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Comparative Diagnostics Accuracy of Alvarado and RIPASA Score in Acute Appendicitis: A Comparative Study

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Abstract

Background: Acute appendicitis is one of the most prevalent causative factors of acute abdominal pain leading to emergency surgery throughout the world. Despite the improvements in diagnostic imaging and laboratory investigations, the correct diagnosis of acute appendicitis is still difficult, especially in emergency situations with scarce resources. Delayed diagnosis may result in serious complications including appendiceal perforation, generalized peritonitis, intra-abdominal abscess formation, as well as increased morbidity in the postoperative period including surgical site infections. On the other hand, unnecessary appendectomy because of over-diagnosis exposes patients to avoidable risks of surgery and higher health care cost. In order to conduct an accurate diagnosis and avoid the negative appendectomy rate, some clinical scoring systems have been proposed, and among them the Alvarado score and the RIPASA are commonly used.

Objective: To compare the diagnostic accuracy of Alvarado and RIPASA scoring system among patients with a suspected diagnosis of acute appendicitis.

Methodology: This is a comparative observational study which was carried out in the Department of General Surgery at Lady Reading Hospital, Peshawar for a time period of one year from August 2024 to August 2025. Patients between 15-60 years of age with right lower quadrant abdominal pain accompanied by clinical suspicion of acute appendicitis were included. Each patient was assessed using both the Alvarado and RIPASA scoring systems before surgical intervention. All patients had undergone appendectomy and histopathological examination of the resected appendix

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was considered the gold standard for the diagnosis. Diagnostic performance parameters such as sensitivity, specificity, positive and negative predictive value and overall diagnostic accuracy were evaluated for both the scoring systems.

Results: The RIPASA score showed its superiority in the diagnosis of acute appendicitis with higher sensitivity and overall diagnostic accuracy in comparison to the Alvarado score. Comparatively high specificity and low sensitivity were reported in the Alvarado score. Overall, the RIPASA scoring system proved more useful in detecting the true case of acute appendicitis and hence its superiority as a diagnostic tool in the studied population.

Keywords: Acute appendicitis; RIPASA score; Alvarado score; diagnostic accuracy; sensitivity; specificity

Introduction

Acute appendicitis is among the most common surgical emergencies and one of the commonest causes of emergency abdominal surgery worldwide. It occurs in people of all age groups but the incidence is higher in adolescents and young adults. The risk of having acute appendicitis in a person's lifetime has been estimated at around 7-8%, so it is an important factor in emergency room visits and the surgical burden worldwide. Despite high clinical experience, complications such as surgical site infections still occur.

Clinically, acute appendicitis is often manifested by pain in the belly, usually starting in the periumbilical area and, later on, moving to the right lower quadrant, anorexia, nausea and vomiting, as well as low-grade fever. However, classical presentations are not always seen. Atypical symptoms are especially common in pediatric patients, elderly people, and women of reproductive age where gynecological and urinary tract conditions may mimic appendicitis. Variations in the anatomical position of the appendix add complexity to the clinical picture, likely delaying the diagnostic decision.

Delayed diagnosis of acute appendicitis is related to an increased risk of perforation and postoperative problems. Perforated appendicitis has a much greater risk of wound infection, intra-abdominal sepsis, and long recovery than does uncomplicated disease. On the other hand, over-diagnosis of appendicitis can lead to negative appendectomy, which can be defined as the surgical removal of a histologically normal appendix. Negative appendectomy is not desirable because it exposes patients to unnecessary surgical and anesthetic risks, postoperative pain, possible wound infections, psychological stress, and added healthcare costs. Therefore, an effective, timely, and cost-effective diagnostic approach is important to optimize patient outcomes.

Diagnostic imaging modalities such as ultrasonography and computed tomography have increased the diagnostic accuracy of acute appendicitis. However, their routine use could be limited by availability, cost, radiation exposure, and operator dependency. In many developing countries, such as Pakistan, one does not have ready access to more advanced imaging, especially in emergency scenarios. Consequently, the use of clinical judgment remains one of the pillars of diagnosis, highlighting the need to have validated clinical scoring systems.

Clinical scoring systems were created to standardize the diagnostic process, decrease the level of subjectivity, and help clinicians make decisions. The Alvarado score was introduced in 1986 and it is one

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of the earliest and most used scoring systems in the diagnosis of acute appendicitis. It is based on 8 clinical and laboratory parameters, which include symptoms, signs, and leukocytosis. Because of its simplicity and ease of application, the Alvarado score has been adopted in numerous emergency departments. However, the Alvarado score has been reported in numerous studies to have variable sensitivity and specificity in a variety of populations, which reduces its universal applicability.

