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Research Article

A Comparative Study of Ripasa Score and Modified Alvardo Score in the Diagnosis of Acute Appendicitis

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Abstract
Acute appendicitis is one of the most common surgical emergencies in clinical practice, with an estimated lifetime prevalence of approximately 1 in 7. Different techniques have been devised to assist in equivocal cases in attempts to decrease negative appendicectomy rates. Except USG and CT as a principal imaging technique for appendicitis, several clinical systems have been developed to aid in the diagnosis of acute appendicitis. Several scoring systems exist specifically for appendicitis are the Alvarado score, the Modified Alvarado score, the Samuel score, Kharbanda's Low Risk score, the Lindberg score, the Ohmann score, the RIPASA score etc. here the present study has been attempted to assess the reliability and practical applicability of the widely used Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) scoring system and comparison of the RIPASA and the modified Alvarado scoring system in the diagnosis of acute appendicitis among patients attending North Bengal Medical College and Hospital, West Bengal, India. Total 98 patients including males and females undergoing emergency appendicectomy in Department of General Surgey, North Bengal Medical College were considered for present study. Depending on the clinical details and investigation, RIPASA scoring system and Modified Alvarado Score System has been administered with corroboration of Histopathological report. Sensitivity, specificity, positive predictive value (PPV) and negative predictive (NPV) for RIPASA & Alvarado system was done. The RIPASA scoring system in the present study had sensitivity of 96.29, specificity 76.4, positive predictive value 95.1, negative predictive value 81.25% and diagnostic accuracy 92.85% whereas Modified Alvarado score had sensitivity of 76.82%, specificity of 88.23%, positive predictive value of 96.92%, negative predictive value of 45.45%, and diagnostic accuracy of 81.25%.The present study revealed that RIPASA scoring system is more convenient, accurate, and specific scoring system for Indian population than Alvarado scoring system.
Keywords: *Appendicitis, Modified Alvarado Scoring System, RIPASA Scoring system.*

Introduction

Acute appendicitis is one of the most common surgical emergencies in clinical practice, with an estimated lifetime prevalence of approximately 1 in 7. It is one of the most common causes of acute abdomen and emergency abdominal surgery[1]. A

differential diagnosis of the disease must include virtually every acute process within the abdomen. It is equally associated with other urgent clinical syndromes like ectopic pregnancy. In addition, appendicitis has a very high and significant morbidity, which increases with diagnostic delay.

The diagnosis of appendicitis is mainly clinical. No single sign, symptom, diagnostic test, or scoring system accurately confirms the diagnosis of acute appendicitis in all cases. Therefore, diagnosis to establish appendicitis remains difficult, particularly among the young, the elderly and females of reproductive age, where a host of other genitourinary and gynecological inflammatory conditions can present with signs and symptoms that are similar with those of acute appendicitis.

Except USG and CT as a principal imaging technique for appendicitis, several clinical systems have been developed to aid in the diagnosis of acute appendicitis. In general they have been shown to increase the diagnostic accuracy in a time-efficient and cost-effective manner. Several scoring systems exist specifically for appendicitis are the Alvarado score, the Modified Alvarado score, the Samuel score, Kharbanda's Low Risk score, the Lindberg score, the Ohmann score, the RIPASA score etc.

In 1986, Alvarado published an appendicitis scoring system for acute appendicitis on the basis of eight predictive clinical factors, popularly known as the Alvarado scoring system[2]. After that the Modified Alvarado score was given by M.Kalan *et al*. in 1994 where patients were scored out of 9 points[3]. However, these scoring systems were developed in western countries and several studies reported very low sensitivity and specificity when applied to a population with a completely different ethnic origin and diet[4].

The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score is named after its hospital of origin in Brunei, Darussalam[5]. It is comparatively a new diagnostic scoring system developed for the diagnosis of Acute Appendicitis and has been shown to have significantly higher sensitivity, specificity and diagnostic accuracy. It is simple and easy to use, and was specifically developed for the Asian region, different than the western region in terms of diet and ethnic origin.

