



# Evaluation of the Diagnostic Accuracy of Modified Alvarado Scoring System in Comparison to Histopathological Results in Acute Appendicitis

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## ABSTRACT

**Background:** Acute appendicitis even today remains the commonest cause of acute abdomen needing surgical intervention. In developing countries the clinical diagnosis still poses a challenge to the surgeon and advanced radiological investigations are not cost effective while histopathological diagnosis remains the gold standard. The Modified Alvarado score augments the accuracy of diagnosis of appendicitis thus reducing the rate of negative appendicectomy.

**Methods:** Patients admitted with clinical findings suggestive of Acute appendicitis were evaluated by applying Modified Alvarado scoring system. Those patients with Alvarado scores above 5 were subjected to appendicectomy. The Modified Alvarado score was correlated with that of histopathological features of appendicectomy specimens.

**Results:** The histopathological features of appendicitis was seen in 87.8% of the cases whose scores were more than 7 while negative appendicitis was seen in 38.1% whose scores were between 5-7. The sensitivity, specificity, positive predictive value and negative predictive value of Alvarado scores in our study were 87.80%, 38.01%, 73.50% and 61.50% respectively.

**Conclusions:** The study concludes that the Modified Alvarado scoring system is more sensitive in diagnosing acute appendicitis with reference to the histopathological findings.

**Keywords:** Acute Appendicitis, Modified Alvarado Scoring System, Appendectomy.

## Introduction

Acute appendicitis is one of the commonest surgical emergencies and appendicectomy being the most common emergency operation performed with lifetime prevalence of approximately 1 in 7.<sup>[1,2]</sup> The clinical presentation of acute appendicitis are varied from fever, vomiting, right iliac fossa (RIF) pain, tenderness and rebound tenderness to atypical vague abdominal pain. Early diagnosis and intervention is very much necessary to prevent morbidity and cost. Approximately 6-7% of the population suffers from this disease during their lifetime.<sup>[3,4]</sup>

In order to increase the diagnostic accuracy and to reduce the high negative appendicectomy rate, various scoring systems and imaging modalities are devised. The Alvarado scoring described in 1986 has been in use in surgical practice in the diagnosis of acute appendicitis.<sup>[5]</sup>

This study was planned to evaluate the modified Alvarado Scoring system with that of Histopathological findings in patients operated upon as acute appendicitis.

## Materials and Methods

This is a prospective study which was conducted in the department of Pathology in a tertiary care hospital for the

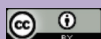
period Jan 2015-Aug 2015. A total of 62 consecutive adult patients admitted during this period who presented with clinical findings suggestive of Acute appendicitis were evaluated by applying Modified Alvarado score (Table 1). And relevant laboratory investigations were done. Those patients with Alvarado scores above 5 were subjected to appendicectomy. The modified Alvarado score was later correlated with the histopathological findings.

The study was approved by the institutional ethical committee. A standard protocol was followed and written consent obtained from patient and/ relative.

**Inclusion Criteria:** The adult patients of both sexes presenting with pain in the abdomen with tenderness in the right iliac fossa were included in the study.

**Exclusion Criteria:** 1) Alvarado score of less than 5. 2) Patients presenting with diffuse abdominal pain suggestive of generalized peritonitis. 3) Patients with history of Diabetes mellitus and immunocompromised status. 4) Pregnant women.

**Statistical Correlation:** The data was entered into MS Excel 2007 version and further analyzed using stata 14. The descriptive data were analyzed as follows: Categorical were analyzed using mean and standard deviation. For



inferential statistics, diagnostic test and Chi-square test was used.

**Results**

In this study, 62 patients were evaluated by physical and laboratory examinations before subjecting them to surgery. Out of the 62 patients, 48 (77.41%) were males and 14 (22.58%) were females in the ratio of 1.58:1. The age range was 19-42 years with a mean of 26±5.7 yrs. (Table 2)

On the basis of Modified Alvarado Scores the patients were segregated into two groups. Group I (Score>7) and Group II (Score 5-7).

In Group 1 out of 41 patients 36 (87.8%) had histopathological features of acute appendicitis and 5 patients (12.2%) showed negative results. In Group II out of 21 patients, 13 (61.9%) were histopathologically confirmed as acute appendicitis while 8 patients (38.1%) showed negative results.

In Group II, the negative appendicitis rate was significantly higher than Group I (38.1% Vs12.2%; P<0.018) (Table 3) with an overall negative appendicectomy rate of 31.7%.

