Avinash Tinaikar
Assistant Professor, Department of General Surgery, Karwar Institute of Medical Sciences, Karwar, Karnataka, India

Vinay Naik
Senior Resident, Department of General Surgery, Karwar Institute of Medical Sciences, Karwar, Karnataka, India

An observational comparative study between RIPASA & modified Alvarado scoring in the diagnosis of acute appendicitis

Avinash Tinaikar and Vinay Naik

DOI: https://doi.org/10.33545/surgery.2019.v3.i4i.293

Abstract
Background: Acute appendicitis is one of the most common surgical emergencies. Different techniques and number of scoring systems have been used for aiding in early diagnosis of acute appendicitis and its prompt management of which Alvarado score is the most popular. So we retrospectively applied and compared Alvarado and RIPASA score in the diagnosis of acute appendicitis in Indian population.
Materials and Methods: We compared retrospectively RIPASA and Alvarado scoring system by applying them to 85 patients in between June 2018 to November 2019. Both scores were calculated for patients who presented with right iliac fossa pain during the study period. Sensitivity, specificity, positive predictive value (PPV), negative predictive (NPV), diagnostic accuracy for RIPASA & Alvarado system was done.
Results: The sensitivity and specificity of RIPASA score were 91.78% and 66.66% respectively. The sensitivity and specificity of Alvarado score were 64.38% and 58.33% respectively.
The diagnostic accuracy of RIPASA scoring system is 88.23% and that of Alvarado scoring system is 63.52%. The results indicate that the RIPASA scoring system is a better diagnostic tool for the diagnosis of acute appendicitis (p<0.001).
Conclusion: RIPASA scoring system is accurate, more convenient, and specific scoring system for Indian population than Alvarado scoring system.

Keywords: Acute appendicitis, RIPASA score, Alvarado score, sensitivity, accuracy

Introduction

Acute appendicitis is one of the most common cause of acute abdomen that mostly requires surgery and is usually diagnosed using clinical history, physical examination findings, and a few laboratory tests [1, 2]. A differential diagnosis of acute appendicitis must include virtually every acute process within the abdomen. Some of the differential diagnosis are equally associated with other urgent clinical syndromes like ectopic pregnancy. Appendicitis has a very high and significant morbidity, which is increased with diagnostic delay. Advanced radiological imaging methods such as ultrasonography and computed tomography (CT) are often resorted to for making a quick and accurate diagnosis [3, 4]. Despite all these facilities, the rate of negative or unnecessary appendectomy due to reduced diagnostic accuracy has gone up to approximately 30% [2]. Except USG and CT for appendicitis, several clinical systems have been developed to aid in the diagnosis of acute appendicitis. A large number of scoring systems have been used for aiding in early diagnosis of acute appendicitis and it's used in prompt management. These scores make use of clinical history, physical examination, laboratory findings and many other parameters. The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) and Alvarado score are new diagnostic scoring systems developed for the diagnosis of Acute Appendicitis and has been shown to have significantly higher sensitivity, specificity and diagnostic accuracy. Modified Alvarado score was given by M.Kalan *et al*. in 1994 where patients were scored out of 9 points [5]. 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. The RIPASA Score is 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 compared to Alvarado Score, particularly when it was applied to Asian population [6].

Corresponding Author:
Vinay Naik
Senior Resident, Department of General Surgery, Karwar Institute of Medical Sciences, Karwar, Karnataka, India

There are very 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 admitted in general surgery wards at Karwar Institute of Medical Sciences, Karwar, Karnataka

Material and Methods

The present study was a retrospective; institution based observational study, conducted among 85 patients including males and females undergoing emergency appendicectomy in Department of General Surgery, Karwar Institute of Medical Sciences, Karwar from June 2018 – November 2019. Patients with Right iliac fossa pain, with suspicion of acute appendicitis and undergoing surgery 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. A total of 85 patients qualified for the study during the study period. All the 85 patients were scored as per Alvarado and RIPASA scoring system; Alvarado score contained 7 parameters, whereas RIPASA Score contained 18 parameters. 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:

Table 1: RIPASA Scoring System

Patients	Score
Demography	
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	0.5
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
Additional Score	
Foreign NRIC	1
Total	17.5

Score <5 – Unlikely to be appendicitis
5-7.5   – Low Probability to be appendicitis
7.5-12   – High Probability to be appendicitis
>12   – Definite appendicitis

