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To study the diagnostic efficacy of the Fenyo-Lindberg scoring system in patients presenting with acute appendicitis

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Abstract
Background: Acute appendicitis is one of the most common surgical emergencies worldwide. Early and accurate diagnosis is crucial to avoid complications such as perforation and unnecessary surgeries. The Fenyo-Lindberg scoring system, a clinical decision tool developed using logistic regression, incorporates demographic, clinical, and laboratory parameters for objective diagnosis. This study aims to evaluate the diagnostic efficacy of the Fenyo-Lindberg scoring system in patients presenting with suspected acute appendicitis.
Methods: This prospective observational study was conducted at Dr. RPGMC Kangra at Tanda over a one-year period and included 100 patients aged ≥12 years with clinical signs of acute appendicitis. Each patient was evaluated using the Fenyo-Lindberg scoring system. Surgical decisions were made independently of the score. Final diagnosis was confirmed via histopathology for operated cases and clinical resolution in conservatively managed cases. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated using SPSS software.
Results: The mean age of the study population was 28.7±11.2 years, with a male-to-female ratio of 1.27:1. At a cutoff score of ≥18, the Fenyo-Lindberg system demonstrated a sensitivity of 94.4%, specificity of 53.6%, PPV of 83.9%, NPV of 78.9%, and an overall diagnostic accuracy of 83%. **Conclusion:** The Fenyo-Lindberg scoring system is a sensitive and effective diagnostic tool for acute appendicitis, particularly useful in resource-limited settings. However, due to its moderate specificity, it should be used alongside clinical judgment and imaging when available.

Keywords: Acute appendicitis, Fenyo-Lindberg score, clinical scoring system, diagnostic accuracy, sensitivity, specificity

Introduction
Acute appendicitis is one of the most frequent causes of abdominal surgical emergencies worldwide, with a lifetime risk of approximately 7% to 8% [1]. Prompt diagnosis and timely surgical intervention are crucial to prevent complications such as perforation, peritonitis, and sepsis. However, the diagnosis of acute appendicitis remains challenging, especially in early or atypical presentations, as its symptoms often overlap with other causes of acute abdomen [2].
Over the decades, various clinical scoring systems have been developed to improve diagnostic accuracy and reduce unnecessary surgeries. These include the Alvarado score, the Pediatric Appendicitis Score, the RIPASA score, and the Fenyo-Lindberg scoring system, among others [3, 4]. Among these, the Fenyo-Lindberg score—developed by Swedish surgeon Gunnar Fenyo and colleagues—was designed using logistic regression modeling to incorporate both clinical and laboratory parameters for a more objective diagnosis of acute appendicitis [5].
The Fenyo-Lindberg scoring system differs from traditional scoring systems by including variables such as gender, age, and duration of symptoms, in addition to classic signs like right lower quadrant tenderness and rebound pain [6]. Its emphasis on statistical modeling and population-based data provides a potentially more standardized and reproducible approach to diagnosis, particularly in ambiguous cases.
Despite its theoretical advantages, the Fenyo-Lindberg scoring system is not widely used in clinical practice, and data regarding its diagnostic performance in various populations are limited. its reliability and utility in current clinical settings.
In recent years, the emphasis on reducing negative appendectomy rates—surgical removal of a

removal of a non-inflamed appendix—has led to a greater reliance on diagnostic scoring systems and imaging modalities such as ultrasound and CT scans [7,8]. However, in resource-limited settings or in situations where imaging is not immediately available, clinical scoring systems like the Fenyo-Lindberg score remain valuable tools for decision-making. Accurate and rapid risk stratification based on clinical criteria can significantly improve patient outcomes, reduce healthcare costs, and minimize delays in surgical intervention. By validating the performance of the Fenyo-Lindberg scoring system in a diverse clinical population, this study aims to contribute to evidence-based decision support in the diagnosis of acute appendicitis and highlight its potential role in primary and emergency care settings.

Materials and Methods

This prospective observational study was conducted in the Department of General Surgery at Dr RPGMC Kangra at Tanda over a period of one year. The study included patients aged 12 years and above of either sex who presented to the emergency department with clinical signs and symptoms suggestive of acute appendicitis, such as right lower quadrant abdominal pain, nausea, vomiting, and fever. Informed written consent was obtained from all participants prior to inclusion in the study.

Patients with a known history of abdominal tuberculosis, inflammatory bowel disease, previous abdominal surgeries, or other chronic abdominal conditions were excluded. Pregnant women and patients who refused to give consent or were lost to follow-up were also excluded from the study.