The overall sensitivity, specificity, positive predictive value and negative predictive value of Alvarado score for acute appendicitis were 87.80 % 38.01 % 73.50 % and 61.50 % respectively.

The Histopathological features of acute appendicitis in the surgically removed appendix were as follows: (Table 4).

Acute appendicitis-41 cases (Fig. 1), Suppurative appendicitis-4 cases (Figs. 2, 3), Gangrenous appendicitis-1 case (Fig. 4), perforated appendix- 1 case and Periappendicitis -2 cases (Fig.5).

**Discussion**

Acute Appendicitis is still a common surgical emergency and poses a diagnostic challenge for the operating surgeon. [6] The negative appendicectomy rates may arise due to judgemental error in clinical diagnosis. Hence to aid the diagnosis and reduce the negative appendicectomy rates Alvarado in 1986 introduced a scoring system. The diagnosis of Acute appendicitis using Modified Alvarado Scoring System is based on three symptoms, three signs and one laboratory finding. It is used as an adjunct to clinical

**Table 1: Modified Alvarado Scoring System**

Clinical Features		Score
Symptoms	Migratory RIF pain	1
	Anorexia	1
	Nausea/ Vomiting	1
Signs	Tender RIF	2
	Rebound tenderness	1
	Elevated temperature	1
	Leukocytosis >10X10 <sup>9</sup> /L	2
Total		9

**Table 2: Age and Sex wise distribution (19-42 yrs)**

Age in years	Group I (41)	Group II (21)
19 -23	16 (12/4)	9 (7/2)
24-28	14 (11/3)	7 (5/2)
29-33	05 (4/1)	4 (3/1)
34-38	04 (3/1)	1 (1/0)
39-43	02 (2/0)	NIL

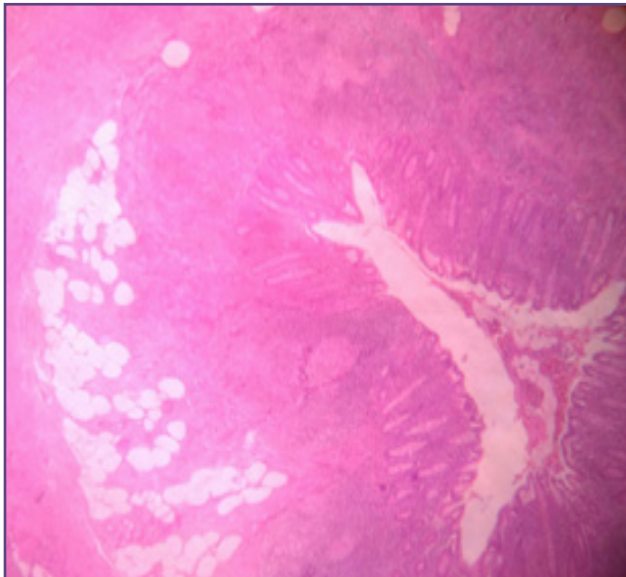
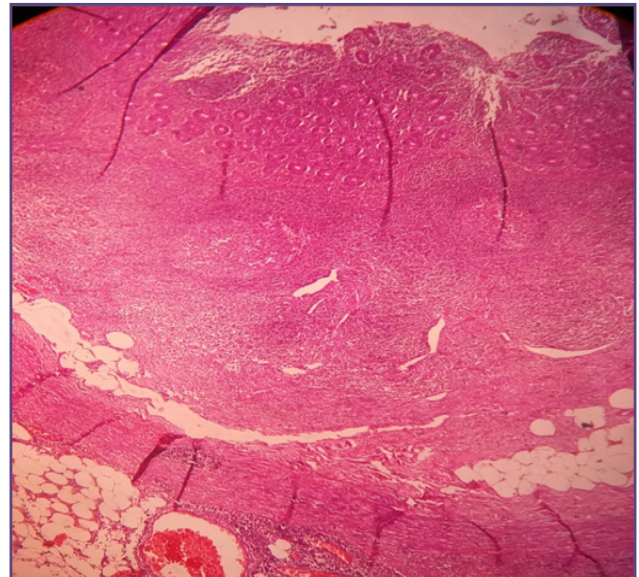
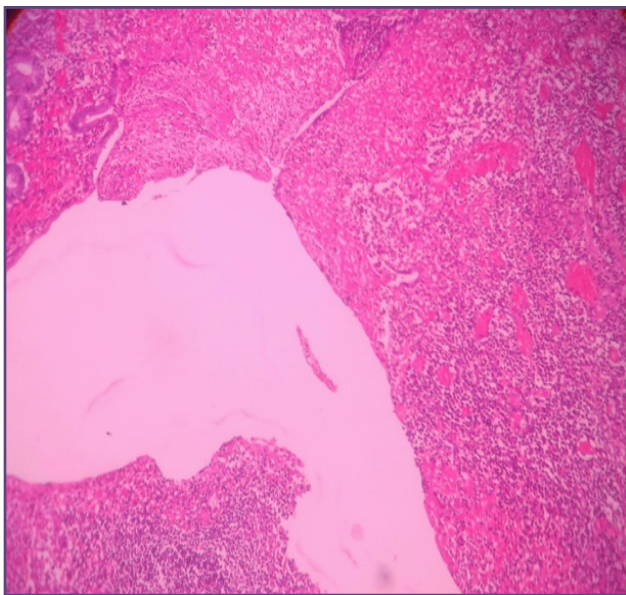
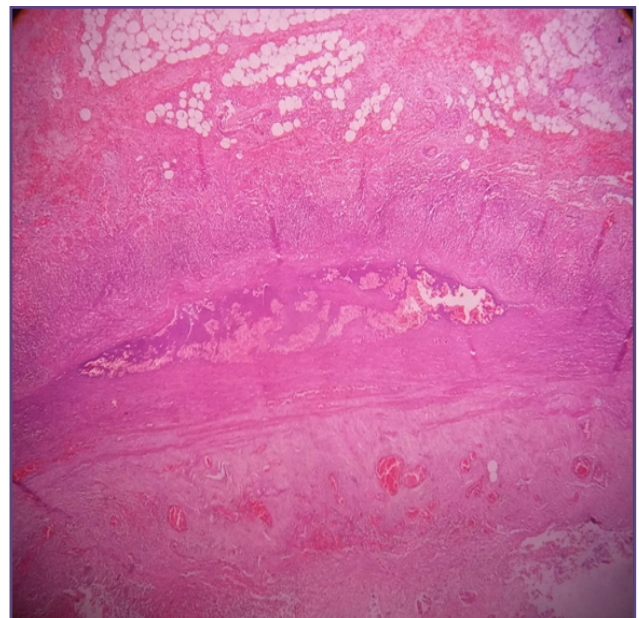
\*Figures in paranthesis indicate males versus females respectively

