

## Research Article

# Role of Alvarado score in the diagnosis of acute appendicitis

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### ABSTRACT

Acute appendicitis is a surgical emergency, which is associated with morbidity and mortality occasionally. If failed to diagnose early the situation may become more complicated. In acute appendicitis it is not possible to have definitive diagnosis by histopathology preoperatively, we would like a simple test like Alvarado scoring system which depends on the presence and absence of certain variable, which provides an accurate guide to whether or not the patient has the condition. Hence, accurate diagnosis and timely intervention is needed. Therefore, the present study was conducted to evaluate the Alvarado scoring system in diagnosing acute appendicitis and its co relation with histopathology. This prospective study was conducted in 100 consecutive patients admitted in the department of general surgery of Narayana Medical College, Nellore with the clinical diagnosis of acute appendicitis. The findings based on the Alvarado score indicate that 68% of the subjects had a score of more than 7 and 22% of the subjects had a score between 5 and 7. Only 10% of the subjects had a score between 1 and 4. Out of 83 eligible subjects 75 were found to have acute appendicitis by histopathological examination. Negative appendicectomy was very low representing up to 9.6% whereas the percentage of positive predictive value was high representing up to 90.4%. Although the diagnosis of acute appendicitis remains mainly clinical evaluation, the scoring system is easy, simple and cheap complementary aid for supporting the diagnosis of acute appendicitis.

**Keywords:** Alvarado score, Abdominal pain, Acute appendicitis, Appendicectomy

### INTRODUCTION

Appendicitis is an acute inflammatory condition of the appendix. It is a surgical emergency of inflamed appendix and most of the cases require immediate removal through surgery either open or laparoscopic appendicectomy.<sup>1-3</sup> It is one of the common cause for abdominal surgical emergencies which has a life time risk of about 7%.<sup>4</sup> Recent studies around the globe also reveal that its lifetime prevalence accounts for 1 in 7.<sup>5</sup> Appendicitis may be associated with morbidity and occasionally mortality. If failed to diagnose early, the situation may become more complicated. These

complications will lead to rupture of appendix causing peritonitis, which leads to circulatory shock.<sup>6</sup> Recent statistics suggest that approximately 6% of the population will suffer from acute appendicitis during their lifetime; therefore, much effort has been directed toward early diagnosis and intervention.<sup>7</sup>

Numerous studies have been revealed that the early diagnosis and timely operative intervention is the key for success in the management of acute appendicitis. However, the picture of acute appendicitis may not be classical, and in such situations, a policy of early surgery to avoid risk may lead to high negative appendicectomy

rates.<sup>8-9</sup> Difficulties arise in diagnosing acute appendicitis varies from person to person especially in young (>5years), old subjects (>70 years) and females of reproductive age. This may be due to atypical presentation which mimics acute appendicitis.<sup>10</sup> In those cases, clinical examination should be accompanied with other diagnostic modalities such as Ultrasound scan or CT scan to exclude diseases other than appendicitis. The primary goal of surgical treatment is removal of an inflamed appendix prior to perforation, with a minimal number of negative appendectomies.<sup>11-12</sup> This goal assumes that perforation is due to prolonging the interval between onset of symptoms and surgical treatment. The goal is achieved by removal of an inflamed appendix prior to perforation, with a minimal number of negative appendectomies.<sup>12</sup> However, some studies reveal that there is a possibility of negative appendectomy and its rate has been reported up to 20-40% in some of the cases. More over many surgeons advocate early surgical intervention for the treatment of acute appendicitis to avoid complications, accepting the negative appendectomy at a rate of about 15-20%.<sup>13</sup>

Previous studies reveal that several scoring systems has been demonstrated for the effective diagnosis of acute appendicitis, but most of these are complex and not feasible in emergency setting.<sup>14-15</sup> The scoring system developed by Alvarado in 1986 was evolved in making an affirmative diagnosis of acute appendicitis. This scoring system is mainly based on clinical symptoms and signs with minimal investigational support. Alvarado score is assessed prospectively to increase accuracy in preoperative diagnosis of acute appendicitis. It was developed by Alvarado in 1986.<sup>3</sup> It includes 3 symptoms (migratory pain in right iliac fossa, anorexia, vomiting/nausea), 3 signs (fever, tenderness & rebound tenderness in right iliac fossa), 2 lab investigations (leucocytosis, shift to left of neutrophils). Therefore the present study is undertaken to diagnose acute appendicitis with the help of Alvarado score.