Table 2: 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	2
Total Score	9

Score <5 – Unlikely to be appendicitis
5-6 – Low Probability to be appendicitis
6-7 – High Probability to be appendicitis
>8 – Definite appendicitis

All the quantitative parameters were described through descriptive statistics such as mean and standard deviation. The scores were assigned to various risk factors based on the probability of the occurrence of event and total scores were computed for all the risk factors. Sensitivity (true positive rate), specificity (test result will be negative when the disease is not present), Positive Predictive Value (probability that the disease is present), Negative Predictive Value (disease is not present when the test is negative) of the scoring system will be estimated by comparing the threshold level of score with surgical findings and histopathology findings. Receiver operating characteristic (ROC) curve were used for delineating threshold score levels. ROC curve compares the diagnostic performance of two or more tests.

Results

Table 3: Distribution of patients with respect to age group.

Age in years	No. of Patients	Percentage
<20	21	24.71
21-30	32	37.65
31-40	19	22.35
41-50	9	10.59
51-60	4	4.70
Total	85	100

The age distribution in the study sample involved upto 60 years of age, majority of the patients belonged to 21-30 years age group.

Table 4: Distribution of patient with respect to gender

Gender	No. of patients	Percentage
Male	58	68.23
Female	27	31.77
Total	85	100

Out of 85 patients included in the study, majority of the patients in the study group were males (68.23%).

Table 5: Distribution of patients with respect to RIPASA score

RIPASA	No. of patients	Percentage
≥7.5	71	83.52
<7.5	14	16.48
Total	85	100

The subject were scored according to RIPASA system and were categorized into high probability group if the score was equal to or more than 7.5 and low probability group if the score was less than 7.5.Most of the patients scored equal to or more than 7.5 (83.52%).

Table 6: Distribution of patients with respect to Alvarado score

Alvarado	No. of patients	Percentage
≥5	52	61.18
<5	33	38.82
Total	85	100

The subjects were also scored according to Alvarado system, according to Alvarado system only 61.18% of the study population were categorized as high probability of acute appendicitis as against 83.52% according to RIPASA system

Table 7: Distribution of patients based on HPE report

HPE report	No. of patients	Percentage
Positive	73	85.88
Negative	23	14.12
Total	85	100

Diagnosis of 85 patients were confirmed by HPE .73 patients were confirmed as acute appendicitis , 12 patients turned out to be negative for acute appendicitis in HPE resulting in negative appendectomy rate of 14.12%

Table 8: Comparison of RIPASA score and HPE report

RIPASA	HPE Report		Total
	Positive	Negative	
≥7.5	67	4	71
<7.5	6	8	14
Total	73	12	85

P<0.001 (0.000004) chi square test: significant

Among 73 patients whose HPE report was positive for appendicitis, 67 patients had RIPASA score ≥ 7.5, with p score of <0.001 as per chi square test, which is statistically significant.

Table 9: Comparison of Alvarado score and HPE report

Modified Alvarado Score	HPE Report		Total
	Positive	Negative	
≥ 5	47	5	52
<5	26	7	33
Total	73	12	85

p> 0.001 (0.239264), chi square test: not significant

Among 73 patients whose HPE report was positive for appendicitis, 47 patients had modified Alvarado score ≥ 5, with p score of >0.001 as per chi square test, which statistically not significant.

Table 10: Correlation of RIPASA score, MASS and Histopathology reports

Scoring		RIPASA	MASS
Observation	True positive	67	47
	False positive	6	26
	False negative	4	5
	True Negative	8	7
	Total	85	85
Correlation (%)	Sensitivity	91.78	64.38
	Specificity	66.66	58.33
	Positive predictive value	94.36	90.38
	Negative predictive value	57.14	21.21
	Accuracy	88.23	63.52
	P value	<0.001	>0.24

The table 10 showed comparison of RIPASA Scoring system and modified Alvarado score which revealed that RIPASA scoring system in the present study had sensitivity of 91.78%, specificity of 66.66%, positive predictive value 94.36%, negative predictive value 57.14%, diagnostic accuracy 88.23% whereas modified Alvarado score had sensitivity of 64.38%, specificity of 58.33%, positive predictive value of 90.38%, negative predictive value of 21.21%, diagnostic accuracy of 63.52%.

