

Original Research Article

Comparison of modified Alvarado and RIPASA scoring systems correlated with intra-operative findings in predicting acute appendicitis

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ABSTRACT

Background: Imaging techniques such as ultrasound and CT (computerised tomography) offer to improve clinical outcome by increasing the accuracy of diagnosis. Ultrasound has the great advantage of being radiation free, however it is operator dependant. In comparison, CT can overcome these limitations and greater sensitivity in the diagnosis of acute appendicitis, with reported accuracies of 93-98% but it is expensive and not available at all centre, particularly in countries, like India. Hence we need a scoring system such as MASS (modified Alvarado scoring system) and RIPASA (Raja Isteri Pengiran Anak Saleha appendicitis) scoring system with good sensitivity and specificity. Aim of the present study was to explore the disease on clinical presentation and to compare both scoring systems in diagnosis of acute appendicitis and correlating both the scoring systems with the intra-operative findings.

Methods: This was a prospective study done between October 2019 and October 2020 on hundred patients who underwent appendectomy at Kempegowda institute of medical sciences and research centre, Bengaluru, Karnataka, India.

Results: In the study among subjects with appendicitis, there was significant association between combined MASS and RIPASA score and intra-operative findings.

Conclusions: In the study combined MASS and RIPASA score with correlated intra-operative findings had diagnostic accuracy in prediction of acute appendicitis.

Keywords: Acute appendicitis, Modified Alvarado score, RIPASA score

INTRODUCTION

Appendix is a worm like diverticulum arising from posteromedial wall of caecum about 2 cm below ileo-caecal orifice. The length of appendix varies from 2 to 20 cm with an average of 9 cm. It is longer in children than in adults. It has variable positions in relation to neighbouring viscera like retrocaecal (65%), pelvic (30%), paracolic, preileal or postileal.¹

Acute appendicitis is one of the most common surgical emergencies, with a lifetime prevalence rate of approximately one in seven.²

Appendectomy is the most commonly performed operation (10% of all emergency abdominal operations) and appendicitis is notorious to simulate other acute abdominal conditions, thus it is important differential diagnosis in patients with right iliac fossa pain. Its incidence is 1.5-1.9 per 1000 population.³

Imaging techniques such as ultrasound and CT offer to improve clinical outcome by increasing the accuracy of diagnosis. Ultrasound has the great advantage of being radiation free, however it is operator dependant. It may be difficult in patients with a retrocaecal appendix and has limited sensitivity. In comparison, CT can overcome

these limitations and greater sensitivity in the diagnosis of acute appendicitis, with reported accuracies of 93-98% but it is expensive and not available at all centre's particularly in countries, like India.^{4,5}

Clinical presentations

Symptom, signs and laboratory findings are abdominal pain is the prime symptom of acute appendicitis. Anorexia nearly always accompanies appendicitis. Although vomiting occurs in nearly 75% of patients. Most patients give a history of obstipation beginning before the onset of abdominal pain. Diarrhoea occurs in some patients, however, particularly children, so that the pattern of bowel function is of little differential diagnostic value. Temperature elevation is rarely >1°C (1.8°F) and the pulse rate is normal or slightly elevated.⁶

Tenderness often is maximal at or near the McBurney point. Direct rebound tenderness usually is present. The Rovsing sign-pain in the right lower quadrant when palpatory pressure is exerted in the left lower quadrant-also indicates the site of peritoneal irritation. Cutaneous hyperesthesia in the area supplied by the spinal nerves on the right at T10, T11 and T12. Mild leukocytosis, ranging from 10,000 to 18,000 cells/mm³, usually is present in patients with acute, uncomplicated appendicitis and often is accompanied by a moderate polymorphonuclear predominance. White blood cell counts are variable, however.⁷

The MASS is a clinical scoring system used in the diagnosis of appendicitis. The score has 6 clinical items and 2 laboratory measurements with a total 10 points. It was introduced in 1986 and although meant for pregnant females, it has been extensively validated in the non-pregnant population. The modified Alvarado score is at present in use. The two most important factors, tenderness in the right lower quadrant and leukocytosis are assigned two points and the six other factors are assigned one point each, for a possible total score of ten points. A score of 5 or 6 is compatible with the diagnosis of acute appendicitis.

