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A COMPARATIVE STUDY OF DIFFERENT SCORING SYSTEMS IN ACUTE APPENDICITIS ADMITTED AND OPERATED AT TERTIARY CARE CENTER

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ABSTRACT

Background- Acute appendicitis is a common surgical emergency that requires prompt diagnosis and treatment. Several scoring systems have been developed to aid in the diagnosis, but their comparative performance is still unclear. This study aimed to compare the diagnostic accuracy of the Alvarado score, Appendicitis Inflammatory Response (AIR) score, and Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score in patients with suspected acute appendicitis. **Methods:** A prospective analysis was conducted from January 2020 to December 2022, including 200 cases of appendicitis. The study evaluated the Alvarado score, AIR score, and RIPASA score, assessing their sensitivity, specificity, and accuracy in diagnosing acute appendicitis. Clinical features and demographic data were also recorded, including gender distribution and histopathological findings. **Results:** A total 200 patients, 122 (61%) were male and 78 (39%) were female. The most common clinical features were abdominal pain (20%), nausea and vomiting (17.5%), and fever (15%). Patients with a histopathological diagnosis of appendicitis had significantly higher white blood cell counts, neutrophil counts, Alvarado scores, RIPASA scores, and AIR scores than those without appendicitis. The RIPASA score demonstrated the highest sensitivity (79%) and accuracy (76%) compared to the Alvarado score (70% sensitivity, 68% accuracy) and AIR score (65% sensitivity, 66% accuracy). **Conclusion:** The RIPASA score is the most effective scoring system for diagnosing acute appendicitis, demonstrating superior sensitivity and accuracy compared to the Alvarado and AIR scores.

Keyword: Acute appendicitis, scoring systems, Alvarado score, AIR score, RIPASA score, diagnostic accuracy.

INTRODUCTION

Acute Appendicitis is one of the most common surgical emergencies in clinical practice with an estimated lifetime prevalence of approximately one in seven. The incidence of occurrence is nearly 1.4 times greater in men than in women. Acute Appendicitis (AA) may occur for several reasons, such as an appendix infection, but the most important factor is the obstruction of the appendicular lumen. If acute appendicitis is left untreated, it may lead to severe complications, like appendicular mass, perforation, or sepsis. However, the differential diagnoses of appendicitis are often a clinical challenge because acute appendicitis can mimic several abdominal conditions².

In the last decades, several scoring systems have been developed to assist clinicians in the assessment of patients with suspected appendicitis³. Among these, the ALVARADO score—proposed for the first time in 1986—is one of the most widely used in the diagnosis of AA based on 6 clinical parameters and 2 laboratory measurements (i.e., localized tenderness in the right lower quadrant, migration of pain, temperature elevation, nausea-vomiting, anorexia, rebound pain, leukocytosis and leukocyte shift to the left)⁴. Despite not being specific enough, a score of 4–5 is compatible with the diagnosis of AA, a score of 7–8 indicates probable appendicitis, and a score of 9–10 indicates a very probable AA⁵. However, the Alvarado score is also considered lacking some parameters, including age, gender, and duration of symptoms, which are crucial in the diagnosis of AA⁶. The (Raja Isteri Pengiran Anak Saleha Appendicitis) RIPASA is one of the most recently developed scoring systems, which is based on six additional clinical and personal patients' parameters than those included in the Alvarado score (i.e., age, gender, duration of symptoms, guarding, Rovsing's sign, and negative urinalysis).

In this case, a RIPASA score of more than 7.5 is considered positive for appendicitis⁷. Although RIPASA and Alvarado scores are the most commonly used in clinical practice, no clear indication exists for choosing what scoring system might be more suitable for patients at risk of AA⁸. Here, we conducted a systematic review and meta-analysis of epidemiological studies comparing RIPASA and Alvarado scores, in order to identify which the one is providing a more accurate diagnosis of AA.

Sensitivity, specificity, and diagnostic accuracy are higher when compared to Alvarado Score, particularly in the Asian population⁹. In the global context, there are very few studies on the comparison of RIPASA score and modified Alvarado score¹⁰.

MATERIALS AND METHODS

The present study was a prospective analysis conducted at a tertiary care hospital from January 2020 to December 2022. The objective of the study was to compare the diagnostic performance of various scoring systems in predicting acute appendicitis among patients admitted and operated on during this period.

