



Cohort Study

The RIPASA scoring system: A new Era in appendicitis diagnosis



Hassan Mumtaz ^{a,*}, Gummadi Sai Sree ^b, Naga Praneeth Vakkalagadda ^b, Krishna Kishore Anne ^c, Sidra Jabeen ^d, Qasim Mehmood ^e, Zainab Mehdi ^e, Hassan Sohail ^f, Abdullah Haseeb ^e, Yumna Zafar ^f, Shaima Saghir ^g, Mohammad Hasan ^h

^a Maroof International Hospital Islamabad, Public Health Scholar, Health Services Academy Islamabad, Pakistan

^b Government General Hospital, Guntur Medical College, Guntur, India

^c National Pirogov Memorial Medical University, Ukraine

^d Liaquat National Hospital and Medical College Affiliate of Jinnah Sindh Medical University, Pakistan

^e King Edward Medical University, Lahore, Pakistan

^f Dow Medical College, Karachi, Pakistan

^g Liaquat National Hospital and Medical College, Karachi, Pakistan

^h Jinnah Post Graduate Medical Center, Pakistan

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ABSTRACT

Introduction: Even though acute appendicitis is a common acute abdominal disease, it is nonetheless difficult to detect. In order to minimize the risk of complications and negative exploratory procedures, early and accurate diagnosis is critical.

We aimed to compare the predictive accuracy of the RIPASA score in diagnosing acute appendicitis with the gold standard of histopathological proven appendicitis as the gold standard.

Methodology: A Prospective Cohort Study was conducted from December 2021 to May 2022 at KRL Hospital. A total of 171 patients who sought treatment for acute RIF pain or suspected appendicitis were included in the study. Patients' surgical proclivities were judged in part based on images and surgeon's expertise. SPSS version 26 was used to enter and analyze the data. This was done using a chi-square test and a Kendall's Tau (Kendall Rank Correlation Coefficient) to evaluate both groups of patients.

Results: At diagnosis, the mean age was 37.93 10.36 years. Kendall's Tau and Chi Square were shown to be significant in contrast to Alvarado scoring. RIPASA Scoring exhibited a 98.02% positive predictive value, a 96.75% sensitivity, an 82.35% specificity, and 95.3% diagnostic accuracy.

Conclusion: The RIPASA score is superior to the Alvarado score when it comes to detecting acute appendicitis in Asian populations. With a brief medical history, a clinical examination, and two simple procedures, parameters can be simply and swiftly obtained in any demographic circumstance.

Introduction

Abdomen surgical emergencies such as acute appendicitis (AA) are among the most often seen, with a lifetime frequency of one out of seven people experiencing severe pain in the right lower abdominal region [1]. Robert Lawson conducted the first appendectomy in England and created the term in Boston [2]. Prior to surgery, the preoperative diagnosis of this prevalent issue is difficult. Clinical characteristics, a precise

diagnosis, and quick action are critical in this case. Acute appendicitis may now be diagnosed more accurately using imaging methods like as ultrasonography and CT scans, although they are costly and not widely accessible in all centers, especially in countries like India [3]. Histopathology confirms the diagnosis of Acute Appendicitis since leukocytosis is seen. AA may be identified by the presence of neutrophils in the mucosa, submucosa, and lamina propria.

Clinical Prediction Rules (CPR) for predicting severity of AA and

* Corresponding author.

E-mail addresses: Hassanmumtaz.dr@gmail.com (H. Mumtaz), saichinnu9725@gmail.com (G.S. Sree), naga25998@gmail.com (N.P. Vakkalagadda), kishoreanne9@outlook.com (K.K. Anne), miss.sidrajabeen@gmail.com (S. Jabeen), qasimmehmood1051@gmail.com (Q. Mehmood), bintemehdi12@gmail.com (Z. Mehdi), hassansohail768@gmail.com (H. Sohail), abdullahhaseeb99@gmail.com (A. Haseeb), yumii.zafar0505@gmail.com (Y. Zafar), shaima_saghir@hotmail.com (S. Saghir), M_hasan_96@yahoo.com (M. Hasan).

