## Original Research Article

# RIPASA score or Alvarado score: diagnosing acute appendicitis

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### ABSTRACT

**Background:** Appendicitis is a much studied about topic since the early years. Even with the advances in imaging techniques, appendicitis still relies upon clinical examination as a main resort of diagnosis. To aid this, several scoring systems have been developed taking into account various symptoms, signs and some basic laboratory investigations. Many studies have been done worldwide to check the sensitivity and specificity of each of these clinical scoring systems in the diagnosis of acute appendicitis. Though the most famous one is the Alvarado scoring system, there is none universally accepted scoring system used for diagnosis so far.

**Methods:** 100 patients with RIF pain and who were suspected of acute appendicitis were evaluated for a period of 24 months. Evaluation was done with regards to RIPASA and Alvarado scoring in all these patients. All the results of both the scoring systems were reported and correlated with histopathological findings. Statistical test were applied to calculate the p value for the association between the variables of studied.

**Results:** There was definitive agreement that both the scoring systems are positively correlating with each other with respect to the diagnosis of the disease (p value 0.0001). The difference in diagnostic accuracy of 25% between the RIPASA score and Alvarado score was statistically significant (p<0.0001). On analysis with chi-square test, both scores are significant at level 1 (p=0.0001). But RIPASA score has higher sensitivity and diagnostic value when compared to Alvarado score.

**Conclusions:** The use of RIPASA scoring would help in decreasing the unwarranted patient admissions and also expensive radiological investigations.

**Keywords:** Acute appendicitis, Alvarado score, RIPASA score

## INTRODUCTION

The abdomen contains within it innumerable viscera and other anatomical components, the diseases of the abdomen gives rise to a lot of clinical curiosity. Acute appendicitis is one of the commonest causes for acute abdomen in any general surgical practice.[1] From the time that it was first described by Reginald Heber Fitz in 1886, it has remained a topic of serial research works for various factors ranging from its etiology, to its management options.[2] As quoted by Bailey and Love, "Notwithstanding advances in modern radiographic imaging and diagnostic laboratory investigations, the diagnosis of appendicitis remains essentially clinical, requiring a mixture of observation, clinical acumen, and surgical science".[3]

So much has been stressed about the various methods of diagnosis, only because the same is extremely important. Appendicitis, which if caught early and managed appropriately can be the most uneventful surgery, while the other end of the spectrum is also true, that when missed, appendicitis can turn into a disease with great morbidity and mortality.

Having understood that clinical evaluation provides the best and most accurate diagnostic modality for

appendicitis, many clinical scoring systems have been developed over the years.[4] This has aided the clinician to a large extent in coming to the right diagnosis and providing early management. What began as a single scoring system, evolved into many over the years, as people constantly made modifications to the existing scoring systems based on the local demographics or by adding more factors. This brought along the next problem, of finding the single best scoring system, or the scoring system with the maximum sensitivity and diagnostic accuracy. To date, the most commonly used scoring system worldwide is the Alvarado and the Modified Alvarado scoring systems (MASS).[4] Hence, these have almost been considered as the undocumented gold standard scoring system among clinicians worldwide. So much so that any new scoring system that has been developed is usually first compared to this.

Raja Isteri Pengiran Anak Saleha appendicitis (RIPASA) score is a simple qualitative scoring system based on 14 fixed clinical parameters. This score has been shown to have higher sensitivity and specificity than Alvarado score among local population. Even though it is developed for local community, it is suggested to be applicable to all regions with the exception of last parameter.

In the present study, RIPASA and Alvarado scoring systems are compared among the local population in the subcontinent of India, to find out which scoring system is more relevant and applicable, in order to aid early diagnosis of acute appendicitis.

## METHODS

Progressive observational study was conducted to compare the reliability of two scores in diagnosing appendicitis. Patients who presented to the General Surgery Department of a Tertiary Medical College Hospital for a period of 24 months from July 2017 to March 2019 with right iliac fossa (RIF) pain and who were suspected of acute appendicitis were considered for the study.

### Inclusion criteria

All patients between the ages of 12 years to 60 years admitted with complaints of RIF pain and clinical suspicion of acute appendicitis.

### Exclusion criteria

Patients who had non RIF pain and who had been admitted with other complaints previously were excluded from the study. Similarly, patients suspected to have Appendicular lump/mass, features of peritonitis, appendicular perforation, and abdominal tuberculosis, gynaecological and obstetrical problems previous were excluded from the study.

After satisfying the inclusion and exclusion criteria, 100 patients with clinical suspicion of acute appendicitis were enrolled in to the study forming the study population.

Evaluation was done with regards to RIPASA and ALVARADO scoring (Table 1) in all these patients. Both scoring systems were applied in all the patients. Statistical data were assessed and compared for both scoring systems. Post-operative specimen sent for histopathological examination.

