



CLINICAL UTILITY OF MODIFIED ALVARADO SCORE IN DIAGNOSING ACUTE APPENDICITIS

General Surgery

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ABSTRACT

BACKGROUND: An infection of the appendix may occur by several reasons. Diagnostic scoring systems have been developed in an attempt to improve the diagnostic accuracy of acute appendicitis. The most prominent of those scores was that developed by Alvarado. A wrongly made diagnosis is responsible for significant mortality and morbidity. The prime goal of surgeon is removal of inflamed appendix before perforation with minimal negative appendectomies. Thus, this arises need of a method, which can complement clinical diagnosis and make clinical decision more precise and consistent.

MATERIALS AND METHOD: Patients seeking treatment in Department of Surgery for right iliac fossa pain and diagnosed acute appendicitis at GMCH, Udaipur.

RESULTS: Male to female ratio was 1.5:1. Maximum patients were in the age group of 20-29 years i.e. 33.33%. Pain abdomen (100%), Rif tenderness (96%), followed by vomiting (92%), fever (90.67%) were the predominant clinical features. Modified Alvarado score had a sensitivity of 90.74%, specificity of 38.10%, positive predictive value of 79.03%, negative predictive value of 61.54%, and diagnostic accuracy of 76%. When modified Alvarado score and ultrasonography were combined together and both were positive, sensitivity of diagnosing acute appendicitis was 90.38% in this study.

CONCLUSION: Incorporation of modified Alvarado scoring system in combination of ultrasonography for establishment of diagnosis in cases of suspected acute appendicitis surely provides higher accuracy and helps in decreasing negative appendectomies.

KEYWORDS

INTRODUCTION

An infection of the appendix may occur for several reasons. However, the usual picture of appendicitis is often not classical, leaving in many cases a diagnostic problem. In patients with questionable findings, the aggressive surgical approach has been "when in doubt, take it out," and the price paid was the frequent removal of normal appendices. This negative laparotomy is associated with higher morbidity but the mortality rate is minimal compared to the lethal potential of appendiceal perforation and peritonitis.¹

Diagnostic scoring systems have been developed in an attempt to improve the diagnostic accuracy of acute appendicitis. The most prominent of those scores was that developed by Alvarado.² Subsequent prospective studies had suggested that the Alvarado score alone was inadequate as a diagnostic test.³ The classic Alvarado score included left shift of neutrophils maturation (given a score of 1) yielding a total score of 10 but Kalan et al⁴ omitted this parameter which was not routinely available in many laboratories, and produced a modified score. An elevated level of C-reactive protein (CRP), an acute phase protein, is one of many downstream indicators of inflammation.

Although the mortality and morbidity from appendicitis has decreased in the last 50 yrs, the diagnostic specificity remains low with false positive rate of 20-25%.⁵ Most physicians are familiar with textbook appearance of appendicitis; anorexia, nausea and vomiting associated with periumbilical pain which shifts to the right lower quadrant with tenderness at McBurney's point and leucocytosis. Several investigations like white cell count, ultrasonography, CT scan, can be done to diagnose acute appendicitis with variable accuracy.⁶

USG with graded compression not only allows confirmed diagnosis but also offers a quick and non-invasive way to demonstrate enlarged mesenteric lymph nodes and mural thickening of terminal ileum. It is accurate in diagnosing those conditions which do not require surgery like ureteric stones and can be used in pregnancy.⁸ However, it is strongly operator dependant.⁹ In case of equivocal diagnosis of appendicitis, repeated clinical and laboratory evaluation is useful.¹⁰ As studied by Stephens and Mazzucco, ultrasound alone resulted in correct diagnosis in 87% cases and Alvarado score alone can diagnose 88% cases.¹¹

Despite of modern diagnostic aids diagnosis of acute appendicitis is

mostly clinical. A wrongly made diagnosis is responsible for significant mortality and morbidity. Diagnostic difficulties in cases with atypical clinical finding had resulted in high rate of negative appendectomies, which had been reported variably between 15-30%.¹² The prime goal of surgeon is removal of inflamed appendix before perforation with minimal negative appendectomies.¹³ Thus, this arises need of a method, which can complement clinical diagnosis and make clinical decision more precise and consistent. Diagnostic scoring systems are useful and easy methods that help us in arriving at a surgical decision.

The use of modified Alvarado scoring system was intended to improve the decision making and to reduce the percentage of the negative appendectomy in this common condition. Predictive value of modified Alvarado score was 80%¹⁴. But, the performance of this system however had not been uniform. Our intention was to evaluate the role of this system in reducing the percentage of the negative appendectomy.