A score of 7 or 8 indicates a probable appendicitis and a score of 9 or 10 indicates a very probable acute appendicitis. The original Alvarado score describes a possible total of 10 points, but those medical facilities that are unable to perform a differential white blood cell count, are using MASS.⁸

The likelihood of appendicitis can be ascertained using the Alvarado scale (Table 1).

A scoring system, with good sensitivity and specificity is in need.

Kalan assessed Alvarado score as to its accuracy in the preoperative diagnosis of acute appendicitis and stated that the presence of high score was found to be an easy

and satisfactory aid to early diagnosis of acute appendicitis in children and men.

Table 1: Modified Alvarado score for acute appendicitis.

Criteria	Score
Symptoms	
Migratory RIF pain	1
Anorexia	1
Nausea and Vomiting	1
Signs	
Tenderness in RIF	2
Rebound tenderness	1
Elevated temperature >37.5 degree C	
Laboratory	
Leukocyte count >10×10 ⁹ /l	2
Shift to left (neutrophilia)	1
Total	10

Table 2: RIPASA score for acute appendicitis.

Parameters	Score
Gender	
Male	1.0
Female	0.5
Age (in years)	
<39.9	1.0
>40.0	0.5
RIF pain	0.5
Migration of RLQ pain	0.5
Anorexia	1.0
Nausea and vomiting	1.0
Duration of symptoms (in hours)	
<48	1.0
>48	0.5
RIF tenderness	1.0
RIF guarding	2.0
Rebound tenderness	1.0
Rovsing's sign	2.0
Fever	1.0
Raised WBC	1.0
Negative urine analysis	1.0
Foreign NRIC	1.0
Total	16.5

However, the false positive rate for appendicitis in women was unacceptably high.^{3,10}

Alvarado and modified Alvarado scores are one of the most popular and most common used scores but validity of these scores are low in Asian population. Recently, RIPASA score has been developed for the diagnosis of acute appendicitis in Asian population by Chee Fui Chong, department of surgery RIPASA hospital Brunei, Darussalam.

RIPASA score has been derived for diagnosis of acute appendicitis which is more suitable for Middle East and Asian population and suggested operation for patients having a score of 7.5 or above out of 15 (Table 2).⁹

METHODS

This was a prospective observational study done between October 2019 and October 2020 on hundred patients who underwent appendectomy, Kempegowda institute of medical sciences and research centre, Bengaluru, Karnataka, India.

Inclusion criteria

All patients presenting with RIF pain and clinically diagnosed as acute appendicitis and patients above 18 years of age were included in the study.

Exclusion criteria

Patients below 18 years of age, patients with generalised peritonitis, appendicular mass, appendicular abscess, patients with features suggestive of generalised peritonitis and pregnant women were excluded from the study.

Patients were subjected to routine investigations, USG and scored based on MASS and RIPASA.

The result of MASS and RIPASA score were reported independently and correlated with intra-operative findings and subjected to statistical analysis and the results were presented.

Statistical analysis

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation.

Table 3: Validity of a test in screening of disease.

Screening test results	Diagnosis		Total
	Diseased	Healthy	
Positive	a (true positive)	b (false positive)	a+b
Negative	c (false negative)	d (true negative)	c+d
Total	a+c	b+d	a+b+c+d

$$\text{Sensitivity} = \frac{a}{(a+c)} \times 100 = \frac{\text{true positive}}{(\text{true positive} + \text{false negative})}$$

$$\text{Specificity} = \frac{d}{(b+d)} \times 100 = \frac{\text{true negative}}{(\text{true negative} + \text{false positive})}$$

Positive predictive value

$$(\text{PPV}) = \frac{a}{(a+b)} \times 100 = \frac{\text{true positive}}{(\text{true positive} + \text{false positive})}$$

Negative predictive value

$$(\text{NPV}) = \frac{d}{(c+d)} \times 100 = \frac{\text{true negative}}{(\text{true negative} + \text{false negative})}$$

$$\text{Diagnostic accuracy} = \frac{a+d}{a+b+c+d} = \frac{\text{true positive} + \text{true negative}}{\text{total}}$$

Sensitivity: Defined as ability of a test to identify correctly all those who have the disease, that is, true positive.

