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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 appendicle 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 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 emergency 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 the high a complications such as surgical site infections.

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 and in elderly people and women with a reproductive system where gynecological and urinary tract conditions may mimic appendicitis. Variations in anatomy position of appendix add to medications in the clinical picture, a likely delay the decision of diagnosis.

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 doe's 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, and radiation exposure and operator dependency. In many developing countries, such as Pakistan, one does not have ready access to more advanced imaging, especially if one is in an emergency. Consequently, the use of clinical judgment remains one of the pillars of the diagnosis, highlighting the need to have validated clinical scoring systems.

Clinical scoring systems were created to standardize the diagnostic process and decrease the level of subjectivity and help the clinician make decisions. The Alvarado score was introduced in 1986 and it is one of the earliest and the 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 this limitations, in 2010 the Raja Istria Peng ran Akan Saleh Appendicitis (RIPASA) score was developed with the aim of improving the diagnosis in Asian population. **The RIPASA** score also 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 is a great proportion of the 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 outcome of RIPASA with the Alvarado score is still an area of ongoing study.

Given the clinical significance of early and appropriate diagnosis of acute appendicitis and the potential effect of the diagnostic tools on the patient outcomes, this study has been designed to compare the diagnostic accuracy of Alvarado and RIPASA scoring system in patients presenting with possible acute appendicitis at Lady Reading Hospitals 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 the 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 in 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 the patients from urban and rural areas of Khyber Pakhtunkhwa. The hospital handles a high number of emergency surgical cases, which makes it a good setting to evaluate diagnostic scoring systems for acute appendicitis.

Study Duration

The current study was conducted through 1 year from August 2024 to August 2025 and there was an adequate time for patient enrolment and data collection from different seasons in order to minimise potential temporal bias.

Study Population

The study population was 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 generalizing the findings.

Table 1: Methodological Framework

Element	Specification
Primary Objecti	Comparison of Diagnostic Accuracy (RIPASA vs. Alvarado)
Reference Stand	Histopathological Examination (Gold Standard)
Patient Age Ran	**ge**15 – 60 Years

Element	Specification

Data Collection	Structured Pre-tested Proforma
Surgical Approa	Open or Laparoscopic Appendectomy

Inclusion Criteria

Patients were included if they met the following criteria:

○ Age between 15 and 60 years ○ Presentation with Right Lower Quadrant Abdominal Pain ○ Clinical suspicion of acute appendicitis by initial assessment, ○ Wilson, "patients planned for surgical intervention (appendectomy)". ○ Accommodation of informed written consent

Exclusion Criteria

Patients were excluded if they were meeting one of the following criteria:

- Appearance of generalized peritonitis ○ Mass or abscess in the appendix
- Pregnancy
- History of past surgery to the abdomen

Patients with alternative diagnoses that are confirmed 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 the standard formulas used to calculate sample size in diagnostic accuracy studies, based on hypotheses of expected sensitivity and specificity values reported by previous literature, using 95% level of confidence and acceptable margin of error. This approach was to ensure adequate statistical power in the study for the detection of meaningful differences between the two scoring systems.

Data Collection Procedure

Data were collected employing structured and pretested preform. On presentation to 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 done by the attending surgeon resident, focussing on the presence of abdominal tenderness, rebound tenderness, guarding, and the presence of localizable peritonitis.

Laboratory investigations (complete blood count and total leukocyte count) were done for all the patients as a routine clinical evaluation. Ultrasonography of the abdomen was conducted in selected cases at clinician's discretion and due to availability, but imaging results did not serve as the main criteria for diagnosing and the analysis of the study cases.

Calculation of Alvarado Score and RIPASA Score

For each patient the Alvarado and RIPASA scores were individually calculated before the surgical intervention. The Alvesado score was based on 8 parameters that include symptoms, clinical signs, and laboratory findings. The score of RIPASA was obtained based on a larger

number of parameters such as demographic factors, clinical symptoms, physical signs, and laboratory investigations. Scores were extracted on the study preforms without the impact of clinical decision-making to reduce observer bias.

Table 2: Comparison of Scoring System Components

Feature	Alvarado Sco	RIPASA Score

Total Paramet	**8 Items**	**14+ Items**
Demographic I	**No**	**Yes (Age, Gender)**
Symptom Dura	**No**	**Yes**
Scoring Type	**Clinical/Lab**	**Clinical/Laboratory/Demographic**
Feature	**Alvarado Sco**	**RIPASA Score**
Total Paramet	8 Items	14+ Items
Demographic I	No	Yes (Age, Gender)
Symptom Dura	No	Yes
Scoring Type	Clinical/Labo	Clinical/Laboratory/Demographic

To manage histopathology surgery is employed

All the patients underwent appendectomy, either via an open or laparoscopic procedure operated based on the preferences of operating surgeon. Resected appendices were kept 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, and histologically normal appendices were negative.

