

Alvarado versus RIPASA score in diagnosing acute appendicitis

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Objective: To compare IPASA and Alvarado scoring systems in terms of diagnostic accuracy for acute appendicitis.

Methodology: The study was carried out from August 2010 to January 2012 at Princess Haya Hospital, Aqaba, Jordan and included 600 patients of suspected acute appendicitis. RIPASA and Alvarado scores were performed for all patients above 14 years in whom decision to operate was made already by independent surgeons. Sensitivity, specificity, predictive values and accuracy were calculated. Data were analyzed using SPSS 16 and STATA 11.

Results: Out of 600 patients, mean age 26.52

years. Negative appendectomy rate was 17%. Sensitivity for RIPASA and Alvarado scores were 93.2 and 73.7, respectively ($P < 0.001$). Predicted negative appendectomy rates for RIPASA and Alvarado systems were 7.8% and 8%, respectively ($P = 0.88$).

Conclusion: Both RIPASA and Alvarado scoring systems could significantly lower negative appendectomy rate. However, RIPASA could identify a significant proportion of patients who would be otherwise missed by Alvarado score. (Rawal Med J 2013;38: 147-151).

Keywords: Acute appendicitis, negative appendectomy, RIPASA score, Alvarado score.

Abbreviations:

SPSS 16	Statistical Package for the Social Sciences software version 16
STATA 11	STATA statistical software package version 11
RIPASA	Raja Isteri Pengiran Anak Saleha hospital
NA	Negative Appendectomy
PPV	Positive Predictive Value
NPV	Negative Predictive Value
PLR	Positive Likelihood ratio
NLR	Negative Likelihood ratio
ROCs	Receiver Operating curves
95% CI	95% Confidence Interval

INTRODUCTION

Acute appendicitis remains the most frequent cause for emergency operations in gastrointestinal surgery.¹ About 6% of population is expected to have appendicitis in their lifetime.² Its diagnosis relies largely on clinical assessment, although both ultrasound and computed tomography (CT) can be helpful.³ A high percentage of negative appendectomies (20%) was considered reasonable, based on the premise that delay would inevitably lead to perforation and thus increased morbidity and even mortality.⁴ The cost to both the patient and the health care system of NA is considerable and a complication rate of up to 6.1% following removal of normal appendices was reported.⁵

Multiple scoring systems have been developed in order to identify those patients who need emergency appendectomy thus avoiding the risk of delay. However, these systems are aimed at identifying patients unlikely to need surgery, thus decreasing the burden of NAs. Of these, Alvarado score system is one of the most widely studied. In 2010, a group in Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital, in Brunei, developed a new scoring system called RIPASA score (Table 1) and claimed that it was more suitable for Asian and Middle East populations than Alvarado scoring system.⁶ The aim of this study was to compare them to the clinical judgment alone, and determine their diagnostic accuracy when applied to our patients in Jordan,

METHODOLOGY

The prospective study was conducted in three hospitals which are members of King Hussein Medical City from August 2010 to January 2012. All patients older than 14 years who underwent appendectomy were included consecutively. Decision to operate was usually made by general surgical teams who were not members of the research team and their decision was based on clinical judgment. Once appendectomy was

decided, the nurse in charge was to inform the research team to meet the patient preoperatively.

Table 1. RIPASA score parameters.*

1	Male	1.0
	Female	0.5
2	Age < 39.9 yrs	1.0
	Age > 40 yrs	0.5
3	RIF pain	0.5
4	Migration of RLQ pain	0.5
5	Anorexia	1.0
6	Nausea & Vomiting	1.0
7	Duration of symptoms < 48 hrs	1.0
	Duration of symptoms > 48 hrs	0.5
8	RIF tenderness	1.0
9	RIF guarding	2.0
10	Rebound tenderness	1.0
11	Rovsing's Sign	2.0
12	Fever	1.0
13	Raised WCC	1.0
14	Negative urinalysis	1.0

*The original score has additional parameter: foreign national record of identity card (NRIC) which is specific to the local population where the system was developed.

