Most Likely.

ANNEXEURE-II

TABLE 1
Adult Appendicitis Score (AAS): score ⩽10 low risk of appendicitis, score 11–15 intermediate risk of appendicitis, and score ⩾16 high risk of appendicitis.

		Score
Symptoms and findings		
Pain in RLQ		2
Pain relocation		2
RLQ tenderness	Women, aged 16–49 years	1
	All other patients	3
Guarding	Mild	2
	Moderate or severe	4
Laboratory tests		
Blood leukocyte count (×10⁹)	⩾7.2 and <10.9	1
	⩾10.9 and <14.0	2
	⩾14.0	3
Proportion of neutrophils (%)	⩾62 and <75	2
	⩾75 and <83	3
	⩾83	4
CRP (mg/L), symptoms <24 h	⩾4 and <11	2
	⩾11 and <25	3
	⩾25 and <83	5
	⩾83	1
CRP (mg/L), symptoms >24 h	⩾12 and <53	2
	⩾53 and <152	2
	⩾152	1

RLQ: the right lower abdominal quadrant; CRP: C-reactive protein.
AAS calculator: www.appendicitisscore.com.

RESULTS

The study's participants ranged in age from 20 to 60, with an average age of 39.76 ± 7.12 years. Table I shows that 109 (60.56%) of the patients were in the 20–40 age range. The male to female ratio of these 180 individuals was 1:1, with 91 (50.56%) being male and 89 (49.44%) being female. The symptoms lasted an average of 27.04 ± 3.38 hours. The distribution of patients with various variables is shown in Table I.

Among those who tested positive for the Adult Appendicitis Score, 122 patients (True Positive) had acute appendicitis, whereas 10 patients (False Positive) had no

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acute appendicitis according to histology. According to Table II, among the 48 individuals with negative Adult Appendicitis Score, 40 (True Negative) and 8 (False Negative) had acute appendicitis on histology, respectively (p=0.0001). Acute appendicitis was diagnosed with a sensitivity of 93.85% Adult Appendicitis Score, a specificity of 80.0%, a PPV of 92.42%, an NPV of 83.33%, and a diagnostic accuracy of 90.0%.

Histopathology revealed that 117 individuals (True Positive) had acute appendicitis among those who tested positive for the alvardo score, whereas 14 patients (False Positive) had no acute appendicitis. Table III shows that of the 49 patients with a negative alvardo score, 36 (True Negative) and 13 (False Negative) had acute appendicitis on histology, respectively (p=0.0001). Acute appendicitis was diagnosed with a sensitivity of 90.72% alvardo score, a specificity of 72.0%, a PPV of 89.31%, an NPV of 73.47%, and a diagnostic accuracy of 85.0%. The diagnosis accuracy of AIR score and Alvardo score stratification by age, gender, and illness duration is shown in Tables IV and V.

Table I
Distribution of patients with variables (n=180)

		Frequency	%age
Age (years)	20-40	109	60.56
	41-60	71	39.44
Gender	Male	91	50.56
	Female	89	49.44
Duration of symptoms (hours)	≤24	107	59.44
	>24	73	40.56

Table II
Diagnostic accuracy Adult Appendicitis Score.

	Histopathology (+ive)	Histopathology (-ive)	P-value
AAS score (+ive)	122 (True positive)	10 (False Positive)	0.0001
AAS score (-ive)	08 (False negative)	40 (True Negative)	

Sensitivity: 93.85%
Specificity: 80.0%
Positive Predictive Value (PPV): 92.42%
Negative Predictive Value (NPV): 83.33%
Diagnostic Accuracy: 90.0%

Table III
Diagnostic accuracy Alvardo score.

	Histopathology (+ive)	Histopathology (-ive)	P-value
Alvardo score (+ive)	117 (True positive)	14 (False Positive)	**0.0001**
Alvardo score (-ive)	13 (False negative)	36 (True Negative)	

Sensitivity: 90.0%
Specificity: 72.0%
Positive Predictive Value (PPV): 89.31%
Negative Predictive Value (NPV): 73.47%
Diagnostic Accuracy: 85.0%

Table IV
Stratification of diagnostic accuracy of adult appendicitis score with respect to age, gender and duration of symptoms.

		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	**20-40**	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**
Duration (hours)	**≤24**	94.35%	74.42%	91.41%	82.05%	10.64%	**0.001**
	>24	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 duration of symptoms.