A total of 200 cases of appendicitis were included in the study. Patients diagnosed with acute appendicitis based on clinical evaluation and imaging findings were included. The inclusion criteria were as follows:

- Patients aged 18 years and older
- Patients diagnosed with acute appendicitis confirmed by clinical assessment and imaging study (ultrasound or CT scan)
- Patients who underwent appendectomy during the study period

The exclusion criteria:

- Patients with a history of previous abdominal surgeries that could affect the diagnosis
- Patients with chronic appendicitis or other gastrointestinal disorders that mimic appendicitis

Scoring Systems

The RIPASA and Alvarado scoring systems were applied prospectively to all 200 patients diagnosed with acute appendicitis. The RIPASA score includes various clinical parameters such as age, duration of symptoms, and specific physical examination findings, while the Alvarado score incorporates similar clinical indicators but with different weighting.

Data Collection

Data were collected from the hospital medical records, including demographic information, clinical presentation, laboratory findings, imaging results, and surgical outcomes. Each patient's score on both the RIPASA and Alvarado scoring systems was calculated and compared to the final diagnosis confirmed by histopathological examination of the appendectomy specimens.

Ethical Considerations

The study was approved by the institutional review board of the hospital, and patient confidentiality was maintained throughout the research process.

Statistical analysis

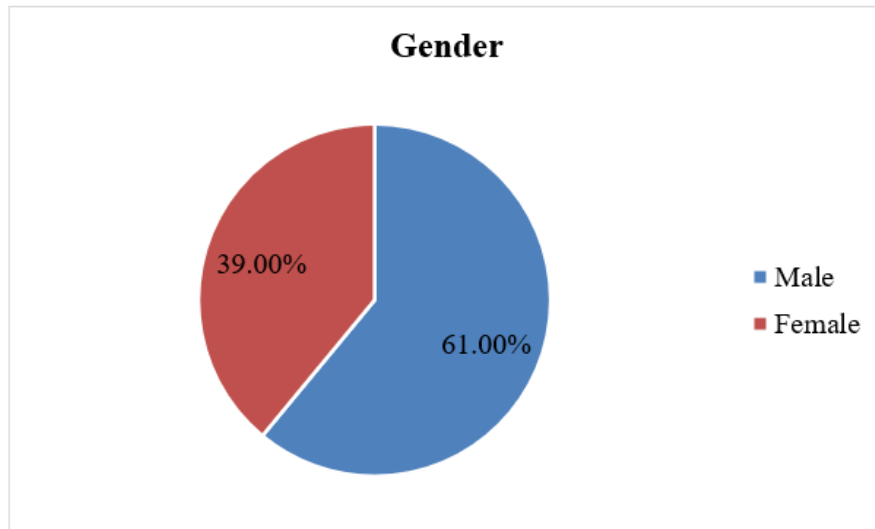
Statistical analysis- categorical variables are presented as the number and percentage of patients. Continuous variables are reported as mean and standard deviation and are compared between the two groups using the t-test for two means. The analysis was conducted using SPSS software, version 20. An alpha level of 5% was applied, meaning any p-value less than

0.05 is considered statistically significant.

RESULTS

Table 1: Distribution according to gender

Gender	No of cases	Percentage
Male	122	61.00%
Female	78	39.00%
Total	200	100.00%

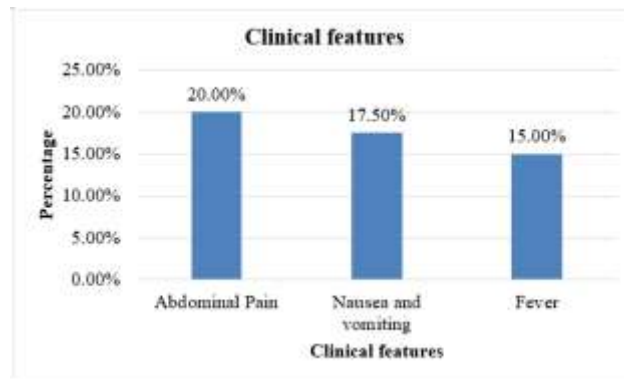


Graph 1: Distribution according to gender

In a study examining different scoring systems for acute appendicitis in patients who were admitted and operated on, the distribution of cases according to gender revealed that there were 200 cases in total. Of these, 122 cases, or 61%, were male patients, while 78 cases, or 39%, were female patients. (Table-1, Graph-1)

Table 2: Clinical features in the study group

Clinical features	No of cases	Percentage
Abdominal Pain	40	20.00%
Nausea and vomiting	35	17.50%
Fever	30	15.00%

