

# Modified Alvarado Scoring System as a Diagnostic Tool in a Central Indian Rural Hospital

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## ABSTRACT

Acute appendicitis is the most common cause of acute abdomen which compels the patient to seek medical attention and appendectomy is most commonly performed operation in acute abdomen. Lifetime risk of acute appendicitis in general population is 7%. Various scoring systems were developed over time to aid the clinical suspicion of acute appendicitis.

**Aim:** The purpose of this study was to compare the Modified Alvarado scores of patients attending a rural hospital and ultrasonographic findings with their operative findings.

**Materials and Methods:** A prospective study was conducted in department of surgery of 1000 bedded rural hospital of central India. Patients presented with abdominal pain suggestive of acute appendicitis and were subsequently operated from November 2014 to August 2016 were included. Both male and female patients were enrolled in the study. Modified Alvarado score was assigned to all and ultrasonography was done, and the results were compared with operative and histopathological findings.

**Results:** 103 patients were included on the basis of inclusion and exclusion criteria. Out of 103 patients included 93 were diagnosed as features of appendicitis on the basis of histopathological study. Out of these 103 patients included in study the ultrasonographic findings were positive in 92 patients and out of these 92 patients, 90 patients were found to have features of appendicitis on histopathology. Out of 95 patients having Modified Alvarado score more than 7, 91 were found to have acute appendicitis. Sensitivity of Modified Alvarado score in this study was 97.8%, the specificity 60%, positive predictive value 95.8%, negative predictive value 75%. Negative appendectomy rate in this study was 9.7%.

**Conclusion:** This scoring system is a simple, efficient, reliable and practicable diagnostic modality to increase the accuracy in diagnosis of acute appendicitis and thus to minimize unnecessary appendectomy.

**Key words-** Modified Alvarado score, acute appendicitis, appendectomy.

## INTRODUCTION

Acute appendicitis is the most common acute abdominal emergency requiring urgent surgical intervention. It has an estimated lifetime prevalence of 7%.<sup>(1)</sup> There are many modalities which allow us for early diagnosis and interventions. Delay in diagnosis will certainly associated with high morbidity and occasionally mortality.

<sup>(2)</sup> Early diagnosis and prompt operative intervention is needed for successful management of acute appendicitis. Sometimes, the acute appendicitis may not be presented in classical manner, and in such situations, the early intervention should be done to avoid perforation but that may lead to high negative appendectomy rates. Mortality is below 1 percent in non-

perforated appendicitis but may reaches up to 5 percent in extremes of ages due to delay in accurate diagnosis & thus making perforation more likely. Both in pediatric and old age there is less tendency to localize the infection and there is much more risk of general peritonitis as compared to general population. Operative intervention is considered as early as possible unless a definite mass is palpable. Mortality is below 1 percent in non-perforated appendicitis but may reaches up to 5 percent in extremes of ages due to delay in accurate diagnosis & thus making perforation more likely. (3) A negative appendectomy rate of 20-40% has been reported in literature and many surgeons advocate early surgical intervention for the treatment of acute appendicitis to avoid perforation, accepting a negative appendectomy rate of about 15-20%. (4)

**Modified Alvarado scoring system**

MODIFIED ALVARADO SCORING SYSTEM	
FEATURES	SCORES
Symptoms	
Migratory right iliac fossa pain	1
Nausea/vomiting	1
Anorexia	1
Signs	
Tenderness in RIF	2
Rebound tenderness RIF	1
Elevated temperature (> 37.5°C)	1
Laboratory	
Leukocytosis (> 10 x 10 <sup>9</sup> /L)	2
Total score	9

Many scoring systems for the diagnosis of acute appendicitis have been tried, but most of these are complex and not feasible in emergency settings. (5) The Alvarado scoring is a clinical system applied in the diagnosis of acute appendicitis. It was introduced in the year 1986. Modified Alvarado score is the modified version of the Alvarado score with exclusion of one laboratory finding i.e. >75% shift to the left of neutrophil maturation. Patients having modified Alvarado score of 1-4 are unlikely to have Acute Appendicitis, Alvarado score of 5-6 have a possibility of Acute Appendicitis, may need urgent surgery, and patients with score of 7-9 are considered to have most

probably Acute Appendicitis. The Modified Alvarado Scoring System (MASS) which uses clinical signs and symptoms was found to be simple and easy to use for the diagnosis of acute appendicitis and can be used by junior surgeons in the emergency settings. (6)