		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	**20-40**	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**
Duration (hours)	**≤24**	91.13%	72.09%	90.40%	73.81%	86.23%	**0.001**
	>24	92.31%	75.0%	82.76%	88.24%	84.78%	**0.001**

DISCUSSION

Surgical emergencies for acute appendicitis are frequent. Although there are several grading systems for acute appendicitis diagnosis, it is still unknown how useful they are in comparison. By contrasting the AAS and AS, this study sought to dispel the ambiguity around the various scoring schemes.[12] Even with the advent of diagnostic laparoscopy, USG, and CT, strategic care of patients with suspected appendicitis is still difficult. The diagnosis is complicated by a number of different illnesses that resemble the clinical appearance. Ionizing radiation is exposed during a CT scan. Conversely, a negative appendectomy may result in unfavorable consequences. Even now, diagnosing appendicitis requires a skilled surgeon's clinical evaluation. There is an urgent need to designate a gold standard scoring system.[13]

AAS was contrasted with AS by Sammalkorpi et al. Of the 829 adults with clinical diagnosis who were enrolled in their study, 47% had appendicitis that had been confirmed.[14] Laboratory results and clinical history were among the information they gathered.[14] Approximately 58% of patients received a score of 16 or higher, which is considered high probability, with a 93% specificity.[14] When compared to earlier scoring methods, the area under the ROC curve was noticeably larger. Thus, based on the aforementioned facts, AAS appears to be more accurate and could, in 50% of cases, eliminate the need for more research.[14]

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According to a systematic review by Podda et al., AS, AIR, and AAS demonstrated good sensitivity in ruling out acute appendicitis.[15] They also came to the conclusion that different scoring schemes aid in lowering the rate of negative appendectomy.[15] It is still unclear which system is better based on the aforementioned research. We recruited 180 RLQ pain sufferers for our study. On the data collecting forms, Alvarado and AAS were computed for each of them. Among those who tested positive for the Adult Appendicitis Score, 122 patients (True Positive) had acute appendicitis, whereas 10 patients (False Positive) had no acute appendicitis according to histology. Histopathology revealed acute appendicitis in 40 (True Negative) and 8 (False Negative) of the 48 individuals with negative Adult Appendicitis Scores (p=0.0001). Acute appendicitis was diagnosed with a sensitivity of 93.85% Adult Appendicitis Score, a specificity of 80.0%, a PPV of 92.42%, an NPV of 83.33%, and a diagnostic accuracy of 90.0%. Histopathology revealed that 117 individuals (True Positive) had acute appendicitis among those who tested positive for the alvardo score, whereas 14 patients (False Positive) had no acute appendicitis. Of the 49 patients with a negative Alvardo score, histology showed acute appendicitis in 36 (True Negative) and 13 (False Negative) cases, respectively (p=0.0001). Acute appendicitis was diagnosed with a sensitivity of 90.72% alvardo score, a specificity of 72.0%, a PPV of 89.31%, an NPV of 73.47%, and a diagnostic accuracy of 85.0%.

Using the following metrics, we discovered a strong link between Alvarado and AAS: WBC count, hemoglobin level, serum C reactive protein (CRP), neutrophil count, lymphocyte count, and serum lactate count. These characteristics, which were previously thought to be biomarkers for diagnosing AA, demonstrated an increase in the severity grading of AA. Clinically speaking, though, no single biomarker has proven to be a reliable diagnostic tool when used alone.[16]

As shown by Chae et al[17], we chose a cut-off value based on a prior study. AAS's superior capacity to stratify patients with AA was demonstrated by its comparatively higher accuracy for both higher and lower cut-off values. Our results are highly supported by the previous publication on AAS building, which is in line with this discovery.[18] Additionally, Kabir et al.[19] showed similar results, showing that AAS can reduce NA and the necessity for radiological diagnosis, with a superior AUC (0.78) than the Alvarado score (0.75). On the other hand, Capoglu et al. showed comparable accuracy and no discernible difference in AUC between AAS and Alvarado.[20]

Chae et al. pointed out that both scores were helpful in ruling out appendicitis in low-risk group I, enabling a safe release.[17] Accordingly, a recent systematic review of the literature on the diagnostic utility of different scoring systems confirmed that AAS and Alvarado were primarily helpful in ruling out appendicitis and identifying patients who were at low risk for AA. This reduced the need for radiological evaluations and decreased the rates of NA in these patient groups.[15]

According to the results of the current study, the Adult Appendicitis Score is a very good diagnostic tool for clinically diagnosing acute appendicitis and choosing the optimal course of action for early surgical intervention in its treatment. The incidence of negative appendicectomies may be reduced by this technique, which may help lessen patients' needless radiation exposure and the related costs of CT scans. This study's single-center design, small sample size, and brief study period were among its drawbacks.

CONCLUSION

For the precise diagnosis of acute appendicitis, the Adult Appendicitis 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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