BENHA MEDICAL JOURNAL bmj

Print ISSN 1110-208X.

Online ISSN 2357-0016

Original article

Accuracy and Sensitivity of RIPASA Score versus Alvarado Score in Diagnosis of Acute Appendicitis

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Received:

Accepted:

Abstract

Background: Acute appendicitis (AA) is a prevalent emergency involving the abdomen that necessitates prompt attention and has a significant risk of negative appendectomy. **Objective:** To compare the sensitivity and diagnostic accuracy of RIPASA and Alverado 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 and Alverado score were reported with a cut off value of 7.5 for RIPASA and 7 for Alverado and correlated to the postoperative histopathology. **Results:** The mean age of the included patients was 33.25 ± 11.39 years. The histopathological outcome in correlation to RIPASA score 84% of cases were true positive while 8.3% were true negative while the correlation with Alverado score 73% of cases were truly positive and 12.4% were truly negative. There was a statistically significant difference between both RIPASA and Alverado scores where RIPASA score was significantly more sensitive and accurate than Alverado with Higher NPV while Alverado score was more specific. **Conclusion:** According to the current results, RIPASA score is a reliable, feasible for Diagnosis of AA with high sensitivity, positive predictive value, and Diagnostic accuracy in comparison with the Alverado score.

Keywords: Acute appendicitis, RIPASA Score , Alverado score

Introduction

Acute appendicitis (AA) is a prevalent emergency involving the abdomen that necessitates prompt attention and has a significant risk of negative appendectomy [1]. However, a wide range of illnesses might have symptoms that resemble AA's clinical presentation, making AA diagnosis difficult in some situations. The diagnosis is mostly based on the clinical presentation, with further confirmation obtained through

expensive and potentially unavailable radiological studies in underdeveloped nations [2, 3].

Surgery has many different types of side effects. Such comorbidities include negative appendectomy (NA), appendicular abscess and perforation, wound infection and dehiscence, and even repeated episodes of adhesion intestinal obstructions. One important factor to think about is the financial impact on the patient and the healthcare system. With the overall goal of reducing the negative appendectomy rates, numerous grading systems have been created to correlate the clinical presentation and investigations with the pathological confirmation of AA, which is mostly dependent on the presence of neutrophils in the appendix wall. [4,5]

The information presented above raised serious concerns about the critical requirement for an accurate acute care scoring system. Numerous Scores, including Alvarado, RIPASA, Eskelinen, Fenyo, Tzakis, and Ohmann, have been established since 1980 to aid in the diagnosis of AA [6]. Numerous studies have reported that the sensitivity, specificity, and accuracy of various scoring systems vary widely and can produce unacceptable findings in various ethnic communities [7]. In the Asian population, RIPASA (Raja Isteri Pengiran Anak Saleha Appendicitis) is correct [8].

We conducted this study to establish clinical prediction rules for predicting AA among Eastern Mediterranean ethnic communities, avoid unnecessary procedures, and improve patient outcomes because the validity of the RIPASA score among this population is still under question.[9].

The need for an accurate score for diagnosis of AA has motivated the authors to conduct this study to compare the acuureacy, sensitivity, specificity of RIPSA score with the commonly used modified Alverdo score

Patients and Methods

Study design

This prospective study was conducted throughout the period from June 2022 till October 2023 in general surgery department -Faculty of medicine, Benha university. The study included 193 patients with suspected appendicitis who were eligible to undergo open appendectomy. The study was conducted after approval of both Research and Ethics Committee in Benha Faculty of Medicine. Written informed consent was obtained from all included patients before enrollment in the study.

