

# Modified Alvarado Score and its Application in the Diagnosis of Acute Appendicitis

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## ABSTRACT

**Introduction:** Appendicitis in its acute form is a commonest surgical emergency. Many a times, the diagnosis is made by clinical examination only. However, other investigations like USG, CTscan are being used in the diagnosis. Despite this, negative appendectomy rates are high. Hence a better diagnostic tool, a scoring system was explored to accurately diagnose appendicitis, thereby reducing negative appendectomies. There is no definitive diagnosis preoperatively. The treatment being surgical, negative appendectomy rates are high. Present study was conducted to evaluate Modified Alvarado Scoring System for diagnosis of acute appendicitis and its correlation by histopathology.

**Material and Methods:** A prospective study was conducted on 150 patients hospitalized with lower abdominal pain suggestive of appendicitis and were subsequently operated from Jan 2010 to Jan 2015 over a period of five years at Raja Rajeshwari Medical College and Hospital Bangalore.

**Results:** Patients of age group from six years to fifty and above years of both sexes were included in the study. Pre-operatively Modified Alvarado Score was assigned to all patients and the results were compared with operative and histopathological diagnosis reports. In our study, Modified Alvarado score of 1-4, 5-7 and 8-10 had the accuracy of 10%, 75% and 100% respectively. Higher the score, higher was the accuracy. Lower score patients should be kept under observation. Score sensitivity was more in males compared to female patients.

**Conclusion:** This scoring system is reliable and practicable diagnostic modality to increase the accuracy in the diagnosis of appendicitis, thus avoiding unnecessary surgery.

**Keywords:** Acute Appendicitis, Alvarado Score, Scoring System, Negative Appendicentomy

Alvarado score has six clinical variables and two laboratory quantification with a total of ten points.

The modified Alvarado score is presently in use for establishing diagnosis of acute appendicitis. The scoring includes elements from the patient's history, the physical examination and from laboratory tests.

1. Abdominal pain migrating to right iliac fossa.
2. Anorexia or ketone bodies in urine
3. Nausea or vomiting
4. Tenderness in right iliac fossa
5. Rebound tenderness
6. Fever of 37.3 degree Celsius or more
7. Leukocytosis more than 10,000 cells per micro liter in the serum
8. Neutrophilia in serum white blood cell count.

Tenderness in the right iliac fossa and leukocytosis are the two most important factors and are assigned two points each and six other factors are assigned one point each, for a total score of 10 points.

A score of 1-4 indicates very unlikely appendicitis, 5-7 probable appendicitis and 8-10 highly probable appendicitis.<sup>8</sup>

A popular mnemonic used to remember the Modified Alvarado score factor is MANTRELS - Migration to right iliac fossa, Anorexia, Nausea/Vomiting, Tenderness in right iliac fossa, Rebound tenderness, Elevated temperature (fever), Leukocytosis and Shift of neutrophils to left.

The high diagnostic value of this scoring system has been confirmed in a number of studies. The general consensus of researchers is that the Alvarado score is noninvasive, safe diagnostic method which is simple, reusable and repeatable and can aptly guide the clinician in establishing diagnosis and subsequent management. It carries high significance in the diagnosis of acute appendicitis.<sup>9-11</sup> Present study was conducted to evaluate Modified Alvarado Scoring System for diagnosis of acute appendicitis and its correlation by histopathology.

## MATERIAL AND METHODS

This study was carried out in the Department of General Surgery, Raja Rajeshwari Medical College and Hospital, Bangalore, for a period of five years from Jan 2010 to Jan

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**How to cite this article:** RajaShekar Jade, Uday Muddebihal M, Naveen N. Modified alvarado score and its application in the diagnosis of acute appendicitis. International Journal of Contemporary Medical Research 2016;3(5):1398-1400.

## INTRODUCTION

Acute appendicitis has customarily been a clinical diagnosis. Around 6% of the general population is believed to have appendicitis in their lifespan.<sup>1</sup> Patients' history and physical examination is very important for proper diagnosis.<sup>2</sup> It is possible to have an absolute diagnosis of appendicitis only after surgery and histopathological examination of specimen. Thus it is impractical to have a definitive preoperative diagnosis. The only confirmation of diagnosis is by histopathology examination. Diagnosis of appendicitis has an considerable rate of negative appendectomy varying from 20-40%<sup>3-5</sup> and an associated morbidity of around 10%.<sup>6</sup> Various scoring systems have been developed for assisting the diagnosis of acute appendicitis, and Alvarado scoring system is one of them.<sup>7</sup>

The Alvarado scoring is a clinical system applied in the diagnosis of acute appendicitis. It was introduced in the year 1986; although meant for pregnant females, it has been extensively validated in non-pregnant population.

