

Alvarado Scoring System in Prediction of Acute Appendicitis

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of Alvarado score for the prediction of acute appendicitis.

Study Design: Analytical study.

Place and Duration of Study: This study was carried out in the Department of Surgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, during the period from January 15, 2009 to July 15, 2010.

Methodology: The study included all adult patients of either gender who presented with clinical findings suggestive of acute appendicitis, who were assigned Alvarado score of < 4 pre-operatively and subsequently underwent emergency appendectomy with histological examination of the resected specimens. Based on the Alvarado score, the patients were stratified into two groups. i.e. Group I (with a score of > 7) and Group II (with a score of 5-7). Alvarado score was compared with the histopathology. The data was subjected to statistical analysis to measure the objective.

Results: The overall sensitivity, specificity, positive predictive value and negative predictive value of Alvarado score for acute appendicitis were 66%, 81%, 96%, 29% respectively. The sensitivity was higher though not significant, for males with a score over 7 than females with similar scores (97% vs. 92%). However, for scores less than 7, sensitivity among males was significantly higher than females with similar scores (79% vs. 61%; $p < 0.05$).

Conclusion: The presence of a high Alvarado score in adult males is highly predictive of acute appendicitis, however, in women of child bearing age other causes of similar clinical presentation lead to a low diagnostic accuracy of the score.

Key words: Acute appendicitis. Alvarado score. Appendectomy. Appendectomy.

INTRODUCTION

Acute appendicitis is one of the commonest abdominal emergencies and appendectomy is in fact the most common abdominal emergency operation performed world over. The clinical presentation of acute appendicitis may vary from non-specific vague abdominal pain to the classic presentation of right iliac fossa pain, tenderness and rebound tenderness. Left untreated, appendicitis has the potential for severe complications, including perforation, sepsis, and even death.¹⁻³

The diagnosis of appendicitis is clinical and essentially is based on history, clinical examination and routine laboratory tests. The classic form of appendicitis may be promptly diagnosed and treated, however, when it presents with atypical features, it poses a diagnostic challenge. In such cases, laboratory and imaging investigation may be useful in establishing a correct diagnosis. Early and accurate diagnosis is essential to prevent morbidity and mortality related to appendicitis. According to available statistics, 1 out of 5 cases of appendicitis is misdiagnosed whereas a normal appendix is found in 15-40% of patients who undergo an emergency appendectomy.¹⁻³ In attempts to increase

the diagnostic accuracy and reduce the high negative appendectomy rate, various scoring systems, imaging modalities and novel techniques have been devised, however, most of these are complex, expensive and difficult to implement in emergency situation.^{1,4-7}

The present study was undertaken to evaluate the usefulness of Alvarado score in patients with provisional diagnosis of acute appendicitis and hence evolve evidence base that would guide clinical decision making in patients presenting with clinical features suggestive of acute appendicitis.

METHODOLOGY

The study included all adult patients of either gender who presented with clinical findings suggestive of acute appendicitis, who were assigned Alvarado score pre-operatively and who subsequently underwent emergency appendectomy with histological examination of the resected specimens. Patients who either did not consent to participate in the study, those who received initial management at other hospitals or those with Alvarado score of 1-4 were excluded. Based on Alvarado score (Table I), the patients were stratified into two groups. i.e. Group I (with a score of > 7) and Group II (with a score of 5-7) All the patients received standard emergency pre-operative management with nil by mouth status, intravenous fluids and Metronidazole, and systemic analgesics. All patients were subsequently treated with appendectomy via Grid iron incision. Operative findings were recorded and the resected specimens were sent for histopathological examination.

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Table I: The Alvarado score.

Variables	Clinical features	Score
Symptoms	Migratory right iliac fossa pain	1
	Anorexia	1
	Nausea/ Vomiting	1
Signs	Tenderness right iliac fossa	2
	Rebound tenderness	1
	Elevated temperature $\geq 37.3^{\circ}\text{C}$	1
Laboratory findings	Leukocytosis $\geq 10.0 \times 10^9/\text{L}$	2
	Neutrophils $\geq 75\%$ or left shift	1
Total score		10

Alvarado score was correlated with the histopathology. The data were recorded on proforma and subjected to statistical analysis to measure the objective.

The data was analysed through Statistical Package for Social Sciences (SPSS) version 10 and various descriptive statistics were used to calculate frequencies, percentages, means and standard deviation. The numerical data such as age were expressed as mean \pm standard deviation while the categorical data such as histopathology of the resected specimens were expressed as frequency and percentages. Two-by-two table was employed to determine sensitivity, specificity, positive predictive value and negative predictive value. Percentages were compared by employing chi-square test and a p-value of less than 0.05 was regarded statistically significant.

RESULTS

Out of a total of 262 patients, 58 % (n=152) were males while 42% (n=110) were females. The age range was 13-61 years, with a mean of 22.27 ± 7.67 years. Majority of the patients (90.45%) were in their 2nd and 3rd decades of life.