Research committee code: (Ms 30-6-2022)

The study included patients of all age groups who received an emergency appendectomy and had histopathological analysis post-surgery to confirm a positive/negative appendectomy Patients who received appendectomies for other causes or in the middle of another surgery were excluded. Patients with previous history of urolithiasis, or pelvic inflammatory disease were also excluded

Procedure

The procedure was done under general and spinal anesthesia following A thorough history and clinical examination all patients together with routine laboratory and radiological investigations . All items of RIPASA score (table 1) and modified Alverado score(table 2) were fulfilled. Taking into consideration the diagnostic cut-

off score for AA by RIPASA is 7.5. and Modified Alverado score of 7 [11]

Histopathological assessment for the appendix was done for all included patients and correlated to both scores.

Assessment:

Five main Diagnostic Parameters of RIPASA vs ALVARADO Score for AA were assessed

Sensitivity of the score = True Positive cases / (True Positive cases + False Negative cases).

Specificity of the score = True Negative cases / (True Negative cases + False Positive cases).

Positive Predictive Value (PPV) = True Positive cases / (True Positive cases + False Positive cases).

Negative Predictive Value (NPV) = True Negative cases / (True Negative cases + False Negative cases).

Diagnostic Accuracy of the score = (True Positive cases + True Negative cases) /All patients.

Outcome and follow up.

Primary Research outcome was to assess the diagnostic accuracy of RIPASA score compared to that of Alvarado score in patients who underwent appendectomy.

Secondary Research was to determine whether the RIPASA and Alvarado scores correlate with the pathological stage of appendicitis present with subsequent avoiding non necessary appendectomy.

Statistical analysis

The sample size required to achieve a power of 1- β =0.80 (80%) for the spearman's correlation at level α =0.05 (5%), under these assumptions amounts to 50 (G*power , version 3.1).

- Data was analyzed using SPSS software.

Data were fed to the computer and analyzed using IBM SPSS software package version 2٥.0**. (**Armonk, NY: IBM Corp**)** Qualitative data were described using number and percent. The significance of the obtained results was less than 0.05. Categorical variables were expressed as frequencies and percentages. Independent samples t-test and Mann-Whitney U-Test is used for comparison of independent groups, as appropriate

Results

The current prospective study included 193 patients with suspected appendicitis who are eligible to undergo open appendectomy. The mean age of the included patients was 33.25 ± 11.39 years. 55% of the included patients were females and 45% were males. Other sociodemographic data and comorbidities were reported in Table 3.

The included patients presented with right iliac fossa pain in 42.5%. Nausea and vomiting were presented in 62.25% while tenderness in the right iliac fossa was presented in all cases while Rovsing sign was positive in 73% of patients. The elevated WBCs was evident in 46.1% of patients Table (3)

In the current study the mean RIPASA score was 9.88 ± 1.12 ranging from 7-14 while the mean Alverado score was 7.9 ± 0.73 ranging from 6-9 Table (4)

As regarding the histopathological outcome in correlation to RIPASA score 84% of cases were true positive while 8.3% were true negative while the correlation with Alverado score 73% of cases were truly positive and 12.4% were truly negative Table (4)

There was a statistically significant more true negative and less True negative cases in RIPASA score when compared to Alverado score.

The main objective of the current study was to compare the sensitivity, specificity, PPV, NPV and diagnostic accuracy of both scoring systems, RIPASA and Alverado.

Table(4) showed that there was statistically significant difference between both RIPASA and Alverado scores where RIPASA score was significantly more sensitive and accurate than Alverado with Higher NPV while Alverado score was more specific

Table 1: RIPASA score [1]

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 >37ºC <39ºC	1
Investigations	
Raised WBC counts	1
Negative urine analysis	1
Total score	16.5

Table 2: Modified Alvarado score **[9]**

Variable	Score
Pain migratory to RIF	1
Anorexia	1
Nausea and vomiting	1
RIF tenderness	2
Rebound tenderness	1
Fever	1
Leukocytosis	2
Score	**9**

Table 3: Sociodemographic data and Comorbidities and Clinical presentation of the studied group

