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Original Research Article

# Prospective Observational Assessment of Alvarado Score in Diagnosis of Acute Appendicitis

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**Conflict of interest: Nil**

**Abstract**

**Background:** Acute appendicitis is a common cause of abdominal pain for which a prompt diagnosis is rewarded by a decrease in morbidity and mortality. Delay in the diagnosis will lead to an increased morbidity and mortality rate, on another hand overzealous diagnosis may lead to increased negative appendectomy rates. Notwithstanding advances in modern radiographic imaging and diagnostic laboratory investigations, the diagnosis of appendicitis remains essentially clinical.

**Material & Methods:** A prospective observational study was planned in which a total of 120 operated cases of appendicectomy were studied in the Department of Surgery, Shri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India, over a period of one year. All patients who underwent an appendectomy at the hospital were identified.

**Results:** 47 out of 100 patients had scored an Alvarado score of less than 7, suggesting a clinically very low probability of having acute appendicitis. In spite of scoring less than 7, 34 patients had been diagnosed with acute appendicitis on histopathological examination, 6 patients had been diagnosed with acute perforated appendicitis while only 21 patients had sub acute appendicitis.

**Conclusion:** In this study, we concluded that the Alvarado score has a very high positive predictive value i.e.; diagnostic accuracy. Also with the help of the Alvarado score, we can reduce the number of negative appendicectomies.

**Keywords:** Alvarado score, acute appendicitis, Positive predictive value



## Introduction

Acute appendicitis (AA) is caused by inflammation of the vermiform appendix with many hypotheses justifying this disease's etiology. One of the main etiologies is obstruction of the appendicular lumen, whether by stool, vegetable seeds, foreign body, or neoplasm, which increases luminal pressure of the appendix with the subsequent impaired vascular supply of the appendicular wall and hence inflammation and perforation [1]. Another hypothesis is going with racial and genetic distribution, while another study is referring to environmental and socioeconomic

distribution [2,3]. Most emergency departments worldwide reported AA as the most common surgical emergency they faced in daily activities [4]. The risk of getting this disease during a person's lifetime is about 6%-9%, affecting the young population between the second and third decades of their lives [5,6]. Medical presentations range from abdominal pain to a life-threatening disease with peritonitis and septic shock. Therefore, early diagnosis of AA is the main factor that leads to the best outcome in managing this common disease [1,7]. The management can also be tailored according to the presentation from nonoperative with antibiotics to exploration laparotomy in delayed and neglected cases.

A correct and timely diagnosis of acute appendicitis is very important in the medical practice since it could avoid complications such as perforation, abscess formation and peritonitis, and at the same time could reduce the negative appendectomy rate. [8]

**Material & Methods:**

A prospective observational study was planned in which a total of 120 operated cases of appendicectomy were studied in the Department of Surgery, Shri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India, over a period of one year. All patients who underwent an appendectomy at the hospital were identified.

Ethical clearance was sought for conducting the research from the research ethics committee before carrying out the study, permission was also sought from the management. Patients themselves and relatives/guardians were informed about the purpose of the study.

**Inclusion criteria:**

All patients operated for appendicectomy at the Department of Surgery, Shri Krishna Medical College and Hospital, Muzaffarpur, Bihar, India.

**Exclusion criteria:**

Patients with following criterias were excluded:

(a) hemodynamically unstable patients;

(b) appendicular mass;

(c) having associated abdominal Koch's, intestinal obstruction, ulcerative colitis; and

(d) appendectomy is done as a part of other surgery.

**Methodology**

Their clinical diagnosis was obtained by the Alvarado score which was compared with their radiological diagnosis obtained by ultrasonography, and Histopathology diagnosis to assess the sensitivity and specificity of the Alvarado score. Demographic data and percentages of clinical signs and symptoms seen were calculated. The data were entered in the data collection tool which is STATA 14 and the results were analyzed and interpreted accordingly. The patients were categorized according to their Alvarado score as shown in Table 1.

