










# RIPASA versus Alvarado score in the assessment of acute appendicitis: A prospective study

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## ABSTRACT

**Objective:** This study aimed to compare Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) and Alvarado scoring to accurately identify acute appendicitis.

**Material and Methods:** A cross-sectional prospective study was carried out in the department of surgery. Patients were enrolled and scored using RIPASA and Alvarado scoring systems. Appendectomy was done, and the specimen was sent for histopathology examination, which was used as the gold standard for diagnosis. Among 400 recruits, 11 patients were lost to follow-up, giving us a sample size of 389 patients. The cut-off value for RIPASA and Alvarado scores was 7.5 and 7.0, respectively. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy in diagnosing acute appendicitis of both scores were analyzed using SPSS.

**Results:** Among 389 patients, 256 (66%) were males, and 277 (71%) were under the age of 40 years. RIPASA was more than 7.5 in 345 cases, while Alvarado was more than 7.0 in 261 patients. RIPASA score had a sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 95.8%, 87.9%, 98.9%, and 65.9%, respectively. In contrast, the ALVARADO score was 71.1% sensitive and 75.8% specific. RIPASA had a diagnostic accuracy of 95.12%, while Alvarado was only 71.46% accurate in diagnosing acute appendicitis.

**Conclusion:** Compared to the Alvarado scoring system, RIPASA is a better tool in terms of accuracy, sensitivity, and specificity for diagnosing acute appendicitis.

**Keywords:** Appendicitis, diagnostic technique, RIPASA score, Alvarado score, diagnostic accuracy

## INTRODUCTION

Acute appendicitis is the most common surgical emergency presenting to hospitals, with a lifetime prevalence of roughly 7% (1). In males, the incidence of acute appendicitis is higher compared to women (2). Several acute abdominal pathologies tend to mimic acute appendicitis' clinical symptomatology. However, appendectomy remains the gold-standard management for acute appendicitis (3). Even though appendicitis is a common problem that hospital patients come in with, diagnosis is still difficult and primarily clinical, with some laboratory findings, such as raised white blood cells (WBC) count, offering some assistance (4).

Grading systems have historically been used to aid physicians in making a more precise diagnosis and preventing unnecessary appendectomies due to the wide variety of reasons for right iliac fossa pain and clinical presentations for appendicitis. In the recent past, imaging modalities such as CT scans have helped with diagnostic challenges (5). In contexts where ordering frequent CT scans would result in extra resources and cost restrictions, clinical scoring criteria are nevertheless regarded as essential diagnostic auxiliary tools (6). The most prominent scoring system in this regard historically has been the Alvarado score, followed by the modified Alvarado score. These scoring systems were developed in the West, but when they were applied to other populations, particularly those in Asia, they did not show the same sensitivity and specificity (7,8). In order to stratify the risk of acute appendicitis among Asians, the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score system, developed in Brunei Darussalam in 2008, has proven to be beneficial (9). The parameters that make up the RIPASA grading system sum into a total score of 17.5 (9). This grading system requires just two routine investigations (WBC count and urine R/E) that are easily reported, yielding results that have a high

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negative predictive value that could reduce hospital costs by preventing negative appendectomy rates (10).

Some centres still utilize the Alvarado score to determine the likelihood of acute appendicitis despite the mounting evidence in favour of RIPASA. Owing to its decreased sensitivity and specificity, there is still a chance of making an inaccurate diagnosis and receiving subpar treatment. Untreated appendicitis can result in worse outcomes such as perforation, peritonitis, or abscess formation (11). Therefore, our study aims to compare the two scoring systems, RIPASA and Alvarado, to accurately identify acute appendicitis in our population.

### MATERIAL and METHODS

A cross-sectional prospective study was carried out at the department of surgery spanning over a time course of one year from January 2022 to December 2022. Approval was obtained from the ethical review board of the institute (Date: 16.12.2021), and informed consent was taken from all the participants. The study included all individuals who were clinically suspected to have acute appendicitis with the aid of an ultrasonography examination. The study eliminated participants who were under the age of 15, pregnant, had an appendicular mass, or had peritonitis-like symptoms. All patients who met the study eligibility requirements underwent RIPASA and Alvarado scoring by the same surgical team. Tables 1 and 2 describe the detailed parameters of the Alvarado and RIPASA grading system. The Alvarado score threshold was set at 7, while the RIPASA score cut-off was set at 7.5, and the scores were deemed positive when they were over 7 and 7.5, respectively. The appendectomies performed on the recruited patients were followed by specimens being sent for histopathology. Upon their discharge, patients were monitored for any postoperative problems and then had a follow-up assessment one week later. After that, histopathology results were recorded to distinguish between positive and negative appendectomies, and the outcomes were then associated with both scores.

