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Original Research Article

Diagnostic efficiency of clinical RIPASA score in acute appendicitis: a prospective study

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ABSTRACT

Background: Accurate diagnosis of acute appendicitis (AA) remains a challenge in emergency surgical settings. The RIPASA score is a clinical tool developed to improve diagnostic accuracy, especially in Asian populations. This study aims to evaluate and compare the positive predictive value of biochemical markers (WBC, CRP) with the RIPASA score in diagnosing acute appendicitis.
Methods: This prospective, hospital-based comparative study was conducted at RNT Medical College, Udaipur. A total of 84 patients presenting with suspected acute appendicitis between January 2023 and July 2024 were included. Clinical evaluation was performed using the RIPASA score, and biochemical markers (WBC and CRP) were assessed. Histopathology confirmed the diagnosis. Diagnostic accuracy was evaluated through sensitivity, specificity, PPV, NPV, and ROC curves.
Results: The RIPASA score showed the highest diagnostic performance with an AUC of 0.87, sensitivity of 82.3%, and specificity of 89.1%. WBC count (>11,100/µl) had a sensitivity of 85.8% and specificity of 72.4% (AUC=0.781). CRP (>40.0 mg/L) showed moderate accuracy with 72.7% sensitivity and 76.5% specificity (AUC=0.56). RIPASA score showed a moderate positive correlation with WBC (Pearson's r=0.47, p<0.01) and a strong positive correlation with CRP (Pearson's r=0.61, p<0.01), while WBC and CRP also showed a weak but significant correlation (Pearson's r=0.35, p<0.05).
Conclusion: RIPASA score is more reliable than CRP and correlated well with WBC in diagnosing acute appendicitis. Combining clinical scoring with selective biochemical markers enhances diagnostic accuracy.

Keywords: Acute appendicitis, RIPASA score, CRP, WBC, Diagnostic accuracy, Predictive value

INTRODUCTION

AA is one of the most common surgical emergencies worldwide, affecting approximately 7% of the population during their lifetime. Despite its frequency, diagnosing AA can be challenging due to variability in clinical presentation, especially among children, women of reproductive age, and the elderly.[1]

A timely and accurate diagnosis is critical to reduce complications such as perforation, abscess formation, and peritonitis, which significantly increase morbidity and healthcare cost.[2] Traditionally, the diagnosis of acute appendicitis has relied on clinical evaluation and supported by laboratory and imaging modalities. However, no single test or imaging modality offers 100% accuracy. Negative appendectomy rates remain between 15%–25% in many settings, particularly in resource-limited environments where advanced imaging may not be readily available. To improve diagnostic accuracy, several clinical scoring systems have been developed.

The Alvarado score, introduced in 1986, is one of the most widely used systems but has shown limited accuracy in Asian populations. To address this, the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA)

score was developed, incorporating 15 variables including clinical signs, symptoms, and basic lab results. It has demonstrated higher sensitivity and specificity compared to Alvarado in multiple Asian studies.[3,4]

Beyond clinical scoring, biochemical markers such as white blood cell (WBC) count and C-reactive protein (CRP) are routinely used to support the diagnosis of appendicitis. Elevated WBC and CRP levels are suggestive of inflammation, but their diagnostic utility as standalone tests remains controversial. Some studies have shown that WBC has good sensitivity, while CRP may help in predicting complicated appendicitis, such as perforation.

The RIPASA score has emerged as a promising tool in Asian populations, demonstrating sensitivity ranging from 82% to 96% and diagnostic accuracy exceeding 90% in some studies.[5] Combining RIPASA with biochemical markers could potentially improve diagnostic confidence and reduce unnecessary surgeries.[6]

Given the continuing need for reliable, cost-effective diagnostic methods for acute appendicitis, particularly in resource-constrained settings, this study aimed to compare the positive predictive value and overall diagnostic accuracy of RIPASA score with that of common biochemical markers (WBC, CRP).

METHODS

Study design and setting

This was a prospective, hospital-based comparative study conducted at RNT Medical College and Associated Hospitals, Udaipur, Rajasthan. The Departments of General Surgery, Biochemistry, and Pathology collaborated to execute the study. The research was carried out over a 12-month period.

Study population

The study included patients aged 18 to 60 years who presented to the emergency department with clinical signs and symptoms suggestive of acute appendicitis. A total of 84 patients were enrolled based on predefined eligibility criteria. Patients were selected consecutively to ensure representation and minimize selection bias.

Inclusion and exclusion criteria

Patients were included if they presented with right iliac fossa pain clinically suspicious for acute appendicitis and provided written informed consent.

Patients were excluded if they had received an appendectomy for non-inflammatory causes, were undergoing concurrent abdominal surgery, or had conditions such as renal/ureteric stones, pelvic inflammatory disease, generalized peritonitis, or untraceable/incomplete medical records.

Data collection procedure

Ethical approval was obtained from the Institutional Ethics Committee of RNT Medical College. Informed written consent was taken. The study followed the Declaration of Helsinki guidelines. Each participant underwent a thorough clinical history and physical examination.