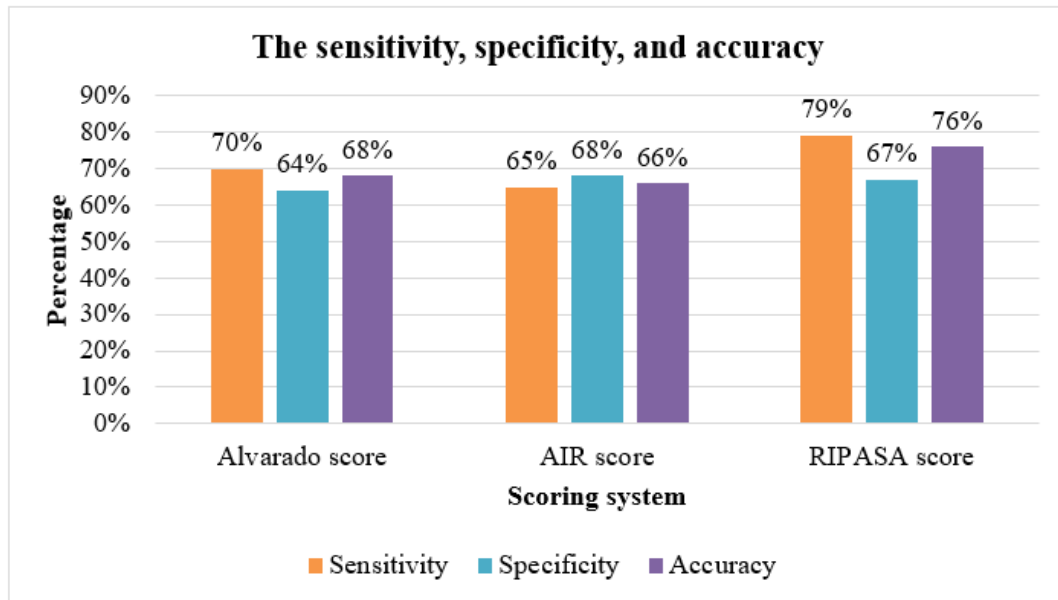


Graph 2: Clinical features in the study group

The most common clinical feature was abdominal pain, present in 20% of cases (40 patients). Nausea and vomiting were observed in 17.5% of cases (35 patients), while fever was noted in 15% of cases (30 patients). (Table-2, graph-2)

Table 3: The sensitivity, specificity, and accuracy of the Alvarado score, AIR score, and RIPASA score

Scoring system	Sensitivity	Specificity	Accuracy
Alvarado score	70%	64%	68%
AIR score	65%	68%	66%
RIPASA score	79%	67%	76%



Graph 3: The sensitivity, specificity, and accuracy of the Alvarado score, AIR score, and RIPASA score

The RIPASA score demonstrated the highest sensitivity at 79%, indicating its effectiveness in correctly identifying patients with the condition. It also had a specificity of 67% and an overall accuracy of 76%. The Alvarado score had a sensitivity of 70%, a specificity of 64%, and an accuracy of 68%, while the AIR score showed a sensitivity of 65%, a specificity of 68%, and an accuracy of 66%. (Table-3, Graph-3)

Table 4: patients with (+) a histopathological diagnosis of appendicitis. Patients without (-) a histopathological diagnosis of appendicitis.

Parameter	Diagnosis	Frequency	Mean	P value
Body temperature	+	24	34.2	>0.05 not significant
	-	6	34.1	
WBC	+	24	8000	<0.05 significant
	-	6	12000	
Neutrophil count	+	24	6000	<0.05 significant
	-	6	10000	
Alvarado Score	+	24	4.9	<0.05 significant
	-	6	3.1	
RIPASA Score	+	24	5.57	<0.05 significant
	-	6	8.71	
AIR score	+	24	4.54	<0.05 significant
	-	6	7.46	

DISCUSSION

The evaluation and management of acute appendicitis have evolved significantly, particularly with the advent of various scoring systems designed to assist clinicians in diagnosing and determining the urgency of surgical intervention. A comparative study of different scoring systems for acute appendicitis was conducted at a tertiary care center, focusing on clinical features and diagnostic efficacy.