The RIPASA scoring system includes more parameters than Alvarado system and the latter did not contain certain parameters such as age, gender, duration of symptoms prior to presentation. These parameters are shown to affect the sensitivity and specificity of Alvarado scoring system in the diagnosis of acute appendicitis[6]. There were few studies[7,8,9] conducted on comparison of RIPASA score and modified Alvarado score in global context. Hence the present study intended to study on Evaluation of the usefulness of the RIPASA scoring system and comparison of the RIPASA and the modified Alvarado scoring system in the diagnosis of acute appendicitis among patients attending North Bengal Medical College and Hospital, West Bengal, India.

Methods

The present study was a prospective, cross-sectional; institution based observational study, conducted among 98 patients including males and females undergoing emergency appendicectomy in Department of General Surgey, North Bengal Medical College from April 2016 – March 2017. Patients with RIF pain, suggestive of acute appendicitis and are undergoing appendicectomy were considered for this study. Patients with appendicular lump, evidence of generalized peritonitis, evidence of acute confusing state, dementia, septic shock. gynecological & urological diseases on clinical ground were excluded from this study. The subjects were informed about the purpose of the study and the necessary ethical clearance has been obtained from ethical committee of the hospital before commencement of the present study.

Then depending on the clinical details and investigation, RIPASA scoring system and Modified Alvarado Score System has been administered with corroboration of

Histopathological report. The RIPASA scoring system and Modified Alvarado Score System are described below:

RIPASA Scoring System

Patients	Score
Sex:-	
Male	1.0
Female	0.5
Age:-	
Age <40 years	1.0
Age >40 years	0.5
Symptoms:-	
Right Iliac Fossa (RIF) pain	0.5
Migration of pain to RIF	1.0
Anorexia	1.0
Nausea and vomiting	1.0
Duration of symptoms <48 hours	1.0
Duration of symptoms >48 hours	0.5
Signs:-	
RIF tenderness	1.0
Guarding	2.0
Rebound tenderness	1.0
Rovsing's sign	2.0
Fever	1.0
Laboratory Investigations:-	
Raised WBC count	1.0
Negative urinalysis	1.0
TOTAL	**17.5**

Modified Alvarado Score System

Parameter	**Score**
1. Migratory RIF pain	1
2. Anorexia	1
3. Nausea / vomiting	1
4. Tenderness in RIF	2
5. Rebound tenderness	1
6. Fever >37.5^0 C	1
7. Leucocytosis ($10X10^9$per Ltr.)	2
Total Score	**9**

True positive, true negative, false positive and false negative cases were obtained through RIPASA scoring system, Modified Alvarado Score and histopathological report. Sensitivity, specificity, positive predictive value, diagnostic accuracy etc were calculated and compared between Modified Alvarado Score and RIPASA scoring system.

Statistical analysis was done using Statistical Package for Social Sciences version 22 for windows [IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM Corp]. Microsoft Word was used to generate bar diagram, table. Tabulation of data was done by using Microsoft Excel Sheet. $P < 0.05$ was considered as statistically significant.

The above mentioned calculations have been done by using the following formulas:

For RIPASA Score

True Positive (TP): No of patients having RIPASA score ≥ 7.5 & Histopathologically acute appendicitis.

False Positive (FP): No of patients having RIPASA score ≥ 7.5 but Histopathologically normal appendix.

True Negative (TN): No of patients having RIPASA score < 7.5 but Histopathologically normal appendix.

False Negative (FN): No of patient having RIPASA SCORE < 7.5 but histopathologically acute appendicitis.

For Modified Alvarado Score

True Positive (TP): No. of patients having Modified Alvarado score 7-9, & Histopathologically acute appendicitis.

False Positive (FP): No. of patients having Modified Alvarado score 7-9, & Histopathologically normal appendix.

True Negative (TN): No. of patients having Modified Alvarado score 1-6, & Histopathologically normal appendix.

