Original Research

MODIFIED ALVARADO SCORE: A DUAL ROLE IN DIAGNOSING AND PREDICTING OUTCOMES IN ACUTE APPENDICITIS

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ABSTRACT

Objective: To evaluate the diagnostic and prognostic efficacy of the Modified Alvarado Score (MAS) in acute appendicitis, and to correlate preoperative scores with intraoperative findings and postoperative outcomes.

Material and Methods: A prospective observational study was conducted at the Department of General Surgery, D.Y. Patil University School of Medicine, Navi Mumbai. One hundred consecutive patients aged ≥18 years with clinically and radiologically confirmed acute appendicitis and MAS >5 were included. Patients with acute on chronic appendicitis, pelvic inflammatory disease, adnexal pathology, or suspected tuberculosis were excluded. MAS was recorded preoperatively. Intraoperative findings, postoperative complications, and hospital stay were documented. Data were analysed using SPSS v26.0. Descriptive statistics, independent *t*-tests, chi-square tests, and Pearson's correlation were applied, with $p<0.05$ considered significant.

Results: The mean age was 27.35 ± 5.45 years; 62% were male. Intraoperatively, 77% had an inflamed appendix, 22% perforation with local peritonitis, and 1% lump formation. Mean MAS was significantly higher in perforation (8.45) compared to inflammation (6.81) (**p**<0.001). Patients with complications had higher MAS (7.83 vs. 6.90; **p**<0.001) and longer hospital stay (7.93 vs. 3.92 days; **p**<0.001). MAS showed a positive correlation with length of stay ($r = 0.596$; **p**<0.001).

Conclusion: MAS is a simple, rapid, and inexpensive tool with high diagnostic accuracy for acute appendicitis. It also predicts intraoperative severity, postoperative complications, and hospital stay, making it valuable for clinical decision-making and patient counselling, especially in resource-limited settings.

Keywords: Modified Alvarado Score, Acute Appendicitis, Diagnosis, Prognosis, Scoring System, Surgical Outcomes.

INTRODUCTION

Acute appendicitis is one of the most common abdominal surgical emergencies, with a lifetime prevalence of approximately one in seven individuals. Despite its frequency, diagnosis remains challenging, as clinical presentation can vary widely across age groups and between sexes. Typical features such as periumbilical pain migrating to the right iliac fossa, anorexia, nausea, and localized tenderness are well recognized; however, a typical presentations are common and may lead to delayed diagnosis or unnecessary negative appendectomy.

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Accurate and timely diagnosis is crucial to prevent complications such as perforation, peritonitis, or abscess formation. Over the decades, multiple clinical scoring systems have been proposed to aid in diagnosis, integrating symptoms, signs, and laboratory parameters. The Alvarado Score, first described in 1986, remains one of the most widely used due to its simplicity, reproducibility, and applicability in emergency settings [1]. The Modified Alvarado Score (MAS) eliminates the "shift to left" criterion, which may not be readily available in many centers, thereby reducing the total score from 10 to 9 while maintaining diagnostic performance.

MAS has been shown to have high sensitivity and specificity in diagnosing acute appendicitis [2, 3]. However, most previous studies have focused primarily on its diagnostic role, with limited attention to its potential prognostic value. The ability to correlate preoperative MAS with intraoperative severity, postoperative

complications, and hospital stay could enhance surgical decision-making, prioritize urgent interventions, and improve patient counselling.

In India, where healthcare resources are often constrained and advanced imaging may not always be available in emergency settings, a reliable, rapid, and inexpensive scoring system is particularly valuable. This study was therefore designed to evaluate both the diagnostic and prognostic efficacy of MAS in patients with acute appendicitis, and to determine its correlation with intraoperative findings and postoperative outcomes in a tertiary care setting.

MATERIALS AND METHODS

Study Design and Setting- A one year prospective observational study was conducted in the Department of General Surgery, D.Y. Patil University School of Medicine, Nerul, Navi Mumbai, a tertiary care center in a metropolitan city.

All patients aged 18 years and above, admitted with clinically and radiologically confirmed acute appendicitis and a Modified Alvarado Score (MAS) greater than 5, were included.

Patients with acute on chronic appendicitis, female patients with suspected pelvic inflammatory disease or adnexal pathology and those with suspected tuberculosis were excluded from the study

A total of 100 patients meeting the inclusion criteria were enrolled.

