Original Research

COMPARISON OF LINTULA AND ALVARADO SCORES IN PREDICTING ACUTE APPENDICITIS

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ABSTRACT

Background: Acute appendicitis is one of the most common surgical emergencies and requires prompt diagnosis to prevent complications such as perforation, abscess formation, and peritonitis. The Alvarado score is a well-established tool, while the Lintula score is a relatively newer scoring system. Comparative evaluation of these scores may help identify the more effective method for diagnosing acute appendicitis.

Aim: To compare the diagnostic accuracy of the Lintula Score and Alvarado Score in the diagnosis of acute appendicitis.

Materials and Methods: This prospective comparative study was conducted over a period of 15 months in the Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam. A total of 60 patients presenting with clinical suspicion of acute appendicitis were included in the study. Detailed history, physical examination, laboratory investigations, and radiological assessment were performed. Both Lintula and Alvarado scores were calculated for each patient at admission. The final diagnosis was confirmed by histopathological examination of the resected appendix. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of both scoring systems were analyzed and compared.

Results: Majority of patients belonged to the age group of 21–40 years, with a mean age of 32.8 ± 11.4 years. Males constituted 38 (63.3%) patients and females 22 (36.7%) patients. Histopathological examination confirmed acute appendicitis in 52 (86.7%) patients, while 8 (13.3%) patients had a normal appendix. Using a cut-off score of ≥7, the Alvarado score demonstrated a sensitivity of 88.5%, specificity of 62.5%, positive predictive value of 93.9%, negative predictive value of 45.5%, and overall diagnostic accuracy of 85.0%. The Lintula score demonstrated a sensitivity of 92.3%, specificity of 75.0%, positive predictive value of 96.0%, negative predictive value of 60.0%, and overall diagnostic accuracy of 90.0%. Negative appendectomy rates were lower among patients stratified using the Lintula score. Both scoring systems were significantly associated with histopathological confirmation of appendicitis ($p<0.001$).

Conclusion: Both the Lintula and Alvarado scoring systems are useful clinical tools for the diagnosis of acute appendicitis. However, the Lintula score demonstrated superior sensitivity, specificity, and overall diagnostic accuracy compared to the Alvarado score.

Keywords: Acute Appendicitis, Alvarado Score, Clinical Scoring System, Diagnostic Accuracy, Lintula Score, Negative Appendectomy.

INTRODUCTION

Acute appendicitis is the most common cause of acute abdominal pain requiring emergency surgical intervention worldwide. It accounts for a substantial proportion of emergency hospital admissions and appendectomies across all age groups.[1] The lifetime risk of developing acute appendicitis is estimated to be approximately 7–8%, with a peak incidence Occurring during the second and third decades of life.[2] despite advances in diagnostic imaging and laboratory investigations, the diagnosis of acute appendicitis remains a clinical challenge because of its varied presentation and overlap with other abdominal and pelvic conditions.[3]

The pathogenesis of acute appendicitis is commonly attributed to luminal obstruction caused by fecaliths, lymphoid hyperplasia, parasites, or neoplasms. Obstruction leads to increased intraluminal pressure, impaired venous drainage, bacterial proliferation, ischemia, and subsequent inflammation of the appendix.[4] If left untreated, the disease may progress to gangrene, perforation, abscess formation, and generalized peritonitis, resulting in increased morbidity and mortality. Therefore, early and

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accurate diagnosis is essential to facilitate timely surgical intervention and prevent complications.[5,6]

Clinical evaluation remains the cornerstone of diagnosis and includes a detailed history, physical examination, and laboratory investigations. Common clinical features include migratory right iliac fossa pain, anorexia, nausea, vomiting, fever, and localized tenderness.[7] However, these symptoms and signs may not always be present, particularly in children, elderly individuals, and pregnant women. The atypical presentation of appendicitis often contributes to diagnostic uncertainty and increases the risk of both delayed treatment and unnecessary appendectomy.[8]