Specificity: It is the ability of test to identify correctly those who do not have the disease, that is, true negative.

PPV: The proportion of patients who test positive who actually have the disease.

NPV: The proportion of patients who test negative who are actually free of the disease.

Diagnostic accuracy: It is the ability of screening test to detect true positives and true negatives in the total population studied.

Graphical representation of data

MS excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram.

P value (probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software

MS excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyse data.

RESULTS

In the study MASS score was highest among subjects with appendicolith and lowest among subjects with not operated (6±2.7). RIPASA score was highest among subjects with appendicolith and appendicular abscess and lowest among subjects with not operated (8.7±2.9).

In the study MASS score had sensitivity of 52.94%, specificity of 53.33%, PPV of 86.54%, NPV of 16.67% and 53% had diagnostic accuracy in diagnosis of acute appendicitis.

In the study RIPASA Score had sensitivity of 96.47%, specificity of 33.33%, PPV of 89.13%, NPV of 62.5% and 87% had diagnostic accuracy in diagnosis of acute appendicitis.

Table 4: Comparison of combined MASS and RIPASA score diagnosis with intra-operative findings.

Comparison	HPE						
	Appendicitis		No appendicitis		Total		
	Count	%	Count	%	Count	%	
Combined	MASS >7 and RIPASA >7.5	83	97.6	10	66.7	93	93.0
	MASS <7 and RIPASA <7.5	2	2.4	5	33.3	7	7.0

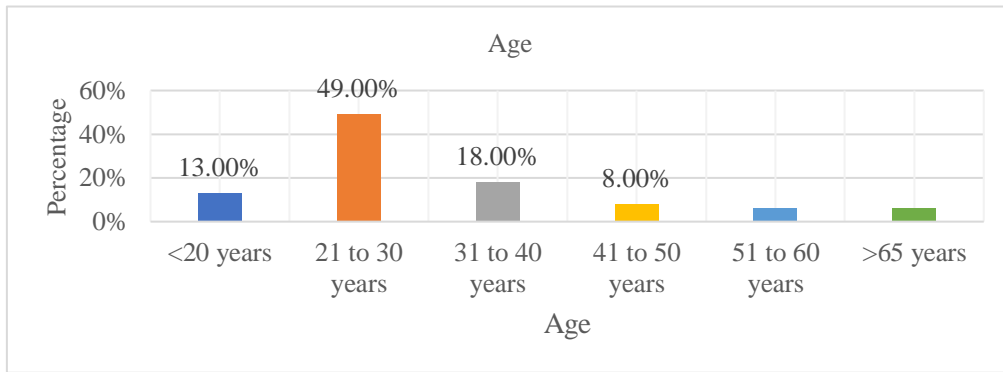


Figure 1: Age distribution of subjects.

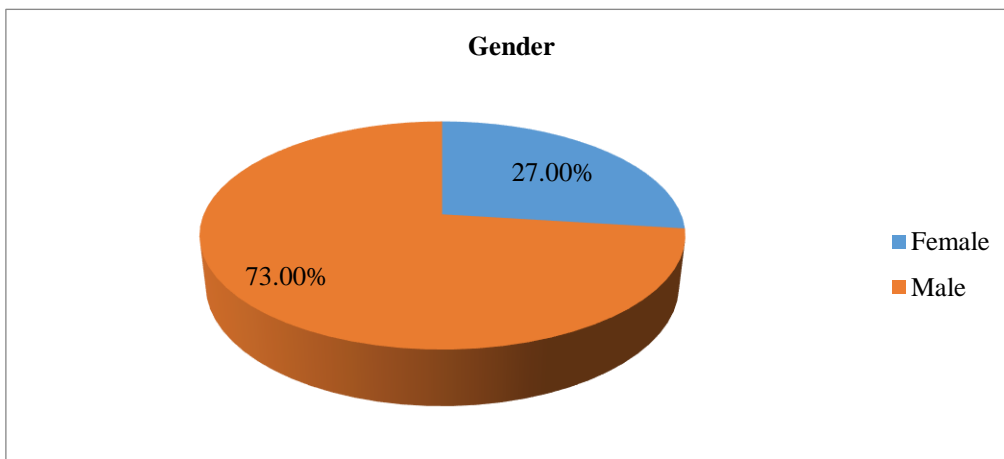


Figure 2: Gender distribution of subjects.