Data Collection- On admission, a detailed history was obtained, and a thorough physical examination was performed. MAS was calculated for each patient based on clinical symptoms, signs, and laboratory investigations, which included a complete blood count and urinalysis.

The MAS was recorded preoperatively, and intraoperative findings regarding the extent and severity of appendicitis were documented. All patients were followed postoperatively until discharge, with complications and duration of hospital stay recorded.

Modified Alvarado Score Criteria- The MAS consists of the following parameters:

- Migratory right iliac fossa pain (1 point)
- Anorexia (1 point)
- Nausea/vomiting (1 point)
- Tenderness in the right iliac fossa (2 points)
- Rebound tenderness (1 point)
- Elevated temperature >37.5°C (1 point)
- Leucocytosis >11,000/mm³ (2 points)

The maximum score is 9. Scores ≥7 were considered clinically diagnostic of acute appendicitis, while scores <7 indicated high probability but equivocal diagnosis.

Surgical Procedure and Follow-Up- The decision to operate was made by the attending surgical team, with consideration of MAS, clinical findings, and imaging. Appendectomy (open or laparoscopic) was performed in all included cases. Resected specimens were sent for histopathological confirmation. Patients were monitored for postoperative complications, and the duration of hospital stay was recorded.

Statistical Analysis- Data were entered into Microsoft Excel (v2019, Microsoft, Redmond, WA, USA) and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies and percentages for categorical data, and as mean ± standard deviation for numerical data. Between-group comparisons were made using the t-test for continuous variables and the chi-square test for categorical variables. Correlation between MAS and duration of hospital stay was assessed using Pearson's correlation coefficient. A *p*-value <0.05 was considered statistically significant.

Ethical Considerations- The study was approved by the Institutional Ethics Committee of D.Y. Patil University School of Medicine, Nerul, Navi Mumbai. Written informed consent was obtained from all participants prior to inclusion.

RESULTS

A total of 100 patients with acute appendicitis were included. The mean age was 27.35 ± 5.45 years (range: 18–42). The highest incidence occurred in the 23–27-year age group (36%), followed by 28–32 years (23%). Males comprised 62% of the cohort (male-to-female ratio: 1.63:1).

Comorbidities were present in 12 patients: 5 had diabetes mellitus and 7 had hypertension. Among diabetics, 4 presented with perforation and 3 developed postoperative fever.

Intraoperative Findings- Intraoperatively, 77 patients (77%) had an inflamed appendix, 22 (22%) had perforation with local peritonitis, and 1 (1%) had lump formation with dense adhesions (Graph 1).

Postoperative Complications- Overall, 29 patients (29%) developed complications. Fever was most common (16%), followed by ileus (7%), ileus with fever (2%), ileus with surgical site infection (1%), and isolated surgical site infection (3%). Seventy-one patients (71%) had no complications (Graph 2).

Time to Surgery- Thirty-two patients (32%) underwent surgery within 6 hours of presentation; 68 patients (68%) after 6 hours. Perforated appendicitis was more common in the early surgery group (68.8%), whereas inflamed appendix predominated in the delayed group (100%) (**p**<0.001) (Table 1)

Modified Alvarado Score Correlations- Mean MAS was significantly higher in perforated appendicitis (8.45) compared to inflamed appendix (6.81) (p<0.001) (Table 2). Patients with post-operative complications had higher MAS (7.83 vs. 6.90; p<0.001) and longer hospital stay (7.93 vs.

3.92 days; p<0.001) (Table 3).

DISCUSSION

This prospective study assessed the diagnostic and prognostic utility of the Modified Alvarado Score (MAS) in acute appendicitis. Our findings demonstrate that MAS is not only a reliable diagnostic tool but also an effective predictor of disease severity, postoperative complications, and hospital stay.

The mean age in our cohort was 27 years, with peak incidence in the 23–27-year group, consistent with prior reports linking lymphoid hyperplasia to higher susceptibility in young adults [4,5,6]. Incidence declined markedly after the late 30s, paralleling the age-related reduction in appendiceal lymphoid tissue. The male predominance (62%) aligns with literature reporting ratios from 1.08:1 to 1.92:1 [7,8], reflecting possible hormonal and lifestyle influences.

Comorbidities were infrequent but clinically relevant. Diabetic patients in our series were more likely to present with perforation, echoing studies showing delayed presentation, altered inflammatory response, and higher complication rates in this group similar to study done by Lindsay et al.[9]. Hypertensive patients did not exhibit a notable difference in severity or outcome, suggesting less direct influence on appendicitis progression.