## METHODS

**Study Design:** A hospital based prospective study was conducted on 100 consecutive patients admitted in one surgical unit of Narayana Medical College & Hospital, Nellore

**Period of Study:** The work was carried out during the period of May 2009 to May 2011.

**Inclusion Criteria:** Patients of any age group and of both sexes presenting to surgery department with symptoms of acute appendicitis with informed consent were included.

**Exclusion Criteria:** Patients presenting with urological, gynecological or other surgical problems including patients with mass in right iliac fossa and those who are not willing / interested were excluded from this study

The admitted patients were subjected to thorough clinical examination, followed by other baseline investigations like, Hb, TLC, DLC, RFT, Urine examination, X-ray Chest, X-ray KUB and ECG were done. A Proforma containing general information about the patient plus eight variables based on the Alvarado scoring system (Table 1) was filled. All the subjects included in the study remained in contact with doctor for early post-operative complications. With appropriate follow up statistical analysis was performed using statistical software (SPSS version 16).

## RESULTS

The present study is undertaken to diagnose of acute appendicitis as per Alvarado score. 100 subjects were enrolled in the study with their informed consent. The Alvarado scoring system is followed in assessing the patients (Table 1). Initially the demographic variables along with Alvarado score have been assessed and findings displayed in Table 2. The demographic data reveals that out of 100 subjects 52 were males and 48 were females. Clinical analysis of appendicitis indicates its incidence was maximum in the age group of 21-30 years of age (34% in the 3rd decade) and the least incidence was in the 5th decade (4%) as illustrated. Further we studied the various components of Alvarado's.

**Table 1: Determination of scoring pattern in Alvarado score. Interpretations of Alvarado score indicate with a score of 1-3 will be unlikely acute appendicitis, but to be kept on observation for 24-48 hours for any raise in Alvarado score. Score more than 4-6 probable (equivocal) acute appendicitis, and score 7-10 definitely (high probable) acute appendicitis.**

S. No	Symptoms	Score
1	Migratory right iliac fossa pain	1
2	Nausea/ Vomiting	1
3	Anorexia	1
<b>Signs</b>		
1	Tenderness in right iliac fossa	2
2	Rebound tenderness in right iliac fossa	1
3	Elevated temperature	1
<b>Laboratory findings</b>		
1	Leucocytosis	2
2	Shift to the left of neutrophils	1
<b>Total</b>		<b>10</b>

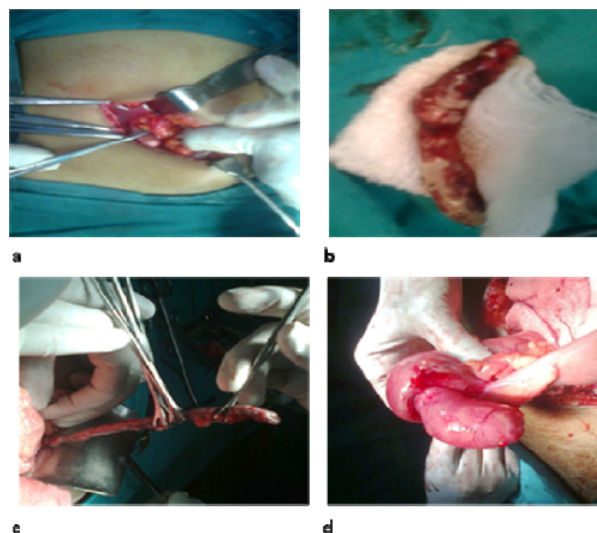
**Clinical Presentation According to the Alvarado's Components:** The findings have been demonstrated in the Table 2. In the components of the Alvarado score, all the subjects were exhibited features related to right iliac fossa, 98% of the subjects had right iliac fossa pain, 60% had