The RIPASA score was calculated for all patients using its 15-parameter checklist. In addition to routine investigations (complete blood count, USG abdomen, and CECT abdomen when indicated), specific biochemical markers such as TLC, CRP, and serum bilirubin were recorded. Patients diagnosed clinically or radiologically with acute appendicitis underwent appendectomy, and the final diagnosis was confirmed through histopathological examination of the excised appendix.

Sample size calculation

The required sample size was determined using G*Power software (version 3.1), estimating a power of 80% ($1-\beta = 0.80$) and a significance level of 5% ($\alpha = 0.05$) for detecting a significant Spearman correlation. This yielded a minimum sample size of 50 patients. To increase statistical robustness and compensate for potential dropouts, 84 patients were ultimately included.

Statistical analysis

All data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were summarized using means and standard deviations, while categorical data were presented as frequencies and percentages. Student's t-test was applied to compare means of continuous variables, and the chi-square test was used for categorical comparisons. Pearson's correlation coefficient was calculated to assess associations between RIPASA score and biochemical markers.

Diagnostic performance was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the ROC curve (AUC) for each diagnostic parameter (RIPASA, WBC, CRP).

RESULTS

The study comprised of 65.5% males and 34.5% females with mean age 31.7±13.57 years. All patients presented with right iliac fossa (RIF) pain, while 50% had migrating pain, 70.2% experienced vomiting, and 53.6% had fever. Clinical signs such as guarding and rebound tenderness were observed in 51.2% and 42.9% respectively. The mean WBC count was

10,093.45±4,709.34 cells/cumm, and the mean CRP level was 18.60±28.75 mg/l. The most common appendix position was retrocaecal (85.7%), followed by pelvic (7.1%) and post-ileal (7.1%). Based on RIPASA scoring, 83.3% had a positive score (≥7.5), suggesting a high diagnostic likelihood of acute appendicitis (Table 1).

Table 1: Demographic, clinical, biochemical, and RIPASA score distribution (n=84).

Variable	Category/value	Frequency (N)	%/Value
Age (Mean±SD)	–	–	31.7 ± 13.57 years
Sex	Male	55	65.5
	Female	29	34.5
Clinical symptoms	RIF pain	84	100
	Migrating pain	42	50.0
	Vomiting	59	70.2
	Fever	45	53.6
	Guarding	43	51.2
	Rebound tenderness	36	42.9
Biochemical markers	WBC (cells/cumm, Mean±SD)	–	10,093.45±4,709.34
	CRP (mg/l, Mean±SD)	–	18.60±28.75
Appendix position	Retrocaecal	72	85.7
	Pelvic	6	7.1
	Post-ileal	6	7.1
RIPASA score distribution	Score ≥ 7.5 (Positive)	70	83.3
	Score < 7.5 (Negative)	14	16.7

Table 2: Diagnostic performance of RIPASA Score, WBC, and CRP.

Tool/Marker	AUC	Cut-off Value	Sensitivity (%)	Specificity (%)	P value	95% CI
RIPASA score	0.87	>9.30	82.3%	89.1%	<0.001	0.796-0.944
WBC count ($\times 10^3$/µl)	0.781	>11,100	85.8%	72.4%	0.022	0.663-0.899
CRP (mg/l)	0.56	>40.0	72.7%	76.5%	0.371	0.428-0.691

Table 3: Pearson's correlation between RIPASA score and biochemical markers (n=84).

Correlation pair	Pearson's r	P value	Interpretation
RIPASA vs. WBC	0.47	<0.01	Moderate Positive (Highly statistically significant)
RIPASA vs. CRP	0.61	<0.01	Strong Positive (Highly statistically significant)
WBC vs. CRP	0.35	<0.05	Weak Positive (Statistically significant)

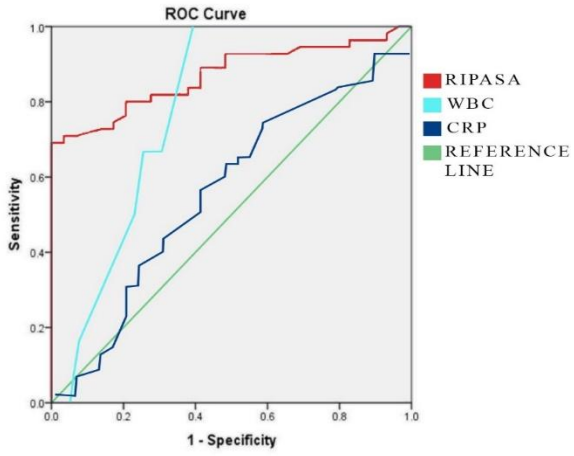

Figure 1: ROC curve for RIPASA score, CRP and WBC count.