The intraoperative distribution — 77% inflamed, 22% perforated, 1% lump formation — mirrors patterns in Indian tertiary centres, where perforation rates often exceed 20% due to late presentation. Higher MAS in perforation (8.45) compared to inflammation (6.81) confirms its prognostic relevance. This supports the concept that higher scores not only indicate diagnostic certainty but also correlate with advanced pathology.

Postoperative complications occurred in 29% of cases, with fever most common. Complication rates were significantly associated with higher MAS and longer hospital stay, reinforcing MAS as a predictor of postoperative course. The correlation between MAS and length of stay (r = 0.596; **p**<0.001) has practical implications for patient counseling, bed management, and surgical prioritization.

Timing of surgery revealed an interesting pattern: patients operated within 6 hours had significantly higher MAS and more perforations, likely reflecting prioritization of sicker patients for urgent surgery. Conversely, those with lower scores were stabilized and scheduled later, often with less severe pathology. This indicates MAS can assist in triaging surgical urgency.

Our findings are in agreement Chan et al. [10], who reported that higher Alvarado scores were associated with greater diagnostic accuracy and severity. While most previous studies have focused solely on diagnosis, our results support extending MAS into prognostication.

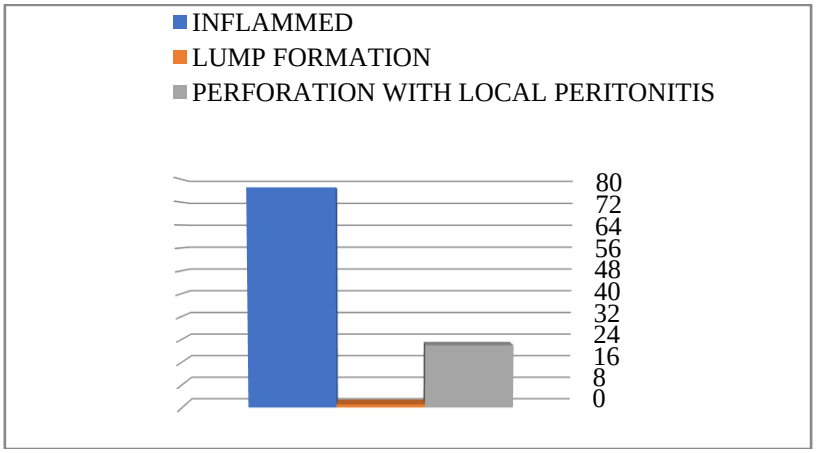
From a clinical standpoint, MAS offers advantages in resource-limited settings where advanced imaging is unavailable or delayed. It is quick to calculate, requires minimal equipment, and can be applied by junior doctors or in rural hospitals. Its prognostic dimension — predicting severity and complications — adds further value in surgical planning and patient counselling.

The strengths of this study include its prospective design, standardized scoring, and complete follow-up for postoperative outcomes. Limitations include its single-centre scope, modest sample size, and exclusion of paediatric patients, which may limit generalizability. Additionally, interobserver variability in eliciting clinical signs could influence scoring, though all assessments were performed by the same surgical unit to minimize bias.

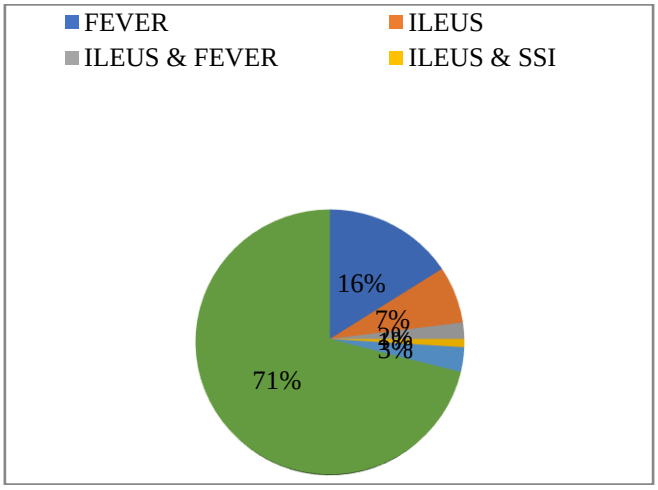
Future research could focus on validating MAS as part of a combined prognostic model with biomarkers such as C-reactive protein or imaging findings, and on evaluating its performance in paediatric and geriatric populations. Multicentre studies with larger sample sizes could further substantiate its role in guiding surgical timing and predicting complications. In conclusion, MAS remains a simple yet powerful tool for diagnosing acute appendicitis and, as our study shows, also serves as a reliable predictor of intraoperative severity, postoperative complications, and hospital stay. Incorporating MAS into routine assessment could enhance decision-making and optimize patient outcomes.