In our study group, abdominal pain was the most prevalent symptom, reported in 40 cases (20%), and followed by

nausea and vomiting in 35 cases (17.5%) and fever in 30 cases (15%). These findings align with the study by **Farahbakhsh et al.**,¹¹ where abdominal pain is consistently highlighted as a primary indicator of acute appendicitis. The study evaluated the diagnostic performance of the Anderson, Alvarado, and Alvarado + CRP scoring systems, revealing that the Alvarado score had the highest sensitivity (95%) and accuracy (77%) compared to the Anderson score, which exhibited lower sensitivity (77%) and specificity (19%) by **Goel et al.**,¹². This contrasts with findings from other studies, such as the one conducted by **Ghali et al.**,¹³ which reported the Adult Appendicitis Score (AAS) as superior in diagnostic accuracy, particularly in reducing the negative appendectomy rate (NAR) and the need for imaging reported by **Ghali et al.**,¹³. The AAS demonstrated a sensitivity of 88.96% and specificity of 39.62%, indicating its effectiveness in identifying patients at risk for appendicitis while minimizing unnecessary surgical interventions.

In a comparative study of different scoring systems for acute appendicitis conducted at a tertiary care center, the Alvarado score, AIR score, and RIPASA score were evaluated for their sensitivity, specificity, and accuracy. The results indicated that the RIPASA score had the highest sensitivity at 79% and accuracy at 76%, compared to the Alvarado score (70% sensitivity, 68% accuracy) and AIR score (65% sensitivity, 66% accuracy). Although the AIR score exhibited the highest specificity at 68%, the overall performance of the RIPASA score suggests it is a more effective tool for diagnosing acute appendicitis, aligning with findings from other studies, such as those by **Pothuraju et al.**,¹⁴ which also reported that the RIPASA score outperformed the Alvarado score in terms of sensitivity and specificity, thereby reducing negative appendectomy rates significantly ($p < 0.001$). Furthermore, the comparative analysis reflects the broader literature indicating that while the Alvarado score remains widely used, the RIPASA score provides a more reliable clinical decision-making framework, particularly in Asian populations, where its application has been shown to enhance diagnostic accuracy and minimize unnecessary surgical interventions¹⁴.

The present study shows that the histopathological diagnosis revealed significant differences in clinical parameters among patients diagnosed with appendicitis (+) and those without (-). The analysis showed that patients with a confirmed diagnosis of appendicitis had a significantly lower white blood cell (WBC) count (8000) and neutrophil count (6000) compared to those without appendicitis, who exhibited higher counts of 12000 and 10000, respectively ($p < 0.05$). Additionally, the Alvarado score was significantly higher in the appendicitis group (4.9) compared to the non-appendicitis group (3.1), while the RIPASA score also demonstrated a significant difference (5.57 vs. 8.71) ($p < 0.05$).

A similar finding was reported by **Farahbakhsh et al.**,¹¹ which highlighted the importance of scoring systems in enhancing diagnostic accuracy, particularly the important role of WBC and neutrophil counts in differentiating between appendicitis and other conditions. Furthermore, the observed mean body temperatures were not significantly different between the two groups, indicating that temperature alone may not be a reliable indicator for appendicitis diagnosis. This study highlights the necessity for utilizing scoring systems like the Alvarado and RIPASA scores, which incorporate laboratory parameters, to improve diagnostic precision and reduce the rate of negative appendectomies, as supported by the literature indicating that scoring systems can significantly aid clinical decision-making in suspected cases of acute appendicitis.

LIMITATIONS

One significant limitation of this study is the potential for selection bias, as the research is conducted at a single tertiary care center. This affects the generalizability of the findings to other healthcare settings, particularly those with differing patient demographics, healthcare practices, or resource availability. Additionally, the retrospective nature of data collection introduces inconsistencies in the scoring of acute appendicitis cases and relies on the accuracy of medical records. Variations in the clinical judgment of attending physicians when applying the scoring systems impact the outcomes and comparisons between the different scoring methods.

CONCLUSION

In this comparative study of different scoring systems in acute appendicitis, the RIPASA score demonstrated the highest sensitivity and accuracy among the Alvarado, AIR, and RIPASA scores, while the AIR score had the highest specificity. Patients with a histopathological diagnosis of appendicitis had significantly higher WBC counts, neutrophil counts, Alvarado scores, and AIR scores than those without appendicitis. However, the RIPASA score was significantly higher in patients without appendicitis. These findings show that the RIPASA score may be the most reliable tool for diagnosing acute appendicitis, while the AIR score may be more effective in ruling out the condition.

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