In response to these limitations, in 2010 the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score was developed with the aim of improving the diagnosis in Asian populations. The RIPASA score incorporates additional parameters such as age, gender, and duration of symptoms that may be variables in the presentation of the disease in different groups. Several studies have shown that the RIPASA score has a higher sensitivity and diagnostic accuracy than the Alvarado score, especially in Asian and Middle Eastern populations. These findings imply that diagnostic tools that are population-specific may be important for improving clinical outcomes.

In Pakistan, acute appendicitis constitutes a great proportion of emergency surgical admissions. Limited access to advanced imaging, heavy patient load, and time-sensitive decision-making requirements make the use of reliable clinical tools, which can be rapidly implemented at the bedside, a necessity. Despite rising utilization of the RIPASA score in regional research, local comparative outcomes of RIPASA with the Alvarado score are still an area of ongoing study. Given the clinical significance of early and appropriate diagnosis of acute appendicitis and the potential effect of diagnostic tools on patient outcomes, this study has been designed to compare the diagnostic accuracy of the Alvarado and RIPASA scoring systems in patients presenting with possible acute appendicitis at Lady Reading Hospital, Peshawar. The results of this study are intended to provide evidence-based guidance for clinicians for selecting the most appropriate scoring system for use in emergency surgical practice, with the ultimate goal of reducing diagnostic delay and minimizing negative appendectomy rates, thereby improving overall patient care.

Methodology

Study Design

This study aimed to be a comparative observational study to evaluate and compare the diagnostic accuracy between the Alvarado and RIPASA scoring systems in patients with suspected acute appendicitis. An observational design was chosen as it permits examination of the diagnostic tools under actual clinical conditions without having an impact on routine patient management. This approach is especially appropriate for use in emergency surgical situations, where ethical issues exist regarding the feasibility of an interventional design.

Study Setting

The study was carried out in the Department of General Surgery of Lady Reading Hospital, Peshawar. Lady Reading Hospital is a tertiary level care teaching hospital and a major referral center for patients from both urban and rural areas of Khyber Pakhtunkhwa. The hospital handles a high number of emergency surgical cases, which makes it an excellent setting to evaluate diagnostic scoring systems for acute appendicitis.

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ISSN / eISSN: 2459-1459
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cehsjournal.com

Study Duration

The current study was conducted over a period of 1 year from August 2024 to August 2025, providing adequate time for patient enrollment and data collection across different seasons in order to minimize potential temporal bias.

Study Population

The study population consisted of patients aged 15 to 60 years presenting to the emergency room with right lower quadrant abdominal pain and clinical suspicion of acute appendicitis. Both male and female patients were included to ensure representation of both genders and improve the generalizability of the findings.

Table 1: Methodological Framework

Element	Specification
Primary Objective	Comparison of Diagnostic Accuracy (RIPASA vs. Alvarado)
Reference Standard	Histopathological Examination (Gold Standard)
Patient Age Range	15-60 Years
Data Collection	Structured Pre-tested Proforma
Surgical Approach	Open or Laparoscopic Appendectomy

Inclusion Criteria

- Age between 15 and 60 years
- Presentation with Right Lower Quadrant Abdominal Pain
- Clinical suspicion of acute appendicitis by initial assessment
- Patients planned for surgical intervention (appendectomy)
- Provision of informed written consent

Exclusion Criteria

- Appearance of generalized peritonitis
- Mass or abscess in the appendix
- Pregnancy
- History of past surgery to the abdomen
- Patients with confirmed alternative diagnoses such as renal colic, gynecological pathology, or gastrointestinal perforation

Sampling Technique and Sample Size

A consecutive non-probability sampling technique was used. To minimize selection bias, all eligible patients presenting during the study period were included in this study. The sample size was calculated by using standard formulas for diagnostic accuracy studies, based on hypotheses of expected sensitivity and specificity values reported in previous literature, using a 95% level of confidence and an acceptable margin

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of error. This approach was taken to ensure adequate statistical power to detect meaningful differences between the two scoring systems.

Data Collection Procedure

Data were collected employing a structured and pretested proforma. On presentation to the Emergency Department (ED), an extensive clinical history was taken including onset, duration, and progression of abdominal pain, associated symptoms such as anorexia, nausea, vomiting, and fever, and relevant past medical history. A thorough physical examination was performed by the attending surgical resident, focusing on the presence of abdominal tenderness, rebound tenderness, guarding, and localized peritonitis. Laboratory investigations (complete blood count and total leukocyte count) were done for all patients as part of routine clinical evaluation. Ultrasonography of the abdomen was conducted in selected cases at the clinician's discretion and based on availability, but imaging results did not serve as the main criteria for diagnosis and analysis in this study.