Parameters	Score
Migratory pain	01
Anorexia	01
Nausea	01
Tenderness in right iliac fossa	02
Rebound tenderness	01
Elevated temperature	01
Raised WBC count	02
Shift to left	01
<b>Total score</b>	<b>10</b>

**Table 2.** RIPASA grading system

Parameters	Score
Male	1.0
Female	0.5
Age <40 years	1.0
Age >40 years	0.5
Pain-Right iliac fossa	0.5
Migratory pain	0.5
Anorexia	1.0
Nausea/Vomiting	1.0
Length of symptoms <48 hrs.	1.0
Length of symptoms >48 hrs.	0.5
Tenderness in right iliac fossa	1.0
Guarding in right iliac fossa	2.0
Rebound tenderness	1.0
Rovsing's sign	2.0
Elevated temperature	1.0
Raised WBC count	1.0
Unremarkable urinalysis	1.0
Foreign nationality	1.0
<b>Total score</b>	<b>17.5</b>

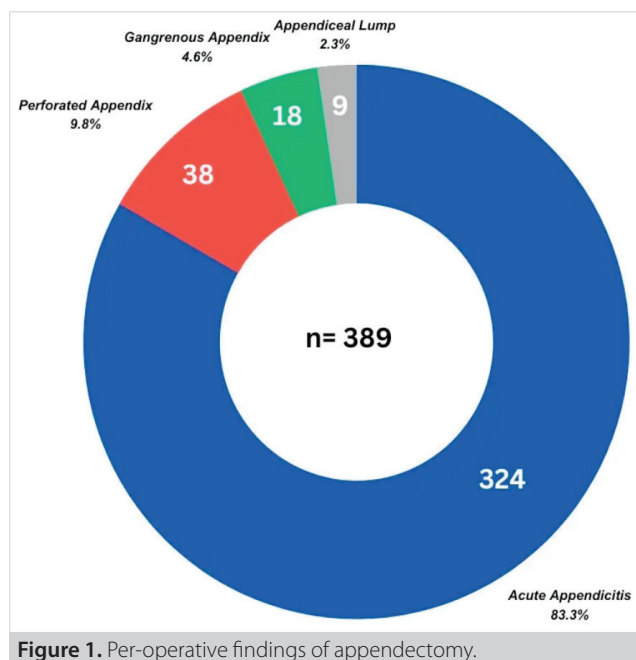
### Statistical Analysis

The data was entered and analysed using Statistical Package for Social Sciences (SPSS) version 23. Frequency and percentages were calculated for age, gender, duration of symptoms, histopathology, RIPASA and the Alvarado scores. The chi-square test was used to compare categorical variables, and the results were tabulated. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of both the scores were calculated. A p-value of 0.05 or lower was deemed significant.

### RESULTS

During the course of the study, 400 patients between the ages of 15 and 65 were enrolled in the study out of which 11 were lost to follow-up, leaving 389 patients for final evaluation. Of the recruited population, 71.2% (n= 277) were younger than 40 years, while 28.8% (n= 112) were older than 40 years. Out of 389 patients, 65.8% (n= 256) were males while 34.2% (n= 133) were females. Of patients, 75.8% (n= 295) had a duration of symptoms of less than 48 hours, while 24.2% (n= 94) had symptoms that lasted more than 48 hours. Out of 389 subjects, 345 (88.7%) had RIPASA scores greater than 7.5, while 261 (67.1%) cases had Alvarado scores greater than 7, as shown in Table 3. The participant's peroperative findings are shown in Figure 1.

Parameters	Frequency, n (%)
Gender	
Male	256 (65.8%)
Female	133 (34.2%)
Age	
<40 years	277 (71.2%)
>40 years	112 (28.8%)
Duration of symptoms	
<48 hrs.	295(75.8%)
>48 hrs.	94 (24.2%)
Histopathology	
Positive	356 (91.5%)
Negative	33 (8.5%)
Alvarado	
>7	261 (67.1%)
<7	128 (32.9%)
RIPASA	
>7.5	345 (88.7%)
<7.5	44 (11.3%)



**Figure 1.** Per-operative findings of appendectomy.

Of the 345 patients with RIPASA >7.5, 341 had appendicitis on the histopathology report and four patients had histopathology reporting negative for appendicitis. A RIPASA score of less than 7.5 was seen in 44 (11.3%) individuals, of whom 15 had positive histopathology results and 29 had negative histopathology reports. Out of 261 patients, 253 cases were histopa-

thology-proven positive with an Alvarado score >7.0, whereas it was less than 7.0 in 128 patients, 103 of whom tested positively and 25 were negative on histopathology results, shown in Tables 4 and 5.

