

# Role of Modified Alvarado Score in the Diagnosis of Acute Appendicitis

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## ABSTRACT

**Introduction:** Acute appendicitis is one of the most common acute digestive diseases presenting in the Emergency Departments worldwide. In spite of advances in the diagnostic modalities and surgical techniques diagnosing acute appendicitis always remains a challenge and delay in decision making may complicate a supposedly simple surgical disease. The diagnosis is all the more complicated in females. Modified Alvarado Scoring System (MASS) is a cheap and quick diagnostic modality which does not need any high end instruments and can be done in the emergency set-up and even in odd hours of night.

**Aim:** To test the efficacy and diagnostic accuracy of MASS in the diagnosis of acute appendicitis.

**Materials and Methods:** Prospective cross-sectional type of study was conducted from January 2015 to December

2015 in the Department of General Surgery. A total of ninety three adult patients (fifty five males and thirty eight females) were enrolled in the study. Sensitivity, specificity, Positive predictive value and Negative predictive value of MASS were found separately in males and compared with those of females to see the efficacy of MASS in the diagnosis of acute appendicitis.

**Results:** Most of the patients having a MASS of 7 or higher were found to have acute appendicitis in comparison to those having score <7. The sensitivity and specificity of MASS were 93.24%, 84.21 %, with acceptable Positive and Negative predictive values 5.91 and 0.08 respectively.

**Conclusion:** The Modified Alvarado Scoring System is a simple and efficient diagnostic tool for the diagnosis of acute appendicitis with acceptable sensitivity and specificity and can be used with good degree of accuracy.

**Keywords:** Appendicular pathology, Diagnostic modalities, Scoring systems

## INTRODUCTION

Acute appendicitis is the most common acute abdominal emergency requiring urgent surgical intervention [1]. It has an estimated lifetime prevalence of 7% [2]. Efforts are being made to come to an early diagnosis and interventions are required [3]. Failure to make early diagnosis may lead to high morbidity [4].

Acute appendicitis may sometimes present with atypical presentations and the diagnosis becomes more challenging when the symptom overlap with some other disease conditions [5].

The basic fundamental question while diagnosing a suspected case of acute appendicitis is whether or not to operate if diagnosed without increasing the rate of unnecessary negative surgical interventions [1].

The Modified Alvarado Scoring System (MASS) which uses some clinical signs and symptoms was found to be simple and easy to use scoring system for the diagnosis of acute

appendicitis and can be used by junior surgeons in the emergency setting [6,7].

## MATERIALS AND METHODS

Prospective cross-sectional type of study was conducted in General Surgery Department of North Eastern Indira Gandhi Regional Institute of Health & Medical Sciences (NEIGRIHMS), Shillong, India over a period of one year from January 2015 to December 2015 in the Department of General surgery after obtaining the Institute Ethics Committee Clearance. A total of ninety three adult patients (Fifty five males and thirty eight females) were enrolled in the study after taking signed consents from the patients. Patients presenting with acute pain right lower abdomen and suspected to suffer from acute appendicitis were included in the study without any randomization. Children below eighteen years of age, and non-consenting adults were excluded from the study. Sensitivity, specificity, Positive predictive value and Negative predictive value of MASS were found separately in males and

compared with those of females to see the efficacy of MASS in the diagnosis of acute appendicitis. Descriptive statistics was used for the statistical analysis.

Patients presenting to the hospital with acute pain in the right lower abdomen was subjected to clinical examination and data was collected as per the required format of the Modified Alvarado Scoring System [Table/Fig-1] and blood was collected at that time itself for total leucocyte count and other blood parameters as deemed fit for anesthesia fitness should the patient require surgery at a later date.

Symptoms	Score
Migratory right iliac fossa pain	1
Nausea/Vomiting	1
Anorexia	1
<b>Signs</b>	
Tenderness in right iliac fossa	2
Rebound tenderness in right iliac fossa	1
Elevated temperature	1
<b>Laboratory Findings</b>	
Leucocytosis	2
Total	9

[Table/Fig-1]: Showing parameters used in Modified Alvarado Scoring System [8].

## RESULTS

About 80% of appendix was found to be inflamed at surgery [Table/Fig-2] and confirmed on histopathological examination after surgery [Table/Fig-3]. Most of the patients having a MASS of 7 or higher were found to have acute appendicitis in comparison to those having score <7 [Table/Fig-4]. The

Operative Findings	Frequency	Percentage (%)
Inflamed appendix	66	70.97
Gangrenous appendix	6	6.45
Perforated appendix	2	2.15
Normal appendix	19	20.43
Total	93	100

[Table/Fig-2]: Showing intraoperative findings of appendix.

Histological Findings	Frequency	Percentage (%)
Acute appendicitis	57	61.29
Suppurative appendicitis	10	10.75
Chronic non- specific appendicitis	7	7.53
Normal appendix	19	20.43
Total	93	100

[Table/Fig-3]: Showing histopathological findings of appendix after surgery.

sensitivity and specificity of MASS was found to be good [Table/Fig-5] with acceptable positive and negative predictive values.

Mass	Histological Findings		Total
	Appendicitis	No Appendicitis	
≥7	69	3	72
<7	5	16	21
Total	74	19	93

[Table/Fig-4]: Showing the Alvarado scores in patients with or without appendicitis.