**MATERIALS AND METHODS**

This prospective cross-sectional observational study was carried out in the Department of General Surgery, Kasturba Hospital, Mahatma Gandhi Institute Of Medical Sciences, Sewagram, Wardha, for a period of 22 months from 1 November 2014 and 31 August 2016. It was carried out on 103 patients hospitalized with right lower abdominal pain suggestive of acute appendicitis. Written informed consent and institutional ethical committee clearance was obtained before the start of study. All patients with suspected preliminary diagnosis of appendicitis were considered for the study. Data included age, sex, symptoms, physical signs and laboratory findings such as white blood cell total and differential count were recorded.

In addition, plain X-Ray KUB region was done in selected cases. Ultrasonography (USG) of abdomen was performed in all patients admitted with suspected appendicitis. Acute appendicitis diagnosis was made clinically and decision for appendectomy was taken. Though all patients were scored using the modified Alvarado score, the same had no insinuation on the decision for surgery. Only patients undergoing surgery were included. Consequently, score of each patient was interrelated with clinical, operative and histopathological findings.

**Statistical analysis**

Data collection was done using questionnaire and further analysis was done using Statistical Package for the Social Sciences, version 12.0 for windows (SPSS Inc. Chicago, IL, USA).

**RESULTS**

Total number of patients who underwent surgery was 103. Age of the patients ranged from 8 years to 75 years of age. Total number of patients were 103 out of which 71 (68.93%) males and 32 (31.07%) were females. The male to female ratio is 2.2:1. In our study, male patients were more than females. Table 1 showing age distribution of patients.

**Table-1: Age distribution.**

AGE	MALE	FEMALE	TOTAL
1-10	3	5	8
11-20	26	9	35
21-30	24	9	33
31-40	8	6	14
41-50	7	2	9
51-60	2	1	3
71-80	1	0	1
<b>Total</b>	<b>71</b>	<b>32</b>	<b>103</b>

The highest occurrence was seen in age group of 11-20 years with highest 35 number of patients.

**Table 2:-Showing distribution of clinical symptoms in acute appendicitis**

Symptoms	(n=103)	Percentage
Pain abdomen	103	100%
Migration of pain to RIF	72	69.9%
Anorexia	84	81.5%
Nausea / Vomiting	90	87.3%
Fever	62	61.1%
Others(urinary complaints, diarrhea)	5	0.04%

All the patients (103 patients, 100%) in our study presented with pain in the abdomen, hence this was the most common presenting symptom. The next common symptom in our study population was nausea/vomiting, which was seen in 90 (87.3%) patients. Anorexia was seen in 84 (81.5%) patients; this was the third most common complaint. Other symptoms such as migration of pain to the right iliac fossa (72 patients, 69.9%), fever (62 patients, 61.1%) were also reported by our patients.

**Table 3:- Distribution of clinical signs in acute appendicitis**

Signs	(n=103)	Percentage
Tenderness	103	100%
Guarding	74	71.8%
Rebound Tenderness	80	77.7%
Tachycardia	84	81.6%
Temp > 39°	62	60.1%
Rovsing Sign	6	0.05%
Psoas Sign	2	0.02%

All patients (103 patients, 100%) in the study had tenderness in the right lower abdomen, whereas rebound tenderness was present in 80 (77.7%) patients. The second most common sign was tachycardia which was seen 84 (81.55%) patients. Guarding was seen in total of 74 (71.8%) patients, which reflects severity of inflammation. Other signs of peritoneal inflammation like Rovsing sign were elicited in 6 (5.8 %) patients and Psoas sign could be elicited in only 2 (1.9%) patients.

**Table 4: Showing Distribution of 'Modified Alvarado Score'**

MAS	Frequency	Percent
More than 7	95	92.2
Less than 7	8	7.8
<b>Total</b>	<b>103</b>	<b>100.0</b>

95 (92.2%) patients had Modified Alvarado Score more than 7 and rests of 8 (7.8%) patients had modified Alvarado score less than 7.