On meeting the patient prior to surgery, history was taken, physical examination performed and the laboratory results reviewed. Both RIPASA and Alvarado scoring systems were performed (Table 1 and 2). Operative findings were followed from operations records. Findings considered positive for appendicitis were limited to the terms: early appendicitis, inflamed appendix, suppurative appendicitis, perforated appendix, gangrenous appendix and appendicular mass. Any other findings were considered NA.

Table 2. Alvarado score parameters.

Migratory right iliac fossa pain	1 point
Anorexia	1 point
Nausea and vomiting	1 point
Right iliac fossa tenderness	2 points
Rebound tenderness	1 point
Fever	1 point
Leucocytosis	2 points
Shift to left (segmented neutrophils)	1 point

Both SPSS 16 and Stata 11 were used for data analysis. t-test was used to compare means, and chi square test were used for categorical variables. Calculations for sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios and accuracy were made using both chi square test and Receiver Operating curves (ROCs). Cut off points used in these calculations were 7 for Alvarado score and 7.5 for RIPASA score. Results were considered statistically significant if $P < 0.05$.

RESULTS

Demographics features of 600 patients included in the study are shown in Table 3. 80.2% of patients were below the age of 40 years while only 9 (1.5%) were above 60 years. 102 patients had NA; of those, 3 had mesenteric lymphadenitis, 4 females had ruptured ovarian cyst, 4 females had ectopic pregnancy, 3 had Crohn's disease and 3 were found to have cecal tumors.

Sensitivity, specificity, PPV, NPV, PLR, NLR, accuracy and predicted NA rate for both RIPASA and Alvarado scores are shown in Table 4. At cut-of value of 7.5 for RIPASA score and 7 for Alvarado score, patients were divided into high risk and low risk groups. 93.2% of patients with inflamed appendix were successfully designated by RIPASA as being high risk group, while it was 73.7% in Alvarado score (0.19478, 95% CI 0.15022-0.23935, $P < 0.001$).

Table 3. Patient demographics.

Total number	600	
Males	360	
Females	240	
Mean age(yrs)	26.52	
Males	26.15	P =0.343
Females	27.08	
Negative Appendicectomy (%)	102(17%)	P=0.07
Male	53(14.7)	
Female	49(20.4)	

Figure 1 depicts ROCs for both scores. The difference in area under the curve between the two is

0.1717 (17.17%) which is the difference in accuracy between the two systems and corresponds to 97 patients who were missed by Alvarado score but correctly diagnosed by RIPASA score. The difference was statistically significant ($P < 0.001$).

Table 4. Comparison between RIPASA and Alvarado scores.

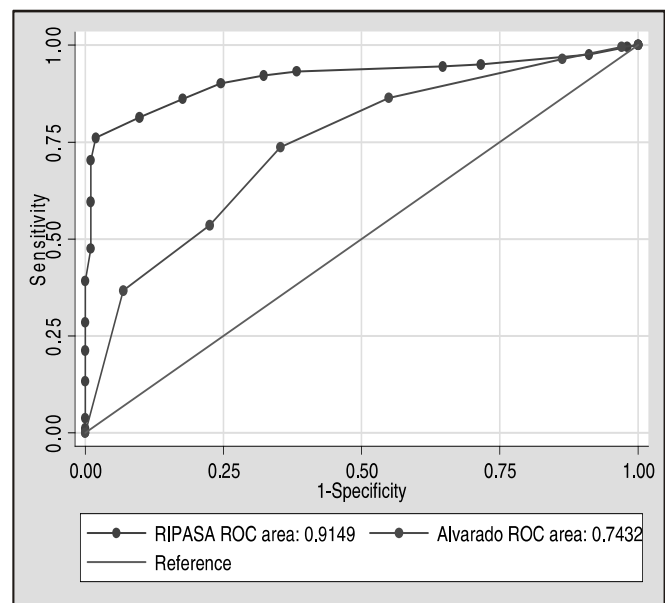
	RIPASA % (95% CI)	Alvarado % (95% CI)	P
Sensitivity	93.2 (90.9-95.4)	73.7 (69.8-77.5)	<0.001
Specificity	61.8 (52.3-71.2)	68.6 (59.6-77.6)	0.30
PPV	92.2 (89.9-94.6)	92.0 (89.3-94.6)	0.88
NPV	64.9 (55.4-74.4)	34.8 (28.2-41.4)	<0.001
PLR	2.4368	2.0880	
NLR	0.1105	0.4065	
Accuracy	91.5 (89.1-93.8)	74.3 (69.3-79.3)	<0.001
Predicted NA rate	7.8 (5.4-10.1)	8.0 (5.3-10.7)	0.88