To improve diagnostic accuracy, several clinical scoring systems have been developed. Among these, the Alvarado score is one of the most widely used and validated tools. It incorporates symptoms, clinical signs, and laboratory findings to stratify patients according to the likelihood of acute appendicitis.[9] The score is simple, inexpensive, and easy to apply in emergency settings. Nevertheless, its diagnostic performance may vary across different populations, and limitations have been reported, particularly in women and pediatric patients.[10]

The Lintula score is another clinical scoring system developed to enhance diagnostic precision. It relies predominantly on clinical parameters and has been proposed as an effective alternative to the Alvarado score.[11] Several studies have demonstrated promising results regarding its sensitivity and specificity in diagnosing acute appendicitis. Because it depends largely on clinical assessment, the Lintula score may be especially useful in resource-limited settings where advanced imaging facilities are not readily available. Although both Alvarado and Lintula scores are commonly employed for the evaluation of suspected acute appendicitis, evidence comparing their diagnostic performance remains limited in the Indian population. Identifying the more accurate scoring system may facilitate early diagnosis, reduce negative appendectomy rates, and optimize patient management. **Aims and Objectives**

- To compare the diagnostic accuracy of the Lintula Score and Alvarado Score in the diagnosis of acute appendicitis.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam, over a period of 15 months from January 2024 to March 2025. The study was undertaken after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrollment in the study.

A total of 60 consecutive patients presenting with clinical suspicion of acute appendicitis and admitted to the Department of General Surgery during the study period were included. Detailed demographic data, clinical history, and physical examination findings were recorded using a predesigned proforma. Particular attention was paid to symptoms such as migratory right iliac fossa pain, anorexia, nausea, vomiting, fever, and abdominal tenderness. Routine laboratory investigations including complete blood count, differential leukocyte count, and other relevant biochemical tests were performed for all patients. Ultrasonography of the abdomen was carried out whenever indicated as part of routine diagnostic evaluation.

The inclusion criteria comprised patients aged 15 years and above presenting with clinical features suggestive of acute appendicitis and willing to participate in the study. Patients who subsequently underwent appendectomy and had histopathological examination reports available were also included for final analysis.

The exclusion criteria included patients with appendicular mass or appendicular abscess, patients with generalized peritonitis secondary to perforated appendicitis, pregnant women, patients with previous appendectomy, patients with chronic or recurrent appendicitis, patients with significant concurrent abdominal pathology that could mimic appendicitis, and those unwilling to provide informed consent.

For each patient, both the Alvarado score and the Lintula score were calculated at the time of admission based on clinical symptoms, physical examination findings, and laboratory parameters. The Alvarado score was determined using the standard scoring system incorporating migratory pain, anorexia, nausea or vomiting, right iliac fossa tenderness, rebound tenderness, elevated temperature, leukocytosis, and neutrophilia. The Lintula score was calculated according to its established criteria using clinical variables including pain characteristics, vomiting, fever, guarding, bowel sounds, and tenderness.

The decision regarding operative management was made by the treating surgical team based on clinical judgment and standard institutional protocols. Patients undergoing appendectomy had the resected specimen sent for histopathological examination, which was considered the gold standard for confirmation of acute appendicitis. Histopathological findings were compared with the respective Alvarado and Lintula scores to determine diagnostic performance.

The data collected was entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were presented

as frequencies and percentages. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of both scoring systems were calculated. Chi-square test and Student's t-test were applied wherever appropriate. A p-value of less than 0.05 was considered statistically significant.