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lowering negative appendectomy rates have been devised, however there has been debate as to whether these scoring systems can improve surgical results and save costs. This is followed by Kalan's modified Alvarado score, which is the most generally verified prediction model [4]. The second scoring method is more user-friendly and almost as sensitive as the original Alvarado score, although it is less accurate [5]. When employed as "rule out" diagnostic tools, however, both scoring systems are more helpful than "rule in" diagnostic methods for female patients of reproductive age [6]. Many studies have shown that these scores are accurate, as have countless other studies. Parallel research failed to duplicate these findings in diverse ethnic communities, despite the prevalence of AA in Western nations [7–11]. This was partly explained by the fact that the features of the patients studied varied and that various doctors in different settings interpreted factors differently. Since ALVARADO scores for the diagnosis of acute appendicitis were found to be unsatisfactorily low, a new scoring system dubbed RIPASA (Raja Isteri Pengiran Anak Saleha Appendicitis) was established for the Asian population [12].

More research has focused on the Eastern population to prove the validity of the RIPASA score system for the diagnosis of AA. In order to increase the diagnostic utility of CPRs with ethnic variations and help minimize needless procedures, reduce the negative appendectomy rate, and improve patient outcomes, the authors devised this prospective cohort research.

We aimed to compare the predictive accuracy of the RIPASA score in diagnosing acute appendicitis with the gold standard of histopathologically proven appendicitis as the gold standard.

Methodology

This prospective cohort study was conducted in KRL Hospital from 1st December 2021 to 1st May 2022. A total of 171 people were included in the study, which was estimated using the WHO calculator with a 95% confidence interval and a 5% margin of error. Non-probability sequential sampling was utilized.

It was the goal of this research to get a better knowledge of CPRs, reduce the number of needless surgeries, lower the incidence of negative appendectomy, and enhance patient outcomes in the long run. However, the primary goal was to verify the improved CPR. In order to guide the research, the RIPASA grading system was consulted.

Inclusion & exclusion criteria

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

Data collection

After receiving clearance from the ethics committee of KRL Hospital, Ref ERC: KRL-HIERC/Dec/29820 Dated 1st Dec 2021 and obtaining informed consent, the clinical data of patients was gathered using standardized case report forms during the first examination. There is a record of the patient's history of medical comorbidities; demographics; physical examination results; laboratory tests; radiographic imaging; and post-operative findings.

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

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

appendicitis diagnosis.

Our study is fully compliant with the STROCCS 2021 guidelines [13]. A complete STROCCS 2021 checklist has been provided as a supplementary file. Our study has been registered on Research Registry with the following UIN: researchregistry7980 [14]. Our study is in accordance with the Declaration of Helsinki.

Data analysis

Data was entered and analyzed using SPSS version 26. Quantitative data was presented as frequencies and percentages. Chi-square test & Kendall's Tau (Kendall Rank Correlation Coefficient) was applied to evaluate both the groups keeping significance less than 0.05. Sensitivity and specificity of RIPASA scoring was assessed comparing Appendicitis on Histology.

Results

The mean age at diagnosis was 37.93 ± 10.36 years. Among the 171 participants recruited for this study, majority of them were males with a percentage of 76.2%, as shown in Table 1.

Discussion

Acute appendicitis, one of the most prevalent medical emergencies, requires immediate surgical intervention [15]. Pain extending from the umbilical area to the right iliac fossa, which is normal, is a common symptom of this condition. There is also a high temperature, anorexia, abdominal pain, and guarding [16]. Acute appendicitis symptoms are vague and unusual in around half of all cases. Even in the modern period, this complicates the diagnosis of acute appendicitis [17]. There are a number of studies that may help in the early detection of acute appendicitis, including CT scans that have a high specificity (95%) and sensitivity (94%). CT scan is now usually performed in major hospitals on all patients suspected for acute appendicitis [11]. Nevertheless, this can be very expensive for an already long-suffering healthcare system.

To support the diagnosis efficiently and cheaply, different scores have been designed that associate the clinical features of acute appendicitis with some laboratory findings to correctly diagnose this condition [18]. One of them is the Alvarado score, which was designed in 1986 and is very popular among surgeons. Another score developed by the clinicians was the modified Alvarado score. Alvarado's score was modified by omitting some points of the clinical parameter. However, the two scores did not differ significantly in results [1]. Despite the fact that both Alvarado score and the modified Alvarado score were established in the West, the specificity and sensitivity levels reached when applied to Asia and the Middle East were poor. In research by Khan et al., the Alvarado scoring system had a 23% specificity and a 59% sensitivity in an Asian population [19]. Al-Hashemy et al., in 2004 found that the modified Alvarado scoring system had a specificity of 80% and a sensitivity of 53.88% in a Middle Eastern population [20].

To overcome this, the RIPASA score was developed by Chee Fui Chong in 2008 in a hospital in Darussalam. It is a simple scoring

Table 1
Gender demographics.

