

A Study on Ripasa Scoring System in Predicting Acute Appendicitis

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Abstract: Background: Acute appendicitis is the most common condition encountered in general surgical practice. Alvarado and Modified Alvarado scores (MASS) are the commonly used scoring systems for its diagnosis, but its performance has been found to be poor in certain populations. Hence, we compared the RIPASA score with MASS, to find out which is a better diagnostic tool for acute appendicitis in the Indian population.

Materials and Methods: We enrolled 100 patients who presented with RIF pain in the study. Both RIPASA and MASS were applied to them, but management was carried out as per RIPASA score. Final diagnosis was confirmed either by CT scan, intra-operative finding, or post-operative HPE report. Final diagnosis was analysed against both RIPASA and MASS. Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic Accuracy was calculated for both RIPASA and MASS. **Results:** It was found that RIPASA was better than MASS in terms of Specificity (94% v/s 86%) and Positive Predictive Value (90% v/s 78%), and also to some extent in terms of Diagnostic Accuracy (73% v/s 68%). Whereas the Sensitivity (52% vs 51%) and Negative Predictive Value (66% v/s 63%) were almost similar in both.

Conclusion: RIPASA is a more specific and accurate scoring system in our local population, when compared to MASS. It reduces the number of missed appendicitis cases and also convincingly filters out the group of patients that would need a CT scan for diagnosis (score 5-7.5).

Keywords: Acute Appendicitis, Modified Alvarado score, RIPASA score.

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I. Introduction

Appendicular inflammation is most frequently seen surgical emergency in clinical scenario, which when encountered, requires best skill and care besides a good clinical assessment¹. Estimated life-time prevalence of acute appendicular inflammation is approx. 1 in 7². Approximate incidence is about 1.5-1.9/1000 population. Appendicular inflammation is seen about 1.4 times more commonly occurring in males with respect to females. Women of procreative age group as result of Genito-urinary and Gynecological conditions which also present with clinical sign and symptoms of acute appendicitis³. Numerous scoring systems have been developed to help the surgeon for diagnosing acute appendicular inflammation in faster and a cost-effective way. Out of which "Modified Alvarado Scoring System" was the commonest scoring system used. Sensitivity and Specificity of MASS varies from 53%-88% and 75%-80% respectively⁴. This scoring system has been considered as an undocumented gold standard scoring system among all clinicians worldwide. But this scoring system has been developed for western population and also various studies conducted has reported lower sensitivity and specificity rate, which when tried to people of discrete Ethnological origin.

The Raja Isteri Pengiran Anak Saleha Appendicitis scoring system⁵ (RIPASA) is a new scoring system developed in 2008 at RIPAS hospital⁵, Brunnei, Darussalam for diagnosing acute appendicular inflammation for Southeast Asian population. It is straightforward quality measuring scoring system based on Fourteen clinical parameters i.e. Two demographic, 5 clinical-related symptoms, 5 clinical-observed signs, 2 investigations with an additional foreign national identity card. This score was shown to have a higher sensitivity value and specificity value than the Alvarado scoring system of local population. Even though, it is developed for local population, it has been applicable for all regions with exception of the last parameter.

In the present study, RIPASA & MASS scoring systems are compared among the local population to find out which scoring system is more relevant and applicable to aid in early diagnosis of Acute Appendicitis.

II. Materials And Methods

Study type: Cross-sectional Prospective Study

Study subjects: Patients presenting to outpatient department of General Surgery & Emergency dept. in SRM hospital

Study period: 18 months (February 2018-August 2019).

Sampling Type: Systematic Sampling.

Study Tool: Pre-tested semi structured questionnaire.

Sample size: 100 patients satisfying the inclusion criteria

Calculated according to the formula:

$$n = \frac{1.96^2 \times \sigma^2}{E^2}$$

1.96 is taken at 95% confidence, Standard Deviation being 20; margin of error is taken as 4.

$$n = \frac{1.96^2 \times 20^2}{4^2}$$

$$n = 96$$

INCLUSION CRITERIA

Patients of Age group b/w 15-50yrs of both sexes presenting with RIF pain TO SRM hospital General Surgery OPD or the Emergency Medicine Department.