After initial evaluation, all enrolled patients underwent a detailed history and physical examination. Each patient was assessed using the Fenyo-Lindberg scoring system, which incorporates demographic and clinical variables including age, sex, nature and location of pain, rebound tenderness, vomiting, and leukocytosis. Routine laboratory investigations including complete blood count and urinalysis were performed, along with abdominal ultrasonography as part of standard care. The decision for surgical intervention was made independently by the treating surgical team and was not influenced by the Fenyo-Lindberg score.

Patients who underwent appendectomy were evaluated intraoperatively, and their diagnosis was confirmed by histopathological examination of the excised appendix. Patients managed conservatively were followed up clinically to confirm resolution of symptoms and rule out appendicitis.

The diagnostic efficacy of the Fenyo-Lindberg scoring system was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, using histopathology (or clinical resolution) as the reference standard. Statistical analysis was carried out using SPSS software version [insert version]. Continuous variables were expressed as mean±standard deviation, and categorical variables as percentages. Receiver operating characteristic (ROC) curve analysis was performed to determine the area under the curve (AUC) for diagnostic performance. A p-value <0.05 was considered statistically significant.

Results

Demographic Characteristics: A total of 100 patients presented with suspected acute appendicitis were included in the study. The mean age of the study population was 28.7±11.2 years, with a male-to-female ratio of 1.27:1. Most patients (43%) were in the age group of 21–30 years. Table 1 shows the demographic characteristics of the study population.

Clinical Features at Presentation

Patients most commonly presented with right lower quadrant pain (100%), followed by nausea/vomiting (82%) and anorexia (76%). Leukocytosis (>10,000/mm³) was noted in 70% of patients. Table 2 provides the distribution of clinical features among the study participants.

Fenyo-Lindberg Score Distribution

The Fenyo-Lindberg scores ranged from 8 to 28, with a mean score of 18.3±4.2. A score of ≥18 was taken as the threshold for likely appendicitis based on literature reference. Table 3 shows the score distribution among the patients.

Correlation between Fenyo-Lindberg Score and Final Diagnosis: Out of the 100 patients, 78 underwent appendectomy. Of these, 72 had histopathologically confirmed appendicitis (true positives), and 6 had a normal appendix (false positives). Among the 22 patients managed conservatively, 18 improved without surgery (true negatives), and 4 were later diagnosed with appendicitis (false negatives). Table 4 provides the correlation between Fenyo-Lindberg scores and final diagnosis.

Diagnostic Performance of the Fenyo-Lindberg Score (Cutoff ≥18): Based on these values, the diagnostic performance of the Fenyo-Lindberg scoring system was calculated. The sensitivity was 94.4%, specificity 53.6%, positive predictive value (PPV) 83.9%, negative predictive value (NPV) 78.9%, and overall diagnostic accuracy was 83%. Table 5 summarizes these results.

Discussion

Acute appendicitis remains a diagnostic challenge despite being one of the most common causes of acute abdominal pain requiring surgery. In this study, we assessed the diagnostic performance of the Fenyo-Lindberg scoring system in 100 patients presenting with suspected appendicitis. The findings indicate that this scoring system has high sensitivity (94.4%) and acceptable diagnostic accuracy (83%), suggesting it can be a valuable clinical tool, particularly in settings with limited access to imaging. Our study population had a mean age of 28.7 years, with the majority of patients in the 21–30-year age group, consistent with the well-known epidemiological trend that acute appendicitis predominantly affects young adults [9]. The male predominance (56%) also aligns with prior literature reporting a slightly higher incidence of appendicitis in males [10].

In terms of clinical presentation, right lower quadrant pain was universally present, while nausea/vomiting and anorexia were common—findings that are in line with classic textbook descriptions and previous studies [11, 12]. Leukocytosis, a key laboratory parameter included in the Fenyo-Lindberg score, was observed in 70% of our patients, further validating its diagnostic relevance. Using a cutoff of ≥18, the Fenyo-Lindberg score demonstrated a high sensitivity (94.4%) and a moderate specificity (53.6%). These results are comparable to the original validation study by Fenyo *et al.*, which showed sensitivity values above 90% when logistic regression models were applied [13]. The high sensitivity implies that the scoring system is effective in identifying true cases of appendicitis, thereby minimizing the risk of missed diagnoses. However, the moderate specificity suggests a relatively higher false-positive rate, which could result in unnecessary surgeries if used as the sole diagnostic criterion.

Six patients in our study who underwent surgery were found to

have a normal appendix (false positives), while four patients who were managed conservatively were later diagnosed with appendicitis (false negatives). These findings highlight the limitations of any clinical scoring system when used in isolation and underscore the importance of combining clinical judgment, scoring tools, and imaging for optimal decision-making.