**Table 1: Categorization of patients according to their Alvarado Score (MANTRELS covers the combination of factors derived from physical signs, symptoms, and laboratory tests described by Alvarado)**

| Alvarado Score | |
|---|---|
| **Feature** | **Score** |
| Migration of pain | 1 |
| Anorexia | 1 |
| Nausea | 1 |
| Tenderness is right lower quadrant | 2 |

| | |
|---|---|
| Rebound pain | 1 |
| Elevated temperature | 1 |
| Leucocytosis | 2 |
| Shift white blood cell count to the left | 1 |
| Total | 10 |

| Recommendations | Score |
|---|---|
| **Highly likely** | **9 or 10** |
| **Likely** | **7 or 8** |
| **Possible** | **5 or 6** |
| **Unlikely(U)** | **<5** |

**Results:**

47 out of 100 patients had scored an Alvarado score of less than 7, suggesting a clinically very low probability of having acute appendicitis. In spite of scoring less than 7, 34 patients had been diagnosed with acute appendicitis on histopathological examination, 6 patients had been diagnosed with acute perforated appendicitis while only 21 patients had subacute appendicitis (Table 1).

**Table 1: Comparison of clinical and histopathological diagnosis**

| Score | Acute appendicitis | Acute perforated appendicitis | Sub-acute appendicitis | Total |
|---|---|---|---|---|
| ≥7 | 34 | 9 | 3 | 46 |
| <7 | 47 | 6 | 21 | 74 |
| Total | 81 | 15 | 24 | 120 |

A score of 7 and more will be counted as a positive test to diagnose acute appendicitis and less than a 7 score will be counted as a negative test to diagnose acute appendicitis (Table 2).

**Table 2: Incidence of acute and sub-acute appendicitis**

| Score | Acute appendicitis | Sub-acute appendicitis | Total |
|---|---|---|---|
| ≥7 (positive test) | 48 (True positive) | 3 (False positive) | 51 |
| <7 (negative test) | 48 (false positive) | 21 (True negative) | 69 |
| Total | 96 | 24 | 120 |

So from the above data PPV of Alvarado score is 95%, suggesting patients having a score of more than 7 are more likely to have acute appendicitis, and NPV is 29.4 % suggesting patients having a score of less than 7 cannot be ruled out for acute appendicitis and alternate investigations should be done to rule out acute appendicitis. Based on this data sensitivity and specificity of Alvarado's scoring for this study is 52% and 86.3 % respectively.

**Discussion**

A study by Owen et al. involving 215 patients over a 12-monthperiod with similar conclusions. However, the negative appendix rate in women in our series using the Alvarado score was higher (33% versus 22%). [9]

Karami, et al. [10], in a prospective study comparing the RIPASA, Alvarado and AIR scoring systems, found that the sensitivity and specificity of the RIPASA score were 93.18% and 91.67%, respectively. The sensitivities of the Alvarado and AIR scores were 78.41% for both.

Naz, et al. [11], in a study to determine the concordance between the RIPASA and the Alvarado scores for the diagnosis of acute appendicitis, found that using the Kappa statistics, the Kappa value was 0.847 ($p > 0.05$) which means a strong agreement between both scoring systems.

The negative appendectomy (NA) rate on HP results was 4% in this study, which is considered favorable in comparison to the literature rate [12-15]. In addition, we found that the female and male gender (51.9% and58.1%, respectively) are equally in obtaining NA in this study, which is entirely different from other studies that confirmed that the NA rate was more prevalent in the female gender [16-18]. The most frequent Alvarado score components were tenderness of the right iliac fossa (99.3%), followed by rebound tenderness and leukocytosis, which are comparable to other studies [19-20]. However, it showed differences between the study of Swami et al. [21], who reported a lower incidence of leukocytosis, and Rodrigues et al. [22], where an elevated temperature was the most predominant.

Bond et al prospectively studied 187 patients with suspected appendicitis and found Alvarado score to have a sensitivity and specificity of 90% and 72% respectively. Hsiao et al conducted a retrospective study and found that sensitivity and specificity for an Alvarado score ≥7 were 60% and 61% respectively. [23] Higher sensitivity and specificity 92% and 82% respectively were found in a retrospective study by Rezal et al. [24] This study also suggested that patients with scores of more than 7 were managed directly by appendicectomy without CT evaluation, this would have caused a 27% reduction in CT scanning. [25,26] A prospective evaluation of Owen et al shows sensitivity and specificity of Alvarado score were 93% and 81% respectively. [9]

## Conclusion:

In this study, we concluded that the Alvarado score has a very high positive predictive value i.e.; diagnostic accuracy. Also, with the help of the Alvarado score, we can reduce the number of negative appendicectomies.

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