Gender	Frequency	Percent
Female	40	23.4%
Male	131	76.60%

Leukocyte left shift was present in 79.6% of the participants with a mean leukocyte count of $16.08 \pm 2.10 \times 10^9/L$ and a mean neutrophil percentage of $84.82 \pm 6.48\%$. The mean CRP level was 61.20 ± 31.19 mg/L. 73 patients had an ASA Grade 2 (42.4%), 68 patients had an ASA Grade 3 (39.5%) whereas only 6 patients had an ASA Grade 1 (3.5%). Rovsing sign was present in 87.13% of the patients as listed in Table 2 below.

Table 2
Frequency of ASA grading & rovsing sign.

ASA grade	Frequency	Percent
Grade 1	6	3.5
Grade 2	73	42.4
Grade 3	68	39.5
Grade 4	24	14.0
Rovsing Sign		
Yes	149	87.13%
No	22	12.87%

93 (54.3%) of the patients did not have postoperative (30-day) complications while 78 (45.7%) reported postoperative (30-day) complications. 42 patients reported having symptoms for 10 h (24.46%), followed by 11–18 h (45.02%) whereas only 35 participants (20.46%) experienced the symptoms for less than 10 h, as shown in Table 3.

Table 3
Frequency of duration of symptoms (hours) & postoperative (30 days) complications.

Postoperative (30 days) complications	Frequency	Percent
No	93	54.3
Yes	78	45.7
Duration of Symptoms (Hours)		
Less than 10 h	35	20.46
10 h	42	24.56
11–18 h	77	45.02
19–24 h	17	9.96

RIPASA was the scoring system assessed in our study, which has the highest value of 15 and the lowest value of 2. The mean score of our 171 participants was 12.95 ± 0.877 . The highest score of 15 was observed in 6 participants, however, the lowest score observed was 11.50 in 17 participants. The most common score was 13.50 which was common in 40 patients, as shown in Table 4.

Table 4
Frequency of RIPASA scoring.

RIPASA SCORE	Frequency	Percent
11.50	17	9.9
12.00	15	8.8
12.50	43	25.1
13.00	27	15.8
13.50	40	23.4
14.00	15	8.8
14.50	8	4.7
15.00	6	3.5

15 patients had 8 ALVARADO score out which 5 (3.33%) had RIPASA score of 12 and 1 patient (6.67) had RIPASA score of 13.50. 78 patients had 9 ALVARADO score out which 24 (3.33%) had RIPASA score of 12.50 and 1 patient (6.67) had RIPASA score of 15.00. 78 patients had 10 ALVARADO score out which 28 (3.33%) had RIPASA score of 13.50 and 2 patient (6.67) had RIPASA score of 12.00. Kendall's Tau (Kendall Rank Correlation Coefficient) & Chi Square was found significant having p value 0.00 in comparison to both scores, as shown in Table 5.

technique and consists of variables that have not been included in previous scoring systems such as the Alvarado score, i.e.: age, sex, duration of symptoms, Rovsing's sign, right iliac fossa guarding, and results of

Table 5
Comparison of ALVARADO score & RIPASA score.

ALVARADO SCORE	RIPASA SCORE									Kendall's tau-c	Chi-Square
	11.50	12.00	12.50	13.00	13.50	14.00	14.50	15.00			
8.00	2	5	4	3	1	0	0	0	0	0.00	0.00
9.00	15	8	24	14	11	5	0	1	1		
10.00	0	2	15	10	28	10	8	5	5		

The positive predictive value of RIPASA Scoring was 98.02%, the negative predictive value was 73.68%, sensitivity was 96.75%, specificity was 82.35%, and diagnostic accuracy was 95.3%, as shown in Table 6. Comparison of RIPASA & ALVARADO scoring is shown in Fig. 1.

urinalysis. Wani et al. found that the sensitivity and specificity of the Alvarado scoring system varies depending on age, gender and duration of symptoms [21].

The inclusion of different parameters from the Alvarado score, it has been shown to affect the specificity and sensitivity of the scoring system for the diagnosis of acute appendicitis, especially in Asian people [22]. In a study conducted by Chong et al., the RIPASA score achieved significantly better specificity (67%) and sensitivity (88%) as compared to the Alvarado score with a specificity of 23% and sensitivity of 59%, when applied to the Asian population [7]. The RIPASA scoring system is

Table 6
Analysis diagnostic parameters for acute appendicitis: Histopathology vs RIPASA scoring.