The RIPASA score was 95.8% sensitive and 87.9% specific in diagnosing acute appendicitis with a positive predictive value (PPV) and a negative predictive value (NPV) of 98.9% and 65.9%, respectively. The sensitivity, specificity, PPV, and NPV of the Alvarado score were 71.1%, 75.8%, 96.9%, and 19.5%, respectively. The diagnostic accuracy of the RIPASA and Alvarado scoring systems was 95.12% and 71.46%, respectively as shown in Tables 4 and 5.

## DISCUSSION

Across the world, acute appendicitis is a common condition with which patients present to the hospital, especially individuals under the age of 40 years. Appendectomy is a common procedure carried out in emergency services accounting for approximately 10% of the surgical procedures carried out for abdominal pathology (12-14). The most crucial factor in a surgeon's clinical evaluation is seen to be the ability to diagnose acute appendicitis. Appendectomy rates of 15-30% come from basing one's choice to operate only on a clinical approach (15,16). Despite the high levels of sensitivity and specificity that contrast-enhanced computed tomography (CECT) scans may attain, it is not always feasible to expose all individuals who may have acute appendicitis to CECT, especially in underdeveloped nations (17).

In this context, a variety of scoring systems have been created, with RIPASA and Alvarado being the most widely utilized. This study compared the two scoring methods among Asian people to identify a superior score with higher diagnostic accuracy. In our investigation, the RIPASA score sensitivity and specificity were determined to be 95.8% and 87.9%, respectively, whereas the Alvarado score was 71.1% sensitive and 75.8% specific. RIPASA score has a PPV and NPV of 98.88% and 97.67% compared to the Alvarado scores of 96.84% and 21.82%. The RIPASA and Alvarado scores' diagnostic accuracy was 97.67% and 69.33%, respectively.

Chisthi et al. have conducted a study in India which reported RIPASA as 87.78% sensitive, 76.47% specific with a diagnostic accuracy of 85.98% (8). Another study conducted in Saudi Arabia by Maksoud et al. have shown a phenomenal RIPASA sensitivity of 96% which was comparable to our results i.e., 95.8% sensitive (18). Regar et al. have conducted a study in India that revealed results comparable to our study, however, with a significantly low specificity of RIPASA (3). Chavan et al. have compared the two scoring systems i.e., Alvarado versus RIPASA and reported results comparable to our study (19). Noor et al. have conducted a study in Peshawar, Pakistan recruiting

**Table 4.** Diagnostic value of RIPASA scoring system

RIPASA	Histopathology		Total
	Positive	Negative	
>7.5	341	4	345
<7.5	15	29	44
	356	33	389
Parameters	Estimates*		Confidence interval (95%)
Sensitivity	95.8% (p= 0.000)		93.4-97.6
Specificity	87.9% (p= 0.000)		74.0-96.1
PPV	98.9% (p= 0.000)		97.3-99.6
NPV	65.9% (p= 0.000)		51.3-78.7
Diagnostic accuracy	95.12%		

\*p-value of  $\leq 0.05$  is considered statistically significant.  
PPV: Positive predictive value, NPV: Negative predictive value.

**Table 5.** Diagnostic value of Alvarado scoring system

Alvarado	Histopathology		Total
	Positive	Negative	
>7	253	8	261
<7	103	25	128
	356	33	389
Parameters	Estimates*		Confidence interval (95%)
Sensitivity	71.1% (p= 0.000)		66.2-75.6
Specificity	75.8% (p= 0.000)		59.6-88.1
PPV	96.9% (p= 0.000)		94.4-98.6
NPV	19.5% (p= 0.000)		13.3-27.0
Diagnostic accuracy	71.46 %		

\*p-value of  $\leq 0.05$  is considered statistically significant.  
PPV: Positive predictive value, NPV: Negative predictive value.

