



Original Research Article

Prediction of acute appendicitis using ultrasonography and modified Alvarado score — A prospective comparative study

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ABSTRACT

Background: Acute appendicitis is not uncommon pathology but clinical diagnosis depends on skills of treating health officer. Now advancement in technology and easy availability of USG and CT scan centers make the easy diagnosis. Some time atypical presentation of acute appendicitis makes delay in diagnosis clinically. But, the modified Alvarado score make easy diagnosis of acute appendicitis and compatible to USG.

Materials and Methods: This is a prospective comparative study conducted at RNT Medical College, Udaipur. This study was done in 50 patients, who were presented with pain right lower abdomen.

Aims and Objectives: to compare the sensitivity and specificity of modified Alvarado score and USG in diagnosis of acute appendicitis.

Results: there were 28 male and 22 female in this study. Age of Youngest patient in the study was 17 years and elder most was 57 years old. Anorexia was common symptoms after pain at right iliac fossa. Appendectomy was done in 48 cases (96%) and two cases were managed conservative. There were 34 (68%) patients who had modified Alvarado score more than 7.

Conclusion: Modified Alvarado Score is a simple, practical and quick tool in securing diagnosis of acute appendicitis when score is >7. Its results are similar to USG finding. It also helps to reduce the rate of negative appendectomy. This study recommend appendectomy in patients presenting with right iliac fossa pain in whom modified Alvarado score is 7 or more.

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1. Introduction

The appendix is the finger like structure. It is blind ended tubular structure. It is also named vermiform appendix. The Latin meaning of vermiform is worm like.¹ Acute appendicitis is common surgical emergency for surgeons, but its correct diagnosis is still clinically difficult and depends on skill of surgeon to surgeon. Because many others pathological condition also presents with similar sign and symptoms. These are ulcerative colitis, acute cystitis,

diverticulitis, peritonitis, trauma, ovarian cyst, ectopic pregnancy etc. Acute appendicitis is the condition in which inflammation of appendix occurs. The common etiology of acute appendicitis is due to obstruction of lumen of appendix. Faecolith or appendicolith are the common reason for obstruction of lumen. Acute appendicitis commonly presented with pain abdomen, nausea, vomiting and fever. Pain abdomen is most common symptom² Classically case presented with para-umbilical pain migrating to right lower quadrant of abdomen. Pain is usually associated with nausea, vomiting, and low grade fever.³ Appendectomy is the first line treatment of acute appendicitis. But

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avoid negative appendectomy is the matter of concern. Alvarado scoring and modified Alvarado scoring systems are the important clinical tools to reach the correct diagnosis of acute appendicitis. Other investigation tools for confirmative diagnosis used are USG, CT scan, MRI, and diagnostic laparoscopy.⁴⁻⁷

2. Materials and Methods

This study was undertaken in the Department of General Surgery at RNT Medical College, Udaipur, from March 2015 to October 2015 on patients admitted with complaint of right lower quadrant abdominal pain suspected of appendicitis. Evaluation of patient was done by comprehensive history, clinic-pathological examination, investigations including USG and Modified Alvarado Score.

2.1. Inclusion criteria

1. All patients above the age of 14years
2. Acute pain abdomen in right iliac fossa clinically presumed to be of appendicular origin.

2.2. Exclusion criteria

1. Patients less than 14 years of age
2. Patient with other pre-existing ileocaecal pathology like ileocaecal Tuberculosis, Malignancy etc
3. Patient who are not willing for appendectomy

Modified Alvarado score was applied on these patients who consist of three symptoms, three signs and a laboratory finding as described by Alfredo Alvarado⁸ and later modified by Kalan et al.⁹

Table 1: Showed modified Alvarado score

Symptoms/Sign/Investigation	Score
Symptoms	
Migration of pain to right iliac fossa	1
Anorexia	1
Nausea/Vomiting	1
Signs	
Tenderness over right iliac fossa	2
Rebound tenderness over right iliac fossa	1
Temperature > 37.5°C (99.5 F)	1
Investigation	
Leukocytosis > 10.5x10 ⁹ /L	2
Total	9