The expected NA rate of RIPASA and Alvarado scores were 7.8% and 8%, respectively. The difference were not statistically significant (0.0026657, 95% CI -0.0327807 - 0.0381122, $P = 0.8826$). However, both rates were significantly lower than the observed NA rate which was 17% ($P < 0.001$).

DISCUSSION

Acute appendicitis is a common surgical condition that is readily treated but can lead to complications such as perforation, peri-appendiceal abscess, peritonitis, and rarely death.⁷ The picture of acute appendicitis may not be classical, and in such situations, a policy of early intervention may lead to high negative appendectomy rates.⁸ Most of newer tests have cost implications, require expertise, and are not available out of hours in the majority of institutions.⁹

Figure 1. ROC plots of RIPASA and Alvarado scores.



Various scoring systems are being used to aid the diagnosis of acute appendicitis and bring down the NA rates. These include but not limited to, Alvarado, Samuel, Tzanakis, Ohmann, Eskelinen, Fanyo, Lindberg, logistic score of Kharbada et al and so on.¹⁰⁻¹³ The most known of these is Alvarado score, which was developed in 1986. It contains 8 predictive factors and said to be practical and easy to use. Since then, there have been various studies, trying to validate the utility and usefulness of this simple scoring system.^{2,14,15} In 2010, RIPASA was developed. Age, gender and duration of symptoms were added since Wani et al have shown that the sensitivity and specificity of the Alvarado scoring system vary with these parameters.⁶ Later, they showed that RIPASA score at cut off value of 7.5 was a better diagnostic scoring system than Alvarado score with its original cut off value of 7.¹⁶ In our study, male to female ratio was 1.5:1 and mean age was 26.52 years. These results are consistent with other studies.¹⁷⁻²¹ The NA rate was 17% which is higher, although not statistically significant ($P = 0.069$). Again, these results are similar to reported by other studies.^{1,15,22,23} If Alvarado score or RIPASA score were used in evaluation of these patients, then the NA rate would be significantly lowered to 8% and 7.8%, respectively. There was no statistically significant difference in NA rates between the two scores and this finding was reported in another study.¹⁶

In this study, RIPASA score achieved sensitivity, PPV, NPV and accuracy comparable to that reported by the developers,⁶ but significantly lower specificity ($P=0.0028$). On the other hand, Alvarado score achieved sensitivity, specificity, PPV, NPV and accuracy comparable to most reports.^{15,22-26}

Comparing the two scores, as shown in table 4, demonstrate that RIPASA score had significantly higher sensitivity, NPV and accuracy than Alvarado score, while there was no statistically significant difference in specificity and PPV. However, RIPASA was not superior to Alvarado score in decreasing NA rate, but it had a higher accuracy and lower false negative rate. Examining the ROC plot shows that area under the RIPASA curve was significantly more than that under Alvarado curve ($P<0.0001$) and it represented 97 patients who were to be missed by Alvarado score but correctly diagnosed by RIPASA score.

CONCLUSION

Both RIPASA and Alvarado score systems were equally able to significantly decrease the NA rate. However, RIPASA score was more sensitive and accurate in diagnosing acute appendicitis and more able to identify a significant proportion of patients who would be otherwise missed by Alvarado score.

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Critical revision of the article for important intellectual content: Baha, Abdallah

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