

Comparison of The Predictive Accuracy of RIPASA Score in Identifying Acute Appendicitis to The Gold Standard of Histo-Pathologically Confirmed Appendicitis

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ABSTRACT

Objective: To compare the predictive accuracy of RIPASA score in diagnosing acute appendicitis with the gold standard of histo-pathologically proven appendicitis as gold standard.

Methodology: This prospective cohort study was conducted in CMH Hospital from Sep 2022 to March 2023. 208 patients over the age of 16 who were sent to the on-call surgeon for treatment of acute RIF pain or suspicion of appendicitis were included in our study. The clinical data of patients was gathered using standardized case report forms during examination.

Patients were divided into two groups a histologically proven AA diagnosis; & a non-appendicitis diagnosis.

Chi-square test was applied to evaluate both the groups keeping significance less than 0.05. Sensitivity and specificity of RIPASA scoring was assessed comparing Appendicitis on Histology.

Results: Results showed that 81% of patients had positive histopathology results for appendicitis, while 19% were negative. Using a cutoff RIPASA score of ≥ 7.5 , 71% of patients were positive, and for a score < 7.5 , 29% were negative. There was a significant association (p -value = 0.001) between histopathology results and RIPASA scores, demonstrating a sensitivity of 76.2% and specificity of 52.5% in identifying acute appendicitis. The positive predictive value (PPV) was 87.03%, and the negative predictive value (NPV) was 34.4%.

Conclusion: The findings indicated lower sensitivity and specificity compared to previous studies, questioning the significance of the RIPASA score as a standalone diagnostic tool. Incorporating imaging modalities and considering age-specific criteria may enhance diagnostic accuracy.

Introduction

With a lifetime prevalence rate of one in seven, acute appendicitis is one of the most prevalent gastrointestinal emergencies.¹ It is characterized by a sharp, acute pain in the right lower abdomen. Despite its ubiquity and severity, the illness remains undiagnosed, with just a 70% accuracy rate. It is considerably more difficult to identify in children and women of reproductive age because of various inflammatory or gynecological diseases with similar symptoms.^{2,3}

The use of radiological imaging methods such as CT or ultrasound improves diagnostic accuracy of acute appendicitis; however, these techniques are expensive and time consuming and may not be readily available when they are required.^{4,5} As a

consequence, delayed appendectomy owing to diagnostic accuracy raises the likelihood of complications such as sepsis and perforation. which increases the mortality rate.⁶

As a result, various methods, such as some grading systems, as MASS (modified Alvarado scoring system) and RIPASA (Raja Isteri Pengiran Anak Saleha appendicitis) can be used to detect unclear instances, reduce the negative appendectomy and mortality rate.^{7,8} The Alvarado Scoring System is the most widely used scoring system in Europe and the United States of America. In Western nations, this approach is widely employed. In a group with a completely different ethnic background and cuisine, the scoring system

was shown to have very poor sensitivity and specificity.⁹ A new scoring system called RIPASA was developed for the Asian population since ALVARADO scores for the diagnosis of acute appendicitis were discovered to be unsatisfactorily low.^{10,11} This approach requires more parameters than the Alvarado system, which may raise the sensitivity and specificity of the scoring system, thereby accelerating the diagnosis of appendicitis and preventing negative appendectomy and consequences of delayed appendectomy.¹⁰ More research has been conducted in the Eastern population to validate the RIPASA scoring system for the diagnosis of AA.

The goal of this study was to compare the predictive accuracy of RIPASA score in diagnosing acute appendicitis with the gold standard of histopathologically proven appendicitis as gold standard.

Methodology

This prospective cohort study was conducted in CMH Hospital from Sep 2022 to March 2023. 208 people were included in our study, using the Rao Soft sample size calculator with a 95% confidence interval and a 5% margin of error, keeping population size as 1500. Non-probability sequential sampling was utilized.

Our study is fully compliant with the STROCSS 2021 guidelines.¹² A complete STROCSS 2021 checklist has been provided as a supplementary file. Our study has been registered on Research Registry with the following UIN: research registry-8269.¹³ Our study is in accordance with the Declaration of Helsinki.

All patients over the age of 16 who were sent to the on-call surgeon for treatment of acute RIF pain or suspicion of appendicitis were included in our study. Patients who have history of prior appendicectomy, chronic abdominal pathology, abdominal surgery in the last 90 days or inguinal hernia were not included in the study. pregnant women due to significant different medical needs were excluded from the study.

After receiving clearance from the ethics committee of CMH Hospital Rawalpindi, obtaining informed consent, the clinical data of patients was gathered using standardized case report forms during the first examination. Record of the patient's history of medical comorbidities; demographics;

physical examination results; laboratory tests; radiographic imaging; and post-operative findings was saved.

Images and the surgeon's judgement helped determine whether or not to operate on patients. For all patients, including those who were treated more conservatively, postoperative complications or the need for a follow-up procedure were monitored for one month.

