

A Comparitive Study between Modified Alvarado Score and Appendicitis Inflammatory Response Score in Diagnosis of Acute Appendicitis

¹Dr. Sanjay Kala, Professor & Head, Department of Surgery, G.S.V.M Medical College, Kanpur

²Dr. R.K. Jauhari, Assistant Professor, Department of Surgery, G.S.V.M Medical College, Kanpur

³Dr. Yuktshwar Mishra, 3.Assistant Professor, Department of Surgery, G.S.V.M Medical College, Kanpur

⁴Dr. Rounak Mehrotra, Junior Resident-III, Department of Surgery, G.S.V.M Medical College, Kanpur

Corresponding Author: Dr. Rounak Mehrotra, Junior Resident-III, Department of Surgery, G.S.V.M Medical College, Kanpur

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Abstract

Background: Acute Appendicitis is one of the most common surgical emergencies encountered by the surgeons. Various scoring system are designed to aid in the clinical assessment of patients of appendicitis. The purpose of this study is to compare usefulness of Modified Alvarado Score (MAS) and Appendicitis Inflammatory Response Score (AIRS) in diagnosis of Acute Appendicitis.

Methods: An observational study in which both the scores (MAS & AIRS) were calculated in patients of Acute Appendicitis(Radiologically confirmed) and the usefulness of scores was compared against the gold standard of Histopathology of resected specimen or CECT whole abdomen in non operated cases.

Results: The results revealed that AIRS (at score>4) demonstrated higher sensitivity and specificity compared to MAS (86% vs 85%) and (70% vs 60%) respectively.

Conclusion: The Appendicitis Inflammatory Response score outperformed Modified Alvarado Score.

Keywords: Appendicitis Inflammatory Response score, Modified Alvarado Score, Acute Appendicitis.

Introduction

Acute appendicitis is common, with a life time risk of about one percent. Symptoms of acute appendicitis overlap with a number of other condition, making the clinical diagnosis of acute appendicitis challenging. It is the commonest acute abdomen emergencies with incidence of 1.17 per 1000 and lifetime risk of 8.6% in men and 6.7% in women. The incidence is highest in adolescents and young adults.[1] Surgeon’s clinical assessment is considered to be the most important factor in diagnosis of appendicitis. A clinical decision to operate leads to removal of normal appendix in 15-30%of cases. Removing normal appendix is an economic burden on both patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and peritonitis Methods

advocated to assist in the diagnosis of acute appendicitis include scoring systems, ultrasonography, computed tomography, diagnostic laparoscopy.

Several scoring systems have been developed to help clinicians in the diagnosis of acute appendicitis. The best-known scores are the Alvarado score, the Modified Alvarado score, the Pediatric Appendicitis Score, the Appendicitis Inflammatory Response score, and the RIPASA score. These tools not only can be used for diagnostic purposes but also for stratification, separating those patients who require observation and workup from those who can be assigned for certain specific treatment. The aim of these scores is to reduce the number of negative appendectomies without increasing the number of perforations.

The Modified Alvarado score was described in 1994 by Klan et al. The AIR score was first reported in 2008.[7] Both these scores are slight modifications and upgradation of standardised Alvarado Score.

The objective of this study was to compare the efficiency of Modified Alvarado scoring(MAS) and Appendicitis Inflammatory Response Score (AIRS) in diagnosis of suspected cases of acute appendicitis. As these two recent scores have not been evaluated simultaneously.

Materials and Methods

All patients presenting to the Department of Surgery at LLR Hospital, GSVM Medical College, Kanpur from February 2018 to October 2019 with probable diagnosis of acute appendicitis were included in the study.

The criteria for probable diagnosis of acute appendicitis were (Inclusion Criteria)-

Clinical Criteria

- Central abdominal pain shifting to right iliac fossa.
- Pain localized to right iliac fossa.
- Localized tenderness in right iliac fossa.

- Associated with fever, vomiting, and anorexia.

