

Accuracy and Sensitivity of RIPASA Score in Diagnosis of Acute Appendicitis

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Abstract:

Background: The most frequent ailment requiring immediate surgical intervention is acute appendicitis. Up to 20% of patients had appendicular perforation, which raises the death and morbidity rates from 3% to 47%. Consequently, even in situations when there is even a low degree of suspicion, the appendix is routinely removed, which results in needless surgery for up to 40% of patients. **Objective:** To evaluate the sensitivity and diagnostic accuracy of Raja Isteri Pengiran Anak Saleha appendicitis(RIPASA)scoring systems of acute appendicitis in correlation with intra-operative findings. **Patients and Methods:** This prospective study included 193 patients with acute appendicitis. All items of RIPASA score were reported with a cut off value of 7.5 and correlated to the postoperative histopathology. **Results:** Mean RIPASA Score was 10.2 ± 2.3 . 9.85% were negative histologically for acute appendicitis. True positive was 170 cases. True Negative cases were 13 patients. The sensitivity of RIPASA score was 96.5%, while the specificity was 76.4%. Diagnostic Accuracy was 94.8%. **Conclusion:** The RIPASA score is an accurate, practicable, and reliable diagnostic tool for acute appendicitis (AA) that also has a high sensitivity, positive predictive value, and diagnostic accuracy. Using a RIPASA score as a reliable diagnostic tool for acute appendicitis (AA), in Egyptians is possible when using a cutoff value of 7.5.

Keywords: Acute appendicitis, RIPASA Score, Diagnostic Accuracy

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Introduction

The most prevalent illness requiring immediate surgical intervention is acute appendicitis (AA). Up to 20% of cases had appendicular perforation^[1,2], which raises the death rate from 0.00002 to 3% and the morbidity rate from 3 to 47%. As a result- even in situations when there is just a modest degree of suspicion- the appendix is routinely removed, which results in needless surgery for up to 40% of patients^[3].

AA is diagnosed on the basis of the clinical history, physical examination, and laboratory tests. Even though it is a common issue, acute appendicitis can be difficult to diagnose, especially in young people, the elderly, and women who are fertile. This is because a variety of other genitourinary and gynecological conditions can mimic the signs and symptoms of acute appendicitis^[4]. The risk of appendicular perforation and sepsis rises when an appendectomy is postponed in an effort to boost diagnostic accuracy, and this raises morbidity and mortality^[5].

Only a histological analysis of the removed appendix can establish AA. Computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound can all significantly aid in the diagnosing process in a number of situations^[6]. However, ultrasound is limited in cases involving obesity, severe abdominal pain, and retrocecal or ruptured appendices. Both CT and MRI are not always available in all centers and are somewhat costly. Furthermore, AA cannot be ruled out by a negative radiological scan when there is clinical suspicion^[7]. To aid in the diagnosis of AA, a number of scoring systems- including the RIPASA scoring system- have been established^[8].

2010 saw the development of the Raja Isteri Pengiran Anak Saleha appendicitis (RIPASA) score in Brunei. Asian and Middle Eastern populations in Pakistan, China, India, Egypt, and Saudi Arabia, then tested and copied the score^[9]. It has been

demonstrated that the new diagnostic scoring system- RIPASA- has much improved sensitivity, specificity, and diagnostic accuracy when used to diagnose acute appendicitis. Simple qualitative rating based on 15 preset clinical characteristics, the RIPASA score is more comprehensive than the Alvarado system, which lacked some parameters like age, gender, and length of symptoms before presentation. It has been demonstrated that these factors influence the Alvarado scoring system's sensitivity and specificity when it comes to the diagnosis of AA^[1].

Non familiarity of application of this scoring system among Egyptian patients has motivated the authors to conduct this study to report the experience about it.

Patients and methods

This prospective study included 193 patients with acute appendicitis attending General Surgery Department at Benha University Hospital, after an approval from the Research and ethical Committee in Benha Faculty of Medicine. Research committee code: (Ms 25-11-2021)

All patients sign a written informed consent. Eligible patients included in this study were recruited from General Surgery Department, Benha University throughout the period from (November, 2021) to (June, 2023).

Inclusion criteria: Patients of all age groups who received an emergency appendectomy and had histopathological analysis post-surgery to confirm a positive/negative appendectomy from (November,2021) to (June, 2023).

Exclusion criteria: Patients who received appendectomies for other causes or in the middle of another surgery or Patients with previous history of urolithiasis or pelvic inflammatory diseases and patients refusing to be included in this study- were excluded.