**Table 2: The demographic data reveals age distribution pattern among patients, out of 100 subjects 52 were males and 48 were females. Clinical analysis of appendicitis indicates its incidence was maximum in the age group of 21-30 years of age (34% in the 3rd decade) and the least incidence was in the 5th decade 51-60 (4%) age group.**

Age (years)	Males	Females	Total (%)
5-10	2 (2%)	2 (2%)	4 (4%)
11-20	16 (16%)	13 (13%)	29 (29%)
21-30	18 (18%)	16 (16%)	34 (34%)
31-40	8 (8%)	11 (11%)	19 (19%)
41-50	2 (2%)	3 (3%)	5 (5%)
51-60	2 (2%)	2 (2%)	4 (4%)
61-70	4 (4%)	1 (1%)	5 (5%)
<b>TOTAL (%)</b>	<b>52 (52%)</b>	<b>48 (48%)</b>	<b>100 (100%)</b>
<b>Distribution in the Different Grades of Alvarado Score</b>			
1-4	4	6	10
5-6	14	8	22
7-10	34	34	68
<b>Total</b>	<b>52</b>	<b>48</b>	<b>100</b>

**Table 3: Clinical presentation according to the Alvarado's components demonstrating the Alvarado score, in all the patients which exhibited the features related to right iliac fossa tenderness.**

Alvarado's Components	No. of Cases	Percentage
Right Iliac Fossa Pain	98/100	98%
Anorexia	60/100	60%
Nausea / Vomiting	74/100	74%
RIF Tenderness	100/100	100%
Rebound Tenderness	72/100	72%
Pyrexia	76/100	76%
Leucocytosis	71/100	71%
Arneth count	26/100	26%
<i>Treatment modalities</i>		
<b>Open appendicectomy</b>	29	29%
<b>Lap appendicectomy</b>	54	54%
<b>Conservative</b>	17	17%



**Figure 1: Intraoperative procedure of appendicectomy. a. Appendicectomy in Mc Burney's incision b. Gangrene appendix c. Appendix. d. Mucocele of appendix.**

**Table 4: Correlation of Alvarado score with histopathology reveal that the rate of negative appendicectomy) was very minimal representing with a percentage of 9.6% whereas the Positive predictive value was maximum up to a percentage of 90.4% among these subjects.**

Clinical score	5-7	8-10	Total no. of cases operated
Biopsy positive	12	63	75
Biopsy negative	03	05	08
<b>Total (83)</b>	<b>15</b>	<b>68</b>	<b>83</b>

anorexia, 74% had nausea/vomiting, 76% of the subjects had pyrexia, 71% leucocytosis and 26 % of the subjects had shift of neutrophils to left. Next, we assessed the grading pattern of Alvarado score among these subjects.

**Distribution in the Different Grades of Alvarado Score:** The results have been displayed in Table 3. Analysis of the subjects based on the Alvarado score indicate that, 68% of the subjects exhibited a score more than 7, equally distributed among males (34) and females (34) where as 22% of the subjects had a score between 5 and 7 representing with males up to 13 and females up to 9 respectively. Only 10% of the subjects had a score between 1 and 4 and in these subjects 4 were males and 6 were females. Later, we studied the correlation between Alvarado score in relation with histopathology of appendix specimen (Figure 1).

**Correlation of Alvarado Score with Histopathology**

Findings (Table 4) reveal that the rate of Negative appendicectomy (the proportion of operated subjects

having normal appendix removed) was very minimal representing with a percentage of 9.6% whereas the Positive predictive value (the proportion of subjects with a positive test result who actually have the disease) was maximum up to a percentage of 90.4% among these subjects.

## DISCUSSION

Since appendicitis is a surgical emergency of inflamed appendix and most of the cases require immediate removal through surgery (Figure 1) either open or laparoscopic appendectomy, necessary treatment modalities are required quickly to reduce mortality rates.<sup>5</sup> Therefore timely clinical decision is essential for better diagnosis with the evidence of history and clinical examination. Several studies clearly demonstrated that surgeon's timely decision is mandatory because unnecessary surgical intervention carries the risk of morbidity and mortality.<sup>6</sup> The diagnosis of acute appendicitis is mainly clinical, though ultrasound and laparoscopy can be helpful. Sometimes the correct diagnosis could hardly be made.<sup>16</sup> Diagnostic accuracy regarding appendicitis also depends on the experience of surgeon yet the need for supportive measures is always there.<sup>3</sup> C.T. Scan may resolve the issue supported by ultrasonography and assessment of C-reactive protein levels.<sup>17</sup> However, for the better outcome various scoring systems have been considered.<sup>18</sup> Numerous studies have revealed various scoring systems for the better diagnosis of appendicitis.<sup>19</sup> Few studies highlighted the importance of Alvarado score but studies on south Indian population is rare. Therefore the present investigation is undertaken to assess the clinical diagnosis of acute appendicitis based on the Alvarado score.