Variable	Male	Female	Combined	p-value
Sensitivity (95% CI)	93.75% (82.80% to 98.69%)	92.31% (74.87% to 99.05%)	93.24% (84.93% to 97.77%)	0.787
Specificity (95% CI)	85.71 % (42.13% to 99.64%)	83.33 % (51.59% to 97.91%)	84.21 % (60.42% to 96.62%)	0.755
Positive Likelihood Ratio (95% CI)	6.56 (1.07 to 40.34)	5.54 (1.56 to 19.72)	5.91 (2.09 to 16.71)	0.841
Negative Likelihood Ratio (95% CI)	0.07 (0.02 to 0.23)	0.09 (0.02 to 0.36)	0.08 (0.03 to 0.19)	0.973
Positive Predictive Value (95% CI)	97.83% (88.47% to 99.94%)	92.31% (74.87% to 99.05%)	95.83% (88.30% to 99.13%)	0.205
Negative Predictive Value (95% CI)	66.67 % (29.93% to 92.51%)	83.33 % (51.59% to 97.91%)	76.19 % (52.83% to 91.78%)	0.752

[Table/Fig-5]: Showing the sensitivity, specificity, PPV, NPV, PLR and NLR in various categories of patients. (CI: Confidence Interval, PPV: Positive Predictive Value, NPV: Negative Predictive Value, PLR: Positive Likelihood Ratio, NLR: Negative Likelihood Ratio)

## DISCUSSION

Acute appendicitis is a clinical diagnosis. Many patients still undergo negative appendicectomies despite the widespread use of advanced imaging modalities and many predictive scoring systems [6]. Even in a developed country like United Kingdom, there is no defined 'acceptable' Negative Appendicectomy Rate (NAR) [6].

A negative appendicectomy rate of 20-40% has been reported in the literature and surgeons in order to avoid the complications of perforated appendicitis usually accept a negative appendicectomy rate of about 15-20% [7].

A higher threshold in performing appendicectomy may improve its diagnostic accuracy but carries an increased risk of appendicular perforation and sepsis; thereby increasing morbidity and mortality [9]. Ultrasonography or computed tomography imaging may improve the diagnostic accuracy

of acute appendicitis but it is associated with an escalated cost [9]. Livingston EH et al., has found that due to injudicious use of CT imaging may diagnose early low-grade appendicitis leading to appendicectomies which otherwise would have resolved by antibiotics therapy alone [7].

Scoring systems and graded compression sonography may improve the diagnostic accuracy of acute appendicitis [10].

The original Alvarado Scoring System was based on three signs, three symptoms and two laboratory data. The Modified Alvarado Scoring System (MASS) where shift of neutrophil count to the left is omitted has also been found to be a quick and inexpensive diagnostic tool for diagnosing acute appendicitis even though the diagnostic accuracies vary [10-12]. A score of 7 was taken as the cut-off originally by Alvarado for operating upon patients with suspected acute appendicitis and the same cut-off point of 7 has been used commonly in various other studies [10-12].

The sensitivity, specificity, positive predictive value and negative predictive values in our series were 93.24%, 84.21%, 95.83% and 76.19% respectively by taking a cut-off point of 7. Similar results have been obtained by Kanumba et al., with a sensitivity, specificity, positive predictive value and negative predictive values of 94.1%, 90.4%, 95.2% and 88.4% respectively [4]. Nishikant Gujar et al., also found sensitivity and specificity of Modified Alvarado Score 98.44% and 94.44% respectively [13].

Nanjundaiah N et al., found sensitivity, specificity, positive predictive value and negative predictive values of 58.9%, 85.7%, 97.3% and 19.1% respectively for MASS [9]. Mán E et al., found that for the diagnosis of acute appendicitis clinical assessment had better sensitivity and sensitivity than Alvarado score [14]. Gurav et al., showed 20.00% and 80.00% sensitivity and specificity in cases of acute appendicitis while 28.57% and 78.83% sensitivity and specificity in case of non-acute appendicitis by using the MASS [15]. Shirzad Nasiri et al., in their series got a sensitivity, specificity, PPV, NPV, and accuracy of 62.7%, 65.7%, 37.5%, 89.8% and 11.5% respectively at a MASS cut-off point of 7 [16]. At a cut-off point of 6, Sun et al., reported a higher sensitivity and NPV, than the traditional cut-off point of 7 [Table/Fig-6] [17].

Parameters	Present study	Kanumba et al.,[4]	Nanjundh N et al.,[9]	Shirzad Nasiri et al.,[16]	Gurav et al., [15]	Nishikant Gujar et al., [13]
Sensitivity	93.24%,	94.1%,	58.9%,	62.7%,	20.00%	98.44
Specificity	84.21 %,	90.4%,	85.7%,	65.7%,	80.00%	94.44%
PPV	95.83%	95.2%	97.3%	37.5%,		
NPV	76.19 %	88.4%	19.1%	89.8%		

[Table/Fig-6]: Showing the comparison with other studies.

## LIMITATIONS

The limitations of the study were the fewer number of the sample size and not comparing the results with other methods for diagnosis of acute appendicitis.

## CONCLUSION

To conclude it may be said that MASS is an inexpensive tool for the diagnosis of acute appendicitis with a variable sensitivity and specificity and may be used in day to day practice. In doubtful cases, ultrasonography may improve the sensitivity and specificity of MASS in the diagnosis of acute appendicitis.

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