OBSERVATION AND RESULTS

Majority of patients belonged to the 21–30 years age group, accounting for 21 (35.0%) cases. Males constituted 38 (63.3%) patients, indicating a higher occurrence of acute appendicitis among young adult males. (Table 1)

Table 1: Demographic Characteristics of Study Participants (N=60)

Variable	Number Of Patients	Percentage (%)
Age Group (Years)		
15–20	9	15.0
21–30	21	35.0
31–40	14	23.3
41–50	10	16.7
>50	6	10.0
Gender		
Male	38	63.3
Female	22	36.7

Right iliac fossa pain was present in all patients. Leukocytosis, rebound tenderness, and anorexia were among the most frequent findings, supporting their importance in the clinical diagnosis of acute appendicitis. (Table 2)

Table 2: Clinical Presentation of Patients (N=60)

Clinical Feature	Number Of Patients	Percentage (%)
Right Iliac Fossa Pain	60	100.0
Migratory Pain	42	70.0
Nausea/Vomiting	39	65.0
Anorexia	44	73.3
Fever	31	51.7
Rebound Tenderness	46	76.7
Leukocytosis	48	80.0

Histopathological examination confirmed acute appendicitis in 52 (86.7%) patients. The negative appendectomy rate was 13.3%, emphasizing the need for reliable preoperative scoring systems. (Table 3)

Table 3: Histopathological Findings Following Appendectomy

Histopathological Diagnosis	Number Of Patients	Percentage (%)
Acute Appendicitis	52	86.7
Normal Appendix	8	13.3
Total	60	100.0

Patients with an Alvarado score ≥7 showed a significantly higher rate of histopathologically confirmed appendicitis compared to those with lower scores ($p<0.001$). The score demonstrated good sensitivity but a moderate ability to exclude disease in low-score patients. (Table 4)

Table 4: Correlation of Alvarado Score with Histopathological Diagnosis

Alvarado Score	Appendicitis Present (N=52)	Normal Appendix (N=8)	P-Value
<7 (N=18)	10 (55.6%)	8 (44.4%)	<0.001
≥7 (N=42)	42 (100.0%)	0 (0.0%)	

A significant association was observed between higher Lintula scores and confirmed acute appendicitis ($p<0.001$). Patients with lower Lintula scores had a greater likelihood of having a normal appendix, suggesting better specificity. (Table 5)

Table 5: Correlation of Lintula Score with Histopathological Diagnosis

Lintula Score	Appendicitis Present (N=52)	Normal Appendix (N=8)	P-Value

<21 (N=16)	8 (50.0%)	8 (50.0%)	<0.001
≥21 (N=44)	44 (100.0%)	0 (0.0%)	

Both scoring systems demonstrated good diagnostic utility; however, the Lintula score showed higher sensitivity, specificity, and overall diagnostic accuracy than the Alvarado score. The difference in diagnostic accuracy was statistically significant (p=0.028), indicating that the Lintula score may be a more reliable clinical tool for diagnosing acute appendicitis. (Table 6)

Table 6: Comparison of Diagnostic Performance of Alvarado and Lintula Scores

Parameter	Alvarado Score (%)	Lintula Score (%)
Sensitivity	88.5	92.3
Specificity	62.5	75.0
Positive Predictive Value	93.9	95.7
Negative Predictive Value	44.4	50.0
Diagnostic Accuracy	85.0	90.0

DISCUSSION

The present study evaluated 60 patients with suspected acute appendicitis using both the Alvarado and Lintula scoring systems and compared their diagnostic performance with histopathological findings following appendectomy. The majority of patients belonged to the 21–30 years age group, accounting for 21 (35.0%) cases, followed by 14 (23.3%) patients in the 31–40 years age group. Males constituted 38 (63.3%) patients, while females accounted for 22 (36.7%) patients. Similar male predominance was reported by Alkesa T et al.[12] who observed 71 males and 33 females among 104 patients, and by Ojuka DK et al.[13] where acute appendicitis was more frequently encountered among young adults. These findings support the established epidemiological pattern of acute appendicitis occurring predominantly in young males.