Appendicitis on Histopathology	RIPASA Scoring	
	Yes/Positive	No/Negative
Yes/Positive	149	3
No/Negative	5	14
Diagnostic Parameters of RIPASA Scoring detecting Appendicitis		
Sensitivity = True Positive/(True Positive + False Negative)	96.75%	
Specificity = True Negative/(True Negative + False Positive)	82.35%	
Positive Predictive Value = True Positive/(True Positive + False Positive)	98.02%	
Negative Predictive Value = True Negative/(True Negative + False Negative)	73.68%	
Diagnostic Accuracy = (True Positive + True Negative)/All Patients	95.3%	

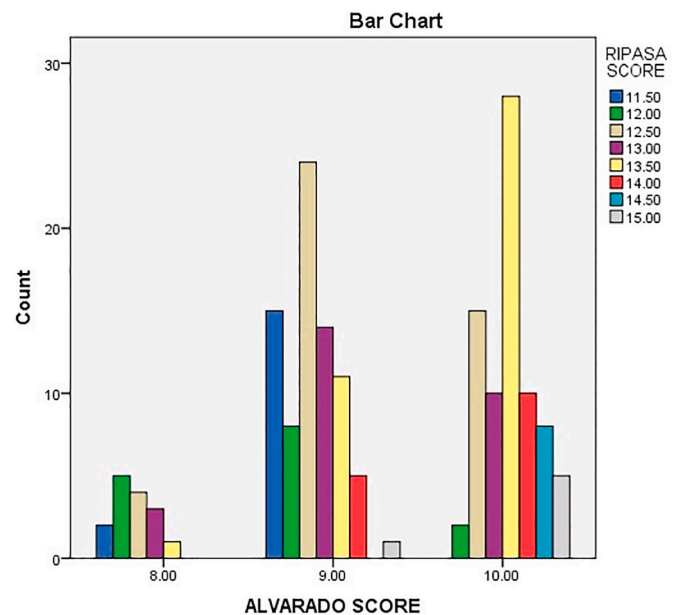


Fig. 1. Bar chart showing ALVARADO & RIPASA SCORE.

simple, easy, and safe and has higher diagnostic accuracy, especially for Asian people who generally live in rural settings and cannot access or afford radiological tools for diagnosis [1].

Sensitivity, specificity, negative predictive value, diagnostic accuracy, and positive predictive value were all calculated using the RIPASA score in the current investigation. Chong et al. [23] did a similar investigation and found comparable findings. 98% of patients were accurately recognized as having acute appendicitis (RIPASA score >7.5) and treated adequately, according to Chong et al. [24].

Our study showed a weak positive correlation between age at diagnosis and neutrophil percentage, $r(169) = 0.21$, $p = 0.007$. Similarly, a very weak positive correlation was also found between age at diagnosis and CRP level, $r(169) = 0.18$, $p = 0.016$. The negative appendectomy in our study was 0%, which is in contrast to those published in 1999 [25] and 2008 [26] who reported rates of 22.9% and 13%, respectively.

Strengths & limitations

Our study had a drawback in that it only included patients from a single center. As a major strength, our study examined the validity of the new scoring system in Pakistani populations.

Conclusion

When it comes to diagnosing acute appendicitis in Asian populations, the RIPASA score is superior than the Alvarado score in terms of accuracy, specificity, diagnostic accuracy, sensitivity and NPV/PPV, as well as NPV. Parameters can be easily and quickly determined in any demographic situation with a brief medical history, clinical examination, and two effortless investigations (negative urinalysis and raised white cell count).

Provenance and peer review

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Declarations

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Ethical approval

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Author contribution

Contributorship Statement:

1. The main concept was determined by Hassan Mumtaz, Qasim Mehmood.
2. Collection of data is done by Hassan Sohail.
3. Data is interpreted by Shaima Saghir, Gummadi Sai Sree, Sidra Jabeen.
4. Writing of the manuscript is done by Zainab Mehdi, Yumna Zafar, Abdul Haseeb, Muhammad Hasan.
5. Manuscript editing is done by Naga Praneeth Vakkalagadda, Krishna Kishore Anne.

Registration of research studies

1. Name of the registry: Research Registry.
2. Unique Identifying number or registration ID: researchregistry7980.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked <https://www.researchregistry.com/browse-the-registry#home/registrationdetails/629d834cb65810002104cc39/>)

Guarantor

Hassan Mumtaz & Qasim Mehmood.

Consent

The informed consent from the patients was obtained considering Helsinki's Declaration.

Declaration of competing interest

Nil.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.104174>.

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