False Negative (FN): No. of patients having Modified Alvarado score 1-6, & Histopathologically acute appendicitis.

Diagnostic Accuracy (DA) is expressed as the proposition of correctly classified subjects among all subjects. It is calculated by the formula:

Diagnostic Accuracy (DA) = $\frac{TP+TN}{TP+TN+FP+FN} x100$

Sensitivity = $\frac{TP}{TP+FN} x100$

Specificity = $\frac{TN}{TN+FP} x100$

Positive Predictive Value (PPV) = $\frac{TP}{TP+FP} x100$

Negative Predicative Value (NPV) =TN/TN+FN

Results

A total of 98 subjects who were provisionally diagnosed with acute appendicitis and underwent appendicectomy were included in the study Out of

98 patients who underwent emergency appendicectomy, 74 (75.5%) appendices were histopathologically proved to have acute appendicitis, 24 (24.5%) appendices were found to be normal on histopathological examination (Table 1). Furthermore, the table 1 showed 24 (24.5%) were of age >40 years, and 74 (75.5%) were of <39.9 years. Among age>40 years, 7 (29%) had normal appendix and 17 (17%) had acute appendicitis. Among age<39.9 years, 10 (13.5%) had normal appendix and 64 (86.5%) had acute appendicitis

Table 1: Frequency Distribution of Age with Histopathology (n=98)

Age (years)	HPE		Total
	Normal appendix	Acute Appendicitis	
Age>40 years	7(29%)	17(71%)	24(24.5%)
Age<39.9 years	10(13.5%)	64(86.5%)	74 (75.5%)
Total	**17(17.34%)**	**81(82.66%)**	**98 (100%)**

The RIPASA score was calculated for all 98 patients. A score of more than or equal to 7.5 was considered as cut-off score and RIPASA POSITIVE. A score 7 or less was considered RIPASA NEGATIVE.

The table 2 showed out of 98 patients 82 (83.67%) had RIPASA Positive and 16 (16.32%) has RIPASA Negative. Out of 82 patients who had RIPASA Positive 4 (4.88%) were found to have normal appendix, and 78 (95.12%) were found to have acute appendicitis on HPE. Out of 16 patients, 13 (81.25%) were found to have normal appendix and 3 (18.75%) had acute appendicitis on HPE

Table 2: Frequency Distribution of RIPASA Score with HPE (n=98).

RIPASA Score	HPE		
	Normal Appendix	Acute Appendicitis	Total
RIPASA ≥ 7.5 (+)	4 (4.88%)	78 (95.12%)	82 (83.67%)
RIPASA< 7.5 (-)	13 (81.25%)	3 (18.75%)	16 (16.32%)
Total	**17 (17.35%)**	**81 (82.65%)**	**98 (100%)**

The Alvarado score was calculated for 98 patients. A score of 7 was considered as cut-off score. A score of 7-9 was considered MODIFIED ALVARADO POSTIVE for Acute Appendicitis. A score of 1-6 was considered as MODIFIED ALVARADO NEGATIVE for Acute Appendicitis.

Table 3: Frequency Distribution of Modified Alvarado Score with HPE (n=98)

Modified Alvarado Score	HPE		
	Normal Appendix	Acute Appendicitis	Total
Modified Alvarado Score (7-9) Positive	2 (2.44%)	63 (76.82%)	65 (66.33%)
Modified Alvarado Score (1-6) Negative	15 (45.45%)	18 (54.55%)	33 (33.67%)
Total	17 (17.35%)	81 (82.65%)	98 (100%)

The table 3 revealed that out of 98 patients, 65 (66.33%) had Modified Alvarado score Positive and 33 (33.67%) had Modified Alvarado score Negative. Out of 65 who had modified Alvarado score positive, 2 (2.44%) had normal appendix and 63 (76.82%) had acute appendicitis. Out of 33 patients who had modified Alvarado score negative, 15 (45.45%) had normal appendix and 18 (54.55%) had acute appendicitis.

