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Sensitivity and Specificity of RIPASA Score in Diagnosis of Acute Appendicitis: A Cross-Sectional Study

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ABSTRACT

Objective: To determine the diagnostic accuracy of RIPASA score in diagnosis of acute appendicitis with histopathology as the gold standard.

Study Design: Cross-sectional study.

Place and Duration of Study: Combined Military Hospital, Rawalpindi, and Pak Emirates Military Hospital, Rawalpindi, Pakistan, from Apr to Sep 2023.

Methodology: A total of fifty-one patients fulfilling the inclusion criteria and diagnosed clinically to have acute appendicitis were included in the study. In all these patients, RIPASA scores were calculated. Patients then underwent appendectomy, and the removed appendix was sent for histopathological analysis. A 2x2 table was drawn for calculating SN, SP, PPV, NPV, and accuracy. Data was analyzed using SPSS v22.00.

Results: Median age of our study pool was 19(14 – 29) years. Thirty-five (68.63%) patients were male, and sixteen (31.37%) were female. Median duration of symptoms was 6(2 – 9) hours. We found that the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of RIPASA score in the diagnosis of acute appendicitis was 89.74%, 83.33%, 94.59%, 71.43% and 88.24%, respectively.

Conclusion: RIPASA score is highly useful in making diagnosis of acute appendicitis and should be used regularly before a decision for surgery is made.

Keywords: Appendicitis, Appendectomy, Diagnostic accuracy, RIPASA score.

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INTRODUCTION

Although the appendix is generally located right below the cecum, surgeons frequently find substantial anatomical heterogeneity in both its placement and length while performing appendectomy.[1] The appendix was once thought to be a redundant body part, but recent studies have shown that it includes a substantial number of bacteria and immune cells, which can have a profound impact on gastrointestinal function, immunity, and the onset and progression of a wide range of diseases.[2,3] An incident of acute appendicitis can occur if the appendicular lumen becomes blocked, causing initiation of an acute phase of inflammation which may be incited by blockage through parasitic infestation, lymph node enlargement, fecaliths and cancer.[4]

Lower abdominal discomfort is a common reason for emergency department visits, with Acute Appendicitis being the most common diagnosis for young children brought in with the complaint of pain in the abdomen particularly in right lower quadrant (RLQ).[5] Acute appendicitis can be difficult to diagnose clinically because doctors need to compile data from a variety of sources (including medical history, test results, and radiology investigations). Several simple scores (like ALVARADO score, AIS score, RIPASA score, AAS score, etc.) have been used to diagnose acute appendicitis, but none have been universally embraced as a conclusive method.[6] In clinical settings, computed tomography (CT) of the abdomen has been widely used to make a diagnosis of acute appendicitis owing to its high accuracy of 95.6%.[7] However, histopathological assessment of the removed appendicular specimen remains the gold standard to make a definitive diagnosis of acute appendicitis.[8]

In Pakistan, where the availability of modern health care provision (like access to CT scan) is scarce,[9] it is essential to study various methods that can increase the diagnostic ability of the surgeons without the use of advanced investigation services to avoid unnecessary surgery and reduce the frequency of negative appendectomies. For this purpose, Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score

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can be a useful tool to aid in making a pre-operative diagnosis of acute appendicitis. Foreword in view, we conducted this study to determine the diagnostic accuracy of the RIPASA score in diagnosis of acute appendicitis with histopathological findings as the gold standard.

METHODOLOGY

This cross-sectional study was conducted on the patients admitted to the indoor surgical department of Combined Military Hospital, Rawalpindi, and Pak Emirates Military Hospital, Rawalpindi, Pakistan, from Apr to Sep 2023 after approval of the ethical review committee, ERC# A/28/ERC/573/23. Sample size was calculated utilizing the WHO sample size calculator by using the following formula:

For calculation of sample size, a confidence level of 95%, a precision of 4.95%, and an expected sensitivity of RIPASA score in making diagnosis of acute appendicitis of 96.7%,[10] were taken, which gave a sample size of 51.

Inclusion Criteria: Patients 14 years of age or older, either male or female, admitted with highly suspected clinical diagnosis of acute appendicitis were included in the study.