Variable	
Age, years	
Mean ± SD	33.25 ± 11.39
Median (Minimum - Maximum)	36 (24 - 48)
<39.9 years	151 (78.24%)
>40 years	42 (21.56%)
Gender	
Male	87 (45%)
Female	106(55%)
ASA grade	
Grade 1	7 (3.6%)
Grade 2	87 (45%)
Grade 3	85 (44%)
Grade 4	14 (7.4%)
Comorbidities	
DM	14 (7.4%)
Hypertension	25 (13%)
IHD	7 (3.6%)
Variables	
Manifestations	
Rt. iliac fossa pain	82 (42.5%)
Anorexia	89(46.1%)
Migratory pain	108(56%)
Nausea and vomiting	124 (62.25%)
Fever	65(33.7%)
Rt. iliac fossa tenderness	193 (100%)
Guarding	111 (57.5%)
Rebound tenderness	139 (72%)
+ve Rovsing Sign	141(73%)
Investigation	
Elevated WBCs	89(46.1%)
Negative urine analysis	111 (57.5%)

Table (4): Correlation between RIPASA and Alverado scores and histopathological assessment

AA on Histopathology	**RIPASA Score**			
	Positive (>7.5)		**Negative (<7.5)**	
Positive (+ve evidence of AA)	162 (84%)	(True positive)	6(3.1%)	(False Positive)
Negative (No inflammatory changes)	9(4.6%)	(False negative)	16 (8.3%)	(True negative)
AA on Histopathology	**Alverado Score**			
	Positive (>7)		**Negative (<7)**	
Positive (+ve evidence of AA)	141(73%)	(True positive)	7(3.7%)	(False Positive)
Negative (No inflammatory changes)	21 (10.9%)	(False negative)	24(12.4%)	(True negative)
Variables	**RIPASA Score**		**Alverado Score**	**P value**
Sensitivity	94.74%		87%	< 0.001*
Specificity	72.7%		77.4%	0.02*
PPV	96.4 %		95.3%	0.82
NPV	64 %		53.3%	< 0.001*
Accuracy	92.7%		85%	< 0.001*
	RIPASA and Alverado scores frequency			
RIPASA Score	**Mean ± SD**			9.88 ± 1.12
	Median (Minimum - Maximum)			10.5 (7 - 14)*
Alverado Score	**Mean ± SD**			7.9 ± 0.73
	Median (Minimum – Maximum)			7.5(6 - 9)

Discussion

AA is a prevalent surgical emergency. The clinical variability and high prevalence of AA is a diagnostic challenge. Many promising diagnostic tests had emerged in clinical practice to avoid negative appendectomy and to decrease overall healthcare costs. Complications related to AA have a bad impact on the patient's prognosis. This is why the need of an accurate prediction scoring system is crucial [10,11] The use of clinical scoring systems will have a good helping tool for healthcare providers for accurate diagnosis of AA. RIPASA Score accuracy and PPV were established for the Asian population with promising sensitivity, PPV and NPV results [8]

Many authors [12] had documented the sensitivity of RIPASA score taking into consideration a cut-off value of 7.5 and reported a range from 95.5% up to 98.5 % and this is going with the results of the current study which reposted sensitivity of 94.74%. However, this was much higher than other studies [13,14] that reported sensitivity of 75% and 68%. This is assumed to the smaller sample size of their study and

the higher cut-off value as they considered 12 and 10, respectively, while 7.5 was the significant cut-off value in the present study.

The sensitivity of Alvarado score was reported by many studies [5,15] taking into consideration a cut-off value of 7 to be up to 89.5% and this is going with the results of the current study which reposted sensitivity of 87% However, this was much higher than Singla et al., and Nanjundaiah et al who reported sensitivity of 53% and 59%, respectively [16,8]This is assumed to the smaller sample size of their study. While the results of the current study were less than that of another Study [17] that reported the sensitivity of Alvarado score to be of 89.5%

The sensitivity of RIPASA score versus the Alverado score was reported by many studies (8,18) which matched the results of the current study.