300 participants revealed the RIPASA sensitivity and specificity at 98.5% and 90%, respectively (20). These values are comparable and slightly better from the results reported in our study. A study recently conducted in Karachi has evaluated 384 patients and shown RIPASA score sensitivity, specificity, and diagnostic accuracy of 95.98% (95% CI 93.36-97.59), 91.67% (95% CI 78.17-97.13) and 95.57% (95% CI 93.03-97.22) (21). RIPASA specificity reported in this study is slightly better but overall results are comparable to our study.

This study was conducted at a single centre, which may limit the generalizability of the findings. It is recommended that future studies with larger sample sizes should be conducted at multiple centres to further investigate this topic. Moreover, the research focused on individuals who underwent an appendectomy procedure. Cases that did not involve surgery were not

taken into account during the study, thus restricting the applicability of the findings to only those who received surgical treatment. Consequently, the outcomes cannot be universally applied to all patients who presented with symptoms of pain in the right lower quadrant.

## CONCLUSION

Compared to the Alvarado scoring system, the RIPASA grading system is superior in terms of accuracy, sensitivity, and specificity providing a reliable predictor for the diagnosis of acute appendicitis. Frequent implementation of the RIPASA grading system in our setting will lessen patient morbidity, shorten hospital stays, and lower the burden of healthcare costs. It can also prevent the need for expensive imaging examinations, which is especially advantageous for the public system in a country with a lower-middle income level.

**Ethics Committee Approval:** This study was approved by Federal Government Polyclinic Ethics Committee (Decision no: FGPC.1/12/2020, Date: 16.12.2021).

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**Conflict of Interest:** The authors have no conflicts of interest to declare.

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**ORİJİNAL ÇALIŞMA-ÖZET**

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**Akut apandisit değerlendirilmesinde RIPASA vs. Alvarado skoru: Prospektif bir çalışma**Syed Shams Ud Din<sup>1</sup>, Inayat Ullah Baig<sup>1</sup>, Mirza Tassarar Hussain<sup>1</sup>, Abdullah Sadiq<sup>1</sup>, Talha Humayun<sup>1</sup>, Umair Ahmad<sup>1</sup>, Aqsa Syed<sup>2</sup><sup>1</sup> Federal Hükümet Poliklinik Hastanesi, Cerrahi Kliniği, Islamabad, Pakistan<sup>2</sup> Akbar Niazi Eğitim Hastanesi, Cerrahi Kliniği, Islamabad, Pakistan**ÖZET**

**Giriş ve Amaç:** Bu çalışma, akut apandisiti doğru bir şekilde tanımlamak için Raja Isteri Pengiran Anak Saleha Apandisit (RIPASA) ve Alvarado puanlamasını karşılaştırmayı amaçladı.

**Gereç ve Yöntem:** Cerrahi anabilim dalında kesitsel prospektif bir çalışma yapıldı. Hastalar kaydedildi ve RIPASA ile Alvarado skorlama sistemleri kullanılarak skorlandı. Apendektomi sonrası örnekler tanıda altın standart olarak kullanılan histopatoloji incelemesine gönderildi. Dört yüz hasta arasında 11 hasta takipte kaybedildi, bu da 389 hastadan oluşan bir örneklem büyüklüğü sağladı. RIPASA ve Alvarado skorları için kesme değeri sırasıyla 7,5 ve 7,0 idi. Her iki skorun da akut apandisit tanısındaki duyarlılığı, özgüllüğü, pozitif prediktif değeri (PPV), negatif prediktif değeri (NPV) ve doğruluğu SPSS kullanılarak analiz edildi.

**Bulgular:** Üç yüz seksen dokuz hastanın 256'sı (%66) erkek, 277'si (%71) 40 yaşın altındaydı. RIPASA 345 vakada 7,5'in üzerindeyken, Alvarado 261 hastada 7,0'in üzerindeydi. RIPASA skorunun sırasıyla %95,8, %87,9, %98,9 ve %65,9'luk bir duyarlılığı, özgüllüğü, pozitif öngörü değeri (PPV) ve negatif öngörü değeri (NPV) vardı. Buna karşılık, Alvarado skoru %71,1 duyarlı ve %75,8 spesifikti. RIPASA'nın tanısıl doğruluğu %95,12 iken, Alvarado akut apandisit tanısında yalnızca %71,46'lık bir doğruluğa sahipti.

**Sonuç:** Alvarado puanlama sistemiyle karşılaştırıldığında RIPASA, akut apandisit tanısında doğruluk, duyarlılık ve özgüllük açısından daha iyi bir araçtır.

**Anahtar Kelimeler:** Apandisit, tanı tekniği, RIPASA skoru, Alvarado skoru, tanısıl doğruluk

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