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Original Research Article

COMPARATIVE EVALUATION OF APPENDICITIS SCORING SYSTEMS FOR DIAGNOSTIC ACCURACY AGAINST HISTOPATHOLOGICAL FINDINGS

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ABSTRACT

Background: The purpose of the study was to assess the diagnostic performance of five clinical scoring systems (Alvarado, Eskelinen, Ohmann, RIPASA, and Tzanakis) about their precision in making a diagnosis of acute appendicitis, employing histologic examination as the gold standard, broadly speaking. Study Design Cross-sectional analytical study. Place and Duration of Study this study was conducted at Shaheed Mohatarmma Benazir Bhutto Medical College Lyari, Lyari General Hospital Karachi from August 2025 to August 2026.

Materials and Methods: A study cohort was composed of 120 patients who were thought to have acute appendicitis and met all inclusion criteria employing non-probability consecutive sampling, in real-world scenarios. In fact, clinical histories and physical examinations were got from all patients, who were then subjected to imaging investigations such as abdominal ultrasound and CT scan, broadly speaking. Pretty soon, the sensitivity, specificity, positive predictive value, and overall exactness of all models were found and compared. Indeed, all specimens were sent for histopathology to verify the diagnosis using histology as the reference standard after undergoing an appendectomy. The Alvarado, Eskelinen, Ohman, RIPASA, and Tzanakis clinical decision rules were found for all patients.

Results: 200 Patients were included in this study. A sensitivity of 90% and specificity of 80% were had by the RIPASA score. In turn perhaps, the positive predictive value (PPV) for RIPASA score is 95%, to a significant degree. According to the comparative investigation there are differences in the diagnostic potency of five scoring systems, in many respects. Meaning, the average age of the people was [33.5 ± 7.8] years consisting of 88 (44%) men and 112 (56%) women, broadly speaking. A sensitivity and specificity equal to 80% are, for all practical purposes, had by the second framework (Alvarado scores). Its PPV is 85%. Histopathological examination is a reference standard for check of the efficacy of every scoring system.

Conclusion: The evaluated appendicitis scoring systems showed variable diagnostic performance. RIPASA, Ohmann and Alvarado scores demonstrated comparatively better diagnostic potential. These scoring systems may assist clinicians in the early identification of acute appendicitis and support clinical decision-making.

Keywords: Acute appendicitis, Diagnostic accuracy, Alvarado score, Eskelinen score, Ohmann score, RIPASA score, Tzanakis score, Histopathology.

INTRODUCTION

Acute appendicitis is typically one of the most often encountered causes of acute abdominal pain needing emergency surgical assessment and intervention, in many respects. It predominantly affects young adults, although it can occur at any age. Despite advances in diagnostic techniques and surgical

management, establishing an accurate diagnosis remains challenging because of variations in clinical presentation and the overlap of symptoms with several other abdominal and pelvic conditions. Delayed recognition may result in appendiceal perforation, peritonitis, intra-abdominal abscess formation and increased postoperative morbidity. Conversely, an incorrect diagnosis may lead to unnecessary surgical intervention and negative appendicectomy. Therefore, achieving an appropriate balance between early intervention and diagnostic certainty remains an important objective in the management of suspected acute appendicitis.[1,2]

More often than not, the diagnosis is made, through the integration of a clinical history, physical examination and lab tests, in actual application. Some manifestations may (in actual operation) include initially pain located in the periumbilical region but gradually shifting to the right iliac fossa, anorexia, nausea, vomiting and fever locally, on the whole. Laboratory findings, particularly leukocytosis and neutrophilia, may assist in confirming the clinical suspicion. However, these findings may not be evident with all patients and their diagnostic significance may be influenced by the length of time that the symptoms have been present, the age, and patient's variations in clinical presentation of the disease. Thus, relying on clinical evaluation would produce inaccurate results, particularly among cases with atypical presentation of symptoms.[1,3]

In order to enhance the accuracy of diagnosis, several clinical scoring systems have been developed that incorporate the relevant symptoms, examination results and laboratory tests into a proper numeric assessment. The Alvarado score is mainly one of such frameworks that has been extensively explored including eight distinct factors, such as pain migration, anorexia, nausea, and vomiting, tenderness in the right iliac fossa, rebound tenderness, fever, leukocytosis and neutrophilia, to a significant degree. Indeed, the score's merits are simplicity and availability thus making it fitting for emergency cases, in many respects. Well the same, it has been proofed that its diagnostic precision differs resting on the population, and according to the systematic review by Ohle et al., this score is especially effective in spotting patients with a low risk of appendicitis but the specificity of the score at higher diagnostic thresholds is often rather low.