**Table5: Histopathological categories of appendectomies**

Histopathology	Frequency	Percent
acute appendix	73	70.9 %
chronic recurrent appendix	15	14.6 %
necrosis	5	4.9 %
normal appendix	10	9.7 %
<b>Total</b>	<b>103</b>	<b>100.0 %</b>

All patients underwent histopathological examination and out of 103 patients 73 (70.9%) had features of acute appendicitis, 15 (14.6%) patients had chronic recurrent appendicitis, appendix of 5 patients were necrosed and rest 10 patients underwent appendectomy had normal appendix on histopathology.

**Table 6:- Table showing appendicitis against modified Alvarado score.**

	Appendicitis Present	Appendicitis Absent	Total
MAS >7	91	4	95
MAS <7	2	6	8
<b>Total</b>	<b>93</b>	<b>10</b>	<b>103</b>

Out of the 95 patients with Modified Alvarado Score (MAS) >7, 91 (95.8%) patients were proved to have acute appendicitis on histopathology and 4 (3.8%) patients had normal appendix. Out of 8 patients with Modified Alvarado score < 7, only 2 (1.9%) patients had Acute

Appendicitis and 6 patients (5.8%) with Modified Alvarado score < 7 had normal appendix. Therefore the sensitivity of Modified Alvarado score as per the data in our study is 97.8%, the specificity 60%, positive predictive value 95.8%, negative predictive value 75%.

**Table 7: Table showing appendicitis against USG findings**

	Appendicitis +	Appendicitis -	Total
USG positive for appendicitis	90	2	92
USG negative for appendicitis	3	8	11
Total	93	10	103

All our patients underwent ultrasonography and 92 patients had features suggestive of either uncomplicated or complicated appendicitis. Of these, histopathology was positive of appendicitis in 90 patients. Of the 11 patients who had no features of appendicitis on ultrasonography, 3 patients had histopathology suggestive of appendicitis. Therefore the sensitivity is 96.8%, the specificity 80%, positive predictive value 97.8%, negative predictive value 72.7%.

## DISCUSSION

The use of MASS in the diagnosis of acute appendicitis has been reported to improve the diagnostic accuracy and consequently reduces negative appendectomy and complication rates. This study was conducted to evaluate the diagnostic value of Modified Alvarado Scoring System in patients with acute appendicitis in our setting. The age distribution in our study was similar to other studies, Out of 103 patients admitted for emergency appendectomy, 71 (68.93%) were males and rest 32 (31.07%) were females. A male predominance is seen in patients with a sex ratio of 2.2:1 which is in accordance with the study conducted by Shakhathreh et al (7) and Nishikant Gujar et al. (8) The higher number of male patients in the study could be due to demographic and social reason. Women with abdominal pain may seek help from local health care workers rather than a hospital because of

various social, religious and economical barriers for female seeking health care.

Range of negative appendectomy (as derived from normal appearance on histopathology) in various studies is from 9% to 41%. The least being in Shakhathreh et al (7) having 9 % and maximum from a study conducted in at Herlev Hospital University of Copenhagen, Herlev, Denmark by Svend Dueholm (9) that showed a negative appendectomy rate as high as 41%. Our study had a rate of negative appendectomy of 9.7 %, where of 103 operated patients, there were 10 patients whom histopathology showed normal appendix. Of 10 patients who did not have appendicitis on histopathology, 7 were males and 3 were females. One of the reasons for low negative appendectomy rate could be the predominance of male patients in our study.

Sensitivity of Modified Alvarado score (MAS) ranges between 67% - 93% and specificity of Modified Alvarado Score ranges between 50%- 93% in the diagnosis of Acute Appendicitis as reported by various authors. In the present study sensitivity of MAS was 97.8% which is comparable with Kalan et al, (4) Fente et al (10) and Emmanuel S et al 2011 (11) who showed a sensitivity of 93%, 93% and 94.1% respectively in their studies. The specificity in diagnosing acute appendicitis in our study is (60%) which is nearly same as Kalan et al (4) and Ramirez et al (12) who reported a specificity of 67% and 72 % respectively. The variation in the diagnostic accuracy of scoring system could be because of the geographical variations, ethnicity, socio-economic factors, duration of symptoms, unusual presentation of patients and laboratory variations. The same score when applied in two different geographical regions has different accuracy. However Modified Alvarado score has a good sensitivity of 97.8 % and specificity of 60 % in our rural population. Hence it can be said that modified Alvarado score should be used as an adjunct to clinical examination for improvement in clinical

diagnosis of acute appendicitis in our population.