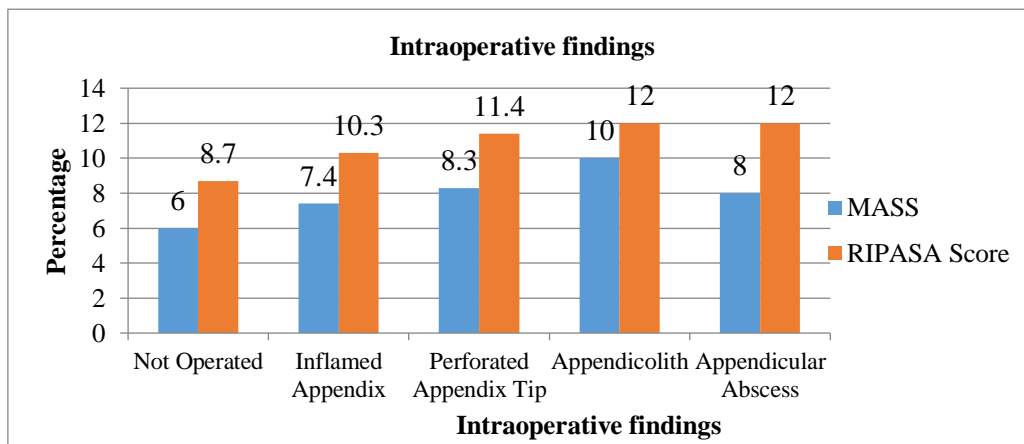


Figure 3: Comparison of MASS and RIPASA scoring system with intra-operative findings.

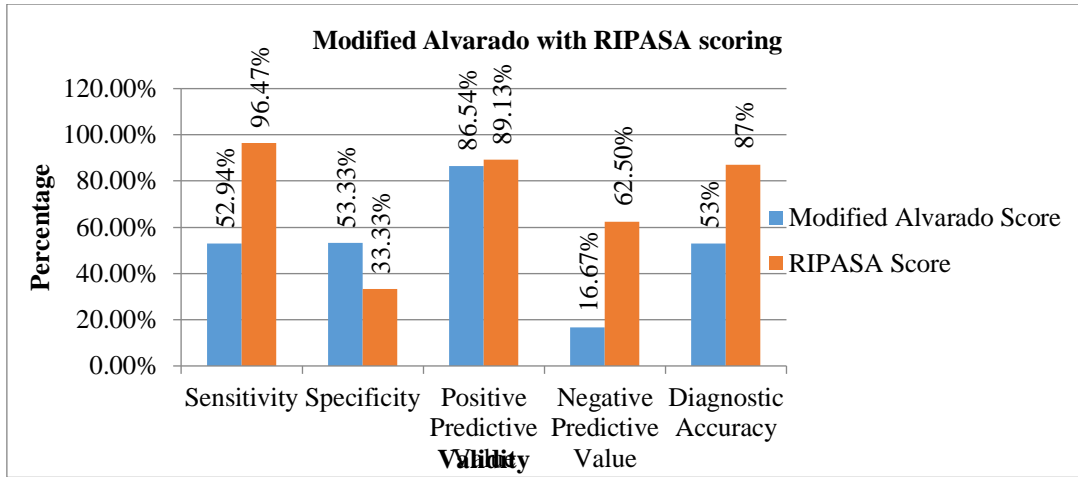


Figure 4: Comparison of MASS with RIPASA scoring in the diagnosis of acute appendicitis.