CONCLUSION

The Modified Alvarado Score is a simple, rapid, and inexpensive tool that provides high diagnostic accuracy for acute appendicitis. In addition, it serves as a reliable predictor of intraoperative severity, postoperative complications, and length of hospital stay. Incorporating MAS into routine preoperative assessment can aid in surgical decision-making, optimize resource allocation, and improve patient counselling. Wider adoption, especially in resource-limited settings, could enhance clinical outcomes.



Graph 1: Intra-Operative Findings



Graph 2: Post-Operative Complications

Table 1: Bivariate Analysis Comparison of Intraoperative Findings and Time of Surgery after Presentation

		Time Of Surgery After Presentation		
		Within 6 Hours	**After 6 Hours**	**Total**
INTRAOPERATIVE FINDINGS	INFLAMMED	9	68	77
	LUMP FORMATION	0	1	1
	PERFORATION WITH LOCAL PERITONITIS	22	0	22
	Total	32	68	100

Chi-Square Tests			
	Value	**Df**	**P Value**
Pearson Chi-Square	63.474[a]	2	0.001

Table 2: Comparison of MAS with Duration of Stay and Intra-Operative Findings

		N	**Mean**	**Std. Deviation**	**Std. Error Mean**	**T Value**	**P Value**
MODIFIED	INFLAMMED	78	6.81	0.807	0.091	-9.060	.0001**

ALVARADO SCORE (OUT OF 9)	PERFORATION WITH LOCAL PERITONITIS	22	8.45	0.510	0.109		
	INFLAMMED	78	3.88	1.227	0.139	-13.592	.0001**
DURATION OF STAY POST OPERATIVELY	PERFORATION WITH LOCAL PERITONITIS	22	9.32	2.697	0.575		

Table 3: Comparison of Modified Alvarado Score & Duration of Stay with Post Op Complications

		N	Mean	Std. Deviation	Std. Error Mean	T Value	P Value
MODIFIED ALVARADO SCORE (OUT OF 9)	Yes	29	7.83	0.805	0.149	4.527	.0001**
	No	71	6.90	0.973	0.116		
DURATION OF STAY POST OPERATIVELY	Yes	29	7.93	3.595	0.668	8.567	.0001**
	No	71	3.92	1.079	0.128		

REFERENCES

1. Golub, R., Siddiqui, F., and Pohl, D. Laparoscopic versus open appendectomy: a metaanallysis. J Am Coll Surg.1998;186: 543-53.
2. Charles V Mann. The vermiform appendix> In: Charles V Mann, RCG russel, Norman S. Williams, eds. Bailey and loves's short practice of surgery. 22nd Ed. Londond. Chapman and Hall, ELBS; 1995: pp. 828-40.
3. [43] John SP Lumley; The acute abdomen; In: John SP Lumley, eds. Hamilton bailey's physical signs: Demonstration of physical signs in clinical surgery. 18th Ed. Oxford. Butterworth – Heinemann; 1997;pp.304-6
4. Ellis H, Nathanson LK. Appendix and appendectomy.In: Zinner MJ, Schwartz SI, Ellis H, editors. Maingot's abdominal operations vol II. 10th ed. Singapore:Appleton and Lange; 1997.p.1191-27
5. Lewis FR. Holcroff JW: Appendicitis- a critical review of diagnosis and treatment in 1,000 cases. Arch. Surg 1975; 110: 677-684.
6. Adiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epedimiol. 1990; 132; 910-925.
7. Oguntola AS, Adeoti ML, Oyemolade TA. Appendicitis: Trends in incidence, age, sex, and seasonal variations in South-Western Nigeria. Ann Afr Med. 2010;9:213-7
8. [52] Sauerland S, Jaschinski T, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. Cochrane Database Syst Rev. 2010 Oct 6; (10): CD001546.
9. Lindsay Bach, Andrew Donovan, Whitney Loggins August 2016The American surgeon 82(8):753-758 DOI: 10.1177/000313481608200837
10. Chan MY, Teo BS, Ng BL. The Alvarado score and acute appendicitis. Ann Acad Med Sing 201; 30: 51-512.

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