In our study of 103 patients who underwent appendectomy, ultrasonography was positive in 92 patients and normal in 11. Out of the 11 patients, 3 (27.2%) had Acute Appendicitis on histopathology.

In the present study sensitivity and specificity of USG in the diagnosis of acute appendicitis was 96.8%, 80%. Numerous studies have documented a sensitivity of 61% to 99%, and specificity of 35% to 100%. Sensitivity (96.8%) of Ultrasonography in the diagnosis of Acute Appendicitis in the present study is well comparable with Joshi et al<sup>(13)</sup> (96%) and is higher than Puylaert et al,<sup>(14)</sup> Jeffery et al,<sup>(15)</sup> Priya Ramachandran et al<sup>(16)</sup> and Khanal BR et al<sup>(17)</sup> who have reported 89%, 89%, 90% and 85.7% sensitivity respectively. However higher sensitivity was reported in Lee JH, et al<sup>(18)</sup> (99%) and lower sensitivity was reported in Ziden et al<sup>(13)</sup> (74.2%).

Specificity of ultrasonography in present study is 80% and is less when compared with Puylaert et al,<sup>(14)</sup> Jeffery et al<sup>(15)</sup> and Priya Ramachandran et al<sup>(16)</sup> who have reported 100%, 96% and 96% respectively. Emphasizing this point, Ultrasonography cannot be solely relied on for the exclusion and surgeon's careful and repeated evaluation must be needed for final diagnosis of acute appendicitis. Now a day's clinical diagnosis alone based on strongly positive clinical signs and supported by scoring system can be a strong indication of operative treatment even if ultrasonography is normal. It can be said that when the appendicitis is clinically obvious owing to strongly positive clinical signs and higher scoring by Modified Alvarado score, it can form basis for indication of operative treatment for appendicitis and in these cases ultrasonography may not be necessary. This only adds the costs and prolongation of time between presentation and operative treatment. However in the cases of equivocal diagnosis Ultrasonography should be used as an adjunct to clinical diagnosis

and thereby decreasing the rates of negative laparotomies.

Main advantage of ultrasonography allows the surgeon to identify other conditions which may not require surgical intervention, thus resulting in low rate of negative laparotomy. It is also of particular use in the patients who do not present classical symptoms and signs of acute appendicitis in children and pregnant women. Thus helping us in fast diagnosis and avoiding unnecessary prolong hospitalization and observation.

## CONCLUSION

Maximum numbers of cases of acute appendicitis were present in the age group of 11-30 years. Acute appendicitis is uncommon in the extremes of ages and is a disease of young adult. Our study had a male preponderance with male: female ratio of 2.2: 1.

Modified Alvarado Score was 97.8% sensitive and 60% specific in the diagnosis of acute appendicitis in present study and positive predictive value and negative predictive value were 95.8% and 75% respectively. Modified Alvarado Score can decrease the negative laparotomy rate.

In this study it was observed that the sensitivity, specificity, predictive value of positive test, predictive value of negative test and overall accuracy of ultrasound with reference to histopathological confirmation was found to be 96.8%, 80%, 97.8%, 72.7% respectively. It can be said that when appendicitis is clinically obvious owing to strongly positive clinical signs and higher scoring by Modified Alvarado score, it can form basis for indication of operative treatment for appendicitis and in these cases ultrasonography may not be necessary. This only adds the costs and prolongation of time between presentation and operative treatment. However in the cases of equivocal diagnosis Ultrasonography should be used as an adjunct to clinical diagnosis and thereby decreasing the rates of negative laparotomies.

Ultrasonography allows the surgeon to identify other abdominal conditions which may not require surgical intervention, and thus resulting in low rate of negative laparotomy.

Modified Alvarado score is simple, fast, reliable, repeatable and non-invasive and safe modality in diagnosis and without no extra expenses and complications.

In rural hospitals Modified Alvarado score will prove a better diagnostic tool due to unavailability of other sophisticated diagnostic measures and it is very handy in peripheral hospitals.

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