Scoring system

- 1-4: Appendicitis unlikely
 5-6: Appendicitis possible
 7-8: Appendicitis probable
 9: Appendicitis definitive

2.3. Aims and objectives

1. To study sensitivity and specificity of modified Alvarado score in diagnosis of acute appendicitis
2. To study sensitivity and specificity of USG in diagnosis of acute appendicitis
3. To compare role of modified Alvarado score and USG in diagnosis of acute appendicitis

2.4. Method of data collection

Patients presenting with pain in the right lower quadrant of abdomen after clinical examination were provisionally diagnosed to have acute appendicitis and were admitted in the hospital. Total 50 cases with the following inclusion and exclusion criteria were being selected for this study and were allocated alternatively to each of the clinical study. A pretested Proforma was used to collect relevant information (patient data, clinical findings, lab investigations, USG findings, histopathological reports etc.) from all the selected patients.

Informed consent was taken from all enrolled patients after detailed counseling. The contents of the consent were read out to the patient in his/her language.

Cases with score of 1-4 will be observed, manage conservatively and will be discharged after improvement. In cases with score 5 or more, abdominal ultrasonography will be done routinely within 4 hours of admission. The sonography findings were recorded as positive and negative for acute appendicitis. The patients with Modified Alvarado score 5 and above with positive ultrasonography will be operated immediately. Patients with negative ultrasound but Modified Alvarado score 7 or above will be also operated upon. Patients with Alvarado score 5-6 will be retained for 48 hours under observation and decision to operate will be made depending on progress in their clinical course and sonography findings. All the excised specimens of appendix will be sent for histopathological confirmation of acute appendicitis.

3. Results

The male female ratio was 1.27: 1 in our study. This study showed that most of the cases were grouped age between 21-30 years (48%) followed by 14-20 years (28%), between 31-40 years (18%) and 6% were above 41years. Age of Youngest patient in the study was 17 years and elder most was 57 years old.

All patients were presented with pain and tenderness in right iliac fossa or right lower quadrant of abdomen. Anorexia was the next second most common symptom (in 66% cases) of this study subjects. Fever was present in 64% cases. Rebound tenderness was elicited in 48% cases (Table 2). Total leucocytes count more than 10500/dl was present in 30 patients (60%). Remaining 20 patients (40%) had total leukocyte count less than 10500/dl

(Table 2). Out of 50 cases, 48 (96%) were managed surgically. Appendicectomy was done in these patients either open or laparoscopic. Remaining two patients were treated conservatively, no surgical intervention was done (Table 3). Histopathological examination revealed acute/chronic appendicitis in 40 patients (83.33%) while eight specimen of appendix (16.66%) were reported normal on HPE (Table 3 and Table 4). All 34 patients with modified Alvarado score >7 were managed by surgical approach (appendicectomy). The histopathology from these patients 30 showed features of appendicitis. From these patients USG showed appendicitis in 97.05% cases and 94.11% were approved by histopathological examination (Table 5).

There were total 16 (8 male and 8 female) patients who had modified Alvarado score <7 . 14 patients from these were managed by appendicectomy depending on their USG reports and their clinical course. Remaining Two patients with modified Alvarado score <7 managed conservatively. USG proved cases are 2 male and 4 female patients in this group. Histopathological proved appendicitis was seen in 4 male and 4 female cases (Table 6).

There were total 39 patients having USG finding of appendicitis. Out of these 39 with 37 (94.87%) have proved appendicitis in histopathological examination while 2 (5.12%) were not proved by histopathology of specimen (Table 7). In our study sensitivity, specificity, positive predictive value and negative predictive value of modified Alvarado score were 80%, 75%, 94.11% and 42.85% respectively (Table 8). While Sensitivity, specificity, positive predictive value and negative predictive value of USG were 92%, 75%, 94.87% and 66.66% respectively (Table 9).