**Table 3: Correlation of Alvarado score with histopathological findings (n= 62)**

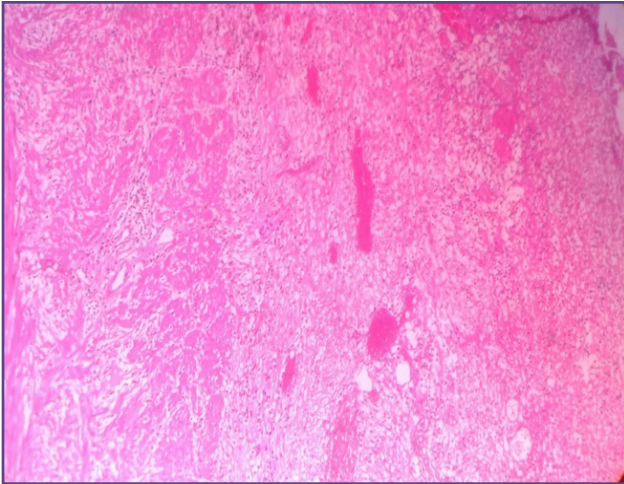
HISTOPATHOLOGY	Group I Group II	p-value
	n=41 n=21	
Abnormal Appendix	36 (87.8%) 13 (61.9%)	P=0.018
Normal Appendix	5 (12.2%) 8 (38.1%)	
Total	41 (100%) 21 (100%)	

**Table 4: Histopathological findings of the operated specimens of Appendix**

Histopathology findings	Group 1 (n=41)	Group 11 (n=21)
Acute Appendicitis	29 (70.73%)	12 (57.14%)
Suppurative Appendicitis	4 (9.75%)	0 (0%)
Gangrenous Appendicitis	1 (2.43%)	0 (0%)
Perforated Appendix	1 (2.43%)	0 (0%)
Periappendicitis	1 (2.43%)	1 (4.76%)
Normal Appendix	5 (12.20%)	8 (38.09%)

**Fig. 1: Photomicrograph showing Acute appendicitis with lymphoid hyperplasia (H&E, X 100)****Fig. 3: Photomicrograph showing Acute suppurative appendicitis (H&E, X100)****Fig. 2: Photomicrograph showing mucosal ulceration and abscess formation in Acute suppurative appendicitis (H&E, X100)****Fig. 4: Photomicrograph showing thrombosed vessels in gangrenous appendicitis (H&E, X400)**





**Fig. 5: Photomicrograph showing Peri appendicitis (H&E, X100) shows acute inflammatory cell infiltrates.**

diagnosis in reducing the false positive appendectomy rates. The surgical intervention was recommended for all patients with a score of  $\geq 7$  and observation for those between 5-6.