Discussion

Acute appendicitis is one of the most common surgical emergencies, the evaluation of which is mainly based on history and clinical findings and they are the most important parameters in reaching a diagnosis of acute appendicitis. Despite of all this making a quick and accurate diagnosis of acute appendicitis can be difficult. Late or incorrect diagnosis of acute appendicitis leads to aggravation of the existing inflammation, resulting in serious complications including appendicular perforation, peritonitis, intra-abdominal abscess, and sepsis, with an increase in morbidity and mortality of patients .The diagnosis in children with acute appendicitis may be difficult due to atypical clinical features and also in elderly and females of reproductive age due to a wide range of differential diagnoses [10]. In such cases, use of advanced radiological examinations such as CT may have now become necessary. CT is also an expensive procedure raising the cost of healthcare and patients are exposed to radiation. There are studies in the literature reporting that unnecessary CT scans lead to unnecessary appendectomies in patients with early low-grade appendicitis which can be resolved spontaneously with antibiotics therapy and this means that such patients are burdened with surgical risks [7]. However, sometimes the diagnosis of acute appendicitis can only be made based on the intra-operative macroscopic appearance of the appendix tissue and the histopathological examination of the removed appendectomy material [4]. Since the problems of correctly diagnosing acute appendicitis have been experienced for a very long time in almost all surgical outpatient departments worldwide, many scoring systems have been developed for the diagnosis of acute appendicitis including Alvarado, modified Alvarado, appendicitis inflammatory response score, Ohmann score, and Lintula score. However, because all these scoring systems produced different results in different ethnic groups and had rather low sensitivities and specificities, there came a need arose to devise new systems. Developed in 2010 and started to be used more widely thereafter, the RIPASA score is an inexpensive, very easy to use and highly reliable quantitative scoring system that enables to make a correct and early diagnosis of acute appendicitis and to significantly reduce the negative appendectomy rate. RIPASA score is simple and easy to use as a quantitative scoring system and most of the included parameters can easily be obtained from good clinical history and examination it also included urine analysis which can be easily performed.

Our 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. Here it is found that the RIPASA score was considerably better than Alvarado score in correctly diagnosing acute appendicitis. Using the RIPASA score, 91.78% of patients who actually had acute appendicitis were correctly diagnosed and placed in the high probability group (RIPASA score > 7.5), compared to only 64.38% when using the Alvarado score on the same population sample. Again, the diagnostic accuracy of RIPASA was 88.23% and Alvarado Score was 63.52% indicating that the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis.

Table 11: Comparative Analysis of Sensitivity and Specificity with Other Global Studies

Study	RIPASA		Alvarado	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Chong *et al*. 2010 [2]	98	81.32	68.32%	87.9%
Alnjadat et al. [8]	93.2	61.8	73.7	68.6
Erdem *et al.* 2013 [11]	100	28	82	75
Reyes-Garcia *et al*.2012 [9]	91.2	84.6	89.5	69.2
Present study	91.78	66.66	64.38	58.33

Table 12: Comparative analysis of the Diagnostic Accuracy

Study	Diagnostic Accuracy (%)	
	RIPASA	Alvarado
Chong *et al*. 2010 [2]	91.83	86.5
Alnjadat et.al [8]	91.5	74.3
Erdem *et al.* 2013 [11]	77	80
Present Study	88.23	63.52

In our study, most of the patients with a RIPASA score ≥7.5 were diagnosed with catarrhal stage appendicitis. The rest of the patients in this group had appendicitis of a more advanced pathological stage. The patients with a RIPASA score 12 and over had suppurative-or gangrenous-stage appendicitis.

Appendicitis was found in the histopathological examinations of most of the patients who had RIPASA scores higher than 7.5. When this is taken into consideration together with the above mentioned disadvantages of CT, we think a CT scan is not necessary for patients with a RIPASA score 7.5 and over.

This type of a practice will fully justify the validity of the existence of a RIPASA scoring system. In this context, it will be useful to inform physicians, particularly those working in rural hospitals without a CT unit, about the necessity to use the RIPASA scoring system more frequently.

Conclusion
The RIPASA score is simple scoring system with high sensitivity and specificity for the diagnosis of acute appendicitis .RIPASA score is currently a better diagnostic scoring system for diagnosis of acute appendicitis compared to Alvarado score particularly in Indian population. Making a correct and prompt diagnosis of acute appendicitis including its possible pathological stage is possible with the RIPASA score, which is easily obtained using simple clinical and laboratory data, without a need of unwanted admissions and expensive imaging studies like CT scan.

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