There were 157 patients in Group I (with a score of > 7) while 105 patients in Group II (with a score of 5-7). In Group I, out of 157 patients, 150 (96%) had acute appendicitis on histopathology while 7 patients (4%) showed negative results. In Group II, out 105 patients, 75 (71%) patients were confirmed as acute appendicitis on histopathology while 30 (29%) showed negative results. Overall rate of negative appendectomy for the two groups was 14%. The rate of negative appendectomy was significantly higher in group II than group I (29% vs. 4%; $p < 0.05$). Gender-wise, the rate of negative appendectomy was significantly higher in females than males (21% vs. 9%; $p < 0.05$).

The overall sensitivity, specificity, positive predictive value and negative predictive value of Alvarado score for acute appendicitis were 66%, 81%, 96%, 29% respectively. The sensitivity was higher though not significant, for males with a score over 7 than females with similar scores (97% vs. 92%). However, for scores less than 7, sensitivity among males was significantly higher than females with similar scores (79% vs. 61%; $p < 0.05$, Table II).

Table II: Correlation of Alvarado score with histopathological findings (n=262).

	Alvarado score		Total
	> 7	5-7	
Histopathology			
Appendicitis	150 [92/58]*	75 [46/29]*	225
Normal appendix	7 [2/5]*	30 [12/18]*	37
Total	157 [94/63]*	105 [58/47]*	

* Figures in parentheses indicate males versus females respectively.

Table III: Histopathology and operative findings among the two groups.

Histopathology/operative findings	Group I (n=157)	Group II (n=105)	p-value (%)
Acute appendicitis	129 (82.16%)	75 (71.42%)	0.02*
Acute appendicitis with perforation	21 (13.37%)	0 (%)	0.01*
Normal appendix with no per-operative diagnosis	1 (0.63%)	12 (11.42%)	0.02*
Meckel's diverticulitis	2 (1.27%)	1 (0.95%)	0.5**
Pelvic inflammatory disease	1 (0.63%)	3 (2.85%)	0.5**
Acute salpingitis	0 (%)	1 (0.95%)	0.5**
Ruptured right ovarian cyst	2 (1.27%)	7 (6.66%)	0.5**
Torsion of ovarian cyst	0 (%)	3 (2.85%)	0.5**
Ruptured ectopic pregnancy	1 (0.63%)	3 (2.85%)	0.5**

* Significant; ** Insignificant.

Out of 262 patients, 21 patients (13%) had perforated appendix and all had Alvarado score over 7 (Table III).

DISCUSSION

Although acute appendicitis is a common surgical emergency presentation, it still poses significant diagnostic challenge to the clinical judgment of young trainee surgeons who are often the first ones to diagnose it. It is highly desirable not to miss a diagnosis as the condition has a potential for significant complications. Also it is equally important to avoid unnecessary surgery for an otherwise normal appendix. In 1986 Alvarado introduced a scoring system in order to aid clinical diagnosis of acute appendicitis and also reduce the rate of negative appendectomies.⁸

In this study, there was a slight male preponderance and more frequent involvement of young individuals. Male predominance and more frequent involvement of younger population is also reported in the published literature.^{1,9,10}

In this series, the rate of negative appendectomy was 14%. This is comparable with the published literature where upto 40% rate of negative appendectomies is reported.^{1,11,12}

In this study, Alvarado scoring system was highly sensitive for the diagnosis of acute appendicitis in adult males. This finding is in conformity with other published studies.¹²⁻¹⁵

Alvarado scoring system was not found to be of high sensitivity in women of child bearing age. In this subset of patients, negative appendectomy rate was 21%. In fact women of child bearing age pose a diagnostic dilemma as various gynaecological conditions may present with signs and symptoms similar to those of acute appendicitis. One concern in this subset of patients is to avert unnecessary appendectomies, however, it is also imperative not to miss or delay a needed appendectomy as there is otherwise risk of perforation with greater morbidity in the short-term potentially leading to late complications such as adhesive obstruction or infertility. Lamparelli *et al.* employed a combination of Alvarado score and laparoscopy in adult females to increase the diagnostic accuracy.¹⁶ Diagnostic laparoscopy is now increasingly being advocated in this group of patients.¹⁷⁻¹⁹

In this study, none of the patients with perforated appendix had an Alvarado score of less than 7. This means that patient with score between 5-7 may safely be kept under observation followed by serial re-evaluation with Alvarado scoring and the decision to operate or not may be changed accordingly.

Alvarado score was found to be simple and easy to apply, since it relies only on history, clinical examination and routine laboratory investigations. Alvarado score provides an economical alternative to the other available costly diagnostic modalities such as CT scan, MRI scans etc. Such economic implications are particularly important in the context of our poor patients. The study illustrates that this simple scoring system in adult males suspected of having acute appendicitis works reliably well. However, in women, particularly those of child bearing age, its predictive value falls disappointingly short of expectations. Unnecessary surgery in this latter group can be avoided by employing other diagnostic modalities such as diagnostic laparoscopy.

This is a single centre study which remains a limitation.

CONCLUSION

The presence of a high Alvarado score in adult males is highly predictive of acute appendicitis, however in women of child bearing age other causes of similar clinical presentation lead to a low diagnostic accuracy of the score. Hence, Alvarado score when employed alone in the pre-operative assessment of adult males can considerably reduce the negative appendectomy rate without increasing morbidity and mortality. In females of child bearing age other diagnostic modalities should be selectively employed to complement the Alvarado score.

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