In our study and that of Ana J et al the Alvarado scoring is highly sensitive in diagnosis of Acute Appendicitis in adults.<sup>[7]</sup> A score of 7 and above is strongly predictive of acute appendicitis and surgery is recommended.<sup>[8,9]</sup>

In the present study there was a male preponderance with younger age group of 20 to 28 years. Similar findings were noted with other studies.<sup>[4,7,10]</sup>

The patients in our study who had Alvarado score above 7, had histopathological features of Acute appendicitis in 87.8% of the cases and only 12.2% had no evidence of Appendicitis. While in patients with score of less than 7, 61.9% had features of Acute appendicitis and 38.1% did not have appendicitis histopathologically.

In the present study the overall rate of negativity appendectomy was 31.7%. This is quite comparable with other published literature where up to 40% rate of negative appendectomies are reported.<sup>[11,12]</sup>

The sensitivity and specificity of Alvarado score in our study was 87.80% and 38.01% while in other studies it was 94.20% & 70%, 66% & 81% and 97.79%&77.77% respectively.<sup>[7,13,14]</sup>

The overall positive predictive value and negative predictive value of Alvarado score in our study was 73.50% & 61.50% respectively which is comparable with other studies 86.90%&69.80%, 94.29%&72.40% and 94.7% & 41.6% respectively.<sup>[13,14,15]</sup>

The findings of Appendicitis with suppuration (9.75%) gangrene (2.43%) and perforation (2.43%) reflects delay in seeking medical help. The perforation rate (2.43%) in our study was similar (2.14%) to a study done by Riti et al<sup>[10]</sup> but suppuration (0.7%) and gangrenous appendicitis (1.42%) was less comparatively.

In order to improve the diagnostic accuracy and delaying appendectomy, the risk of perforation and sepsis may increase. And on the other hand with reduced diagnostic accuracy the negative appendectomy rate increases.

The scoring system is less sensitive in women of child bearing age and poses a diagnostic challenge as other gynaecological conditions may mimic acute appendicitis. One has to avoid unnecessary appendectomy but on the other hand missing the diagnosis may risk perforation and morbidity. Under such circumstances the other diagnostic modalities such as laparoscopy can be used in pregnant women.<sup>[7]</sup>

The Modified Alvarado Scoring system helps even the General Practitioners and Medical Officers of the Primary Health Centres to make an early referral to the qualified surgeon. The incidence of Acute appendicitis and its complications are evident with Alvarado score of more than 7 and its significance to justify early surgical intervention.

## Conclusion

Modified Alvarado scoring system is easy, simple, non invasive and highly sensitive in preoperative diagnosis of Acute appendicitis. The scores over 7 in adults is highly predictive of acute appendicitis and early surgical intervention is indicated to avoid complications like suppuration, gangrene and perforation. And patients with a score between 5-7 needs reevaluation and probably a contrast enhanced C T Scan will reduce the rate of appendectomy.

## Reference

1. Ramchandra J, Sudhir M, Satyanarayana BA. Evaluation of Modified Alvarado Score in preoperative diagnosis of acute appendicitis. *Journal of Evolution of Medical and Dental Sciences*,2013;2:9019-9029.
2. Jagdish BK, Mukesh DK, Palekar HD, Upendra P. Utility of Alvarado score in diagnostic acute appendicitis in children: A cross sectional study. *National Journal of Medical Research*,2014;4:125-127.
3. Rajashekar J, Uday M, Naveen N. Modified Alvarado score and its application in the diagnosis of Acute Appendicitis. *International Journal of Contemporary Medical Research*,2016;3:1398-1400.
4. Kodliwadmath HB, Bhaskaran A, Prasad CSBR, Basavaraj M, Ambikavathy M, Vasantkumar G. Evaluation of Modified Alvarado score in the diagnosis of Acute Appendicitis and its correlation with Ultrasonography and histopathology. *J Clin Biomed Sci*,2011;1(4):149-157.