Appendicitis and no appendicitis patients were divided into two groups: "Appendicitis" included patients who have a histologically proven AA diagnosis; "Appendicitis" included patients who have a non-appendicitis diagnosis.

Data was entered and analyzed using SPSS version 26. Quantitative data is presented as frequencies and percentages. Chi-square test was applied to evaluate both the groups keeping significance less than 0.05. Sensitivity and specificity of RIPASA scoring was assessed comparing Appendicitis on Histology.

Results

Out of 208 patients in this study, 67.3% (140) were Male and 32.7% females. The median age of the patients was 25 IQR (17-33), and close to 71.2% of patients lie in the age group of 9-30, as shown in Table I

Table I: Distribution according to the age group	
Age groups	Median Age
9 thru 20	33.7
21-30	37.5
31-40	16.3
41-50	4.8
51-60	2.9
61-70	4.3
71-90	0.5

RIPASA scores of the patients were distributed as follows. The low-score group (<5) consisted of 5 (2.4%) patients, the intermediate-score group consisted of 56 (27%) patients, and the high-score group consisted of 147 (70.6%) patients.

On the basis of Histopathology results, there were 168 (81%) patients with positive for

appendicitis whereas 40 (19%) were negative, similarly when cutoff RIPASA score ≥ 7.5 was used 147 (71%) were positive and for the score < 7.5 61 (29%) patients were negative.

Table II shows that there is a significant association between histopathology and RIPASA score, with a p-value of 0.001 based on the Chi-square test. Among the 208 cases, 168 were positive for acute appendicitis, while 40 were negative. The majority of the positive cases (123) had a RIPASA score in the range of 7.5-11.5. In contrast, the negative cases were mostly distributed in the lower RIPASA score range (< 5). The p-value obtained from the Chi-square test is 0.001, which is less than 0.05, indicating that there is a statistically significant association between histopathology results and RIPASA Score ranges.

Table II: Association between histopathology and RIPASA score

Histopathology	RIPASA Score range				Total	P-Value
	< 5	5-7	7.5-11.5	≥ 12		
Negative	4	17	19	0	40	0.001
Positive	1	39	123	5	168	
Total	5	56	142	5	208	

The sensitivity of the RIPASA score is 76.2%, indicating that it correctly identifies 76.2% of the cases with acute appendicitis. The specificity of the RIPASA score is 52.5%, indicating that it correctly identifies 52.5% of the cases without acute appendicitis. The positive predictive value (PPV) of the RIPASA score is 87.03%, indicating that if the score is positive, there is an 87.03% chance that the patient has acute appendicitis. The negative predictive value (NPV) of the RIPASA score is 34.4%, indicating that if the score is negative, there is a 34.4% chance that the patient does not have acute appendicitis. The accuracy of the RIPASA score is 71.6%, indicating that it correctly identifies 71.6% of the cases as either positive or negative for acute appendicitis.

The ROC curve analysis showed that the RIPASA score has a moderate ability to distinguish between patients with acute appendicitis and those without it, with an area under the curve of 0.72, having a standard error of 0.044 & 95% Confidence Interval of 0.634-0.805. However, it was not possible to determine a suitable cutoff value for the

RIPASA score to diagnose acute appendicitis without significantly compromising its specificity. This means that using a specific cutoff value would lead to a high rate of false positives, which could result in unnecessary appendectomies for patients without acute appendicitis, as shown in Figure I.

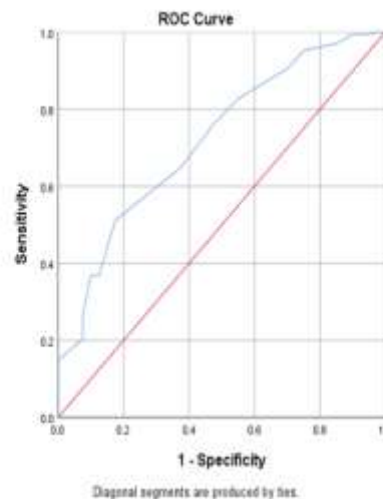


Figure I: The ROC curve

Discussion

Acute appendicitis is a prevalent and complex surgical emergency that poses significant challenges. If left untreated, it can result in serious complications such as appendiceal perforation and peritonitis, which are associated with high rates of mortality and morbidity.¹⁴ At the same time, it is a frequently encountered surgical emergency, particularly among junior doctors during their on-call duties. Emergency appendectomy, the surgical removal of the appendix, accounts for approximately 10% of all emergency abdominal surgeries.¹⁵ The assessment of acute appendicitis primarily relies on the patient's medical history and clinical findings, which play a crucial role in establishing a diagnosis of this condition.¹⁶

Junior medical doctors generally carry the burden of the responsibility for diagnosing acute appendicitis in poor or emerging nations such as Pakistan. This circumstance emerges as a result of a shortage of senior doctors as well as a lack of resources, such as access to CT scans or ultrasound equipment. The absence or restricted availability of these diagnostic modalities makes effectively diagnosing this acute illness difficult. A precise

diagnosis of acute appendicitis necessitates both experience and the use of modern imaging tools. Because of their extremely high sensitivity and specificity ratios, CT scans and ultrasound tests have proven to be invaluable instruments.¹⁷ However, the growing number of patients per medical institution, or the lack of such facilities in rural regions, exacerbates the diagnostic challenges.¹⁸