Radiological Criteria

- Abdominal Sonography suggestive of Appendicitis(i.e. diameter, non compressibility, probe tenderness & peri appendiceal fluid).
- Contrast Enhanced CT of Abdomen if Sonography finding was equivocal.

Operative Criteria

When clinico-radiological examination were unable/equivocal to diagnose Appendicitis then Diagnostic Laparoscopy was planned to look for the pathology.

After examining the patients the decision to operate was made by radiological confirmation. The surgical procedures consisted of either open appendectomy or laparoscopic appendectomy.

The resected specimen of Appendix was examined histopathologically and reports suggesting of Acute appendicitis, Acute Suppurative appendicitis, Acute or Chronic appendicitis were taken as confirmatory diagnosis of the disease.

In Non operated cases Acute appendicitis with phlegmon formation on CECT was taken as confirmatory diagnosis.

Since the number of negative appendectomy was nil we compared the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of each of these scores in diagnosing a histopathologically and radiologically proven Acute Appendicitis.

The reports suggestive of Chronic appendicitis were taken as negative.

While waiting for surgery detailed history, examination and investigations were recorded for the variables for the scores and subsequently both these scores were calculated in each patient.

➤ **Exclusion Criteria**

- Age <2 years.
- Non willing patients.
- Patients with palpable right illiac fossa lump
- Patients with features of Generalized peritonitis.

Characteristics of the appendicitis inflammatory response (AIR) score and the Modified Alvarado score

Diagnosis	Modified Alvarado score	AIR score
Nausea or vomiting	1	1
Anorexia	1	
Migratory pain in RLQ	1	
Pain in RLQ		1
Tenderness in RLQ	2	
Rebound tenderness	1	
Muscular defense		
Light		1
Medium		2
Strong		3
Elevated Body temperature	1	1
Polymorphonuclear leukocytes		
70–84%		1
≥85%		2
WBC count		
>10.0 × 10 ⁹ /l	2	
10.0–14.9 × 10 ⁹ /l		1

Diagnosis	Modified Alvarado score	AIR score
≥15.0 × 10 ⁹ /l		2
CRP concentration		
10–49 g/l		1
≥50 g/l		2
Total score	9	12

Modified Alvarado score: sum 0–4 = not likely appendicitis, sum 5–6 = equivocal, sum ≥ 7 = probably appendicitis
 Acute appendicitis response score (AIR): sum 0–4 = low probability, sum 5–8 = indeterminate group, sum 9–12 = high probability

RLQ right lower quadrant, CRP C-reactive protein, WBC white blood cell

Statistical Analysis

Statistical analysis was performed with IBM SPSS Statistics Subscription (11-2018). A *p* value of <0.05 was considered statistically significant. The area under the receiver operating characteristic (ROC) curves was used to examine the performance characteristics of the two scoring systems.

Results

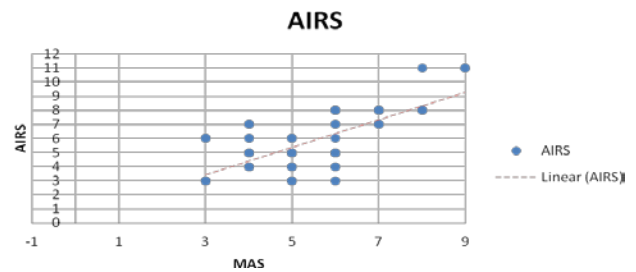
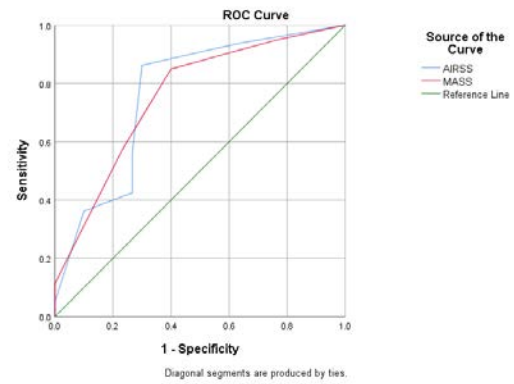
The present study included 110 patients with suspicion of acute appendicitis. There were 71 male patients (64.5%) and 39 female patients (35.45%) with the mean age of 27 years.