**Table 1: RIPASA and Alvarado scoring systems.**

| RIPASA scoring system[5] | | Alvarado scoring system | |
|---|---|---|---|
| Patient's demographic | Score | Feature | Score |
| Female | 0.5 | Migratory pain | 1 |
| Male | 1.0 | Anorexia | 1 |
| Age <39.9 years | 1.0 | Nausea | 1 |
| Age> 40 years | 0.5 | Tenderness in RIF | 2 |
| Symptoms | | Rebound tenderness | 1 |
| RIF pain | 0.5 | Elevated temperature | 1 |
| Pain migration to RIF | 0.5 | Leucocytosis | 2 |
| Anorexia | 1.0 | Shift of WBC count to left | 1 |
| Nausea and vomiting | 1.0 | Total | 10 |
| 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 >37°C, <39°C | 1.0 | | |
| Investigations | | | |
| Raised WBC count | 1.0 | | |
| Negative urinalysis | 1.0 | | |
| Additional scores | | | |
| Foreign NRIC | 1.0 | | |
| Total | 14.5 | | |
| 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 | | Score <5- appendicitis unlikely 5-6- appendicitis possible 7-8- appendicitis likely >8- appendicitis highly likely | |

The decision to operate on the patient (versus conservative line of management) was based solely on

the clinical suspicion of an experienced surgeon who was not part of/involved in the study.

The diagnosis of acute appendicitis was confirmed by operative findings and histopathological assessment of the appendicectomy specimen with the ultimate criterion for the final diagnosis of acute appendicitis being the histological demonstration of polymorphonuclear leukocytes throughout the thickness of the appendix wall.

Those patients who were treated conservatively and subsequently discharged were reviewed in the surgical out-patient within a week. Histopathology reports are collected and attached to the file. At the time of discharge, these documents were removed from the case sheet and analysis done. Each score was correlated with intra operative finding and histopathology finding separately. Results for both scores were compared with each other.

Standard software like SPSS was used for statistical analysis. A total value above 7.5 was considered to be a positive RIPASA with High probability of Acute Appendicitis. A score above 7 was considered to be a positive Alvarado and a high probability of acute appendicitis. All the results of both the scoring systems were reported and correlated with histopathological findings. Chi square test was applied to calculate the p value for the association between the variables of studied

## RESULTS

96% belonged to the age group below 40 years, and 4% above. Gender differentiation was 71% male and 29% female. 82% presented within 48 hours of onset of symptoms and 18% after 48 hours. 100% of the patients had RIF pain, as was the inclusion criteria of the study. 100% of them had RIF tenderness, 93% had a negative urinalysis, 49% had fever and 76% had a raised TC. 89% of the patients had nausea or vomiting. 89% patients had migratory pain and 84% had anorexia   and about 87% had rebound tenderness.

As planned, RIPASA and Alvarado scoring system was applied to all the 100 patients who presented with RIF pain.

### *Analysis of RIPASA scoring system*

Considering the optimal cut-off threshold score of 7.5 for the RIPASA score the patients were categorized under 2 categories. 92% of the patients had score of >7.5 and were categorized as positive, 8% with a score of <7.5 were categorized as negative (Figure 1).

Out of 95 cases of histopathologically confirmed appendicitis, RIPASA score Identified 90 cases. On the other hand, when RIPASA score suggested unlikely to be appendicitis in 8 cases, histopathology turned out to be negative in 3 cases (Figure 2).
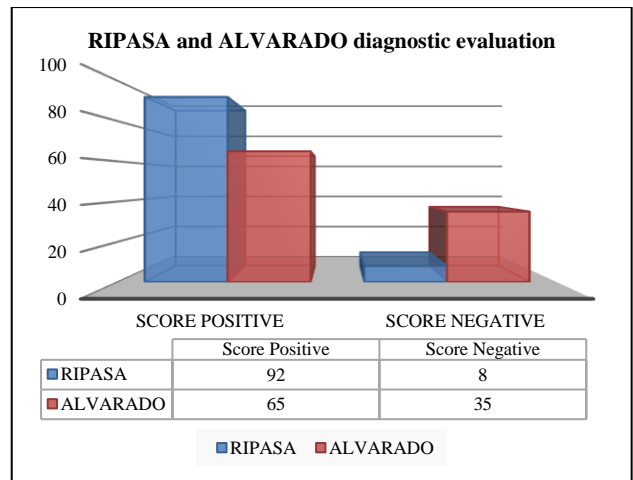