EXCLUSION CRITERIA

1. Those Patients complaining with non-RIF pain
2. Age <15 and >50years
3. Patients admitted for some-other complaints and later on developing RIF pain during hospital stay
4. Pregnancy
5. K/C/O Tuberculosis
6. Critically-ill patients
7. H/o Trauma
8. Proven malignancy
9. Patients who are absconded before full evaluation

Methodology: All the patients presenting to the Emergency and General Surgery Department of SRM College Hospital and Research Centre with clinical suspicion of acute appendicular inflammation during the above mentioned study period, screening will be done. The investigator applies the above mentioned inclusion and exclusion criteria's. Those patients matching the criteria will be requested for taking part in the study. Those patients whose consent has been obtained will be recruited as study subjects. After admission, RIPASA and MASS scoring will be done according to the scoring sheets as mentioned below. In both above groups after obtaining final scores, patients were categorized under 4 groups.

CATEGORY	RIPASA Score	MASS Score
D (Definite)	>12	>8
HP (High Probability)	7.5-12	6-7
LP (Low Probability)	5-7.5	5-6
U (Unlikely)	<5	<5

After categorizing, the treatment plan of the patient was done with respect to RIPASA scores.

Patient's under HP/D category are taken up for surgery immediately.

Patient's under LP category are subjected to CT abdomen for aiding the diagnosis.

Patient's under U category are worked upon other associated conditions of abdominal pain excluding appendicitis with the help of imaging modalities and relevant laboratory investigations.

Scoring of the patients will be done for each review of the admitted patient until a decision has been made whether to proceed with appendectomy procedure or to continue with conservative medical management.

At the time of the discharge of the patient, the scoring sheets are removed from the patient file. The admission date, date of discharge, date of surgery, Any Imaging study reports, Post-operative events (complications) will be made a record in the scoring sheets.

Histopathological reports of the appendix specimen which was sent at the time of surgery will be collected and recorded in the scoring sheet.

None of the above mentioned two scoring systems plays a role in the management or to plan a protocol for management.

The diagnostic condition of the patient, further plan of treatment- both will be decided by the duty surgeon depending on his skills.

Atlast, above obtained scores will eventually be compared with the Clinical examination findings, Intra-operative findings and also Histo-pathological findings.

Medically managed patients are discharged and follow-up was done in the OPD, while the patients who underwent surgery, the final impression is confirmed by the intra-operative findings and Histopathological report. After final diagnostic confirmation either from CT abdomen report or Intra-abdominal operative findings, Histo-pathological report- Analysis is done made by comparing RIPASA and MASS scores.

Statistical analysis: Validity of RIPASA score as a diagnostic test for appendicitis was established by calculating its sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), Diagnostic accuracy along with 95% confidence interval (CI), using operative diagnosis confirmed by histopathology as gold standard.

III. Result

In the present study, patients of age-group 15-50years is included with mean age being 30years with standard deviation being 9.386. The maximum number of patients belonged to second and third decade. 36% of the patients belonged to 15-25years age group. 30% patients belonged to 26-35years age group. 27% patients belonged to 36-45years age group. 7% patients belonged to >45years age group.

		Age Group			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15 – 25 Years	36	36.0	36.0	36.0
	26 – 35 Years	30	30.0	30.0	66.0
	36 – 45 Years	27	27.0	27.0	93.0
	> 45 Years	7	7.0	7.0	100.0
Total		100	100.0	100.0	

Table 1: Showing Age-wise distribution in the study

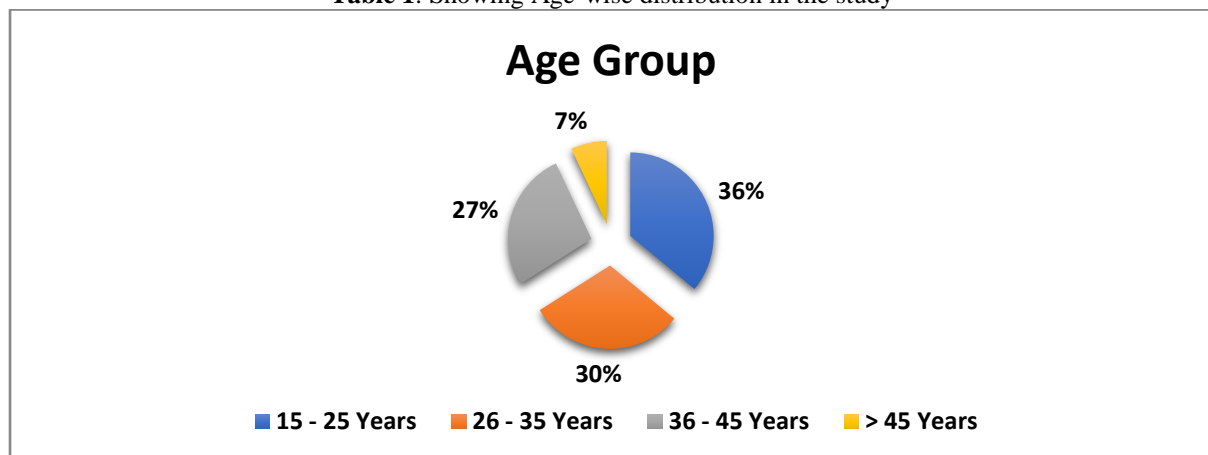


Figure 1: Age-wise distribution

Both sexes are affected with Male preponderance observed in the present study with 58% males and 42% females.