AIMS AND OBJECTIVE

1. To determine the clinical utility of modified Alvarado scoring system in diagnosis of Acute Appendicitis.
2. To compare the predictive value of modified Alvarado score with Ultrasonography and Histopathological findings in patients with Acute Appendicitis.

MATERIALS AND METHOD

Patients seeking treatment in the outpatient / inpatient / emergency units of Department of General Surgery for right iliac fossa pain and diagnosed of acute appendicitis at Geetanjali Medical College and Hospital Udaipur between November 2017 to May 2019. Patients who satisfy the inclusion and exclusion criteria were subjected following assessment and intervention.

Inclusion Criteria:

Patients of both sexes, aged more than equal to 18 years.

Exclusion Criteria

Patients with Acute Right Iliac Fossa (RIF) pain determined to have primary urological and gynaecological etiology or having palpable Right iliac fossa lump.

The Modified Alvarado Score

Several diagnostic tools and scoring systems had been developed and

been characterised as understandable, non-invasive, cost effective. The Alvarado scoring system is purely based on history, clinical examination and few laboratory tests and is very easy to apply. The Alvarado score was first described in 1988 by Alfredo Alvarado as a practical score for the early diagnosis of acute appendicitis that would be instituted in outpatient setting. The Alvarado score was modified by Kalan et al⁹ by excluding one laboratory finding shift to left of neutrophils maturation (Table-1).

METHOD OF THE INTERVENTION

Patients on admission were evaluated on the basis of modified Alvarado scoring system. Patients with score of 1-4 were considered unlikely to have acute appendicitis. Those with score 5-6 probably had and those with score 7-9 were considered having definitive diagnosis (Table-2). The modified Alvarado score would increase or decrease on reassessment. Ultrasound abdomen of the patients was performed and the ultrasonological findings were correlated with the score. Also, serum CRP values were measured and positive CRP level taken as > 6mg/l. Patients with score 7 or >7 were subjected to surgery. Clinical, ultrasonographic, operative and CRP findings were correlated and confirmed with histopathological findings in the diagnosis of acute appendicitis. The cases subjected to emergency surgery were adequately prepared by parenteral fluids, electrolyte supplementation and administration of broad spectrum antibiotics intravenously. Surgery was done under spinal or general anaesthesia as and when required. Grid iron incision was employed in majority of cases. Biopsy sent for histopathological examination. Postoperatively patients were kept nil orally, till bowel sounds returned; parenteral fluids, electrolytes, antibiotics, and analgesics were continued. Patients were monitored for any postoperative complications. Postoperative sutures were removed 7 to 10 days after surgery. Patients were called with their histopathological reports on follow up.

Table 1: The Modified ALVARADO Scoring System

Parameters	Manifestation	Score
Symptoms	Migratory pain	1
	Anorexia	1
	Nausea/Vomiting	1
Signs	Right Iliac fossa tenderness	2
	Rebound tenderness	1
Laboratory Values	Elevated temperature	1
	Leukocytosis	2
Total		9

Table 2: Method of Intervention

Score	Method of intervention
1-4	Admission, oral antibiotics, Serum CRP values, USG. Repeat ALVARADO score after 24 and 48 hr
5-6	Admission, Serum CRP values, USG, Parenteral antibiotics. Repeat ALVARADO score after 24 and 48 hr. If suggestive of acute appendicitis than plan for surgery and specimen sent for HPE.
7-9	Patients will be taken for surgery after admission, USG and blood investigations. Specimen sent for HPE.

OBSERVATIONS

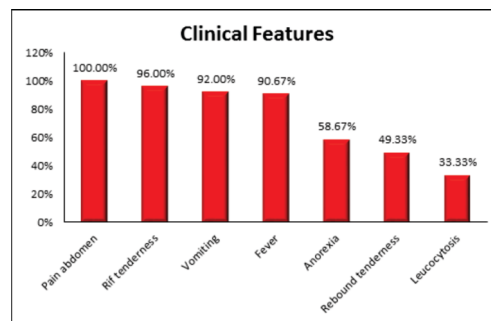
In present study, out of 75 patients 47 (62.67%) were male and 28 (37.33%) were female. Male to female ratio was 1.5:1. Similar to the prevalence shown in study done by Vandakudri et al¹⁵ in which 56.7% were male and 33.3% were female.