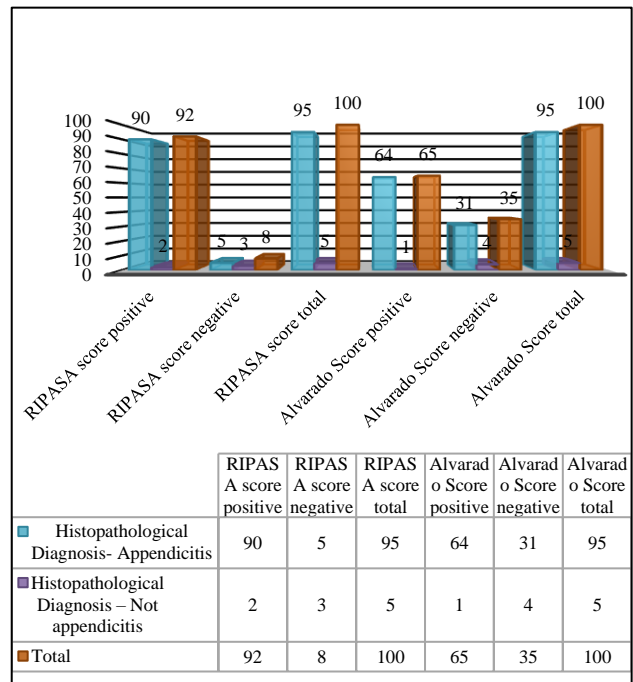**Figure 1: Clinical diagnostic evaluation of RIPASA and Alvarado scores.**



**Figure 2: Diagnostic evaluation of RIPASA with final diagnosis on histopathology.**

Fischer's exact test has been applied over Table 2 and Ripasa scoring system diagnosis correlates well with histopathological diagnosis (p value was <0.0031) (Table 2).

**Table 2: Qualitative analysis of both the scoring system.**

| Alvarado score | RIPASA score | | Total |
| --- | --- | --- | --- |
| | **Positive >7.5** | **Negative <7.5** | |
| **Positive ±7** | 65 | 0 | 65 |
| **Negative <7** | 27 | 08 | 35 |
| **Total** | 92 | 08 | 100 |

*Interpretation:* In this study, sensitivity was 94.73% and specificity was 60% with 95%. Positive predictive value (PPV) showed an estimate 97.82% and negative predictive value was 37.4%. Diagnostic accuracy of RIPASA is also high (93%).

### Analysis of ALVARADO scoring system

Alvarado score when applied to all the patients in the study group had 65 patients in the >7 group and 35 patients in <7 group (Figure 1).

Out of 95 cases of histopathologically confirmed appendicitis, Alvarado score identified only 64 cases, whereas Alvarado score suggested unlikely to be appendicitis in 35 cases, histopathology turned out to be negative in only in 5 cases (Figure 2).

Fischer's exact test has been applied over Table 2 and Alvarado scoring system diagnosis correlates well with histopathological diagnosis (p value was <0.0494) (Table 2).

*Interpretation:* In this study, Sensitivity was 63.36% and specificity was 80%. Positive predictive value (PPV) showed an estimate 98.45% and negative predictive value was 11.42%. Diagnostic accuracy of Alvarado score was 71.11%

On analyzing the cross table no.3 by Fisher's exact test, there is definitive agreement that both the scoring systems are positively correlating with each other with respect to the diagnosis of the disease (p value 0.0001) (Table 3).

**Table 3: Comparison between RIPASA and Alvarado scoring system.**

| Parameter | RIPASA | Alvarado |
|---|---|---|
| Sensitivity | 94.73% | 67.36% |
| Specificity | 60% | 80% |
| Positive predictive value | 97.82% | 98.45% |
| Negative predictive value | 37.4% | 11.42% |
| Diagnostic accuracy | 93% | 68% |

### DISCUSSION

Clinical prediction rules (CPR) are defined as decision-making tools, which include 3 or more variables obtained from the history, physical examination or basic diagnostic tests in order to assist the clinician in decision making.[5] In recent times, as there is a quest to improve diagnostic accuracy, there has been an increase in the use of CPRs. These use specific criteria in order to establish probabilities of outcomes or to aid in assisting management decisions.

The basis of all medical diagnoses and decisions depend upon the ability of a clinician to assess the potential risk and benefit, along with sound clinical knowledge. This helps in making wise, educated decisions, which is the cornerstone of good medical practice. Practice variation can result in patient outcome differences, but standardization of practice based on the best evidence can result in improved care. Numerous studies have demonstrated the efficacy of evidence based clinical algorithms (EBCA) such as pathways and protocols in reducing delays in time-sensitive medication administration, deciding on surgery, and reducing mortality.[6] Integrating CSSs into EBCA is key to standardizing patient care and this will help in global and individual health outcomes.

### ALVARADO scoring and modified ALVARADO scoring systems (MASS)

In 1986, Alvarado published what is now one of the most well-known and studied appendicitis scores.[7] A retrospective study was done on 305 patients admitted for suspected appendicitis. Clinical and laboratory findings were compared in relation to pathologically proven acute appendicitis. An Alvarado score of ≥7 was considered high risk for appendicitis. It was found to have a sensitivity of 81% and a specificity of 74%. Since then, numerous studies have been done world across to check the Alvarado scoring in various populations.