Patients:

All included patients in this study were subjected to complete history intake,

physical examination, routine laboratory and radiological investigations.

All items of RIPASA score Table 1 [10] were documented such as gender, aging, symptoms like: right iliac fossa pain, migration of pain, anorexia, nausea and vomiting, and signs like: right iliac fossa tenderness, rebound tenderness, Rovsing's sign, Fever Laboratory tests: Raised WBCs, -ve urine analysis.

Procedure and assessment

Following the taking of a history, a clinical examination, and investigations, all of the RIPASA score's requirements were satisfied.

Table (1): RIPASA score for diagnosis of acute appendicitis [10].

Scoring element	score
Sociodemographic data	
Male	1
Female	0.5
Age <39.9 years	1
Age >40 years	0.5
Symptoms	
RIF pain	0.5
Pain migration to RIF	0.5
Anorexia	1
Nausea & Vomiting	1
Duration of symptoms <48 hrs.	1
Duration of symptoms >48 hrs.	.05
Signs	
RIF tenderness	1
Guarding	2
Rebound tenderness	1
Rovsing sign	2
Fever >37°C <39°C	1
Investigations	
Raised WBC counts	1
Negative urine analysis	1
Total score	16.5

Assessment:

Five main Diagnostic Parameters of RIPASA Score for AA included: Sensitivity of RIPASA score = True Positive cases / (True Positive cases + False Negative cases). Specificity of RIPASA score = True Negative cases / (True Negative cases + False Positive cases). Positive Predictive Value (PPV) = True Positive cases / (True Positive cases

The Medical Records at the hospital were searched in order to retrieve the relevant data.

The RIPASA score is composed of 15 different characteristics, all of which are presented in Table 1. According to RIPASA, a score of 7.5 was used as the diagnostic threshold for AA. Histopathological examination of the appendix was performed on all of the patients who were involved in the study, and the results were associated with the RIPASA score.

+ False Positive cases). Negative Predictive Value (NPV) = True Negative cases / (True Negative cases + False Negative cases). Diagnostic Accuracy of RIPASA score = (True Positive cases + True Negative cases) / All Patients.

Outcomes:

The primary Research Objective was to assess the accuracy of RIPASA score in patients who underwent appendectomy.

The secondary Research Objective was to decrease the number of negative appendectomies and overall cost.

Statistical Analysis

Sample size: The sample size required to achieve a power of $1 - \beta = 0.80$ (80%) for the spearman's correlation at level $\alpha = 0.05$ (5%), under these assumptions amounts to 193 (G*Power, version 3.1). Data of interest was retrieved from the hospital's electronic database in the Medical Records department and collected in an Excel Data Collection Sheet.

Data was analyzed using SPSS software version 25.0. (Armonk, NY: IBM Corp): Continuous variables were reported using the mean and standard deviation for data that exhibit normal distribution; the median and interquartile range were used for data that do not. Categorical variables were expressed as frequencies and percentages. Independent samples t test and Mann-Whitney U-Test was used for comparison of independent groups, as appropriate. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and negative appendectomy rates for Alvarado and RIPASA scoring systems- were calculated. Results were compared in reference to the gold standard in diagnosing appendicitis

(i.e. histopathological analysis of the excised appendix). We plot receiver operating characteristic (ROC) curves for both scoring systems and use area under the curve (AUC) for comparing the diagnostic performance of the two scores. Spearman's Correlation Coefficient were used to assess for correlation between the different Alvarado/RIPASA scores and the pathological stage of appendicitis. P value less than 0.05 is statistically significant

Results

The mean age was 34.2 ± 3.2 . Among them 74.1% aged <39.9 years while 25.9% aged >40 years. 46.7% were male while 53.3% were female. 3.6% were grade 1, 45% grade 2, 44% grade 3 while 7.4% grade 4. 11.4% had DM, 13% had Hypertension and 5% had IHD, Table (2). 45% of patients had rt. iliac fossa pain, 44% had anorexia, 70% had nausea and vomiting, 25% had Fever, 100% had rt. iliac fossa tenderness, 55% had guarding while 87% had rebound tenderness. 45% had elevated WBCs, 55% had negative urine analysis and 87% had Rovsing Sign, Table 3.

Table (2): Sociodemographic data among studied cases.