Age Distribution

Age group (yrs)	No.	%
<20	19	25.33%
20-29	25	33.33%
30-39	14	18.67%
40-49	6	8.00%
50-59	5	6.67%
60-69	4	5.33%
70-79	2	2.67%
Total	75	100.00%

In the present study, maximum patients were in the age group of 20-29 years i.e. 33.33%, followed by age group of 11-20 years i.e. 25.33% and 18.67% in age group of 30-39 years. Only 2.67% were in the age group of more than 70 years. Similarly, in the study done by Ramchandra J et al¹⁶, maximum patients were in the age group of 11-20

years i.e. 39%, followed by 32% in the age group of 21-30 years and 15% in the age group 31-40 years. Only 2% were in the age group of 61-70 years similar to our study. Similar observations were made by Vandakudri et al.¹⁵



In our study the predominant clinical features seen were pain abdomen (100%), Rft tenderness (96%), followed by vomiting (92%), fever (90.67%), anorexia (58.67%), rebound tenderness (49.33%) and leucocytosis in 33.33%. Similar findings were seen in the study done by Mudawat K et al.¹⁷

Comparison between Modified Alvarado Score and Histopathological Findings

	Histopathology				
Modified Alvarado Score	Positive		Negative		
	No.	%	No.	%	Total
	49	79.03%	13	20.97%	62
	5	38.46%	8	61.53%	13
	54		21		75

For score <6, surgery done on basis of positive USG and clinical findings. In our study out of 62 modified Alvarado score positive cases, 49 (79.03%) were histological positive and 13 (20.97%) were negative, whereas in the remaining 13 modified Alvarado score negative cases 5 (38.46%) were histological positive. Modified Alvarado score had a sensitivity of 90.74%, specificity of 38.10%, positive predictive value of 79.03%, negative predictive value of 61.54%, and diagnostic accuracy of 76% and a false negative error rate of 9.26% in diagnosing acute appendicitis. Similarly the overall sensitivity of acute appendicitis reported by Ramchandra et al¹⁶, Kalan M et al⁵, were 88.63%, 83.7%, respectively comparable with our study.

Patel V et al¹⁸ observed that out of 51 modified Alvarado score positive cases, 49 (96%) were histological positive and 2 (4%) were negative, whereas in the remaining other 35 modified Alvarado score negative cases 20 (57.14%) were histological positive, results were quite different from our observations, but similar to the findings of the study done by Timilsina et al¹² who observed that out of 86 modified Alvarado score positive cases, 81 (94.18%) were histological positive and 5 (5.81%) were negative. Whereas in the remaining 39 modified Alvarado score negative cases 37 (94.87%) were histological positive.

Comparison between Modified Alvarado Score and Ultrasonography Findings in the Diagnosis of Acute Appendicitis

	USG			
	Positive		Negative	
Modified Alvarado Score	No.	%	No.	%
Positive	52	96.30%	2	3.70%
Negative	21	100%	0	0%
Total	73	97.33%	2	2.66%

In our study out of 54 modified Alvarado score positive cases, 52 (96.30%) were also positive on ultrasonography and 2 (3.70%) were negative. Whereas, in the remaining modified Alvarado score negative cases 21 (100%) were positive on ultrasonography for acute appendicitis.

Similar to our study Gupta M et al¹⁴ found that after combining modified Alvarado score and USG, diagnostic accuracy was markedly increased. There were 37 true positive cases when both were positive. Also, Patel V et al¹⁸ studied that when modified Alvarado score and ultrasonography were combined together and both were positive sensitivity of diagnosing acute appendicitis was 100%. On ultrasonography, 73 (97.3%) patients were positive for acute

appendicitis, while 2 (2.66%) patients were negative.

Comparison between Modified Alvarado Score, Ultrasonography, Histopathological Findings

	Histopathological			
	Positive		Negative	
Modified Alvarado Score & USG	No.	%	No.	%
Both Negative	0	0%	0	0%
Modified Alvarado Score Positive & USG Negative	13	61.90%	8	38.10%
Modified Alvarado Score Negative & USG Positive	2	100%	0	0%
Both Positive	47	90.38%	5	9.6%
Total	62	82.67%	13	17.33%

When modified Alvarado score and ultrasonography were combined together and both were positive, sensitivity of diagnosing acute appendicitis was 90.38% in this study.

Histopathologically, acute appendicitis was confirmed in 62 (82.67%) patients. C-reactive protein was raised in 56 (74.66%) patients. Of those with raised C- reactive protein, 6 (16%) patients had normal appendix on histopathology. C-reactive protein was normal in 19 (17.33%) patients.