### RIPASA scoring

A fairly newer scoring system developed in 2008, where a study was done in RIPAS Hospital, Brunei Darussalam, to find a more favorable scoring system than Alvarado and modified Alvarado as these were found to have poor sensitivity and specificity in Middle Eastern and Asian population.[8,9] A mixed population of 400 adults and children who had an appendectomy were retrospectively identified, the records of 312 were used to derive the score. Individual criteria were weighted (0.5, 1, 2) based on probabilities and a panel of staff surgeons. The resulting maximal RIPASA score was 16- a threshold of 7.5 proving a sensitivity of 88% and specificity of 67%. PPV and NPV were 93% and 53%, while accuracy was 81%. Using the score, an absolute reduction in negative appendectomies of 9% would have occurred.[8,9]

Chong et al continued to evaluate their new score by prospectively enrolling 200 adults and children in a comparison of the RIPASA and Alvarado scores.[10] In this group of patients, the RIPASA was statistically superior to the Alvarado score in sensitivity (98% versus 68%), NPV (97% versus 71%) and accuracy (92% versus 87%). Specificity, PPV and negative appendectomy rates were similar between the 2 scores.

Out of 95 cases of histopathologically confirmed appendicitis, RIPASA score identified 90 cases. On the other hand, when RIPASA score suggested unlikely to be appendicitis in 8 cases, histopathology turned out to be negative in 3 cases. Thus it has detected appendicitis in

97.83% of cases and only minimum number of cases have been missed.

Out of 95 cases of histopathologically confirmed appendicitis, Alvarado score identified only 64 cases, whereas Alvarado score suggested unlikely to be appendicitis in 35 cases, histopathology turned out to be negative in only 5 cases. Thus more number of cases have been missed by using this scoring system. In our study the RIPASA score was found to be more sensitive

(94.73%) as compared to Alvarado score (67.36%), while Alvarado score was more specific (80%) as compared to RIPASA score. The negative predictive value of RIPASA score was 37.4% as compared to Alvarado score (11.42%). Accuracy of RIPASA score was 93% as compared to Alvarado score which was 68%. This findings are also supported by many studies as Chong et al, in RIPAS hospital, Brunei between November 2008 to June 2009 and others as shown in Table 4.[10,11]

**Table 4: Comparison of ALVARADO and RIPASA score by other studies and our study.**

| | Parameter | Chong et al[10] | Alnjadet et al | Erdem et al | Reyes et al | Present study |
|---|---|---|---|---|---|---|
| **RIPASA score** | Sensitivity | 98% | 93.2 | 100 | 91.2 | 94.73% |
| | Specificity | 61.3% | 61.8% | 28% | 84.6 | 60% |
| | PPV | 85.3% | 92.2% | 75% | 96.3 | 97.82% |
| | NPV | 97.4% | 34.9% | 100% | 38.8 | 37.4% |
| | Diagnostic accuracy | 91.8% | 91.5% | 77% | 93% | 93% |
| **Alvarado score** | Sensitivity | 68.3% | 73.7 | 82 | 89.5 | 67.36% |
| | Specificity | 87.9% | 68.6 | 75 | 69.2 | 80% |
| | PPV | 86.3% | 92 | 88 | 92.7 | 98.45% |
| | NPV | 71.4% | 34.8 | 66 | 60 | 11.42% |
| | Accuracy | 86.5% | 74.3 | 80 | 89 | 68% |

When the RIPASA score was applied, 90.0% of patients who actually had acute appendicitis were correctly diagnosed and placed in the high-probability group (RIPASA score >7.5) and managed appropriately, compared to only 64% when using the Alvarado score on the same population sample. Thus, the Alvarado score failed to diagnose 26% of patients (n=26) with acute appendicitis and wrongly classified them in the low-probability group (Alvarado score <7.0).

The difference in diagnostic accuracy of 25% between the RIPASA score and Alvarado score was statistically significant (p<0.0001), indicating that the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis in our patient population.

On analysis with chi-square test, both scores are significant at level 1 (p=0.0001). But RIPASA score has higher sensitivity and diagnostic value when compared to Alvarado score (Table 3).

## CONCLUSION

Sensitivity of both RIPASA and ASS are comparable, but there seems to be a definite upgrade in specificity and diagnostic accuracy in RIPASA scoring over Alvarado scoring system. With its high sensitivity (94.73%) and diagnostic accuracy (93%), the RIPASA score can also help to reduce unnecessary and expensive radiological investigations such as routine CT imaging. There is significant reduction in the number of negative

appendectomies predicted, which will lead to less morbidity to the patient and also help in reducing unnecessary expenditure of health resources.

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