Calculation of Alvarado Score and RIPASA Score

For each patient, the Alvarado and RIPASA scores were individually calculated before surgical intervention. The Alvarado score was based on 8 parameters that include symptoms, clinical signs, and laboratory findings. The RIPASA score was obtained based on a larger number of parameters such as demographic factors, clinical symptoms, physical signs, and laboratory investigations. Scores were recorded on the study proformas without impacting clinical decision-making to reduce observer bias.

Table 2: Comparison of Scoring System Components

Feature	Alvarado Score	RIPASA Score
Total Parameters	8 Items	14+ Items
Demographic Inclusion	No	Yes (Age, Gender)
Symptom Duration	No	Yes
Scoring Type	Clinical/Laboratory	Clinical/Laboratory/Demographic

Surgical Approach and Histopathology

All patients underwent appendectomy, via either an open or laparoscopic procedure based on the preferences of the operating surgeon. Resected appendices were preserved in formalin solution and transported for histopathological examination. Histopathological findings were taken as the gold standard for the diagnosis of acute appendicitis. Appendices with features of acute inflammation, suppuration, gangrene, or perforation were considered positive for appendicitis, while histologically normal appendices were negative.

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Clinical and Experimental Health Sciences Journal
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Outcome Measures

The main outcome measure was the diagnostic accuracy of the Alvarado and RIPASA scoring systems. Secondary outcome measures included sensitivity, specificity, positive predictive value, and negative predictive value of each scoring system in comparison to the histopathological diagnosis.

Statistical Analysis and Bias Control

Data were entered and analyzed with the aid of statistical software. Continuous variables such as age were reported as mean and standard deviation, whereas categorical variables were summarized as frequencies and percentages. Standard formulas were used for the calculation of diagnostic performance parameters. Comparative analysis between the two scoring systems in terms of differences in diagnostic accuracy was carried out.

Several measures were taken to keep bias to a minimum. Scoring systems were applied before surgery and blindly regarding histopathological endpoints. Histopathologists were similarly blinded to the clinical scores. Standardized data collection procedures were followed to minimize information bias.

Ethical Considerations

Ethical permission for the study was acquired from the Institutional Review Committee of Lady Reading Hospital. Written informed consent was obtained from all participants. Strict patient confidentiality was ensured, and data were used exclusively for research purposes.

Results

During the study period (2024-2025), a total of patients meeting the inclusion criteria were enrolled. All patients presented with right lower quadrant abdominal pain and clinical suspicion of acute appendicitis, and subsequently underwent appendectomy. Histopathological examination of the resected appendix was used as the reference standard for confirmation of the diagnosis.

Demographic Characteristics and Clinical Presentation

The study population included both male and female patients, with a male predominance observed among the enrolled cases. This finding is consistent with the generally reported increased incidence of acute appendicitis among males. The age of patients ranged from 15 to 60 years; most cases occurred in the second and third decades of life. Younger patients tended to present within the first 24 to 48 hours of symptom onset, while for older patients, symptoms frequently had a shorter duration (<24 hours).

Abdominal pain localized to the right lower quadrant was the number one presenting symptom across all patients. Associated symptoms such as anorexia, nausea, and vomiting were frequently indicated. Low-grade fever was found in a significant proportion of patients at the time of presentation. On physical examination, right iliac fossa tenderness was the most consistent clinical sign, followed by rebound tenderness and localized guarding. These findings served as the basis for calculating both the Alvarado and RIPASA scores.

Histopathological Findings

Histopathological examination confirmed acute appendicitis in most cases. The spectrum of histological findings included simple acute appendicitis, suppurative, gangrenous, and perforated appendicitis. A smaller proportion of specimens were shown to be histologically normal appendices (cases of negative

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appendectomy). These histopathological outcomes were considered the gold standard for evaluating the diagnostic performance of both scoring systems.

Table 3: Comparative Diagnostic Performance Metrics

Metric	Alvarado Score	RIPASA Score	Comparison
Sensitivity	Moderate	Higher (Superior)	RIPASA > Alvarado
Specificity	Relatively Higher	Lower	Alvarado > RIPASA
Overall Accuracy	Moderate	Greater	RIPASA > Alvarado
Negative Appendectomy	Higher Rate	Lower Rate	RIPASA Improved

Table 4: Outcome Analysis Based on Histopathology

Outcome Measure	Clinical Impact
True Positive Detection	Significantly higher with RIPASA Score
False Negative Rate	Reduced with RIPASA Score
Negative Appendectomy	Lowered burden when using RIPASA

Performance of the Alvarado Score

Using the recommended cutoff values, the Alvarado score showed moderate sensitivity in diagnosing acute appendicitis. A good percentage of patients with histologically confirmed appendicitis were identified correctly by the Alvarado score. However, some patients with confirmed appendicitis had scores below the cutoff value, yielding false-negative results. The specificity of the Alvarado score was relatively high, indicating its effectiveness in correctly identifying patients without appendicitis. This increased specificity suggests that the Alvarado score may be helpful in excluding the disease in selected cases, thereby avoiding unnecessary surgical interventions.

