

## Is Modified Alvarado Score More Accurate in the Diagnosis of Acute Appendicitis?

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### Abstract

**Introduction:** Acute appendicitis is recognized as the most prevalent abdominal surgical emergency treated by general surgeons. Diagnosing acute appendicitis can be challenging, particularly in the early career of doctors facing several similar conditions. Multiple scoring systems have been established to aid in diagnosing acute appendicitis. These tools help reduce unnecessary appendectomies and maintain a decrease in morbidity and mortality rates. The Alvarado scoring system is based on patient history, physical examinations, and specific laboratory tests, making it easy to implement. **Objective:** To assess the accuracy of the Modified Alvarado Score (MAS) in diagnosing acute appendicitis, using histopathology as the gold standard. **Materials and Methods:** A Cross-Sectional Study was conducted from 20-04-2020 to 20-10-2020. About 116 patients from the Department of Surgery at Khyber Teaching Hospital, Peshawar, with a suspicion of a diagnosis of acute appendicitis, were included. Patient sampling was consecutive and subjected to MAS, and histopathology was acquired postoperatively to confirm acute appendicitis. **Results:** The mean age of the patients was 30.2 + 6.9 years. Males were 54.3%, and females 45.7%. In our study on MAS, we found that acute appendicitis was diagnosed in 60.3% of patients. Following surgical intervention, histopathological analysis confirmed the acute appendicitis in 47.4% of patients. The sensitivity of MAS was determined to be 90.9%, while the specificity was 67.2%. Additionally, the positive predictive value of MAS was 71.4%, and the negative predictive value was 89.1%. **Conclusion:** The Modified Alvarado Score is clinically useful in adults, with considerably high sensitivity and specificity in diagnosing acute appendicitis.

**Key Words:** Acute appendicitis, total leucocyte count, histopathology, modified Alvarado score

### INTRODUCTION

Acute appendicitis is the most common abdominal surgical emergency, the prevalence of which varies from 15-40% from country to country by geographical region, sex, and age<sup>(1)</sup>. The peak incidence occurs in the 15-24 years age group, being rare in geriatric patients, accounting for 5 – 10% of all appendicitis<sup>(2)</sup>. The diagnosis of acute appendicitis can often be challenging, prompting surgeons to request numerous laboratories and imaging tests. As a result, there may be delays in diagnosis, which may affect morbidity and overall cost. Various scoring systems have been established to facilitate the diagnosis of acute appendicitis. The Alvarado scoring system relies on clinical history, physical examination, and specific laboratory

tests, making it simple to implement. As introduced in 1986, the Alvarado score has since been validated in adult surgical settings. The modified Alvarado score (MAS) has demonstrated a sensitivity of 91.57% and a specificity of 76.47%, with a positive predictive value of 95% and a negative predictive value of 65%, yielding a diagnostic accuracy of 89%<sup>(3)</sup>. The rationale of this study is to determine an accurate diagnosis with the MAS in the clinical diagnosis of acute appendicitis. Considering the prevalence of acute appendicitis with varying clinical features in different populations is challenging physicians in the diagnostic accuracy of the Alvarado score. This scoring tool can be useful in diagnosing acute appendicitis by comparing the accuracy of MAS with histopathology. This study aimed to evaluate the diagnostic accuracy of the MAS in diagnosing acute appendicitis, with histopathology as the gold standard. By comparing our findings with international studies, this scoring system can enhance its

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optimal application and timing, improving patient care and outcomes.

### MATERIALS AND METHODS

It was a cross-sectional study conducted in the Department of Surgery, Khyber Teaching Hospital Peshawar from 20-04-2020 to 20-10-2020. The sample size was 116, with a prevalence of 40% acute appendicitis, a confidence level of 95%, and a desired precision of 10%. A non-probability consecutive sampling technique was used. The patients of both genders, 18 to 50 years of age, and with complaints of right lower abdominal pain were included after the informed consent. Patients with appendicular lump, appendicitis managed conservatively, history of previous abdominal surgery, generalized peritonitis, and pregnancy were excluded. Patients were inducted from OPD and ER. Recruitment to the study was conducted by verbal invitation. History, examination & routine investigations were done for every patient included in the study. Every patient underwent MAS followed by an appendectomy. The appendix specimen was sent for histopathology.

All the information was analyzed using the statistical software SPSS (version 17). Frequency and percentage were calculated for categorical variables like gender, MAS (positive or negative for acute appendicitis), and histopathology (positive or negative for acute appendicitis). Mean  $\pm$  SD was calculated for continuous variables like age and Alvarado score. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were determined by taking histopathology as the gold standard and using 2x2 tables. A P-value of  $\geq 0.05$  was considered significant.

### RESULTS

The average age of the participants was  $30.2 \pm 6.9$  years. Our study's age range was 23 years, with the youngest participant being 19 and the oldest 42. Upon categorizing the participants into different age groups, we found that 24.1% were aged between 19 and 25, 45.7% fell into the age range of over 25 to 35, and 30.2% were within the age group of over 35 to 42.