		Sex			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	58	58.0	58.0	58.0
	Female	42	42.0	42.0	100.0
Total		100	100.0	100.0	

Table 2: Gender-wise distribution

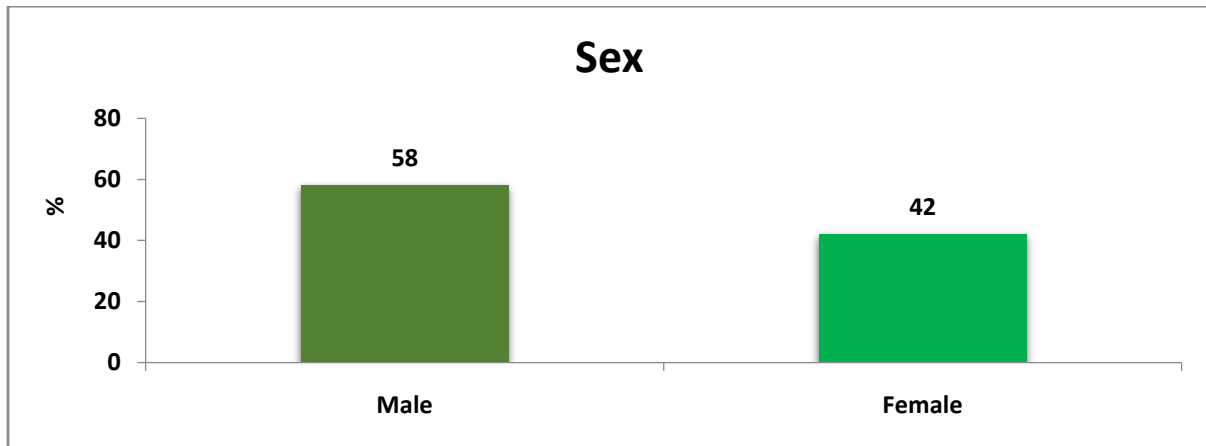


Figure 2: Gender-wise distribution

According to the above mentioned methodology, RIPASA and MASS scoring was applied and done to all the 100 patients.

Analysis of RIPASA scoring system:

78% of patients belonged to <40years age-group and 22% are above.

Differentiation in gender was done- 58% are male and 42% are females.

100% patients in the study have RIF pain, which was a parameter as the included in the criteria, 33% of the patients presented within 48hours of onset of symptoms, 67% of the patients presented after 48hours of the onset of symptoms, 29% of the patients had migratory pain, 28% of the patients had Anorexia, 61% of the patients had Nausea/vomiting, RIF tenderness is seen in 80% of the patients, 48% of the patients had negative urine analysis,47% of the patients had a raised total leukocyte counts.