Table 2: Showing presenting sign and symptoms

Symptoms	No. of patients	% of cases
RIF Pain	50	100
Anorexia	33	66
Nausea/vomiting	39	78
Tenderness in RIF	50	100
Rebound tenderness	24	48
Elevated temperature	32	64
Elevated Leucocyte count	30	60

4. Discussion

We know that diagnostic accuracy in cases of acute appendicitis should be very high because negative appendicectomy carries significant morbidity as there is a greater risk for abdominal adhesions after appendicectomy and economical burden for patients along with health care system. Delay in treatment due to diagnostic uncertainty leads to higher complication rate, higher morbidity and mortality.¹⁰

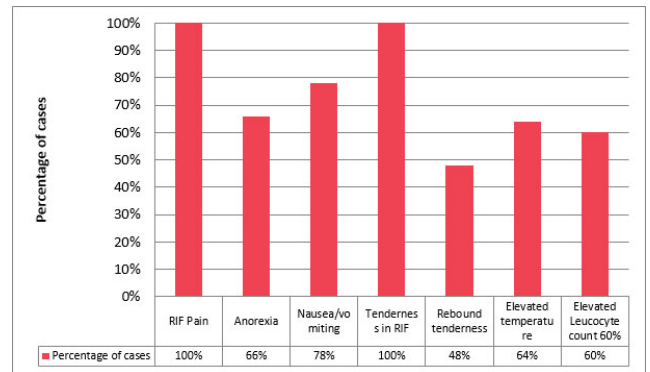


Chart 1: Bar diagram of presenting sign and symptoms

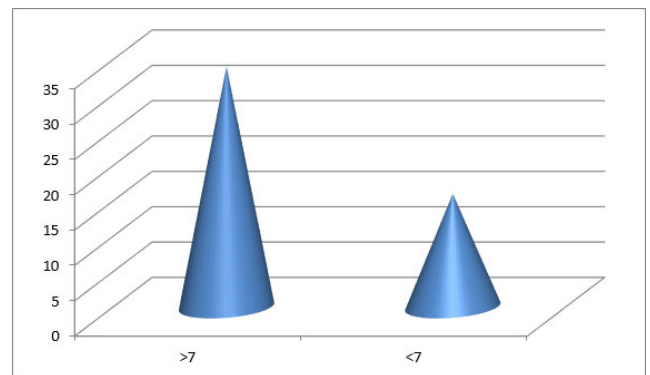


Chart 2: Appendicectomy cases with different modified Alvarado score

Various scoring systems were introduced for increasing the clinically accuracy for diagnosis and reducing the negative appendicectomy but most of these are complex and not feasible in emergency setting. Therefore, a scoring system used for the diagnosis of acute appendicitis should be simple enough to be used as an emergency department setting. Modified Alvarado Score is just a simple mathematical tabulation of common clinical signs and symptoms found in patients of acute appendicitis. It has been reported to be a cheap and quick diagnostic tool in patients with acute appendicitis.^{10,11}

In our study, we have divided the modified Alvarado scoring system in two groups. Firstly with a score >7 termed as Modified Alvarado Score positive and secondly with a score <7 termed as Modified Alvarado Score negative. Out of 50 patients; 34 were considered positive (score >7) and they underwent appendicectomy irrespective of ultrasonography findings. Patients who were scored negative for Modified Alvarado Score (Score <7); underwent appendicectomy on the basis of positive ultrasonography findings and their clinical course during hospital stay. Out of the 16 patients with negative Modified Alvarado Score, 6 showed positive ultrasonography findings underwent appendicectomy and 6 other with negative

Table 3: Pre-operative modified Alvarado score and course of action taken

Score	No. of patients	Course of action			HPE report	
		Appendicectomy	Conservative	Appendicitis	Normal appendix	Not sent
>7	34	34	0	30	4	-
<7	16	14	2	10	4	-