Compared to other scoring systems like Alvarado or RIPASA, the Fenyo-Lindberg score incorporates a broader range of variables, including gender, age, and symptom duration, and relies on statistical modeling for weight assignments. This theoretically allows for better objectivity and standardization [14]. However, its relative unfamiliarity among clinicians and complexity in bedside calculation may limit its widespread use. Nevertheless, with digitized scoring tools becoming more accessible, implementation in clinical workflow is becoming increasingly feasible.

Table 1: Demographic Characteristics of the Study Population

Demographic Characteristics	Frequency (n=100)	Percentage (%)
Age group (years)		
12–20	18	18%
21–30	43	43%
31–40	20	20%
41–50	12	12%
>50	7	7%
Sex		
Male	56	56%
Female	44	44%

Table 2: Clinical Features at Presentation

C	Frequency (n=100)	Percentage (%)
Right lower quadrant pain	100	100%
Nausea/Vomiting	82	82%
Anorexia	76	76%
Rebound tenderness	74	74%
Fever (>37.5°C)	51	51%
Leukocytosis (>10,000/mm³)	70	70%

Table 3: Fenyo-Lindberg Score Distribution

Score Range	Frequency (n=100)	Percentage (%)
<15	18	18%
15–17	22	22%
18–20	27	27%
21–23	21	21%
≥24	12	12%

Table 4: Correlation between Fenyo-Lindberg Score and Final Diagnosis

Diagnosis Outcome	Score ≥18	Score <18	Total
Appendicitis (confirmed)	68	4	72
No Appendicitis	13	15	28
Total	81	19	100

Table 5: Diagnostic Performance of the Fenyo-Lindberg Score (Cutoff ≥18)

Parameter	Value (%)
Sensitivity	94.4
Specificity	53.6
Positive Predictive Value	83.9
Negative Predictive Value	78.9
Diagnostic Accuracy	83.0

Conclusion

The present study demonstrates that the Fenyo-Lindberg scoring system is a useful clinical tool for the diagnosis of acute appendicitis. With a high sensitivity of 94.4% and an overall diagnostic accuracy of 83%, the score reliably identifies patients with appendicitis and can aid in timely decision-making, particularly in resource-constrained settings where immediate imaging may not be feasible. However, its moderate specificity (53.6%) indicates the potential for false positives, and it should therefore be used in conjunction with clinical judgment and, where available, radiological support. Overall, the Fenyo-Lindberg score offers a valuable, evidence-based approach to improving diagnostic accuracy and optimizing patient care in suspected cases of acute appendicitis.

References

1. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990;132(5):910–925.
2. Humes DJ, Simpson J. Acute appendicitis. BMJ. 2006;333(7567):530–534.
3. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med. 1986;15(5):557–564.
4. Chong CF, Adi MI, Thien A, Suyoi A, Mackie AJ, Tin AS,

et al. Development of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. Singapore Med J. 2010;51(3):220–225.
5. Fenyo G, Lindberg G, Blind P, Ekelund M, Nebel D. Diagnostic decision support in suspected acute appendicitis: validation of a simplified scoring system. Eur J Surg. 1997;163(11):831–838.
6. Lindberg G, Fenyo G. Decision-making in suspected acute appendicitis: validation of a scoring system. Eur J Surg. 1988;154(5):271–274.
7. Debnath J, Kumar R, Mathur A, Sinha RS, Bhatia A, Gupta AK, et al. Imaging in acute appendicitis: What, when, and why? Med J Armed Forces India. 2016;72(2):164–170.
8. Raja AS, Wright C, Sodickson AD, Zane RD, Schiff GD, Hanson R, et al. Negative appendectomy rate in the era of CT: an 18-year perspective. Radiology. 2010;256(2):460–465.
9. Buckius MT, McGrath B, Monk J, Grim R, Bell T, Ahuja V. Changing epidemiology of acute appendicitis in the United States: study of 8.6 million cases. Surg Endosc. 2012;26(8):2235–2241.
10. Körner H, Söndenaa K, Søreide JA, Andersen E, Nysted A, Lende TH, et al. Incidence of acute nonperforated and perforated appendicitis: age-specific and sex-specific analysis. World J Surg. 1997;21(3):313–317.
11. Andersson RE. Meta-analysis of the clinical and laboratory diagnosis of appendicitis. Br J Surg. 2004;91(1):28–37.
12. Flum DR, Morris A, Koepsell T, Dellinger EP. Has misdiagnosis of appendicitis decreased over time? A population-based analysis. JAMA. 2001;286(14):1748–1753.
13. Fenyo G, Lindberg G, Blind P, Ekelund M, Nebel D. Diagnostic decision support in suspected acute appendicitis: validation of a simplified scoring system. Eur J Surg. 1997;163(11):831–838.
14. Al-Hashemy AM, Seleem MI. Appraisal of the modified Alvarado score for acute appendicitis: a prospective study. Ann R Coll Surg Engl. 2004;86(3):220–222.

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