Usefulness Of The Alvarado Scoring System With Respect To Age, Sex And Time Of Presentation, With Regression Analysis Of Individual Parameters

M Wani, M Yousaf, M Khan, A BabaAbdul, M Durrani, M Wani, M Shafi

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Abstract

Appendicitis is an important differential diagnosis in patients with right iliac fossa pain. Diagnosis in patients with equivocal signs can be difficult. We studied 96 consecutive patients admitted and operated with the impression of acute appendicitis, purely on a clinical basis. A pre-operative Alvarado score was done in all patients and compared with intraoperative and histopathological findings. We found that the Alvarado score had high specificity and low sensitivity which also varied with age, sex and time since onset of symptoms. From our study we concluded that this score should not be used as an admission criterion but it should be used to exclude true negatives after admission on clinical basis. Besides, regression analysis revealed that tenderness in the right iliac fossa and migration of pain were most important and anorexia was the least important parameter.

INTRODUCTION

Appendicitis is an important differential diagnosis in patients with right iliac fossa pain. As this is an acute condition, it is impractical to have a definitive diagnosis by a gold standard test (histopathology) before surgery; therefore, we prefer to use a simple test like the Alvarado Scoring System, which is based on the presence or absence of certain variables and is simple and convenient to use. This study was conducted to evaluate the utility and reliability of the Alvarado scoring system for the diagnosis of acute appendicitis in our set-up, by the comparison of the Alvarado scores of patients with their post-operative findings and to ascertain the relative importance of individual parameters of the Alvarado Score in determining the diagnosis.

Acute appendicitis is one of the most common surgical emergencies with a life time prevalence of approximately 1 in 7. Its incidence is 1.5-1.9/1000 in male and female populations. Surgery for acute appendicitis is the most frequently performed operation (10% of all emergency abdominal operations).

The diagnosis of acute appendicitis is based on history, clinical examination and a few laboratory investigations e.g., WBC count, etc. Imaging techniques are not very useful and patients with equivocal signs can present a diagnostic challenge. In all cases, however, a definitive diagnosis can only be obtained at surgery and after pathological examination of the surgical specimen. Prior to surgery the diagnostic accuracy of acute appendicitis remains unsatisfactory, ranging from 25 to 90% and being worse in females than in males. Also a negative appendectomy rate of 20-40% has been documented and many surgeons would accept a rate of 30% as inevitable.[1] Removing a normal appendix is an economic burden on both the patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis. Difficulties in diagnosis often arise in very young, elderly and female patients of reproductive age because they usually have an atypical presentation. Many conditions may also mimic acute appendicitis; in fact, significant numbers of all adults on exploration have diseases other than appendicitis.[2]

In spite of their shortcomings, scoring systems are valid instruments and invaluable in discriminating acute appendicitis from non-specific abdominal pain.[3] Of the many scoring systems currently available, the Alvarado scoring system is the most widely employed, because of its convenience, better accuracy and easy applicability.[4] Studies show that patients with a low Alvarado score (<4) do not have acute appendicitis and Owen et al. (1992) reported that there was no perforated appendicitis in patients with a score

below 6 and recommended the use of the score by general practitioners.[5] Therefore the utility of the Alvarado scoring system cannot be denied. Thus, this study was designed to evaluate the usefulness of this scoring system in the diagnosis of acute appendicitis in our set-up.

METHODS AND MATERIALS

This is a prospective study comprising 96 consecutive patients who were operated in surgical unit 3 of SMHS Hospital with the pre-operative diagnosis of acute appendicitis, from September 2005 to September 2006. Patients of all age groups and both genders who were diagnosed with acute appendicitis purely on a clinical basis and admitted in the hospital for surgery were included in this study. The Alvarado score is based on three symptoms, three signs and two laboratory findings, as shown in Table 1.