2015. It was carried out on 150 patients hospitalized with 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, urine for routine examination was done for all cases. Plain X-Ray KUB region was done in selected cases. Ultra sonogram (USG) of abdomen was performed when the diagnosis was doubtful especially in female patients to exclude gynecological causes. Acute appendicitis diagnosis was made clinically and decision for appendicectomy was taken. Though all patients were scored using the modified Alvarado score, the same had no insinuation on the decision for surgery. Consequently, score of each patient was interrelated with clinical, operative and histopathological findings.

**STATISTICAL ANALYSIS**

Statistical analysis was done using SPSS software. Results are based on descriptive statistics.

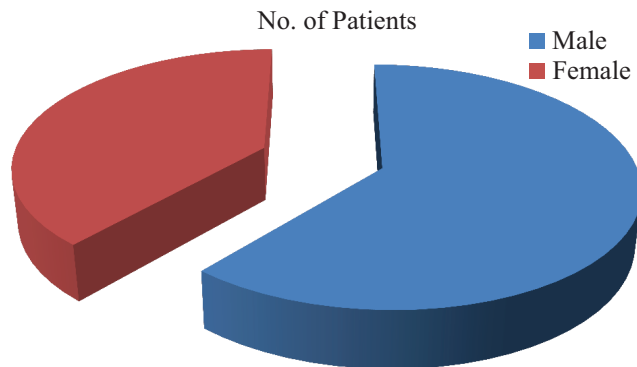
**RESULTS**

Total number of patients who underwent surgery was 150. Age of the patients ranged from 8 years to 60 years of age. Majority of the patients in the third decade (44%), followed by second decade (29%) (Table 1). In our study, male patients were more than females (Table 2 and Figure 1). Post operatively, all the specimens were sent for histopathological examination. The report confirmed appendicitis in 132 patients (88%), remaining specimens (18) did not confirm any evidence of appendicitis. The scoring system was found 100% sensitive in 8-10 score group (Table 3). Out of 18 patients, per operatively, one patient had evidence of salphingitis, one with ruptured ovarian cyst, two patients showed evidence of mesenteric lymphadenitis, four patients had Pelvic inflammatory disease and in remaining ten patients no abnormal pathology found (Table 4).

**DISCUSSION**

Acute appendicitis is most often a clinical diagnosis. However now-a-days most of the doctors order CT scan or ultrasonogram prior to evaluation. CT scan reports, 95% accuracy, whereas ultrasonography has sensitivity up to

90% and specificity of 80-90% in the diagnosis of acute appendicitis. Alvarado scoring systems can be safely used by general practitioners and primary health care medical personnel to determine need for referral to a qualified surgeon. Patients are either referred lately or unnecessarily due to lack of competency to make an appropriate diagnosis. Pain in right iliac fossa with guarding, accompanying fever and elevated leucocyte count are found to be more predictive



**Figure-1:** Sex distribution

Sl. No.	Age Group (Years)	No. of Patients	Percentage
1	Upto 10	6	4
2	11 to 20	44	29
3	21 to 30	65	44
4	31 to 40	24	16
5	41 to 50	8	5
6	>51	3	2
Total		150	100

**Table-1:** Age distribution

Sex	No. of Patients	Percentage	Male:Female
Male	92	60	3:2
Female	58	40	

**Table-2:** Sex distribution

Score	Patients	Acute Appendicitis	Normal Appendix	Percentage
1 - 4	10	1	9	10%
5 - 7	48	36	12	75%
8 - 10	92	92	0	100%

**Table-3:** Sensitivity in different score range group

Sl. No.	Appendix Status	Findings	No. of patients	Percentage
1	Acute Appendicitis	Inflammatory	118	78.6
		Suppurative	8	5.3
		Gangerous	4	2.7
		Perforated	2	1.4
		Total	132	88
2	Normal Appendix with other Pathology	Salphingitis and Rupture of ovarian cyst	2	0.65
		PID	4	2.67
		Mesenteric lymphadenitis	2	1.34
		No pathology found	10	6.6
		Total	18	12
Total	-	-	150	100

**Table-4:** final diagnosis from correlation of preoperative diagnosis with histopathological findings

of appendicitis in most of the cases.

Alvarado recommended surgery for patients with score 7 or more and observe patients with less than 6. In most appendicectomy the naked eye examination of appendix quite often confirms diagnosis, but at times a normal looking may be reported as one with appendicitis. Hence, histological report was taken as the final word in the diagnosis of acute appendicitis.<sup>12</sup>

Results from our study shows that acute appendicitis was common in 21-30 age group (44%) followed by age group 11-20 (29%). Epidemiological studies have recorded that appendicitis is more common in age group of 11-30 years.<sup>13</sup> Studies indicate males are more prone to infection as compared to females.<sup>14</sup> Our study shows ratio of male and female being 3:2.