Specificity of RIPASA score in the current study was 72.7% which matched the reports of many authors [14,19]. However, it was much higher than those reported by Dezfuli et al., and (Şenocak et al., who reported 46.5% and 37.5 %, respectively, and this is assumed to be due to large number of false negative cases reported in their study [20, 21] . Also it was less than what reported by another study [13] who reported 99.7 % specificity and this can be explained by higher cut-off value in their study which was 12.

The Specificity of Alvarado score in the current study was 77% which matched with the results of many authors [17,22] However, it was much higher than those reported others [15,18]] who reported 16% and 44 %, respectively, and this is assumed to be due to the variable cut off values used in their studies and the results was less than what was reported by Sinnet et al., who reported 90 % specificity . [23]

Specificity of RIPASA score in the current study was 72.7% which is lower than that of Alvarado score which was 77.4% matching what was reported by many authors [24].

The positive predictive value of RIPASA score reported in the present study was 96.4% and this matched the results of Chae et al., and Noor et al., who reported 99.2% and 98.9 % respectively[25,12] and this was much higher than what was reported by Dezfuli et al., and Golden who reported 69.6% and 39%, respectively, and this is assumed to be due to the large number of false positive cases reported in their study[20,26].

While the positive predictive value of Alvarado score reported in the present study was 95.3% and this matched the results of many studies that reported 97.3% and 96.67 %. [8,23] and this was much higher than what was reported by other studies [15,26] that reported 74% and 53%, respectively, and this is assumed to be due to the large number of false positive cases reported in their study.

The positive predictive value of RIPASA score reported in the present study was 96.4% while that of Alvarado score in the same study was 95.3% in line with many studies (17,18, 24)

The NPV in the present study of RIPASA score was 69.23% and this matched with the results of NaNjuNdaiah et al., However this was less than what was reported by Subramani et al. who reported 97.4%, and this is assumed to be due to the large

number of true negative cases reported in their study in relation to the sample size.[8,27] While the NPV of Alvarado score in the current study was 53% and this matched with the results of Garcia et al., However this was less than what was reported by Golden et al., who reported 79%, and this is assumed to be due to the large number of true negative cases reported in their study in relation to the sample size. [17,26]

The NPV in the present study of RIPASA score was 69.23% while that of Alvarado score was 53% in line with what was reported by many authors [17, 26]

Many studies [12] had documented the accuracy of RIPASA score to be within the range from 90.5% up to 97.5%, and this was similar to the diagnostic accuracy of RIPASA reported in the present study was 94.7% although the current results were much higher than Pasumarthi et al., and Chae et al., and this may be due to very large number of false positive cases reported in their study and this due to inclusion of many patients with urological symptoms. [28,25]

Frountzas, M et al., also had documented the accuracy of Alverado score to be within the range from 58% up to 86.5%, and this was similar to the diagnostic accuracy of Alverado reported in the present study was 85% although the current results were much higher than Singla et al., and this may be due to very large number of false positive cases reported in their study and this due to inclusion of many patients with urological symptoms [5,16]

The diagnostic accuracy of RIPASA score was 92.7% according to the present study while the diagnostic accuracy of Alvarado score was 85%.

Conclusion:

According to the current results, RIPASA score is a reliable, feasible for Diagnosis of AA with high sensitivity, positive predictive value, and Diagnostic accuracy in comparison with the Alverado score.

Recommendations:

RIPASA score can be used as a reliable method for diagnosis of AA among Egyptian considering the cut-off value of 7.5

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To cite this article: Mohamed I. Abourizk, Emad M. Abdelrahman, Ahmed M. Zidan, Mena R. Armanyous and Mohamed A. Fadey. Accuracy and sensitivity of RIPASA score Versus Alvarado score in diagnosis of acute appendicitis. BMFJ XXX, DOI: 10.21608/bmfj.2024.249370.1954