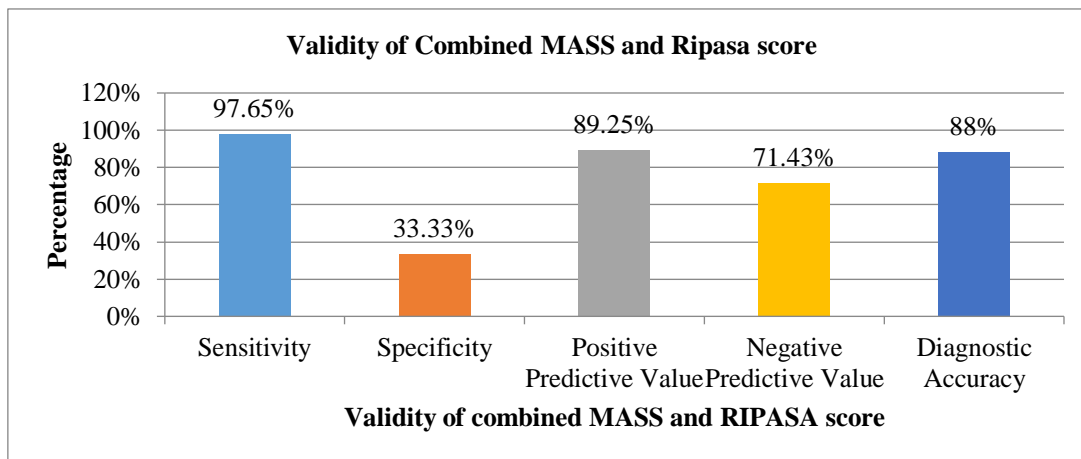


Figure 5: Validity of combined MASS and RIPASA score diagnosis with intra-operative diagnosis.

In the study among subjects with appendicitis, 97.6% had MASS >7 and RIPASA >7.5 and among subjects with no appendicitis, 33.3% had MASS <7 and RIPASA <7.5. There was significant association between combined MASS and RIPASA score and intra-operative findings.

In the study combined MASS and RIPASA score had sensitivity of 97.65%, specificity of 33.33%, PPV of 89.25%, NPV of 71.43% and 88% had diagnostic accuracy in diagnosis of acute appendicitis.

DISCUSSION

Acute appendicitis is one of the emergencies encountered in the world particularly in age group less than 30 years. Surgeon’s good clinical assessment is considered to be the most important requisite in the diagnosis of appendicitis. Several other conditions can mimic this clinical condition.^{11,12}

It remains a difficult diagnosis to establish, particularly among the young, the elderly and females of reproductive age, where a host of other genitourinary and gynaecological inflammatory conditions can present with

signs and symptoms that are similar to those of acute appendicitis.¹³

A delay in performing an appendicectomy in order to improve its diagnostic accuracy increased the risk of appendicular perforation and sepsis, which in turn increased morbidity and mortality. The opposite was also true, where with reduced diagnostic accuracy, the negative or unnecessary appendicectomy rate was increased and this was generally reported to be approximately 20-40%.¹⁰

Several authors considered higher negative appendicectomy rates acceptable in order to minimise the incidence of perforation.¹⁴

The decision of performing an appendectomy was largely based on history, clinical examination and investigations.²⁰

Diagnostic accuracy can be further improved through the use of USG or CT imaging. However, such routine practice may inflate the cost of health care substantially. A recent study had suggested that such indiscriminate use

of CT imaging may lead to early low-grade appendicitis and unnecessary appendectomies which would otherwise be resolved spontaneously by antibiotics therapy.¹⁵

Therefore the scoring systems were derived to diagnose acute appendicitis.

Alvarado score had good sensitivity and specificity when applied to foreign population but not to Asian population. Hence RIPASA scoring system which was more extensive yet simple scoring system consisting of 17 fixed parameters and an additional parameter (NRIC) that was unique to Asian population, which had better sensitivity and specificity.¹⁶

With our scoring systems correlated with intra-operative findings unnecessary expensive radiological investigations can be avoided thereby reducing health care expenditure.

Intra-operative findings such as inflammation mentioned as acute appendicitis, perforated appendix, appendicolith, were assessed in all patients included in the study.

There was lack of published studies which correlated intraoperative findings with scoring systems and further analysis through multi-centric prospective studies was needed.

CONCLUSION

From the detailed analysis, we found that individually, the association between intra-operative finding and MASS shows no significant association ($p=0.654$).

RIPASA score has significant association between intra-operative findings ($p=0.005$).

But when both the scores were combined, showed significant association with intra-operative findings ($p=0.001$).

And overall diagnostic accuracy of this study was 88%.

This study helps us avoid unnecessary expensive radiological investigations, negative appendectomy rates; thereby incorporating a simple and easy system.

Further analysis is required through multi-centric prospective studies as there is lack of studies who have correlated intra-operative findings with scoring systems.

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