In our study, patients with Alvarado score results being 1-4, 5-7 and 8-10 respectively with accuracy percentage 10%, 75% and 100% confirmed appendicitis. The one patient 1-4 group whose appendix was confirmed as appendicitis histopathologically, the score being 4 with migratory pain, right iliac fossa tenderness and vomiting. The leucocyte count was normal. A negative rate of appendicectomy is about 20-40% in surgical literature.<sup>15</sup> In our study, it was 12%.

Use of Alvarado score decreased unusually high false positive appendicectomy rate of 44% to 14%, in a prospective study of 215 patients which included both adults and children. Many surgeons across the world opined that maximum of 15-20% negative appendicectomy are acceptable.<sup>16</sup> Removal of normal appendix seems to be logical to lower the rate of complications of acute appendicitis. But, unnecessary appendicectomy bears long term risks and morbidity to patients.<sup>17</sup>

However there are no signs/ symptoms or laboratory tests that are 100% reliable in the diagnosis of acute appendicitis. In our study modified Alvarado score system that the accuracy of diagnosis was very dependable and acceptable with higher score patients. Thus the diagnostic score may be used as a guide to decide whether patient needs surgery or observation. Patients with 8 and above should undergo surgery and patients with 5-7 should be kept under observation and evaluated every 4 hours to note if the score remains same or increases accordingly decision may be taken for surgery. Patients with score 4 or less are very unlikely, but not impossible to have appendicitis and they can be discharged from hospital after conservative treatment, with the advice to come back if the symptoms persist or condition become worse.

## CONCLUSION

Alvarado scoring is easy, simple, cheap, non invasive tool in preoperative diagnosis of acute appendicitis and it is more useful at junior level doctors and for primary health care doctors. Moreover it is repeatable at no cost. Thus the application of this scoring system improves diagnostic accuracy and consequently reduces appendicectomy.

## REFERENCES

1. HESOnline. <http://www.hesonline.nhs.uk/id=2015?sep13:1287>
2. Peterson MC, Holbrook JH, Hales D, et al. Contribution

of history, physical examination, and laboratory investigations in making medical diagnosis. *West J Med.* 1992;156:163-165.

3. Teicher I, Landa B, Cohen M et al. Scoring system to aid in diagnosis of appendicitis. *Ann Surg.* 1983;198:753-759.
4. Ohmann C, Franke C, Yang Q. Clinical benefit of diagnostic score for appendicitis: Results of a prospective interventional study. German study group of acute pain abdomen. *Arch Surg.* 1999;134:993-996.
5. Kalan M, Talbot, Cunliffe WJ. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: A prospective study. *Ann R CollSurg.* 1994;76:418-419.
6. Baidya.N, Rodrigues, G, Rao A. Evaluation of Alvarado scores in acute appendicitis. *Internet J Surg.* 2007;9.
7. Alvarado A. A practical score for early diagnosis of acute appendicitis. *Ann Emerg Med.* 1986;15:557-564.
8. Douglas CD. Randomized controlled trial of ultrasonography in the diagnosis of acute appendicitis, incorporating the Alvarado score. *BMJ.* 2000;321:919.
9. Teo BS, Ng, BL. The Alvarado score and acute appendicitis. *Annals of the academy of Medicine Singapore.* 2001;30:510-2.
10. Mackli CP, Radcliffe, Merri JM, Stringer MD. A prospective evaluation of modified Alvarado score for acute appendicitis in children. *Annals of Royal college of surgeons of England.* 1997;79:203-5.
11. Chan MY, TeoBS, Ng BL. The Alvarado score and acute appendicitis. *Annals of the Academy of Medicine, Singapore.* 2001;30:510-12.
12. Dado G, Anania G, Baccarani U. Application of a clinical score for the diagnosis of acute appendicitis in childhood. *J PediatrSurg.* 2000;35:1320-22.
13. Addiss DG, Shaffer N. The epidemiology of appendicitis and appendicectomy in United States. *American journal of epidim.* 1990;132:910-25.
14. Williams NS, Bulstrode CJK. *Bailey and Love's Short practice of surgery 25<sup>th</sup> edition.* Hodder Arnold. 2008; p: 1205-6.
15. Al Qahatani HH, Muhamudh AA, Alvarado score as an admission criterion for suspected appendicitis in adults. *Saudi j gastroenterology.* 2004;10:86-91.
16. Jones PF. Suspected acute appendicitis: Trend in the management over 30 years. *B J Surg.* 2001;88:1570-77.
17. Kjossey KT, Losanoff JE. Duplicated vermiform appendix - Case report. *Brit J Surg.* 1996;83:125.

**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 22-03-2016; **Published online:** 22-04-2016