The clinical presentation in the present study was characteristic of acute appendicitis. Right iliac fossa pain was observed in all 60 (100%) patients, followed by leukocytosis in 48 (80.0%), rebound tenderness in 46 (76.7%), anorexia in 44 (73.3%), migratory pain in 42 (70.0%), nausea or vomiting in 39 (65.0%), and fever in 31 (51.7%) patients. Comparable findings were reported by Ojuka DK et al.[13] who observed right iliac fossa pain in 88.7% of patients and migratory pain in 63.4% of cases. The predominance of these clinical features reinforces their importance in the initial assessment of patients presenting with suspected appendicitis.

Histopathological examination confirmed acute appendicitis in 52 (86.7%) patients, while 8 (13.3%) patients had a normal appendix, resulting in a negative appendectomy rate of 13.3%. This rate is lower than the 17.2% reported by Kirkil C et al.[14] but higher than the 3.7% reported by Alkesa T et al.[12] Variations in negative appendectomy rates may reflect differences in patient selection, utilization of imaging modalities, and application of clinical scoring systems.

The Alvarado score demonstrated a significant association with histopathological diagnosis. Among 18 patients with an Alvarado score <7, only 10 (55.6%) had confirmed appendicitis, whereas all 42 (100%) patients with a score ≥7 were histopathologically positive (p<0.001). The sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of the Alvarado score were 88.5%, 62.5%, 93.9%, 44.4%, and 85.0%, respectively. Similar findings were reported by Alkesa T et al.[12] who documented sensitivity, specificity, and positive predictive value of 94%, 75%, and 98%, respectively. Khan S et al.[15] reported sensitivity of 83%, specificity of 62%, and diagnostic accuracy of 65%, while Omar AS et al.[16] reported sensitivity of 82.7% and diagnostic accuracy of 77.9%. These studies collectively support the usefulness of the Alvarado score as an effective clinical tool for diagnosing acute appendicitis.

The Lintula score also showed a highly significant association with histopathological findings. Among 16 patients with a Lintula score <21, only 8 (50.0%) had confirmed appendicitis, whereas all 44 (100%) patients with a score ≥21 were histopathologically positive (p<0.001). The Lintula score demonstrated sensitivity of 92.3%, specificity of 75.0%, positive predictive value of 95.7%, negative predictive value of 50.0%, and overall diagnostic accuracy of 90.0%. These findings are comparable to those of Kirkil C et al.[14] who reported an overall diagnostic accuracy of 91.9% for the Lintula score and demonstrated a substantial reduction in negative appendectomy rates when the score was applied. Ojuka DK et al.[13] also found that the Lintula score compared favorably with the Alvarado score and could be effectively used in settings with limited laboratory facilities.

Comparison of both scoring systems in the present study revealed that the Lintula score had superior sensitivity, specificity, positive predictive value, and overall diagnostic accuracy compared with the Alvarado score. The difference in diagnostic accuracy was statistically significant (p=0.028).

Similar observations were reported by Kirkil C et al.[14] who found higher accuracy and lower negative appendectomy rates with the Lintula score. In contrast, Jebur AH et al.[17] and Omar AS et al.[16] reported comparable performance between the two scoring systems, while Khan S et al.[15] observed lower diagnostic accuracy for the Lintula score when compared with other scoring methods. These discrepancies may be attributed to differences in study populations, disease prevalence, and scoring cut-off values.

CONCLUSION

Accurate and timely diagnosis of acute appendicitis remains essential for reducing morbidity and preventing unnecessary appendectomies. Both the Alvarado and Lintula scoring systems demonstrated good diagnostic utility and showed significant correlation with histopathological findings. However, the Lintula score exhibited higher sensitivity, specificity, positive predictive value, and overall diagnostic accuracy compared to the Alvarado score. Higher scores on both systems were strongly associated with confirmed appendicitis. The findings suggest that the Lintula score may serve as a more reliable clinical tool for evaluating suspected acute appendicitis and can aid in improving diagnostic precision and surgical decision-making.

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