Distribution of patients as per score

	MAS	AIRS
≤4	30	32
5 to 7	71	46
≥8	9	32
Total	110	110
Result		

Acute Appendicitis - 80
Chronic Appendicitis - 30
Total - 110

Result	No. Of Patients
Acute Suppurative Appendicitis(Biopsy proven)	11 (10%)
Acute Appendicitis(Biopsy proven)	12 (10.9%)
Acute on Chronic Appendicitis(Biopsy proven)	53 (48.1%)
Acute Appendicitis(CECT proven)	4 (3.6%)
Acute Appendicitis Total	80 (72.27%)
Chronic Appendicitis(Biopsy proven)	30 (27.2%)
Total	110



Discriminating capacity of the AIR score compared to the Modified Alvarado score, according to patient gender and age using receiver operator characteristic (ROC) curve analysis

Distribution of Parameters of scores in the study

	Acute Appendicitis	% in Acute	Chronic Appendicitis	% in Chronic	TOTAL	% in Total
Nausea or Vomiting	49	61.25	22	73.33	71	64.54
Anorexia	55	68.75	12	40	67	60.91
Elevated Temperature	58	72.5	11	36.67	69	62.73
Migratory Pain in RLQ	64	80	26	86.67	90	81.82
Pain in RLQ	80	100	30	100	110	100
Tenderness in RLQ	76	95	24	80	100	90.91
Rebound Tenderness	59	73.75	5	16.67	64	58.18
Light Muscular Defense	34	42.5	21	70	55	50
Medium Muscular Defense	24	30	5	16.67	29	26.36
Strong Muscular Defense	12	15	0	0	12	10.91
Leucocytosis	23	28.75	6	20	29	26.36
Mild	19	23.75	6	20	25	22.73
Severe	4	5	0	0	4	3.64
Elevated PMNs	46	57.5	13	43.33	59	53.64
Less	34	42.5	13	43.33	47	42.73
High	12	15	0	0	12	10.91
Elevated CRP	72	90	16	53.33	88	80
Less	32	40	8	26.67	40	36.36
High	40	50	8	26.67	48	43.64

RLQ right lower quadrant, RIF right illiac fossa Pain and Tenderness in the RIF/RLQ are the most common presentation in the study. Rebound Tenderness was demonstrated in 74% patients. The area under the ROC curve of the AIR score was 0.765 and significantly better than the area under the curve of 0.757 of the Modified Alvarado score (p < 0.05).

	No. of Patients	AIRS	p value	MASS	p value
Overall	110	0.765	0.000	0.757	0.000
Gender					
Male	71	0.766	0.004	0.881	0.000
Female	39	0.827	0.001	0.661	0.086
Age (years)					
<18	19	0.864	0.008	0.665	0.231
18 - 49	85	0.701	0.000	0.776	0.007
≥ 50	6	0.750	0.355	0.250	0.355

Various Correlations between Scores and Results

Diagnostic characteristics of the AIR score and Modified Alvarado score according to the cutoff points

	MASS >4	AIRS >4	MASS >8	AIRS >8
Sensitivity	0.85	0.86	0.11	0.36
Specificity	0.6	0.7	1	0.9
PPV	0.85	0.88	1	0.91
NPV	0.6	0.66	0.3	0.35
Accuracy	0.78	0.82	0.35	0.51

PPV- Positive Predictive Value, NPV- Negative Predictive Value

Discussion

A clinical scoring system by the virtue of its simple design and application, estimates the probability of appendicitis in a patient and helps in the decision-making process for treatment . A clinical score may be suitable as an instrument for making important clinical decisions such as selecting patients for immediate surgery, further examination with imaging techniques, or observation. The score can be repeated during active observation and aid in the decision to plan surgical intervention. However it is imperative to remember that the purpose of scoring system is not to establish a primary diagnosis of appendicitis, but simply to clarify in the scene of uncertainty.