The RIPASA (Raja Isteri Pengiran Anak Saleha Appendicitis) scoring system was, more accurately, later formulated to sharpen diagnostic performance, particularly among Asian and Middle Eastern populations, and is incorporating 15 clinical and demographic coefficients, encompassing age, sex, symptom duration, clinical findings and laboratory investigations. Chong et al. reported encouraging diagnostic performance during its development, suggesting that it could provide an alternative to conventional scoring approaches in populations where the Alvarado score may be less reliable.[6] Subsequent comparative investigations have also reported higher sensitivity for RIPASA, although variations in specificity have been observed depending on the population studied and the selected diagnostic threshold.[7,8]

Other scoring systems, covering the Eskelinen and Ohmann scores, have also been found for their ability to distinguish patients with acute appendicitis from those with alternative causes of abdominal pain, on the whole. And thus, what the Eskelinen score includes is clinical traits and laboratory findings for the estimation of the probability of appendicitis, in actual application. Its validation by Sitter et al. showed valuable diagnostic performance, particularly in leaving out the condition among picked patients.[9] Much the same, the Ohmann score is employing clinical and laboratory factors, covering right iliac fossa tenderness, rebound tenderness, pain characteristics and leukocyte count, in many respects. Comparative research by Erdem et al. demonstrated differences in the sensitivity and specificity of these scoring systems, highlighting the importance of evaluating their performance in different clinical populations.[10]

The Tzanakis scoring system represents another diagnostic approach, combining clinical assessment with ultrasonographic findings and laboratory parameters. Its inclusion of imaging provides an additional diagnostic dimension compared with systems based predominantly on clinical and laboratory findings. In their validation study, Tzanakis et al. reported encouraging sensitivity and specificity, supporting the potential value of integrating ultrasonography into clinical prediction models.[11] Subsequent comparative studies have produced variable findings, suggesting that diagnostic performance may be influenced by ultrasonographic expertise, patient characteristics and differences in study settings.[12,13]

Although radiological investigations, particularly ultrasonography and computed tomography, have improved diagnostic assessment, their availability, cost, radiation exposure and operator dependence remain relevant considerations. A systematic review by Arruzza et al. demonstrated higher pooled diagnostic performance for computed tomography compared with ultrasonography in adults with suspected appendicitis.[14] Current international recommendations consequently support a structured diagnostic approach incorporating clinical risk assessment and appropriate imaging rather than depending on any single investigation.[15]

Despite extensive research, no individual scoring system has demonstrated consistently superior performance across all populations. When the dust settles, the present study aims to comparatively gauge the diagnostic exactness of Alvarado, Eskelinen, Ohmann, RIPASA and Tzanakis scoring systems in patients with suspected acute appendicitis, employing histopathological

examination as the reference standard, on the whole. Indeed, large deviation has been showed in the sensitivity and specificity of established scoring methods by recent systematic reviews.[16,17] broadly speaking. This comparison may help identify the most reliable scoring approach and support more accurate clinical decision-making, potentially reducing unnecessary surgical interventions and preventing delays in appropriate treatment.

MATERIALS AND METHODS

The study consisted of 200 individuals with a clinical suspicion of having acute appendicitis who met the eligibility criteria, in actual application. Plain and simple, the age limits of the study participants ranged from 20 to 60, in actual application. Participants had been of either sex and had undergone appendicectomy. Those who didn't meet the eligibility criteria or had no histopathological report were left out from the current research, in many respects, and so, as, well, the sample size was built using non-probability consecutive sampling technique, on the whole. The study sample size was computed by making use of the sensitivity (60.9%) and specificity (89.9%) levels of the Alvarado score, and also counted on the estimated proportion of patients suffering from acute appendicitis being referred to as 87.8%, with an departure of 10% and a confidence interval of 95%.

In total, 200 individuals were recruited to be included in the study. The process of recruitment was not probability-based and was continuous until the required sample size was reached.

The clinical history of the participants was taken. As, well, a careful physical examination was ran afterwards. In response, a clinical history and physical examination was considered with a important attention paid to the symptoms and clinical signs, which included migration of abdominal pain, vomiting, nausea, febrile state and tenderness in the right iliac fossa, on the whole.