Table 3 Pearson's correlation analysis showed a statistically significant moderate positive correlation between the RIPASA score and WBC count, stronger correlation between RIPASA and CRP (r=0.61, p<0.010, and weak yet statistically significant correlation was noted between WBC and CRP levels (r=0.35, p<0.05). The area under the curve (AUC) for RIPASA score was 0.87, indicating excellent discriminative ability. A cut-off value of >9.30 yielded a sensitivity of 82.3% and specificity of 89.1%, making RIPASA the most reliable among the three diagnostic tools evaluated. The area under the curve (AUC) for CRP was 0.56, suggesting poor discriminatory power. At a cut-off value of >40 mg/l, CRP showed a sensitivity of 72.7% and specificity of 76.5%. Despite moderate sensitivity and specificity, CRP alone may not be a dependable marker. The AUC for WBC WAS 0.781, reflecting good diagnostic performance. A cut-off value of >11,100 cells/µl

provided 85.8% sensitivity and 72.4% specificity, making WBC a useful supportive marker in conjunction with clinical scoring systems (Figure 1). The AUC for WBC WAS 0.781, reflecting good diagnostic performance. A cut-off value of >11,100 cells/µl provided 85.8% sensitivity and 72.4% specificity, making WBC a useful supportive marker in conjunction with clinical scoring systems (Figure 1).

DISCUSSION

AA continues to be a common surgical emergency requiring accurate and prompt diagnosis. Numerous diagnostic modalities-ranging from clinical scoring systems to laboratory markers-have been employed to improve accuracy and reduce negative appendectomy rates.

The mean age in our study confirms the global observation that acute appendicitis predominantly affects young adults. This trend is widely documented across various population-based studies. One study observed that 61.8% of patients were under 40 years of age, mirroring the demographic profile seen in our sample.[7] Similarly, another study reported comparable age trends in a Sudanese population, emphasizing the importance of age-specific diagnostic vigilance in younger adults.[8] A higher incidence in males was evident in our study, which aligns well with other research findings. A study from Udaipur, India also reported male predominance, which may be attributed to both biological predisposition and diagnostic complexity in females of reproductive age.[9]

All patients in our study reported right iliac fossa (RIF) pain, with 70.2% presenting with vomiting and 53.6% experiencing fever. Migrating pain and guarding were reported in approximately half the cohort. These symptoms are well-established hallmarks of appendicitis and are also heavily weighted in both the Alvarado and RIPASA scoring systems. Vomiting and fever have similarly been reported in 87.5% and 66.7% of patients respectively in previous research[8]. In our cohort, the mean WBC count was 10,093.45 cells/µl, and the mean CRP level was 18.6 mg/l. Although elevated WBC counts were observed in the majority, the correlation with the RIPASA score was moderate and statistically significant ($r=0.47$, $p<0.01$), and CRP also showed a strong positive correlation with RIPASA ($r=0.61$, $p<0.01$), indicating the utility of combined clinical and biochemical assessment.

These results underscore the limited utility of standalone biochemical markers in diagnosing acute appendicitis. This is consistent with earlier findings, where despite normal WBC and CRP levels in 17 patients, correct diagnoses were made based on RIPASA scores alone.[9] The study found that 83.3% of patients had a RIPASA score ≥7.5. This threshold has been widely validated. One study reported a sensitivity of 96.7% and specificity of 93% at this cut-off, and another analysis achieved a 95.5% sensitivity with RIPASA.[10,11] These consistent results across diverse populations strongly support the reliability of the 7.5 cut-off value in clinical decision-making.

In Egypt, one study confirmed a diagnostic accuracy of 94.3% with RIPASA, reporting a PPV of 97.27% and NPV of 69.23%.[7] A comparable level of accuracy was reported in an Italian cohort, where RIPASA showed the highest area under the ROC curve (AUC=0.851), surpassing the Alvarado (0.766) and AIR (0.796) scores.[12] Multiple studies have shown that RIPASA outperforms the Alvarado score, especially in Asian and Middle Eastern populations. In one comparative study, RIPASA demonstrated better specificity and overall diagnostic accuracy than the Modified Alvarado Score (MASS), particularly in screening patients for imaging or surgical intervention.[13]

Although imaging modalities like ultrasound and CT are crucial in diagnosis, some studies have questioned their routine use in comparison to structured clinical scores. For example, one study comparing RIPASA with USG and CECT found that while CECT was slightly superior, RIPASA still performed significantly well in emergency triaging[14]. The study's finding of a high retrocecal appendix rate (85.7%) may explain some atypical presentations. The strength of the RIPASA score lies in its ability to accommodate such variations through its expanded 15-point system. Previous research has shown RIPASA to be particularly helpful in diagnosing cases with vague or atypical symptoms, where traditional diagnostic methods often failed[15]. In resource-limited healthcare settings where imaging may not be readily available, RIPASA offers a cost-effective, non-invasive, and repeatable method for timely diagnosis.

CONCLUSION

The present study confirms that the RIPASA score demonstrated high diagnostic accuracy for acute appendicitis, outperforming WBC and CRP in sensitivity and specificity. Its ease of use and reliability make it especially valuable in resource-limited settings. While WBC and CRP may provide supportive value, clinical scoring remains the cornerstone of diagnosis. Incorporating RIPASA into routine assessment can improve early detection and reduce unnecessary surgeries.

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