Exclusion Criteria: Patients who have undergone appendectomy earlier, those in whom an alternative diagnosis was made for abdominal pain, those unfit for surgery due to hemodynamic instability, and those requiring emergent appendectomy due to perforation of the appendix were excluded from the study.

Patients were selected by using a non-probability consecutive sampling technique. Once selected, all the baseline characteristics, including age (in years), gender, and duration of symptoms (in hours) were documented. After that RIPASA score was calculated for all the patients. A cut-off diagnostic value of RIPASA score was set at 7.5.[11] This was followed by drawing a 2x2 contingency table, which was then used to calculate sensitivity (SN), specificity (SP), positive predictive value (PPV), negative predictive value (NPV), and the accuracy of RIPASA score in the diagnosis of acute appendicitis.

True positive (a): It referred to a patient who had a RIPASA score ≥7.5 and had an acute appendicitis diagnosis on histopathology. False positive (b): It referred to a patient who had a RIPASA score ≥ 7.5 but did not have an acute appendicitis diagnosis on histopathology. False negative (c): It referred to a patient who did not have a RIPASA score ≥7.5 but had an acute appendicitis diagnosis on histopathology. True negative (d): It referred to a patient who did not have a RIPASA score ≥ 7.5 and did not have an acute appendicitis diagnosis on histopathology.

Data was analyzed by using Statistical Package for Social Sciences (SPSS) version 22.00. Normality of data was checked by Shapiro-Wilk test, which showed that both age and duration of symptoms were not distributed normally and so were represented using median (IQR). Qualitative data (gender, presence of RIPASA score ≥7.5, and histopathological diagnosis of acute appendicitis) were represented by using percentages and frequencies. A $p \leq 0.05$ was taken as significant.

RESULTS

The study sample was fifty-one patients. Median age of study pool was 19(14 – 29) years. There were 35(68.63%) male participants, while the remaining 16(31.37%) participants were female. Median duration of symptoms was 6(2–9) hours. These baseline characteristics are summarized below in Table-I.

Table-I: Baseline characteristics of study participants (n=51)

Characteristics	n (%)
Median Age	19 (14 – 29) years
Gender	
Male	35(68.63%)
Female	16(31.37%)
Median duration of symptoms	6(2 – 9) hours

The frequency of patients found to have RIPASA score ≥ 7.5 was 37(72.55%), while number of patients with acute appendicitis diagnosis on histopathology was 39(76.47%). A total of 35(68.63%) patients had both RIPASA score ≥7.5 as well as an acute appendicitis diagnosis on histopathology [TP], while those with RIPASA score ≥7.5 but without an acute appendicitis diagnosis on histopathology were 2(3.92%) [FP]. Similarly, patients who did not have RIPASA score ≥ 7.5 but had an acute appendicitis diagnosis on histopathology were 4(7.84%) [FN], while those who neither had RIPASA score ≥ 7.5 nor a diagnosis of acute appendicitis on histopathology were 10(19.61%) [TN]. Based on the following 2x2 contingency table, Table-II was drawn.

Based on the formulas, it was found that sensitivity (SN), specificity (SP), positive predictive value (PPV), negative predictive value (NPV), and accuracy of RIPASA score in diagnosis of acute appendicitis with histopathological finding as gold standard was 89.74%, 83.33%, 94.59%, 71.43% and

88.24%, respectively. This is tabulated below in Table-III.

Table-II: Contingency Table of RIPASA score for TP, TN, FP, and FN (n = 51)

	Acute Appendicitis on Histopathology	No acute Appendicitis on Histopathology
RIPASA score ≥ 7.5	35 (TP)	2 (FP)
RIPASA score < 7.5	4 (FN)	10 (TN)

Table-III: Diagnostic parameters of RIPASA score in Diagnosis of Acute Appendicitis with Histopathological Findings as Gold Standard (n = 51)

Sensitivity [TP/TP+FN x 100]	**89.74%**
Specificity [TN/FP+TN x 100]	83.33%
PPV [TP/TP+FP x 100]	94.59%
NPV [TN/FN+TN x 100]	71.43%
Accuracy [TP+TN/TP+TN+FP+FN x 100]	88.24%