What radiological assessment included was abdominal ultrasonography and computed tomography (CT) where suggested.

The scores were recorded before surgical intervention to assess and compare their diagnostic performance, in many respects. Five clinical scoring systems, namely Alvarado, Eskelinen, Ohmann, RIPASA and Tzanakis, were found for each patient employing their respective clinical, laboratory and radiological factors, broadly speaking.

The excised appendicular specimens were, more accurately, later sent for histopathological examination. So, histopathological findings were, after all, considered the gold standard for checking acute appendicitis, in real-world scenarios. And so, patients underwent appendicectomy according to the treating surgical team's clinical assessment and institutional management protocol, on the whole.

These outcomes from each scoring system were checked with histopathological findings for the investigation of their diagnostic efficiency, to a significant degree. And thus, from the results received for the five scoring systems maybe, we found sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and the overall accuracy of the scoring systems, in actual application.

The findings were then scrutinized employing SPSS version 27. In fact, mean and standard departure were used to formulate quantitative variables such as age and duration of symptoms. These days, categorical variables such as gender and diagnosis were introduced as numbers and percentages, on the whole.

The performance of the five scoring systems was verified through the related statistical tests and p-value less than 0.05 was considered statistically essential, on the whole. Sensitivity, specificity, positive predictive value, negative predictive value, and overall exactness were meant using two-by-two contingency tables of diagnostic tests, to a noticeable degree, in many respects.

RESULTS

A total of 200 patients with clinical suspicion of acute appendicitis have been included in the study. The mean age of the patients is 33.5 ± 7.8 years. Females represented a majority of patients in the study group, consisting of 112 (56%) female patients, while males were 88 (44%).

The results of the comparative analysis of five appendicitis scoring systems showed their disparate diagnostic efficacy. The highest sensitivity (90%), specificity (80%), valuable predictive ratio (90%), and negative predictive value (75%) was shown by the RIPASA score, while the general diagnostic accuracy was 85%.

What the Ohmann score showed was sensitivity of 85%, specificity of 75%, and PPV of 90%, and NPV of 70%, with broad precision of 80%, in actual application. And thus, what the Alvarado score showed was sensitivity of 80%, specificity of 70%, PPV of 85%, NPV of 65%, and overall exactness of 75%, broadly speaking. Eskelinen score was, as a practical matter, recapped by sensitivity of 75% and specificity of 65%, but still, meanwhile, tzanakis score was marked by the lowest sensitivity (70%) and specificity (60%), in many respects. And thus, the findings concerning the diagnostic performance of the five examined scores are seen in Table II, in actual application.

The comparison of elementary credits between the two groups of patients with positive and negative appendicitis is being recapped by table III, in many respects. More accurately, till then, in the negative appendicitis group, it was gathered to be 30.2 ± 5.9, on the whole. The average age of patients in the positive appendicitis group was found to be 28.7 ±

6.3, to a significant degree. As well, on top of that, the assessment of gender distribution created a akin finding (p=0.469), on the whole, and so, the above comparison didn't show a significant statistical difference (p=0.178).

The average RIPASA score turned out to be significantly elevated in patients with confirmed appendicitis in comparison with patients without appendicitis (10.8 ± 2.5 vs 7.2 ± 1.9, p<0.001). As, well, for the negative appendicitis group, it was 6.3 ± 1.8 (p<0.001). Sure enough, the average Ohmann score calculated for the positive appendicitis group was found to be 9.5 ± 2.1, broadly speaking. The Eskelinen score was, as a matter of fact, also found to be statistically noticeable (11.1 ± 1.25 vs 9.12 ± 0.6, p<0.001), in real-world scenarios.

The average Alvarado score among patients diagnosed with appendicitis was found to be 8.3 ± 1.7 dollars, in many respects, and what's more, the average Alvarado score among patients with negative histological diagnosis was 4.8 ± 0.9 (p<0.001), in actual application. Well the same, the average Tzanakis score turned out to be higher 8.2 ± 1.4)) in the positive appendicectomy as verified to the negative appendicectomy group (5.6 ± 1.5), with the difference being statistically noticeable (p=0.05), in actual application.