Kalan et al first reported MAS in 1994 [8], which was based on modification of Alvarado score by excluding the shift to left because of unavailability in the labarotries and its unavailibility in emergencies. The presence of a high score of MAS was found to be an easy and efficient aid to early diagnosis of acute appendicitis. However there was no significant

difference in negative appendectomy rates and was only slightly better than Alvarado Score [9]. This scoring system did not incorporate C-reactive protein value. A recent meta-analysis has shown that there is fivefold increase in the positive likelihood ratio for acute appendicitis when both WBC count and C-reactive protein are elevated [11]. Later in 2008 ,Appendicitis Inflammatory Response(AIR) score was developed in Sweden by incorporating C- reactive protein value and modification of the variables of AS by prospectively collected data of variables of AS with independent prognostic value to each of them using a mathematically more appropriate method for the construction by giving grading to each variable, as it was more objective and graded[6][7]. More recently AIR - like scoring system was developed by Sammalkorpi et al known as Adult Appendicitis Score[10].This scoring system also included C-reactive protein evaluation. It demonstrated improved sensitivity and specificity with respect to AS in predicting Acute Appendicitis. In the present study,C-reactive protein demonstrated a sensitivity of 87.5% and specificity of 46.6 % in predicting Acute appendicitis.

Studies have concluded that decisions to operate based solely on physical examination, result in a higher rate of negative appendectomies[4] [5]. Therefore it is a common practice to use US or CT in patients suspected of having appendicitis . However, false negative results may delay surgery and subsequently increase morbidity.[3] With the use of CT, there is exposure to ionizing radiation and it should be used selectively to minimize this risk[2]

The present study shows that the AIR score has a better statistical discrimination for patients with acute appendicitis and outperforms the Modified Alvarado score. The present study shows that the AIR score with

a cut off score of >4 has a sensitivity of 86 %, specificity of 70 %, PPV of 88% and NPV of 66%. MASS at cut off 4 has a sensitivity of 85%, specificity of 60%, PPV of 85% and NPV of 60%. Whereas AIR with a cut off score of 8 has a sensitivity of 36 %, specificity of 90 %, PPV of 91 % and NPV of 35%. MASS at cut off score of 8 has a sensitivity of 11 %, specificity of 100 %, PPV of 100 % and NPV of 30 %. The present study shows that AIR has slightly better sensitivity and specificity than MASS. Also at cut off score of 4, AIR has good sensitivity and so can better detect new cases of appendicitis. Thus AIR has an advantage over MASS as it has better statistical discrimination for patients with acute appendicitis. The overall accuracy of the AIRS was found to be better than MASS, both at high cut off as well as at low cutoff. These results of the study at low cut off are comparable with the studies of Castro et al [6] which compared the established AS with newly formed AIRS. Though at high cut off the results were not comparable in both studies because on higher score all the parameters points towards the diagnosis. The AIRS also outperformed AS in a study by Kollár et al with higher specificity and positive predictive value [19] at the lower cut off. Our study has similar conclusions with respect to comparison between AIR and MASS. This scoring system could aid in the diagnosis and selecting patients who require timely surgery or those who require further evaluation. Finally, the score could safely reduce hospitalization and unnecessary investigations in patients in whom the diagnosis is unlikely. This study validates that the AIR score has a higher discriminating power and outperforms the Modified Alvarado score.

Conclusion

The study shows Appendicitis inflammatory response score outperformed Modified Alvarado score displaying higher sensitivity and specificity. Despite being easily available MASS can not clearly categorize the patients of suspected acute appendicitis. When CT scan is not available or contraindicated, AIRS in combination with USG maybe used for diagnosis of acute appendicitis. It will also help in cost cutting.

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