

## Evaluation of Alvarado Score in Diagnosing Acute Appendicitis

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### Abstract

**Background:** Using a reliable scoring system to diagnose acute appendicitis can help reduce the rate of unnecessary surgery and, henceforth, its complications. This cohort study aimed to evaluate Alvarado scoring system for diagnosing acute appendicitis in our health facility.

**Methods:** 100 patients of different age groups with clinical suspicion of acute appendicitis admitted in the General Surgical Ward, Karak Teaching Hospital in Karak, Jordan, from April, 2013 to December, 2014 were included in the study. All patients underwent surgery and were grouped according to the variables of Alvarado scoring system and then divided into two groups. Group I patients (score 7 or more), group II patients (scores 3-5, and 5-6). Diagnosis was confirmed by histopathologic examination. Reliability of scoring system was assessed by calculating negative appendectomy rate and positive predictive value.

**Results:** Out of total 100 patients, appendicitis was confirmed 80 patients, thus giving negative appendectomy rate of 20% (male 6%, female 16%). Perforation rate was 4%, positive predictive value was 90%, negative predictive value of 29%, sensitivity of 54%, specificity 75%, and diagnostic accuracy value of 58%.

**Conclusion:** Alvarado score is not sensitive tool for aiding diagnosis of acute appendicitis.

**Keywords:** Acute appendicitis; Appendectomy; Scoring system; Alvarado Score

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### Introduction

Acute appendicitis is the most common abdominal surgical emergency with a lifetime cumulative incidence of 7% [1]. In 1886; Fitz described the traditional signs and symptoms of acute appendicitis [2].

The diagnosis of acute appendicitis is basically clinical depending on history, clinical examination and sometimes aided by laboratory investigations (such as white blood cells count or CRP level). Imaging modalities are not requested routinely because they have been shown to add very little information unless there are complications. The definitive diagnosis is achieved at surgery and after histopathologic examination of the resected appendix [3].

Delay in diagnosis and management may result in significant morbidity and, sometimes, mortality. A number of scoring systems have been developed for aiding early diagnosis of acute appendicitis. Previous reports mentioned that scoring systems

are a valuable and valid instrument of discrimination between acute appendicitis and nonspecific abdominal pain [4].

Alvarado scoring system, introduced in 1986, is one of these systems and is based on history, clinical examination and few laboratory findings (Table 1) [5].

### Materials and Methods

This study was carried out on 100 consecutive patients admitted to the Surgical Ward of Karak Teaching Hospital, Karak-Jordan, with the clinical diagnosis of acute appendicitis during the period from April 2013 to December 2014. Patients of any age group and both sexes presenting to the emergency department with pain in right iliac fossa pain and operated with appendectomy were included in the study. Patients with clear presentation of other diagnoses such as urological, gynaecological or acute abdomen conditions other than appendicitis were excluded from the study.

All included patients were admitted after initial assessment in the emergency department and base-line investigations

including complete blood count, urine routine examination, and serum bilirubin level. Then study format was filled in for each patient by a general surgery officer. The format consisted of general patient demographics and Alvarado score variables. The sums of all the scores were calculated for each patient and according to the results patients were divided into two groups: Group I Alvarado score <7 (low and intermediate suspicion group), and group II Alvarado score ≥ 7 (high suspicion group). All the patients underwent appendectomy after variable hours of observation, and the surgical specimens were examined grossly and pathologically. The formats were completed with pathology reports and post operative course.

Finally the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy value of Alvarado scoring system were calculated.

## Results

Our study was conducted on one hundred consecutive patients with clinical picture of acute appendicitis. Among these patients 44 were female (44%) and 56 were male (56%). The male to female ratio was 1:1.2. Mean age was 22.9 years (range 5-61 years, standard deviation +12.5 years), with median age of 19 years. The frequency distribution of patients according to Alvarado scoring system is shown in Table 2.