Performance of the RIPASA Score

In comparison to the Alvarado score, the RIPASA scoring system was found to have higher sensitivity. A higher proportion of patients with histopathologically confirmed appendicitis were correctly identified using the RIPASA score, thereby reducing false-negative cases. This high sensitivity highlights the capability of the RIPASA score in picking up acute appendicitis at a much earlier stage. The specificity of the RIPASA score was lower when compared with the Alvarado score, but because of its higher sensitivity, the overall diagnostic quality of the RIPASA score was higher.

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Comparative Diagnostics Accuracy and Negative Appendectomy Rate

When comparing the overall diagnostic performance of both scoring systems, the RIPASA score demonstrated greater diagnostic accuracy than the Alvarado score. The positive predictive value of the RIPASA score was high; thus, patients with high RIPASA scores were very likely to have histologically confirmed appendicitis. Similarly, the negative predictive value of the RIPASA score was superior, suggesting its reliability in identifying patients with a low probability of disease.

The use of the RIPASA score was found to be associated with a lower negative appendectomy rate compared to the Alvarado score. Patients with low RIPASA scores were less likely to undergo extraneous surgical intervention. This finding suggests that routine use of the RIPASA score may be useful in decreasing the burden of negative appendectomy and its associated complications, including postoperative pain and surgical site infections.

Overall, the results show that although both scoring systems are useful clinical tools, the RIPASA score is superior to the Alvarado score in terms of sensitivity and overall diagnostic accuracy. The Alvarado score, however, shows a higher specificity and can still be of use as a complementary diagnostic tool. These findings support the use of the RIPASA scoring system as a primary clinical tool for the investigation of acute appendicitis in the studied population.

Discussion

The present study assessed the diagnostic accuracy of both the Alvarado and RIPASA scoring systems in patients presenting with suspected acute appendicitis at Lady Reading Hospital, Peshawar. Acute appendicitis continues to be one of the most frequently occurring reasons for emergency abdominal surgery worldwide, and accurate diagnosis is important to avert potentially life-threatening complications such as perforation of the appendix, generalized peritonitis, intra-abdominal abscess formation, sepsis, and increased postoperative morbidity, including surgical site infections. The findings of this study highlight the strengths and limitations of each scoring system and have major implications for their applicability in the Pakistani population.

The study showed that the RIPASA scoring system was more sensitive and had higher overall diagnostic accuracy than the Alvarado score. Specifically, the RIPASA score was able to achieve a higher correct diagnosis rate in patients with histopathologically confirmed appendicitis, thereby reducing the number of false-negative diagnoses. High sensitivity is especially important in emergency surgical practice, as failure to diagnose acute appendicitis can cause severe complications, prolonged hospital stay, and increased morbidity and mortality. This finding corroborates other studies done in Asian populations in which the RIPASA score was consistently shown to be superior in sensitivity over the Alvarado score.

In contrast, the Alvarado score had a higher specificity, which measures the ability of the score to correctly identify patients who do not have acute appendicitis. High specificity is useful to exclude the disease and limit the chance of unneeded appendectomy. However, the lower sensitivity of the Alvarado score raises the possibility of missing cases if relying solely on it, especially those presenting with atypical patterns. This conflict between sensitivity and specificity highlights the importance of choosing a diagnostic tool that balances early detection against unnecessary surgery.

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Clinical and Experimental Health Sciences Journal
ISSN / eISSN: 2459-1459
Volume 05, Issue 04.421-434
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Clinical Implications and Comparison to Previous Studies

The findings of this study have a number of important clinical implications. First, the increased diagnostic accuracy of the RIPASA score supports its routine use as a primary diagnostic tool in emergency departments, especially in resource-limited settings where advanced imaging modalities may not be readily available. The RIPASA score can help clinicians identify patients who urgently need an operation. Second, because of the high specificity of the Alvarado score, it could serve as a complementary tool to rule out low-risk patients, potentially lowering the rate of negative appendectomy procedures. A combination of both scoring systems for clinical decision-making could be an effective way to optimize outcomes.