DISCUSSION

In present study, it was found that the RIPASA score was a reliable score when compared with histopathological diagnosis to make a clinical diagnosis of acute appendicitis. In comparison to the present study, Butt *et al*.,[10] reported a relatively higher accuracy of RIPASA score at 95.1%, thus reinforcing the findings of this study. Acute appendicitis is a frequent surgical emergency, occurring in about 100 out of every 100,000 people. While typically low risk, complications such as perforation raise morbidity and mortality, making early diagnosis and treatment crucial.9 Relying solely on clinical symptoms for surgery can result in a high rate of unnecessary appendectomies—up to 39%. Advanced imaging, like CT scans, lowers this risk but increases radiation exposure and costs. Clinical scoring systems, such as RIPASA, offer an alternative for improving diagnostic accuracy.[11]

The clinical diagnosis of acute appendicitis remains a challenge, particularly in resource-limited settings where advanced imaging like CT scans may not be readily available or cost-effective. Research by Naeem *et al.,* emphasizes the diagnostic utility of clinical scoring systems, specifically highlighting that the RIPASA score demonstrates high sensitivity and accuracy when compared to the Lintula score.[12] This aligns with the findings of Moris *et al*., who validated the RIPASA score as a superior tool over the traditional Alvarado score for South Asian populations.[13] By incorporating demographic factors such as age and gender, these studies suggest that RIPASA provides a more valid clinical picture, effectively reducing the reliance on expensive radiological interventions.[14]

The necessity for accurate scoring is further underscored by the risks associated with misdiagnosis, which can lead to either unnecessary surgery or dangerous complications. Failing to diagnose the condition promptly can result in perforated appendicitis, which Potey *et al*., and Suleimanov *et al*., associate with severe outcomes, including prolonged hospital stays and rare, life-threatening complications like necrotizing fasciitis. These risks highlight the critical need for a reliable, rapid bedside tool to stratify patient risk immediately upon presentation.[15,16]

Noureldin *et al*., discuss the negative appendicectomy rate, noting that while some negative explorations are traditionally accepted to avoid perforation, modern surgical practice aims to minimize these through better predictive modeling.[17,18] In another study, Aslam *et al.,* reported even higher diagnostic accuracy of RIPASA score.[19] In correlation with the present study's findings, there is a strong recommendation for the RIPASA score to be adopted as a primary, cost-effective method to rule out acute appendicitis. In another study conducted by Majid *et al*., at CMH, Rawalpindi also confirmed that the diagnostic accuracy of the RIPASA score was comparable to the present study at 88.9%.[20] Our results are consistent with Majid *et al*., who argued that the RIPASA score's high sensitivity makes it an ideal screening tool in busy surgical units. By utilizing this scoring system, clinicians can confidently identify low-risk patients who can be safely observed, thereby preserving hospital resources and avoiding the costs and morbidity associated with unnecessary surgical or radiological procedures. In another study, conducted at Ayub Medical Institute, Abbottabad, by Akbar *et al*., reported sensitivity, specificity, PPV, and NPV of the RIPASA score were much higher as well in comparison to the present study.[21]

This study reinforces the conclusion that in the absence of universal access to high-resolution imaging, clinical scoring remains the gold standard for efficient surgical triage. Based on the outcomes of the present study, it is strongly recommended that RIPASA score should be adopted as a highly reliable tool to diagnose

acute appendicitis clinically and to decide on proceeding with early surgical intervention for its treatment. This will not only reduce the rate of negative appendicectomies but also avoid the unnecessary exposure of patients to radiation and the high cost of CT scans.

CONCLUSION

In conclusion, the RIPASA score demonstrates significant utility as a diagnostic tool for acute appendicitis. Its regular application in clinical practice, particularly before surgical intervention, is strongly recommended. By incorporating the RIPASA score into the diagnostic workflow, clinicians can improve the accuracy of identifying cases of acute appendicitis, thereby minimizing the risk of unnecessary surgical procedures such as negative appendectomies. This approach not only enhances patient outcomes by reducing exposure to unwarranted surgical risks but also alleviates the financial burden associated with advanced radiological investigations like CT scans.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SDH & MA: Data acquisition, data analysis, critical review, approval of the final version to be published.

MN & BS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SAMR & MJ: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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