Table 4: Comparison of RIPASA Scoring System and Modified Alvarado Score in Diagnosis of Acute Appendicitis

Diagnosis Efficacy	RIPASA Scoring System	Modified Alvarado Score
Sensitivity	96.29	76.82
Specificity	76.4	88.23
PPV	95.1	96.92
NPV	81.25	45.45
Diagnostic accuracy	92.85	81.25

The table 4 showed the comparison of RIPASA Scoring System and Modified Alvarado Score which revealed that the RIPASA scoring system in the present study had sensitivity of 96.29, specificity 76.4, positive predictive value 95.1, negative predictive value 81.25%, diagnostic accuracy 92.85% whereas Modified Alvarado score had sensitivity of 76.82%, specificity of

88.23%, positive predictive value of 96.92%, negative predictive value of 45.45%, diagnostic accuracy of 81.25%.

Discussion

Present study compared sensitivity and specificity between Alvarado Scoring System with that of RIPASA. Sensitivity or true positive rate is the proportion of actual positives which is correctly identified that is the percentage of sick people who are correctly identified as having the condition. Specificity or true negative rate is the proportion of negatives which are correctly identified that is the percentage of healthy people who are correctly identified as not having the condition[9]. Here it is found that the RIPASA score was considerably better than Alvarado score in correctly diagnosing acute appendicitis. Using the RIPASA score, 96.29% of patients who actually had acute appendicitis were correctly diagnosed and placed in the high probability group (RIPASA score > 7.5), compared to only 76.82% when using the Alvarado score on the same population sample. Again, the diagnostic accuracy of RIPASA was 92.85% and Alvarado score was 81.25 indicating that the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis. The result of this study corroborated with other global studies conducted among different populations in respect of higher percentage of sensitivity and specificity (Table 5).

Table 5. Comparative Analysis of Sensitivity and Specificity with Other Global Studies

Study	RIPASA		Alvarado	
	Sensitivity(%)	Specificity(%)	Sensitivity(%)	Specificity(%)
Chong *et al.* 2010[6]	98%	81.32%	68.32%	87.9%
Alnjadat et.al[7]	93.2%	61.8%	73.7%	68.6%
Erdem *et al.* 2013[10]	100%	28%	82%	75%
Reyes-Garcia *et al.*2012[8]	91.2%	84.6%	89.5%	69.2%
Present study	96.3%	76.4%	76.8%	88%

In case of the Diagnostic Accuracy which relates to the ability of a test to discriminate between the target condition or disease and health, the present research work has been showed a higher diagnostic accuracy of RIPASA (92.85) than Modifidied Alvarado Score (81.25). Other studies[7,8,9] also showed the similar results except the study conducted by Erdem et al.[11] (Table 6)

Table 6: Comparative analysis of the Diagnostic Accuracy

Study	Diagnostic Accuracy (%)	
	RIPASA	Alvarado
Chong *et al.* 2010[7]	91.83	86.5
Alnjadat *et al.* 2013[8]	91.5	74.3
Erdem *et al.*2013[11]	77	80
Present study	**92.85**	**81.25**

Therefore, RIPASA score is a useful tool for diagnosis of acute appendicitis and significantly reduces the number of patients undergoing negative appendectomy, as it provides a structured way to collect patient data and a more coherent and comprehensive preoperative evaluation and can be applied as an adjunct to clinical judgment. Nevertheless, Unnecessary and expensive radiological investigations can be avoided by using RIPASA score and thus reducing health care expenditure.

Conclusions

The RIPASA score is currently a better diagnostic scoring system for acute appendicitis compared to the Alvarado score, with the former achieving significantly higher sensitivity and diagnostic accuracy, particularly in Indian population. Moreover, this scoring system is easy, quick, inexpensive to use and can be used in both rural and urban areas where other diagnostic modalities may not be available, and as per the study analysis, it reveals that RIPASA scoring system is better sensitive test for diagnosing acute appendicitis.

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