CONCLUSION

In our study modified Alvarado score alone had a sensitivity of 90.74% for diagnosing acute appendicitis. But when modified Alvarado score and ultrasonography are combined together and both are positive sensitivity of diagnosing acute appendicitis is 96.30%. Although ultrasonography is used frequently for diagnosis of acute appendicitis, but using modified Alvarado score can also be a useful tool in clinical decision making. But nothing can replace careful evaluation by an experienced surgeon and when, the clinical signs and the symptoms are combined with USG findings, the diagnostic accuracy is significantly high. USG also helps in diagnosing other causes of RIF pain which helps in excluding appendicular pathology. It should be emphasized that USG does not replace clinical examination, but is a useful adjunct in the diagnosis of acute appendicitis.

Acute appendicitis is one of the most common acute abdominal condition requiring emergency surgery and its diagnosis remains challenging. Thus, we finally conclude that incorporation of modified Alvarado scoring system in combination of ultrasonography for establishment of diagnosis in cases of suspected acute appendicitis surely provides higher accuracy and helps in decreasing negative appendectomies.

REFERENCES

- Teicher IR, Landa B, Cohen M, Kabnick LS, Wise L. Scoring system to aid in diagnosis of acute appendicitis. *Ann Surg* 198 ;198:753-9.
- Zimmer MJ, Ashley SW. Maingot's Abdominal Operations. 11 th ed. McGraw Hill; 2007. p. 589-608
- Ohmann C, Yang Q, Franke C. Diagnostic scores for acute appendicitis. *Eur J Surg* 1995; 161:273-81.
- Kalan M, Talbot D, Cunliffe WJ, Rich AJ. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: A prospective study. *Ann R Coll Surg Engl* 1994; 76:418-9.
- Puylart JBCM, Rutgers PH and Lalisang RI: A prospective study of Ultrasonography in the diagnosis of appendicitis. *The New England Journal of Medicine* 1987; 317(11): 666-669.
- Wilcox RT and Traverso LW: Have the evaluation and treatment of acute appendicitis changed with new technology. *Surg Clin North Am* Dec 1997; 77(6): 1355-1370.
- Puylart JBCM: Mesenteric adenitis and acute terminal ileitis: US evaluation using graded compression. *Radiology* 1986; 161: 691-695.
- Hoffmann J and Rasmussen OO: Aids in the diagnosis of acute appendicitis. *Br J Surg* 1989; 76:774-779.
- Ooms HWA, Koumans RKJ and KangYou PJH: Ultrasonography in the diagnosis of acute appendicitis. *Br J Surg* 1991; 78: 315-318
- Andersson RE, Hugander A, Ravn H et al: Repeated clinical and laboratory examination in patients with an equivocal diagnosis of appendicitis. *World J Surg* 2000; 24(4): 479-485.
- Stephens PL and Mazzucco JJ: Comparison of ultrasound and the Alvarado score for the diagnosis of acute appendicitis. *Conn Med* 1999;63(3): 137-140.
- Bhusan Raj Timilsina, Rajiv Shah, Sudeep Raj KC, Hari Prasad Upadhyay, Sunita Lamsal, Narayan Belbase, Sujit Kumar RIPASA vs Modified Alvarado Scoring System for diagnosis of Appendicitis. Vol-14, (4), Oct-Dec 2018.
- Hoffmann J, Rasmussen OO. Aids in the diagnosis of acute appendicitis *Br S Surg*. 1989;76(8):774-9.
- Money Gupta, Verinderjit Singh Virdi, Laxmi Agnihotri, Vishal Mandia. Evaluation of Modified Alvarado Score and Ultrasonography for the Diagnosis of Acute Appendicitis. *March* 2016; 5 (3), 1623-94.
- Vandakudri AB, Koppad SN, Gunasagar DM, Desai M. Evaluation of modified Alvarado score in the diagnosis of acute appendicitis. *Int J Res Med Sci* 2016;4:84-8.
- Ramachandra J, Sudhir M, Sathyanarayana B. Aevaluation Of Modified Alvarado Score In Preoperative Diagnosis Of Acute Appendicitis Volume 2/ Issue 46/ November 18, 2013.

- Keerthi Mudavath, Thinaganar K. A study on the clinical and sonological correlation in the diagnosis and management of acute appendicitis in a tertiary care centre June 2019; Vol 6 (6).
- Vishad Patel, Manoj Kela, Sanjay Prasad, Ajeet Singh Gautam, Mohit Gupta Evaluation of modified Alvarado scoring system in diagnosis of acute appendicitis - a prospective study. *Int Surg J*. 2016 May; 3(2):621-625.