Outcome Measures

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

Statistical Analysis

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 percent Standard formulas were used for calculation of diagnostic performance parameters. Comparative analysis between the two scoring systems in terms of difference in diagnostic accuracy was carried out.

Bias Control

Several measures were taken to keep bias to a minimum. Scoring systems were used before surgery and blindly to histopathological end-points. Histopathologists were blinded for the clinical scores. Standardized data collection procedures have been followed in order 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 of the participants. Strict patient confidentiality was ensured and data were used exclusively for research purposes

Results

During the study period (2024-2025) a total of were enrolled in the study patients meeting the inclusion criteria. All patients were right lower quadrant abdominal pain and clinical suspicion of

acute appendicitis, thus performed appendectomy. Histopathological examination of the resected appendix was used as the reference standard for confirmation of diagnosis.

Demographic Characteristics

The study population was both male and female with a male predominance being 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 of the cases occurred in the second and third decades of life. Younger patients tended to present in the first 24 to 48 hours of symptom onset, while for older patients, symptoms were frequently less than 24 hours (long duration).

Table 3: Comparative Diagnostic Performance Metrics

Metric	Alvarado	RIPASA	S Comparison

Sensitivity	Moderate	Higher (Superior)	RIPASA > Alvarado
Specificity	Relatively Higher	Lower	Alvarado > RIPASA
Overall Accu	Moderate	Greater	RIPASA > Alvarado
Negative Appendectom	Higher Ra	Lower Rat	RIPASA Improved

Clinical Presentation

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

Histopathological Findings

Histopathological examination confirmed acute appendicitis in most of the cases. The spectrum of histological findings was simple acute appendicitis, superlative, gangrenous, and perforated appendicitis. A smaller proportion of specimens were shown to be histologically normal appendices (cases of negative appendectomy). These histopathological outcomes were considered as the gold standard for the evaluation of the diagnostic performance of both scoring systems.

Table 4: Outcome Analysis based on Histopathology

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

Performance of the Alvarado Score

Using the cutoff value of recommendations, the Alvarado score showed moderate sensitivity in diagnosing acute appendicitis. A good percentage of patients with appendicitis whose appendix was histologically confirmed were identified correctly by the Alvarado score. However, some patients with confirmed appendicitis had scores below the cutoff value, and their results were false negative. The specificity of the Alvarado score was relatively more, which indicates the effectiveness of the test in the correct identification of the patients without appendicitis. This increased specificity indicates that the Alvarado score may be helpful in excluding the disease in selected cases, which may avoid unnecessary surgical interventions.

Performance of RIPASA Score

In comparison to the Alvarado score, the RIPASA scoring system was found to have a higher sensitivity. A higher proportion of patients with histopathological confirmed appendicitis were

correctly identified applying the RIPASA score, and therefore, false-negative cases were reduced. This high sensitivity brings to the fore the capability of the RIPASA score in picking up acute appendicitis in a much earlier stage. The specificity of the RIPASA score was lower when compared with the Alvarado score, but because of a higher sensitivity the overall diagnostic quality of the RIPASA was higher.

Comparative Diagnostics Accuracy

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

Negative Appendectomy Rate

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

Summary of Findings

Overall, the results show that although both scoring systems are useful as a diagnostic tool, 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 should support the use of the RIPASA scoring system as a primary clinical tool for investigation of acute appendicitis in the studied population.

Discussion

The present study has made an attempt to assess the diagnostic accuracy of both Alvarado and **RIPASA** scoring system 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 in the world, 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 are important to highlight the strengths and limitations of each of the scoring systems and have major implications on their applicability in the Pakistani population.

Comparison of the Diagnostic Performance

The study showed that the RIPASA scoring system was more sensitive and had overall diagnostic accuracy than the Alvarado score. Specifically, the RIPASA score was able to show a higher proportion correct diagnosis of patients with histopathologic confirmed appendicitis, therefore reducing the number of false-negative diagnoses. High sensitivity is especially important in case of emergency surgical practice as failure to diagnose acute appendicitis can cause severe complications, prolonged hospital stay and increase morbidity and mortality. This finding corroborates other studies done in Asian populations in which the RIPASA score was consistently shown to be superior in its 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 relying solely on the Alvarado scoring system to miss cases, especially those present with atypical patterns. This conflict for sensitivity and specificity highlights the importance of choosing a diagnostic tool that is a balance between making an early detection and not a motion to unnecessary surgery.

Clinical Implications

The findings of this study have a number of important clinical implications. First, the increased diagnostic accuracy of the RIPASA score supports the routine use of this RIP score as a diagnostic tool in the emergency department, especially in resource-limited settings, where the use of advanced imaging modalities may not be readily available. The RIPASA score can help clinicians identify patients who urgently need to undergo an operation and who should not miss a diagnosis due to an incorrect outcome. Second, because of the high specificity of the Alvarado score, this procedure could be made a complementary tool to rule out low-risk patients, thereby potentially lowering the rate of negative appendectomy procedures. A combination of both scoring systems for clinical decision-making could also be an effective way to optimize decisionmaking and improving patient outcomes.