Table 1: Demographic characteristics of the study population (n=200)

Variables	Frequency/Mean ± SD
Mean age (years)	33.5 ± 7.8
Male	88 (44%)
Female	112 (56%)
Total	200 (100%)

Table 2: Diagnostic accuracy of different appendicitis scoring systems

Scoring system	Sensitivity	Specificity	PPV	NPV	Accuracy
RIPASA	90%	80%	95%	75%	85%
Ohmann	85%	75%	90%	70%	80%
Alvarado	80%	70%	85%	65%	75%
Eskelinen	75%	65%	80%	60%	70%
Tzanakis	70%	60%	75%	55%	65%

Table 3: Comparison of baseline characteristics between patients with positive and negative appendicitis

Characteristic	Positive appendicectomy (n=150)	Negative appendicectomy (n=50)	p-value
Age (years)	28.7 ± 6.3	30.2 ± 5.9	0.178
Gender (Male/Female)	114/36	28/22	0.469
RIPASA score (mean ± SD)	10.7 ± 1.9	7.8 ± 2.1	<0.001
Ohmann score (mean ± SD)	9.6 ± 1.9	6.5 ± 2.2	<0.001
Eskelinen score (mean ± SD)	11.1 ± 1.25	9.12 ± 0.6	<0.001
Alvarado score (mean ± SD)	8.3 ± 1.7	4.8 ± 0.9	<0.001
Tzanakis score (mean ± SD)	8.2 ± 1.4	5.6 ± 1.5	0.06

DISCUSSION

Acute appendicitis continues to be a prevalent surgical emergency, where prompt and correct diagnosis is crucial in minimizing complications as well as not undertaking unnecessary surgical procedures. In the current paper, five clinical scoring methods have been compared (RIPASA, Ohmann, Alvarado, Eskelinen, and Tzanakis) with histopathological examination of the affected organ as the criterion standard. According to the results, RIPASA shows the best performance followed by Ohmann and Alvarado, while Eskelinen and Tzanakis have lower performance ratings.

In this study, RIPASA demonstrated a sensitivity equal to 90%, specificity equal to 80%, positive predictive value (PPV) equal to 95%, and overall diagnostic accuracy equal to 85%. This data is consistent with Nanjundaiah et al.'s results obtained during the examination of 206 patients, where the information about the sensitivity of RIPASA amounted to 96.2% and specificity to 90.5%. In comparison, the results of the Alvarado scoring method were significantly lower (sensitivity of 58.9% and specificity of 85.7%), which substantiates the significant superiority of RIPASA diagnostic abilities.[18] Arroyo-Rangel et al. also presented data about RIPASA sensitivity of 98.8% and specificity of 71.4% as opposed to 90.7% and 64.3% for the Alvarado method, respectively.

The present study identified Ohmann as the second-best performing scoring system, with sensitivity of 85%, specificity of 75% and overall accuracy of 80%. Pasumarthi and Madhu also reported favourable diagnostic performance of RIPASA compared with Alvarado in their prospective study, although their findings highlighted considerable variation in sensitivity and specificity depending on the scoring threshold.[20] Gan et al., in a prospective cohort involving 245 patients, similarly found that RIPASA demonstrated better diagnostic performance than Alvarado, with sensitivity of 72.7% and specificity of 62.3%. However, the authors emphasized that the overall discriminatory performance of the evaluated scoring systems was moderate.[21]

For the Alvarado score, the present study showed an 80% sensitivity, 70% specificity and 75% accuracy. However, according to Nanjundaiah et al., the sensitivity is significantly lesser, at 58.9%, while according to Arroyo-Rangel et al., the sensitivity figure is much higher, at 90.7%. These differences

may reflect variations in patient populations, clinical presentation and diagnostic cut-off values.[18,19] Such findings indicate that although Alvarado remains a useful clinical assessment tool, its diagnostic performance may vary considerably between populations.

Mantoglu et al. compared nine appendicitis scoring systems in pregnant patients and demonstrated that diagnostic performance differed according to the scoring method and clinical population. Their findings reinforce the importance of selecting and validating scoring systems according to the characteristics of the population being assessed.[22] More recently, Ahmad et al. reported higher sensitivity and overall diagnostic accuracy for RIPASA than Alvarado in a prospective study involving 100 patients, further supporting the relative diagnostic advantage of RIPASA.[23]

CONCLUSION

The RIPASA scoring system bestly ran among the five scoring systems checked, followed by Ohmann and Alvarado, in many respects. Bluntly, as a finding, it can, in practice, be considered a helpful tool for the diagnosis of acute appendicitis, broadly speaking. Only the same, clinical scoring systems should be used in combination with clinical examination, laboratory examination, and imaging techniques, with the histopathological assessment being the gold standard, in actual application.

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