The Alvarado scoring system first described in 1986 is simple scoring system that can be instituted easily in outpatient section. Alvarado scoring system (Table 1) works mainly based on the history, physical examination and few laboratory investigations.<sup>18</sup> which remains the mainstay of correct diagnosis of acute appendicitis.<sup>6-14</sup> Out of 100 subjects, 83% were suspected with acute appendicitis and underwent appendectomy (Figure 1). Of those operated, 8 subjects were found to have normal appendix and others were associated with symptoms related to pathology. The rate of negative appendectomy found to be very less representing with a percentage of 9.6% (Table 4).<sup>20-23</sup> Similarly, various studies also presented comparable data and also represented the same rates of incidence related to positive and negative appendectomy (Table 4).<sup>8</sup> Thus, our study is correlated to other studies demonstrating the sensitivity of Alvarado scoring system.<sup>24</sup>

In the present study, none of the patients exhibited an Alvarado score below 4 had appendicitis. Hence, we admitted the patients with a score of 3 and above assessed the impact of Alvarado scoring system among these

people. Therefore, 10 patients with score of 3 and 4 has been admitted and kept under critical observation (Table 2). After thorough examination none of them had appendicitis and our present findings strongly support the basis of Alvarado scoring system. Similar observations has been demonstrated by another study.<sup>25</sup>

Further, 22 patients were exhibited a score in between the range of 5 and 6 were admitted into the hospital out of which 15 patients were subjected to appendectomy, whereas the remaining 7 subjects were discharged on conservative treatment. Thus, the present study strongly supports that the patients with Alvarado Score of 4 or less have no appendicitis and thus no surgical intervention is required. Our findings are correlated with other studies which demonstrated similar results.<sup>25</sup> However, the patients exhibiting a score of 5 or above probably may require surgical intervention. Moreover, it is also important to note that the scoring may not be accurate criterion in patients who fails in giving proper history, such as very young or those with communication problem.<sup>13</sup> Several studies also support our findings.<sup>15</sup>

68 patients were exhibited Alvarado score, between the range of 7 and 10, underwent emergency surgery and found to have acute appendicitis associated with various complications related to pathology, which also further supports the high sensitivity and specificity of Alvarado scoring system (Table 2).

The present study also reveals that the rate of negative appendectomy was very minimal representing with a percentage of 9.6% whereas the Positive predictive value was maximum up to a percentage of 90.4% among these subjects (Table 4). Thus, the Alvarado score showed a good correlation with the histopathological results, "higher the score, greater the incidence of histological proven acute appendicitis". Moreover applying the Alvarado's clinical scoring among the patients presenting with a clinical manifestations of acute appendicitis in the emergency setup prevents false-negative operations.

Various diagnostic aids have been administered to increase the diagnostic accuracy of acute appendicitis but still the clinical diagnosis is superior. In the present study diagnostic tools like ultrasonography has been employed to predict and confirm the diagnosis of acute appendicitis. However patients exhibiting with typical clinical presentations of acute appendicitis based on the Alvarado score does not need modern diagnostic tools like ultrasonography. In addition, the information given by ultrasonography did not improve the diagnostic accuracy in cases of negative or equivocal Alvarado Score.

## CONCLUSION

The above study clearly concludes that the Alvarado score may be a good clinical diagnostic system for exclusion of acute appendicitis with score below 4. In

patients whose clinical scoring falls between the range of 5 and 7 requires critical observation and appropriate investigations like ultrasound and CT scan before the surgical intervention. The present study strongly recommends immediate appendectomy in all patients whose clinical score is more than 7.

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