Comparison to Previous Studies

Several studies have found similar results in diagnosing performance using RIPASA score. Chong et al. (2010) first developed the RIPASA score in Asian populations and showed greater sensitivity and diagnostic accuracy than the Alvarado score. Subsequent studies performed in Pakistan and 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 were performed in the Western populations to report slightly lower sensitivity for RIPASA score, suggesting that demographic and epidemiological factors may influence the performance of clinical scoring systems. These findings highlight the need to validate diagnostic tools in specific populations before any wide implementation.

Effect on Negative Appendectomy Rates

One of the most important advantages of using a highly sensitive scoring system like RIPASA is the future possibility of decreasing negative appendectomy rates. Negative appendectomy, i.e. surgical excision of histologically normal appendix, places patients at undue risk of surgical and anaesthetic complications and contributes to increased postoperative complications, prolonged hospital stay and healthcare expenditure. In this study the use of the RIPASA score was related to reduced rate of negative appendectomy compared to the Alvarado score. This finding is in line with past literature and underscores the importance of applying accurate clinical scoring in improving surgical outcome and patient safety.

Emergency Surgical Decision-Making

Accurate preoperative diagnosis of acute appendicitis is of great importance for emergency surgical decision making. Delays in diagnosis can lead to progression from simple to complicated appendicitis including perforation and generalized peritonitis which are associated with increased morbidity and mortality. 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 RIPASA score enables clinicians to prioritize patients in order to immediately perform surgery on them with reduced susceptibility to complications related to delayed treatment.

Limitations of the Study

Despite its strength, this study has several limitations that should be acknowledged. First, the study was performed at a single tertiary care center which may restrict the generalizability to other healthcare settings. Second, the sample size, while adequate for statistical analysis, may not reflect all the different variations for presentation of disease in different populations. Third, the imaging studies, such as ultrasonography or CT scan, were not applied to all patients in a similar way, which may have affected the diagnostic decision in some cases. Finally, the study only looked at short-term consequences and long-term follow-up data in regards to postoperative complications or recurrence was not recorded.

Future Directions

Future research needs to focus on multicenter studies involving larger and more diverse populations to validate the results of this study. Additionally, integration of clinical scoring systems with modern imaging modalities could be explored with the additional benefit of further improving diagnostic accuracy and reducing the negative appendectomy rates. Educational programs for junior doctors and surgical residents on the use of clinical scoring systems may help to increase adherence to evidence-based protocols and improve patient outcomes. The development of electronic or app-based scoring calculators may also support redesigning bedside assessment and decision-making that occurs in an emergency setting in a timely manner.

Conclusion of Discussion

In conclusion, the RIPASA scoring system has superior sensitivity and overall diagnostic accuracy to the Alvarado score in patients with suspected acute appendicitis. While the Alvarado score has higher specificity, it has a lower sensitivity, which may reduce its usefulness as a

stand-alone diagnostic tool. The combined use of both scoring systems might be a balanced way to optimize the diagnostic precision and minimize the unnecessary surgical interventions. These findings are in favors of the adoption of RIPASA score as a primary diagnostic tool in emergency surgical practice especially in Asian populations and resource limited settings with the potential benefits of structured clinical assessment in improving patient care and decreasing the morbidity associated with acute appendicitis.

Conclusion

The results of this study showed that RIPASA scoring system clearly showed superior diagnostic performance as compared to Alvarado score in presented patients with suspected acute appendicitis. Specifically, the RIPASA score yielded greater sensitivity and overall diagnostic accuracy and should lead to more reliable identification of patients with 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 is part of better patient safety and care outcomes.

While the Alvarado score had relatively higher specificity, which determines the usefulness of the score in ruling out non-appendicitis cases, this score in addition to having a low sensitivity is not a good diagnostic tool by itself. Nevertheless, the Alvarado score is also a potential complementary tool, especially in the low-risk patients or in settings with limited clinical resources. The combined use of the two scoring systems could provide a balanced approach, where both the diagnostic accuracy is maximized and the number of unnecessary surgical interventions is minimized, with all the complications of a negative appendectomy.

The introduction of the RIPASA score in clinical practice has a wider implication to healthcare delivery. Its application has the potential to improve clinical decision-making in the emergency department, improve patient triage, and reduce the burden of negative appendectomy in healthcare systems. Additionally, the population-specific nature of the score makes it an ideal score for Asian countries such as Pakistan, where demographic factors and pathological characteristics of the disease can vary separately from those of Western populations.

In conclusion, the routine use of the RIPASA scoring system, either alone or together with the Alvarado score, is recommended in order to increase the accuracy of the diagnosis, decrease the rate of negative appendectomy and improve patient outcomes. Adoption of structured scoring systems should be followed by training of clinicians and their integration into standardized emergency department protocols in order to be most effective. Future studies may be conducted to integrate clinical scoring and imaging modalities and digital tools to further refine the diagnosing appendicitis and optimize patient care in different clinical settings.

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