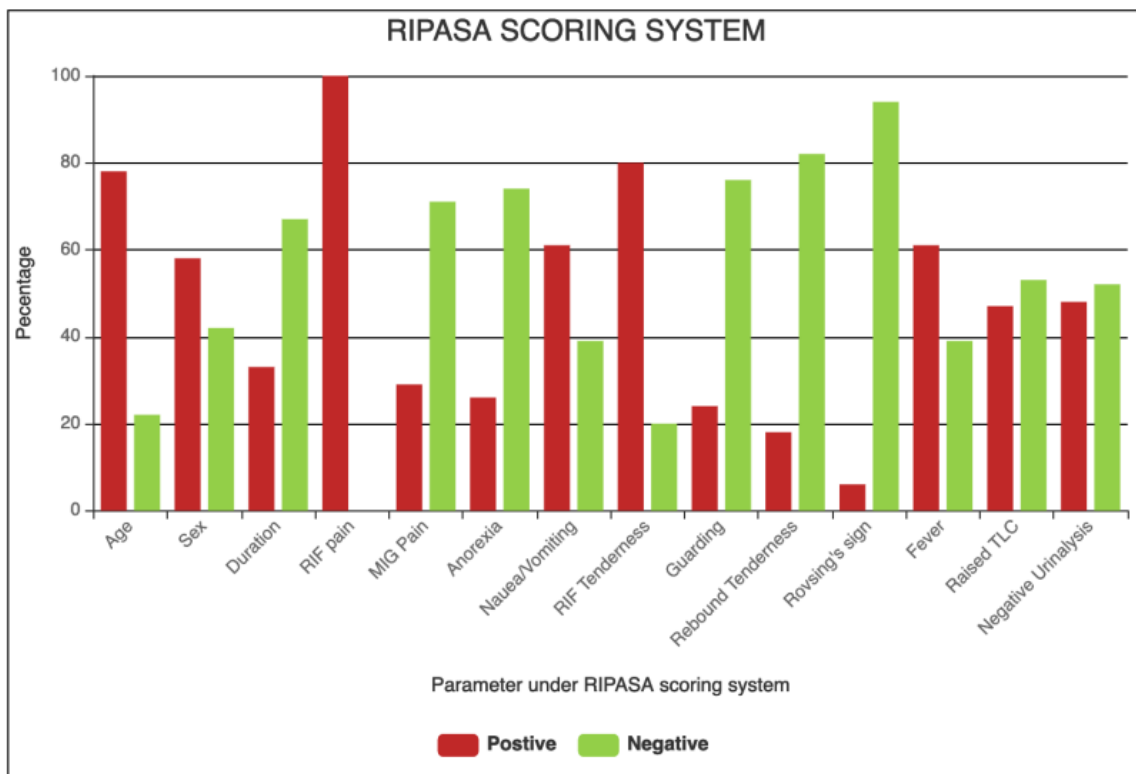


Fig-3: Parameters of RIPASA scoring system in the present study

Final Scoring in RIPASA:

Finally, after summarizing the score, patients are categorized into 4 categories as mentioned above. 5% of the patients has a score of more than 12- Definite (D) category. 25% patients has a score of 7.5-12- High Probability category. 39% patients had a score of 5-7.5- Low probability category. 36% patients had a score of <5- Unlikely category.

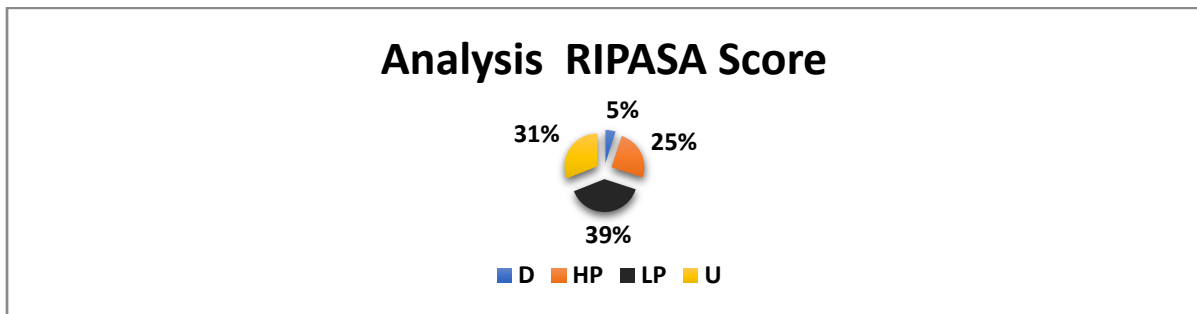


Fig-4: Categories after final scoring in RIPASA.
D-Definite, HP-High Probability, LP-Low probability, U-unlikely

Analysis of MASS:

30% of the patients had Migratory pain, Anorexia is seen in 24% patients, Nausea/Vomiting is seen in 54% patients, RIF tenderness is seen in 80% patients, Rebound tenderness is seen in 16% patients, Fever is seen in 65% patients, Raised TLC is seen in 49% patients.

