ORIGINAL ARTICLE

Diagnostic utility of RIPASA and modified ALVARADO scoring systems in acute appendicitis in Karachi, Pakistan

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Abstract

Objective: To determine the diagnostic accuracy and utility of RIPASA and modified ALVARADO scoring systems for acute appendicitis in the population of Karachi, Pakistan.

Material and Methods: A cross-sectional study was conducted from May 2017 to November 2021 in the Department of Surgery, Unit III at Abbasi Shaheed Hospital, Karachi. Following ethical approval of the study and acquisition of consent, data was collected prospectively from participants presenting with features attributable to acute appendicitis. RIPASA and modified ALVARADO scores were estimated for all participants. Taking histopathology of appendix as the gold standard, sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios, and diagnostic accuracies were calculated for both scoring systems.

Results: We evaluated 384 patients with a clinical suspicion of acute appendicitis ranging from 15 years to 65 years in age. 64% were under the age of 40 years and 61.19% were males. Out of 384, RIPASA was >7.5 in 337 cases while modified ALVARADO was >7 in 250 participants. Taking histo-pathology as the gold standard, the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of the RIPASA scoring system were 95.98%, 91.67%, 99.11%, 70.21% and 95.57% respectively. In contrast, the modified ALVARADO score was 69.54 % sensitive, 77.78 % specific with a diagnostic accuracy of 70.31%.

Conclusion: RIPASA scoring system has superior sensitivity, specificity, and accuracy for the diagnosis of acute appendicitis when compared to the modified ALVARADO score, and hence, can serve as a more useful diagnostic tool in our population.

Keywords: Acute appendicitis, RIPASA, modified ALVARADO, diagnostic accuracy

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Introduction:

Acute appendicitis, with a reported incidence of 17.7 million in 2019, remains an exceedingly common surgical emergency globally.[1] Owing to the protean clinical presentations appendicitis and a wide range of aetiologies for right iliac fossa pain, scoring systems have traditionally been employed to narrow down the differential diagnosis and prevent negative appendectomies. Wide spread availability of the CT scan has facilitated the diagnosis of acute appendicitis, thereby averting unnecessary operations and hospital stay.[2] However, clinical scoring criteria are still regarded as important diagnostic adjuncts, especially in settings where ordering frequent CT scans would impose additional resource and cost constraints.[3] In this regard, several scoring systems have been used traditionally, the most notable one being the ALVARADO score followed by the modified ALVARADO score. Set in the West, these systems have failed to demonstrate the same sensitivity and specificity when applied to other populations, especially in Asia.[4,5]

The Raja Isteri Pengiran Anak Saleha appendicitis (RIPASA) scoring system, drafted in Brunei Darussalam in 2008, emerged as a useful criterion in stratifying the risk of acute appendicitis among Asians.[6] In addition to the classic com-

Table 1: RIPASA and modified ALVARADO scoring systems

RIPASA SCORE	
DEMOGRAPHY	**SCORE**
Female	0.5
Male	1
Age <40y	1
Age >40y	0.5
SYMPTOMS	
RIF pain	0.5
Pain migration to RIF	0.5
Anorexia	1
Nausea & Vomiting	1
Symptoms <48 hrs	1
Symptoms >48 hrs	0.5
SIGNS	
RIF tenderness	1
Guarding	2
Rebound tenderness	1
Rovsing's sign	2
Fever >37 C <39 C	1
INVESTIGATIONS	
Leucocytosis >11000/uL	1
Negative urine analysis	1
ADDITIONAL SCORE	
Non-Asian	1
TOTAL	17.5

MODIFIED ALVARADO SCORE	
SYMPTOMS	**SCORE**
Migratory RIF pain	1
Nausea/ vomiting	1
Anorexia	1
SIGNS	
RIF tenderness	2
RIF rebound tenderness	1
Elevated temperature>99F	1
LABORATORY FINDINGS	
Raised WBC count	2
TOTAL	9

ponents of right iliac fossa (RIF) pain, anorexia, nausea, vomiting, it also includes age, gender, duration of symptoms, additional clinical signs- RIF guarding and Rovsing's sign, and a negative urine analysis to give a total score of 17.5.[6] Not only does it require 2 in-expensive, readily reported investigations, but its high negative predictive value may also decrease the hospital cost burden by preventing negative appendectomy rates.[7]

Despite the increasing evidence in favour of RIPASA, several centres continue to use the ALVARADO score in assessing the likelihood of acute appendicitis. Owing to its lower sensitivity and specificity, the risk of incorrect diagnosis and thus, sub-optimal management remains. Undiagnosed appendicitis may lead to perforation, peritonitis, or abscess formation, all of which carry a worse prognosis.[8] Hence, in our study, we aim to determine the accuracies of the two scoring systems- RIPASA and modified ALVARADO in diagnosing acute appendicitis in our population.