Variables	
Age, years	
Mean \pm SD	34.2 \pm 3.2
Median (Minimum - Maximum)	35 (25 - 50)
<39.9 years, n (%)	143 (74.1%)
>40 years, n (%)	50 (25.9%)
Gender	
Male, n (%)	90 (46.7%)
Female, n (%)	103 (53.3%)
ASA grade	
Grade 1, n (%)	7 (3.6%)
Grade 2, n (%)	87 (45%)
Grade 3, n (%)	85 (44%)
Grade 4, n (%)	14 (7.4%)
Comorbidities	
DM, n (%)	22 (11.4%)
Hypertension, n (%)	25 (13%)
IHD, n (%)	10 (5%)

Table (3): Manifestations and Investigation data among studied cases.

Manifestations	
Rt. iliac fossa pain, n (%)	87 (45%)
Anorexia, n (%)	85 (44%)
Nausea and vomiting, n (%)	135 (70%)
Fever, n (%)	48 (25%)
Rt. iliac fossa tenderness, n (%)	193 (100%)
Guarding, n (%)	106 (55%)
Rebound tenderness, n (%)	168 (87%)
Rovsing Sign	
Yes, n (%)	168 (87%)
No, n (%)	25 (13%)
Investigation	
Elevated WBCs, n (%)	86 (45%)
Negative urine analysis, n (%)	105 (55%)

The mean RIPASA Score was 10.2 ± 2.3 . 2.6% cases had score 7, 12% had score 8, 22.8% had score 9, 19.2% had score 10, 16% had score 11, 16% had score 12, 8.8% had score 13 while 3.1% had score 14. The mean RIPASA Score was 10.2 ± 2.3 , Table (4).

Table 5 shows that true Positive was 170 cases. True Negative was 13.

Interpretation of Table (6) - determined the Diagnostic Parameters of RIPASA Score for AA.

1. Sensitivity of RIPASA score = 96.5%.
2. Specificity of RIPASA score = 76.4%.
3. PPV of RIPASA score = 97.7%.
4. NPV of RIPASA score = 68.4%.
5. Diagnostic Accuracy of RIPASA score = 94.8%.

Table 6 shows that there were strong significant correlations between RIPASA scores and age, sex, right iliac fossa pain, anorexia, nausea and vomiting, and Rovsing's sign.

Table (4): RIPASA Score data among studied cases.

RIPASA Score Frequency	
7, n (%)	5 (2.6%)
8, n (%)	23 (12%)
9, n (%)	44 (22.8%)
10, n (%)	37 (19.2%)
11, n (%)	31 (16%)
12, n (%)	30 (16%)
13, n (%)	17 (8.8%)
14, n (%)	6 (3.1%)
RIPASA Score	
Mean \pm SD	10.2 ± 2.3
Median (Minimum - Maximum)	10.5 (7 - 14)

Table (5): Correlation between RIPASA score and histopathological findings.

Acute Appendicitis on Histopathology	RIPASA Scoring	
	Positive (>7.5)	Negative (7.5)
Positive	170 (True positive)	4 (False Positive)
Negative	6 (False negative)	13 (True negative)

Table (6): Correlations between RIPASA scores and different parameters.

Correlations		
		RIPASA scores
Age	r	-.495**
	P	<0.0001
Sex	r	.498**
	P	<0.0001
Right iliac fossa pain	r	.560**
	P	<0.0001
Anorexia	r	.720**
	P	<0.0001
Nausea and vomiting	r	.515**
	P	<0.0001
Rovsing's sign	r	0.38
	P	<0.0001

P value< 0.05 is significant, P value< 0.01 is highly significant.

Discussion

The most frequent ailment requiring immediate surgical intervention is acute appendicitis. Up to 20% of patients had appendicular perforation, which raises the death and morbidity rates from 3% to 47%. Consequently, even in situations when there is even a low degree of suspicion, the appendix is routinely removed, which results in needless surgery for up to 40% of patients [1].

The current study included 193 patients suffering from acute appendicitis. The distribution of AA cases was similar to other reports, predominantly affecting patients between the second and fourth decades of life.

In the current study, 46.7% of cases were males while 53.3% were females and this age and sex distribution and this was not in line with Arroyo-Rangel et al- who reported more incidence in males than in females [11].

The clinical presentation and the prevalence of symptoms and signs- is the cornerstone for diagnosis of AA. In the current study, the clinical presentation had a variable incidence where 45% of patients had rt. iliac fossa pain, 44% had anorexia, 70% had nausea and vomiting, 25% had fever, 100% had rt. iliac fossa tenderness, 55% had guarding while 87% had rebound tenderness. 45% had elevated WBCs and 55% had negative urine analysis. 3.6%

were grade 1, 45% grade 2, 44% grade 3 while 7.4% grade 4. 87% had Rovsing Sign.