Table 4: Pre-operative ultrasonography and course of action taken

Ultrasonography	Appendicectomy	Biopsy (Appendicitis)	No Histopathology Abnormality in Appendix
Positive 39	39	37	2
Negative 9	9	3	6
Total 48	48	40	8

Table 5: Comparison of modified Alvarado score and ultrasonography with treatment plan result of our treatment plan of score > 7

Gender	Modified Alvarado score	USG positive		Treatment plan		Confirmed appendicitis	
		No.	%	Conservative	Appendicectomy	No.	%
Men	20	19	95	0	20	19	95
Female	14	14	100	0	14	13	92.85
Total	34	33	97.05		34	32	94.11

Table 6: Comparison of modified Alvarado score and ultrasonography with treatment plan result of our treatment plan of score < 7

Gender	Modified Alvarado score < 7	USG positive		Treatment plan		Confirmed appendicitis	
		No.	%	Conservative	Appendicectomy	No.	%
Men	2	2	25	1	7	4	57.14
Female	8	4	50	1	7	4	57.14
Total	16	6	37.5	2	14	8	57.14

Table 7: Showing overall sensitivity and specificity of ultrasonography and modified Alvarado score with histopathology

Diagnostic approach result	Appendicitis (Biopsy Positive)	Non-appendicitis (Biopsy Negative)	Total
USG positive	37	2	39
USG negative	3	6	9
Total	40	8	48

Table 8: Showing overall sensitivity and specificity of modified Alvarado score

Diagnostic test result	Appendicitis (Biopsy Positive)	Non-appendicitis (Biopsy Negative)	Total
Score >7 positive	32	2	34
Score <7 negative	8	6	14
Total	40	8	48

Table 9: Showing comparison between sensitivity and specificity of modified Alvarado score and ultrasonography

	Modified Alvarado score	Ultrasonography
Sensitivity	80	92
Specificity	75	75
Positive Predictive Value	94.11	94.87
Negative Predictive Value	42.85	66.66

ultrasonography finding underwent appendectomy after their clinical condition deteriorate. In present study; the sensitivity and specificity of Modified Alvarado Score is 80.0% and 75.0% respectively. Shirzad Nasiri et al (2012) documented their results of Modified Alvarado score with taking 7 cut of point the sensitivity was 65.7% and while taking 6 cut off point the sensitivity is 85.1%.

Modified Alvarado Score and Ultrasonography both are very helpful to diagnose the acute appendicitis. An ultrasonography finding varies according reporting officer. But Modified Alvarado Score is simple mathematical calculation of signs, symptoms, and leukocyte value. Modified Alvarado score is more sensitive than USG.¹² Our study shows near equal sensitivity of both modified Alvarado score and USG. We found that Modified Alvarado scoring system reduces the negative appendectomy rate compare to USG reporting.

Talukder DB et al (2009) in their series showing similar results as in their study sensitivity of Modified Alvarado Score 68% to 95% after dividing data between male, female, MAS >7 and <7.¹³ Shamir M Kohla et al (2015) also noted diagnostic accuracy 88.89% in male while 78.13% in female.¹⁴

5. Conclusion

This study concluded that, Modified Alvarado Score is a simple, practical and quick tool in securing diagnosis of acute appendicitis when score is >7. Its results are similar to USG finding. It also helps to reduce the rate of negative appendectomy.

But patients with Modified Alvarado Score <7 also have a good chance of having acute appendicitis. So the patients with <7 Modified Alvarado Score should be further evaluated by USG which has high negative predictive value in comparison to Modified Alvarado Score. It reduces the delay in treatment.

5.1. Management suggestions based on our study are

1. If score is 7 or more : Appendectomy is indicated
2. If score is <7: Probably is a case of appendicitis should be considered for USG or CT scan.

6. Source of Funding

None.

7. Conflict of Interest

The author declares that there is no conflict of interest.

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