Materials and Methods:

This cross-sectional study was conducted at the Department of Surgery, Unit-I at Abbasi Shaheed Hospital, a public-sector tertiary care hospital in Karachi, Pakistan. Prior approval from ethical committee of the hospital. Informed consent from the patients taken, data was prospectively collected from May 2017 to November 2021.

384 participants were enrolled in the study, as selected by non-probability consecutive sampling. Patients presenting with signs and symptoms raising the suspicion of acute appendicitis including right iliac fossa (RIF) pain, migration of pain, anorexia and nausea/vomiting were included in the study. Participants were excluded if an alternative cause of RIF pain was found, such as a gynaecological or urological aetiology (ovarian cyst or torsion, ectopic pregnancy, pelvic inflammatory disease, tubo-ovarian abscess, urinary calculi, urinary tract infection). RIF masses/ lumps were likewise excluded.

Details of the participants' demography, clinical presentation, brief history, and examination findings were recorded in a pre-designed questionnaire. Information obtained from the relevant laboratory investigations such as total leukocyte count were also recorded.

Table 2: Per-operative findings of appendectomy

PER OPERATIVE FINDINGS	FREQUENCY n (%)
Acute appendicitis	274 (71.35)
Perforated appendix	54 (14.06)
Gangrenous appendix	24 (6.25)
Appendiceal lump	19 (4.95)
Abscess	13 (3.38)

Table 3: Diagnostic value of RIPASA scoring system

	HISTOPATHOLOGY		
	Positive	Negative	**TOTAL**
RIPASA >7.5	334	*3*	337
RIPASA <7.5	*14*	33	47
	348	36	384

PARAMETER	**ESTIMATE**	**95% CI**
SENSITIVITY	95.98%	93.36 – 97.59
SPECIFICITY	91.67%	78.17 – 97.13
PPV	99.11%	97.42 – 99.7
NPV	70.21%	56.02 – 81.35
POSITIVE LIKELIHOOD RATIO	11.52	5.99 – 22.14
NEGATIVE LIKELIHOOD RATIO	0.043	0.038 – 0.051
DIAGNOSTIC ACCURACY	95.57%	93.03 – 97.22

Table 4: Diagnostic Value of Modified ALVARADO Scoring System

	HISTOPATHOLOGY		
	Positive	Negative	**TOTAL**
Modified ALVARADO>7	242	*3*	250
Modified ALVARADO<7	*106*	28	134
	348	36	384

PARAMETER	**ESTIMATE**	**95% CI**
SENSITIVITY	69.54%	64.51 – 74.14
SPECIFICITY	77.78%	61.91 – 88.28
PPV	96.8%	93.81 – 98.37
NPV	20.9%	14.87 – 28.54
POSITIVE LIKELIHOOD RATIO	3.129	2.44 – 4.01
NEGATIVE LIKELIHOOD RATIO	0.39	0.37 – 0.407
DIAGNOSTIC ACCURACY	70.31%	65.56 – 74.66

RIPASA and modified ALVARADO scores were calculated for included participants (see table 1). RIPASA >7.5 or modified ALVARADO >7 were considered as having a high suspicion of acute appendicitis. A clinical diagnosis of acute appendicitis was followed by appendectomy and the removed specimen was sent for histopathology to obtain a definitive diagnosis. Histopathology was deemed positive for acute appendicitis if neutrophils could be demonstrated in the muscularis layer of the appendix extending up to the serosa.

Data was entered and analysed by SPSS version-16. Frequency and percentages were reported for categorical variables. Sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios, and diagnostic accuracies for both the scoring systems, including the corresponding 95% confidence intervals, were calculated via Open Epi version 3.01. Histo-pathology of the removed appendix specimen was taken as the gold standard. A p-value of <0.05 was considered significant.

Results:

384 patients aged 15 years to 65 years were enrolled in the study over 5 years. Out of them, 64% (n=246) were under the age of 40 years while 36% (n=138) were above 40 years. 61.19% (n=235) were males. The duration of symptoms was <48 hours for 75.26% (n=289) patients while 24.73% (n=95) presented after 48 hours. 337 out of 384 participants had a RIPASA score >7.5 while a modified ALVARADO score >7 was found in 250 cases. Table 2 shows the per-operative findings of the participants.