This variable presentation incidence matched many studies [11-13] and this variability- was the main determinant of the cut off value for any scoring system and the main indicator for development of an accurate scoring system.

In the current study, the mean RIPASA Score was 10.2 ± 2.3 . 2.6% and this was greatly different from Naem et al. who reported a mean RIPASA score of 7.721 ± 3.23 . However, the current reported score was close to the Score reported by Mousa et al.- who reported a mean score of 9.70 ± 2.12 and this variability can be explained by the different cut off values for diagnostic accuracy and subsequent enrollment of patients with mild cases of query appendicitis [12,14].

In the current study- taking into consideration a cut off value of 7.5 for the diagnosis of acute appendicitis- 90.15% of cases confirmed acute appendicitis by histopathology, matching the results of Verma et al- who used the same cut off value. But this was higher than the confirmed cases of AA by Naeem et al.- who reported only 46.5 % showed +ve histopathological findings of AA and this simply can be explained by inclusion of cases with mild iliac fossa pain in their study [14].

A range of 95.5% to 98.5% was reported in numerous studies [15-17] that examined the sensitivity of the RIPASA score with a cut-off value of 7.5- these findings align with the findings of the current investigation, which revealed a sensitivity of 96.5%. On the other hand, this was significantly greater than the sensitivity reported by Korkut et al. and Ozdemir et al. who reported 75% and 68%, respectively. This is thought to be due to their study's smaller sample size and higher cut-off value, which they judged to be 12 and 10, respectively, whereas the current study's significance cut-off was 7.5 [17,18].

The current study's 76.4% RIPASA score specificity mirrored the findings of many authors [18,19]. It was less than that reported by Korkut et al. [17]- who reported 99.7% specificity, and this can be explained by a higher cut-off value in their study, which was 12. However, it was much higher than those reported by other authors [20,21] who reported 46.5% and 37.5%, respectively. This is assumed to be due to the large number of false negative cases reported in their study.

The current study demonstrated a positive predictive value of 97.7%, and this was significantly higher than what was reported by Dezfuli et al. [20] and Golden et al. [22], who reported 69.6% and 39% respectively. This is thought to be because of the large number of false positive cases reported in their study and this matched the results of Chae et al. [23] and Noor et al. [24], who reported 99.2% and 98.9% respectively.

In the current study, the NPV was 68.4%, and this agreed with NaNjuNdaiah et al. [25] findings. Nevertheless, this was lower than the 97.4% reported by Subramani et al. [26], and it is thought that this is because there were a lot truer negative instances recorded in their study compared to the sample size.

Numerous researches [27] had shown that the RIPASA score's accuracy fell between 90.5% and 97.5%, which was comparable

to the RIPASA's 94.8% claimed diagnostic accuracy in the current study. Although the current results were significantly higher than those of Pasumarthi et al. [28] and Chae et al. [23], this could be because many patients with urological symptoms were included in the study, which resulted in a significant number of false positive instances.

Similar results were obtained from a similar experiment conducted by Chong et al. [29]. Acute appendicitis was correctly diagnosed in 98% of patients (RIPASA score > 7.5).

A study conducted in Pakistan by Butt et al. [30] was conducted to determine the usefulness of the RIPASA rating system as the gold standard for histopathology-based acute appendicitis diagnosis. The RIPASA score has a sensitivity of 96.7%, specificity of 93.0%, and diagnostic accuracy of 94.8%. The NPV was 95.54% and the PPV was 94.8%.

According to Magsi et al. [31], a RIPASA score greater than 7.5 indicated 83.1% sensitivity, 97.8% specificity, 95% diagnostic accuracy, 88.46% PPV, and 96.55% NPV.

According to Singh et al. [32], the RIPASA score has a sensitivity of 91% and a specificity of 60%. The PPV (positive predictive value) is 85%, while the NPV (negative predictive value) is 73%.

Anwer et al. [33] discovered that using histology and CT- as the gold standards- allowed for an evaluation of the diagnostic accuracy of RIPASA. We employed histology as the gold standard in our investigation and found that the accuracy was 89.4%, the specificity was 76.9%, and the sensitivity was 97.9%.

Conclusion

The RIPASA score is an accurate, practicable, and reliable diagnostic tool for acute appendicitis (AA), that also has a high sensitivity, positive predictive value, and diagnostic accuracy. Using a RIPASA score as a reliable diagnostic tool for acute

appendicitis (AA) in Egyptians is possible-when using a cutoff value of 7.5.

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