Figure 1

Table 1: Alvarado scoring system

Features	Score
Symptoms	
Migratory right iliac fossa pain	1
Nausea/Vomiting	1
Anorexia	1
Signs	
Right iliac fossa tenderness	2
Fever >37.30C	1
Rebound tenderness in right iliac fossa	1
Laboratory Tests	
Leucocytosis (>10x109/L)	2
Neutrophilic shift to the left >75%	1
Total Score	10

The patients were admitted as cases of acute appendicitis on the basis of clinical suspicion alone. This was followed by Alvarado scoring. The decision to operate was made independently of the Alvarado Score and based purely on clinical judgment. The diagnosis of those who underwent surgery was confirmed by both operative findings and histopathological examination of the appendectomy specimen. These findings were compared with the Alvarado Score of the patients, which was calculated after admission.

Two separate calculations were then made. Firstly, the reliability and efficacy of the Alvarado scoring system was assessed by calculating its sensitivity and specificity. This was done separately for different age groups (0-20 and >20), for both sexes and for progressively increasing durations of time that elapsed from onset of symptoms to admission. Literature indicates that a score of 7 or more is highly suggestive of acute appendicitis. Based on this fact, we considered a score of less than 7 as a negative result, while a score of 7 to 10 was considered positive. These results were compared with the postoperative findings and hence we obtained true positives and negatives and false positives and negatives. A negative appendectomy was defined when a normal appendix was removed at surgery.

Secondly, the relative importance of individual parameters of the Alvarado score was ascertained by performing a regression analysis to see their correlation with diagnosis and outcome.

RESULTS

The study comprised 96 patients, 48 males & 48 females, with ages ranging from 7 to 70 years (mean 25.46 years). All the patients underwent surgery after calculation of the Alvarado score, which was compared with the per-operative and postoperative findings.

None of the patients had an Alvarado score below 4. The negative appendectomy rate in our study was 19.1% for males and 35.4% for females (overall 32.3%). The results for the sensitivity, specificity and positive predictive value were as follows:

Figure 2

Table 2: Sensitivity & Specificity Of Alvarado Score In Different Age Groups In Females

Age Group	Alvarado Score	Operative Findings		Sensitivity	Specificity	Positive Predictive Value
		Positive	Negative			
0-20	≥7	13	2	86.66%	75%	86.66%
	4-6	2	6			
≥21	≥7	12	1	66.66%	83.33%	92.3%
	4-6	6	5			

Figure 3

Table 3: Sensitivity & Specificity Of Alvarado Score In Different Age Groups In Males

Age Group	Alvarado Score	Operative Findings		Sensitivity	Specificity	Positive Predictive Value
		Positive	Negative			
0-20	≥7	13	2	86.66%	75%	86.66%
	4-6	2	6			
≥21	≥7	12	1	66.66%	83.33%	92.3%
	4-6	6	5			

Figure 4

Table 4: Sensitivity & Specificity of Alvarado Score after Different Durations of Presentation.

Duration Of Pain	Alvarado Score	Operative Findings		Sensitivity	Specificity	Positive Predictive Value
		Positive	Negative			
24 Hours or Less	≥7	32	1	71.1%	93.75%	97%
	4-6	13	15			
1-3 Days	≥7	10	1	58.8%	87.5%	90.9%
	4-6	7	7			
> 3 Days	≥7	2	3	33.33%	25%	40%
	4-6	4	1			

The data clearly shows that the specificity and hence the ability of the Alvarado scoring system to exclude true negatives (i.e. patients who do not have acute appendicitis) remains reasonably high in both age groups for both males and females. In contrast, the sensitivity and hence the ability of the Alvarado scoring system to detect true positives (i.e. patients who do have acute appendicitis) falls considerably in the age group of above 20 for both sexes.

As the time lapse from the onset of symptoms to the presentation increases the specificity remains high while the sensitivity falls greatly after the first 24 hours. However, even the specificity falls precipitously after 3 days.

The positive predictive value remains high in both age groups (< and > 20 years of age), in both sexes (89.3% for males and 90.5% for females) and also for up to 3 days after the onset of symptoms (pain); after that it declines.