By taking histopathology as the gold standard, RIPASA score had a sensitivity of 95.98% and specificity of 91.67%. The PPV and NPV were 99.11% and 70.21% respectively. RIPASA was estimated to have a diagnostic accuracy of 95.57%. Refer to table 3.

The modified ALVARADO score was 69.54% sensitive and 77.78% specific for acute appendicitis. The PPV and NPV were reported to be 96.8% and 20.9% respectively. The diagnostic accuracy for modified ALVARADO score was 70.31%. Refer to table 4.

Discussion:

The results from our study reveal a high sensitivity and specificity of the RIPASA score in contrast to the modified ALVARADO score (Sensitivity: 95.98% vs 69.54%; Specificity: 91.67% vs 77.78%). Similar conclusions have been drawn from literature across the entire Asian continent. The highest sensitivity has been reported at 98% from Brunei Darussalam where the score originated from.[6] Maksoud et al. revealed that the score was 96% sensitive in the Saudi population, in contrast to the 59.6% sensitivity of modified ALVARADO score.[9]

A study conducted in India reported the sensitivity of RIPASA at 87.78% and specificity at 76.47%. The same study also calculated an overall accuracy of 85.98%.[10] Reports from another neighbour, Iran, also narrated a high sensitivity of RIPASA at 93.2%. The scoring system, however, was only 45.61% specific in this case.[11] Interestingly, research done on the Western population also demonstrated an accuracy of 80% in diagnosing acute appendicitis with RIPASA score. The sensitivity and specificity in this case were some what comparable to other Asian studies at 85.3% and 69.8%.[12] In yet another study from Pakistan, RIPASA score yielded a diagnostic accuracy of 88% with 91.11% sensitivity and 60% specificity.[13]

The modified ALVARADO score fails to consider some important parameters which have been established as risk factors and clinical features of acute appendicitis.[14] These include a younger age of onset, male gender, and a shorter symptom duration. Males have been reported to suffer from the condition more frequently, especially at younger ages.[15,16] The age of peak incidence in adults is also younger, reported between 18-30 years in a study.[16] All these concerns have been addressed in the RIPASA score, which might explain the reason behind its improved sensitivity and positive predictive value. A non-Asian ethnicity also scores an additional point in the new RIPASA score, which has also been considered a risk factor for appendicitis.[6]

In addition to the classical rebound tenderness, two additional signs- guarding and Rovsing's sign are also incorporated into the RIPASA score to improve diagnostic accuracy. Rovsing's sign is elicited by pressure over the left iliac fossa which in turn leads to pain in the right iliac fossa.[17] Increasing pressure in the appendix in anti-peristaltic fashion and thereby, demonstrating indirect tenderness leads to less biased pain localization.[17] This sign was regarded as the examination finding most suggestive of acute appendicitis (positive likelihood ratio: 3.52) in a systematic review.[18] The same review estimated a pooled likelihood ratio of 2.09 for guarding and 2.19 for rebound tenderness.[18] A negative urinalysis effectively rules out various differential diagnoses of urological origin and thus, might contribute to improved specificity of the score for appendicitis.[19]

A negative predictive value of 70.21% has also been observed with the use of RIPASA in our study. Other researchers have reported much higher NPV's of 97.54% from Singapore and 83.87% from Iran.[6,11] Another study from our city presented an even lower NPV of 42.85%.[13] As a low score is hypothesized to effectively rule out appendicitis, the RIPASA scoring system can also bring down the rates of negative appendectomies,[20] which have been reported up to 15-16% with ALVARADO and 10% with modified ALVARADO scores.[7,21]

Based on these findings, we can effectively conclude that the routine use of RIPASA scoring system in our healthcare set-ups will not only lead to the correct diagnosis but also reduce patient morbidity, limit hospital stay and decrease the healthcare cost burden. It can also abort the need to resort to expensive imaging investigations and is, therefore, particularly beneficial for a lower-middle income country's public setup like ours.

Limitations: Due to the intrinsic limitations of a single-centred study, more accurate population-specific conclusions could have been drawn with larger-scaled research. The patients were received by different doctors and the assessment was not always made by the senior consultants.

This could have resulted in some discrepancy in patient assessment and reporting.

Conclusion:
The RIPASA scoring system can prove to be a better diagnostic tool for acute appendicitis in our Pakistani population owing to its higher sensitivity, specificity, and diagnostic accuracy when compared to the modified ALVARADO score.

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Role and contribution of authors:
Farhina Salahuddin, collected the data, references and did the initial writeup.

Asfaruddin Qureshi, critically went through the article and did useful changes in the final draft.

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