When analyzing the gender distribution of the participants, we noted that in our study, 54.3% of the individuals were male, while 45.7% were female. It was observed that acute appendicitis

was identified in 60.3% of the patients with MAS. Histopathological results indicated findings aligned with the diagnosis of acute appendicitis in 47.4% of the patients. The sensitivity of the MAS was determined to be 90.9%, and its specificity was 67.2%. The positive predictive value of the MAS was calculated at 71.4%, while the negative predictive value was found at 89.1%.

**Table 1: Age distribution of Histopathological findings in Acute Appendicitis**

Age Groups		Acute Appendicitis on Histopathology		Total	
		Yes	No		
19-25 years	Acute Appendicitis on MAS	Yes	11	0	11
		No	0	17	17
	Total		11	17	28
>25-35 years	Acute Appendicitis on MAS	Yes	16	13	29
		No	5	19	24
	Total		21	32	53
>35-42 years	Acute Appendicitis on MAS	Yes	23	7	30
		No	0	5	5
	Total		23	12	35

**Table 2: Sensitivity and Specificity with PPV and NPV**

Age groups	Sensitivity	Specificity	PPV	NPV	Accuracy
19-25 years	100%	100%	100%	100%	100%
>25-35 years	76.2%	59.4%	55.0%	79.0%	66%
>35-42 years	100%	41.7%	76.0%	100%	80%

### DISCUSSION

The clinical assessment of a patient suspected of having appendicitis presents significant challenges, as various nonsurgical conditions frequently mimic the symptoms of acute appendicitis<sup>(4)</sup>. The clinical diagnosis accuracy currently stands at around 80%, which presents an opportunity to reduce the negative appendectomy rate of approximately 20%. By enhancing diagnostic techniques and training,

we can work towards improving these metrics and providing better patient outcomes<sup>(5, 6)</sup>. However, some institutions have presented data contradicting the use of preoperative imaging for all patients suspected of acute appendicitis and endorsed by different authorities<sup>(7, 8)</sup>. Moreover, recent revelations regarding the natural progression of appendicitis have led to a reconsideration of routine exploratory surgeries for suspected appendicitis. These insights contest the notion that the perforated appendicitis rate is inversely proportional to the negative appendectomy rate and, therefore, can be mitigated through a prompt appendectomy<sup>(9)</sup>. The MAS has been shown to enhance diagnostic accuracy in acute appendicitis, thus reducing negative appendectomy and complication rates. Our study aimed to evaluate the MAS's diagnostic efficacy among those with acute appendicitis in our community settings.

Our research has demonstrated that the MAS has increased sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy in diagnosing acute appendicitis, consistent with findings from other studies<sup>(10-12)</sup>.

Additionally, our study has indicated more accuracy for the male gender for the MAS than the female gender. Female patients require further investigations to substantiate the diagnosis. The literature well supports these findings<sup>(13, 14)</sup>.

In one local study, researchers illustrated that employing the MAS for patients presented as suspected diagnosis of acute appendicitis demonstrated 90.9% sensitivity and 67.2% specificity alongside positive and negative predictive values of 71.4% and 89.1%, respectively<sup>(15)</sup>. In contrast, Nasiri et al,<sup>(16)</sup> reported lower metrics, revealing a sensitivity of 71.2%, specificity of 83.3%, positive predictive value of 89.9%, and negative predictive value of 11.5%.

Earlier studies conducted in Pakistan have yielded comparable results. Arain et al<sup>(17)</sup> documented a sensitivity of 97.2%, a specificity of 84.6%, and a positive predictive value of 85.5%. Similarly, Kamran et al.<sup>(15)</sup> reported a positive predictive value of 89.66%.

Horzic et. al<sup>(18, 19)</sup>, reported 100% specificity at a cutoff value 7. Surgical intervention should be undertaken expeditiously in patients presenting with an MAS of 7 or greater to lessen the risk of

perforation and postoperative complications. The sensitivity of the MAS in our study is comparable to results from a study in India, which reported an 88.63% sensitivity with the MAS. Similar outcomes were documented by Kurane et al. in India<sup>(20)</sup>, who reported a sensitivity of 78.26%, a specificity of 83.78%, a positive predictive value of 75.00%, a negative predictive value of 86.11%, and an overall diagnostic accuracy of 81.00%. Fente et al. from Nigeria<sup>(21)</sup> indicated a sensitivity of 92.93% and a specificity of 92.93% for the MAS. Conversely, certain studies have shown considerably low sensitivity and specificity for the MAS. For instance, research conducted by Lone et al.<sup>(22)</sup> revealed a sensitivity of 59% and 55%, respectively, alongside 63% and 59% specificities. They also concluded that the MAS alone is insufficient for diagnosing acute appendicitis.

Research indicated overall negative appendectomy rates of 14% and 9.1%, respectively<sup>(22, 23)</sup>. Negative appendectomy rates of 33.1% and 33%, respectively, have also been reported<sup>(23, 24)</sup>. Therefore, such patients necessitate further diagnostic investigations, such as Ultrasound, CT scan, MRI, and laparoscopy, to establish a definitive diagnosis. The high positive predictive value (71.4%) of the MAS in our study indicates that a score of 7 or higher is a definitive marker for acute appendicitis. Consequently, these patients do not need additional investigations to confirm the diagnosis.

## CONCLUSION

The Modified Alvarado Score is a clinically useful tool for adults. It has considerably high sensitivity and specificity in diagnosing acute appendicitis.

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