This situation presents an interesting and unified area of research, as it stimulates an investigation into alternative diagnostic methods or scoring systems that can assist in the precise diagnosis of acute appendicitis in settings with limited resources. By exploring innovative solutions or diagnostic algorithms that can enhance diagnostic accuracy without solely relying on advanced imaging, Hence the role of the different scoring system have played a significant role in decreasing negative appendectomy rates.¹⁹ Unnecessary appendectomies have been associated with a significant increase in postoperative complications such as Surgical site infection, Ileus, and Adhesions.²⁰ Alfred Alvarado created a validated scoring method in 1986, which proved valuable in facilitating a swift and precise detection of appendicitis, hence addressing the challenge of redundant appendectomies.²⁰ Because ALVARADO scores for acute appendicitis were determined to be inadequate, a new scoring system known as RIPASA (Raja Isteri Pengiran Anak Saleha Appendicitis) was devised for the Asian population.²¹ Several studies have been conducted to assess and demonstrate the significant disparities in diagnostic accuracy between the ALVARADO and RIPASA scoring systems. These studies sought to determine the extent to which the two scoring systems differed in their capacity to appropriately diagnose acute appendicitis. The majority of these meta-studies have consistently demonstrated a significant difference in favor of the RIPASA score, indicating its superior diagnostic accuracy and utility compared to the ALVARADO score.^{22,23}

However in our study the findings were not similar to what most of the other studies have demonstrated Sensitivity: Sensitivity 76.2%, Specificity 52.5%, PPV 87.03%, NPV 34.4% Accuracy 71.6% AUC 72 couple of studies conducted in Pakistan by Hassan et al and Zeb et al had following findings, 96.75% sensitivity, an 82.35%

specificity, 98.02% PPV and 95.3% diagnostic accuracy Sensitivity 96.7%, specificity 72.7%, PPV of 97.5%, NPV of 66.7% accuracy of 94.6% respectively.²¹⁻²⁴ These findings are consistent with other studies conducted in the Asian population, also highlight the significant impact of the RIPASA score, whose sensitivity in diagnosing acute appendicitis is comparable to that of diagnostic modalities such as ultrasound and CT scan. When used in conjunction with these imaging techniques, the RIPASA score can further improve appendicitis diagnosis accuracy.

The results of our study were similar to those reported by Ozdemir et al, who found a sensitivity of 68%, specificity of 71%, positive predictive value (PPV) of 89%, negative predictive value (NPV) of 39%, diagnostic accuracy of 75%, and an area under the curve (AUC) of 70%. Additionally, Golden et al reported a sensitivity of 78%, specificity of 36%, PPV of 39%, and NPV of 76%. These findings, along with our own study results, raise doubts about the significance of the RIPASA score compared to histopathology in diagnosing acute appendicitis.^{25,26}

Golden et al study featured a population that was skewed towards older patients and was conducted outside of Asia. This demographic diversity may help to justify their conclusions. However, in our study, the population was largely younger, with around 70% of individuals aged 9 to 30. Only 18% of the population were over 45-year-old patients. Furthermore, approximately 15% of the population was under the age of 12. These age distributions may have had a substantial influence on the RIPASA score's sensitivity. It is well recognized that recognizing pain symptoms in younger people can be difficult which could contribute to the lower sensitivity observed in our investigation.²⁸ However, the presence of 18% older patients may result in a misdiagnosis, as clinicians may neglect appendicitis in older people due to its higher occurrence in younger age groups. These age distribution characteristics in our study sample potentially influenced the diagnostic performance of the RIPASA score and should be considered when interpreting the results.²⁹

While acknowledging the study's shortcomings, it is important to emphasize that it was done at a single hospital, which may raise questions about the findings' generalizability. Other studies, however, have yielded similar results,

demonstrating a degree of stability across diverse research settings.^{30,31}

Our study findings do not support the use of clinical scoring systems as the sole diagnostic evaluation approach when medical imaging is deemed necessary by the physician. It is advised that exclusion and inclusion criteria be incorporated into the scoring system, especially for some younger age groups where the RIPASA score may be difficult to apply. Modifying the scoring tool for these age groups may improve its utility.³¹ It is

also recommended to use scoring tools in conjunction with imaging modalities. Imaging modalities have demonstrated higher consistency in

delivering trustworthy results than scoring methods such as ALVARADO and RIPASA. Despite this, our hospital has continued to rely on imaging modalities in the hopes of discovering a solution that will limit ionizing radiation exposure while still effectively detecting appendicitis.

Conclusion

our findings point to the need for improved scoring methods for appendicitis diagnosis, particularly when combined with imaging modalities. The goal is to strike a balance between precise diagnosis and patient radiation exposure.

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