In group I we had 52 patients totally: 2 patients (2%) with Alvarado score of 3-5, one female and one male, and both had unremarkable appendix pathology. 50 patients (50%) with Alvarado score of 5-7, 25 males and 25 females: The appendix was perforated in two patients, a 40-year old female and a 8-year old male; gangrenous in one patient: A 13-year old female, and unremarkable in 13 patients: 10 females and 3 males. The remaining cases were mostly purulent appendicitis. The true negative (normal appendix) for group I is, thus, 15 cases.

In group II; 48 patients the score was 7-9: 30 males, and 18 females: The average age was 25.5 years. Migratory pain and right iliac fossa tenderness were found in all patients, anorexia in 30% of patients, nausea and vomiting in all but one patient. The temperature was elevated in all but one patient; the average temperature was 38.1. Leukocytosis was evident in 95% patients;

**Table 1** Alvarado scoring system.

Symptoms	Score
Migratory right iliac fossa pain	1
Nausea/ vomiting	1
Anorexia	1
Signs	
Tenderness in right iliac fossa	2
Rebound tenderness in right iliac fossa	1
Elevated temperature	1
Laboratory findings	
Leukocytosis	2
Shift to the left of neutrophils	1
Total	10

**Table 2** Alvarado score distribution among patients.

Alvarado Score	n
3-5	2
5-7	50
7-9	48
Total	100

**Table 3** Pathology types in 100 appendix specimens.

Type	Number of case
Gangrenous	30
Purulent	37
Perforated	4
Catarrhal	9
Unremarkable	20

**Table 4** Diagnostic accuracy of Alvarado score.

Group	n	Confirmed Appendicitis	Normal Appendix
I (Alvarado score ≥ 7)	48	43 (True positive)	5 ( False positive)
II (Alvarado score ≤ 7)	52	37 (False negative)	15 (True negative)
Sensitivity 54%		Specificity 75%	Positive predictive value 90%
Negative predictive value 29%		Diagnostic accuracy value 58%	

average 13,200 without left shift. The appendix was perforated in two male patients and unremarkable in five patients (the false positive), gangrenous in 29, and purulent in 12.

The appendix was normal or unremarkable in 20 (14 females, 6 males) patients which mean a 20% negative appendectomy rate, and perforated in four (three males, one female) patients; perforation rate 4%. The pathology results are shown in Table 3.

In this study, the sensitivity of Alvarado score was 54%, specificity 75%, positive predictive value 90%, negative predictive value 29%, and diagnostic accuracy value 58% as shown in Table 4.

## Discussion

Although it is the most common cause of acute abdomen, acute appendicitis remains a challenging diagnosis because it is primarily a clinical diagnosis with a long list of differential diagnoses. The negative appendectomy rate in this series was 20% which is congruent with the rates reported in the literature of 8% to 33% [6]. Clinical scoring systems proved to be useful in the diagnosis of some surgical conditions. In the past few years deferent scoring systems developed to help diagnosis of acute apendicitis [7]. Although, many scoring systems advocated but most are sophisticated and difficult to implement in the real clinical situation [7]. On the other hand, Alvarado scoring system is a simple system that can be used easily in the clinic or emergency department [5]. To be helpful, the scoring system must be both sensitive and specific. The sensitivity in this study was 54% which is similar to that reported by Al Hashemy and Seleem [6] and lower than that reported by Lone et al of 88% [8]. The positive predicative value 90% in this study is close to that of other studies which may actually reflect the high prevalence of acute appendicitis [9,10]. Negative predictive value was 29%,

and diagnostic accuracy of 58%. Our study shows that Alvarado scoring system is not sensitive enough to consider highly or routinely dependent on for the diagnosis of acute appendicitis. In addition, it may not be accurate in diagnosing acute appendicitis even in patients with score  $\geq 7$  as shown in our series with 5 false positive cases out of 48 (10%).

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## Conclusion

In this study, Alvarado scoring system was found not sensitive in aiding diagnosis of acute appendicitis, probably due to the heterogeneous population studied. Further refinement and adjustments of the scoring system may be needed to improve sensitivity and decrease the controversy over its use routinely.

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