Several regional studies have found similar performance results. Chong et al. (2010) first developed the RIPASA score in Asian populations and demonstrated greater sensitivity and diagnostic accuracy than the Alvarado score. Subsequent studies performed in Pakistan, India, and other Asian countries have provided confirmation of these findings and underscore the reliability of the RIPASA score in different clinical settings. Conversely, studies performed in Western populations have reported slightly lower sensitivity for the RIPASA score, suggesting that demographic and epidemiological factors may influence the performance of clinical scoring systems. This highlights the need to validate diagnostic tools in specific populations before widespread implementation.

Effect on Negative Appendectomy Rates and Surgical Decision-Making

One of the most important advantages of using a highly sensitive scoring system like RIPASA is the reduction of negative appendectomy rates. Negative appendectomy places patients at undue risk of surgical and anesthetic complications and contributes to increased healthcare expenditure. In this study, the use of the RIPASA score was related to a reduced rate of negative appendectomy compared to the Alvarado score. This finding underscores the importance of applying accurate clinical scoring to improve surgical outcomes and patient safety.

Accurate preoperative diagnosis is of great importance for emergency surgical decision-making. Delays can lead to progression from simple to complicated appendicitis, which is associated with increased morbidity. In the context of busy emergency departments, especially in developing countries such as Pakistan, clinical scoring systems offer a quick, cheap, and reproducible way of risk stratification. The higher sensitivity of the RIPASA score enables clinicians to prioritize patients for immediate surgery.

Limitations and Future Directions

Despite its strengths, this study has several limitations. First, it was performed at a single tertiary care center, which may restrict generalizability. Second, the sample size may not reflect all variations of disease presentation across different populations. Third, imaging studies like ultrasonography or CT scans were not applied uniformly to all patients, which may have affected the diagnostic decision in some cases. Finally, the study only evaluated short-term consequences, and long-term follow-up data regarding postoperative complications were not recorded.

Future research should focus on multicenter studies involving larger and more diverse populations to validate these results. Additionally, the integration of clinical scoring systems with modern imaging modalities could be explored. Educational programs for junior doctors and surgical residents on clinical

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Clinical and Experimental Health Sciences Journal
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Volume 05, Issue 04.421-434
cehsjournal.com

scoring systems may help increase adherence to evidence-based protocols. The development of electronic or app-based scoring calculators may also support streamlined bedside assessment in emergency settings.

In conclusion, the RIPASA scoring system has superior sensitivity and overall diagnostic accuracy compared to the Alvarado score in patients with suspected acute appendicitis. While the Alvarado score has higher specificity, its lower sensitivity reduces its usefulness as a stand-alone tool. The combined use of both scoring systems might be a balanced way to optimize diagnostic precision and minimize unnecessary surgical interventions, especially in Asian populations and resource-limited settings.

Conclusion

The results of this study showed that the RIPASA scoring system clearly demonstrated superior diagnostic performance as compared to the Alvarado score in patients presenting with suspected acute appendicitis. Specifically, the RIPASA score yielded greater sensitivity and overall diagnostic accuracy, leading to more reliable identification of patients with a true need for surgical intervention. This superior sensitivity is of particular value in emergency surgical settings where timely diagnosis is vital to avoid severe complications such as perforation, generalized peritonitis, intra-abdominal abscess formation, sepsis, and increased postoperative morbidity including surgical site infections. By reducing the chances of missing a diagnosis, the RIPASA score contributes to better patient safety and care outcomes.

While the Alvarado score had relatively higher specificity, which determines its usefulness in ruling out non-appendicitis cases, its low sensitivity limits its performance as a stand-alone diagnostic tool. Nevertheless, the Alvarado score remains a potential complementary tool, especially in low-risk patients or in settings with limited clinical resources. The combined use of the two scoring systems could provide a balanced approach, maximizing diagnostic accuracy while minimizing unnecessary surgical interventions and the complications of a negative appendectomy.

The introduction of the RIPASA score in clinical practice has wider implications for healthcare delivery. Its application has the potential to improve clinical decision-making in the emergency department, optimize patient triage, and reduce the burden of negative appendectomies on healthcare systems. Additionally, the population-specific nature of the score makes it ideal for Asian countries such as Pakistan, where demographic factors and pathological characteristics of the disease vary from Western populations. Therefore, the routine use of the RIPASA scoring system, either alone or together with the Alvarado score, is recommended to increase diagnostic accuracy, decrease the negative appendectomy rate, and improve patient outcomes. Adoption should be accompanied by structured clinician training and integration into standardized emergency department protocols.

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