The results of the regression analysis are given in the form of a regression equation as follows:

TOTAL SCORE = - 0.821 + 1.05 M + 0.921 A + 0.959 N + 1.47 T + 0.958 R + 1.02 E + 0.976 L + 0.942 S

Each parameter is indicated by its corresponding letter (according to the acronym MANTRELS) given after its regression score. The higher the value of a particular parameter the greater is its correlation with the diagnosis and therefore the more important it is in determining the diagnosis and final outcome. From the above equation it is clear that right lower quadrant tenderness is the most important parameter followed by migration of pain. The least important parameter is anorexia. The p-value was calculated to be 0.000 which is highly significant.

DISCUSSION

In spite of the radical advances in medical technology, appendicitis still poses a diagnostic challenge. The main aim of the clinician is to reach an accurate diagnosis in the fastest most economical way possible without subjecting the patient to unnecessary surgery or investigations. Presently, a good clinical acumen remains the mainstay of correct diagnosis of appendicitis. However, such clinical skills are gained only after considerable experience. Also a majority of the time the junior surgeons have to make the initial assessment of suspected cases of acute appendicitis in the casualty or OPD; hence the need for a complementary diagnostic aid. Recently, ultrasonography has shown good results, but they have limitations and drawbacks.[6] Likewise, many diagnostic scoring systems have proven to be complex and difficult to be implemented in a clinical situation. In contrast, the Alvarado score, first described in 1988, is a simple scoring system that can be instituted easily in the outpatient setting.

Our study tries to analyze the utility and efficacy of the Alvarado scoring system in our set-up so that we are able to better interpret the scores which will help us to improve the usage of this diagnostic tool in the OPD.

Our results showed that the Alvarado scoring system has a low sensitivity. Hence as a clinical aid for diagnosing cases of acute appendicitis among patients complaining of right iliac fossa pain it has limited value, especially in older patients (over 20) and when the patient presents after the first 24 hours. On the other hand, the Alvarado scoring system has a high specificity, in both sexes, over a wide range of age groups and also in patients who present late. In other words, it is useful in identifying patients who do not have acute appendicitis and hence in avoiding unnecessary surgery. As a result, the negative appendectomy rate can be lowered by the use of the Alvarado scoring system; a fact that is also reflected by its high degree of positive predictive value and thus of diagnostic accuracy.

The results of the regression analysis of the parameters in the

Alvarado score show that migration of pain is the single most important symptom pointing towards a diagnosis of acute appendicitis.

Therefore, given the observations and inferences made in our study, certain conclusions and guidelines can be laid down for the proper usage of the Alvarado scoring system to maximize its utility:

1. Any patient with suspected acute appendicitis should be admitted purely on clinical suspicion, and the Alvarado score should not be used as an admitting criteria.

2. Following admission, evaluate the patient and calculate the Alvarado score keeping in mind the patient's age, sex and duration of symptoms, because as we have inferred all these have a bearing on the interpretation of the Alvarado score.

3. If the score is 7 or above, perform a laparotomy with the impression of acute appendicitis. However, if the score is below 7, keep the patient under observation and calculate the score again after 12 hours. If the score remains below 7, patient is unlikely to have appendicitis.

4. Of all the parameters, maximum stress should be laid on history of migration of pain and finding right lower quadrant tenderness.

CORRESPONDENCE TO

Mudassir Maqbool Wani Doctors Hostel Room no 20 GMC Srinagar, JK, India Pin 190010 Email mudds_123@Yahoo.co.in Phone no 9906533228

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Author Information

Mudassir Maqbool Wani
Department of General Surgery, SMHS Hospital

Mohhamed Nasir Yousaf
Department of General Surgery, SMHS Hospital

Mussadiq A. Khan
Department of General Surgery, SMHS Hospital

Aijaz BabaAbdul
Department of General Surgery, SMHS Hospital

Munan Durrani
Department of General Surgery, SMHS Hospital

Mubashir M. Wani
Department of General Surgery, SMHS Hospital

Muhhamed Shafi
Department of General Surgery, SMHS Hospital