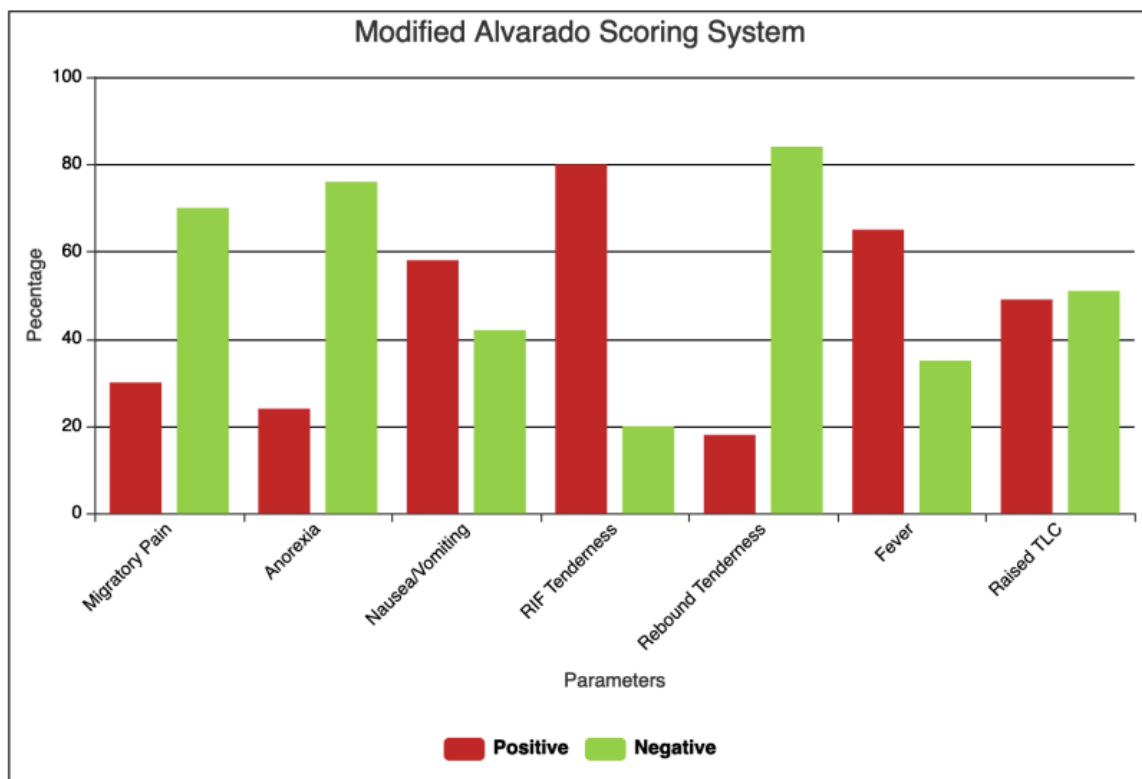


Fig-5: Parameters Of MASS in the present study

Final Scoring in MASS:

On summarizing the final score, patients were classified into 4-categories. 15% patients are with score >8- Definite (D) category, 16% patients with score 6-7- High Probability (HP), 20% of the patients with score 5-6- Low Probability (LP), 47% of the patients are having <5 score- Unlikely (U).

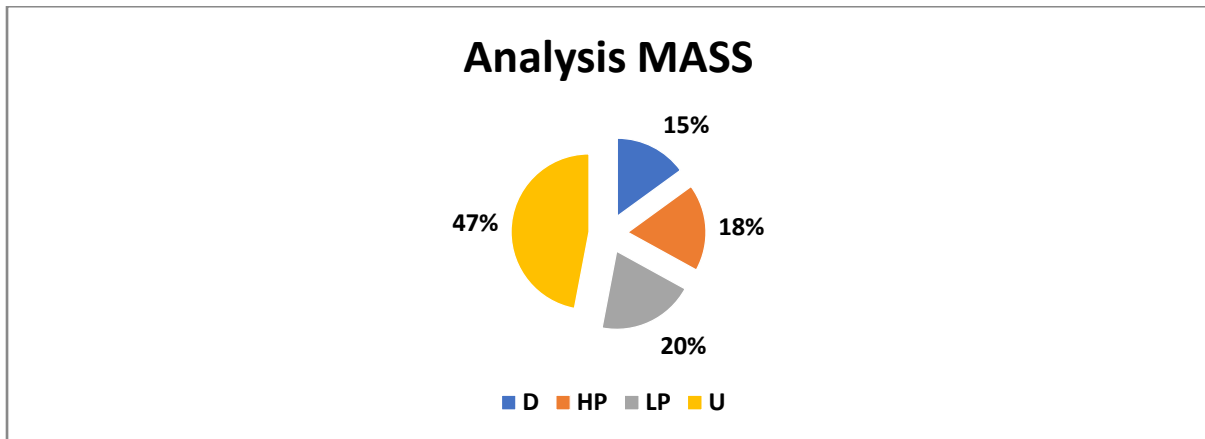


Fig-6: Categories in Final scoring of MASS
 D-Definite, HP- High Probability, LP- Low Probability, U- Unlikely

As mentioned above, plan of treatment is carried out as per RIPASA scoring. Patients who are under U category, underwent Usg abdomen scan and other relevant investigations for knowing the causes of abdominal pain, these category patients are managed conservatively with medical treatment or were referred to other departments for further management based on the underlying condition.

Patients under the LP category, underwent CT Abdomen as it has a higher sensitivity and specificity rates in finding out the appendicular inflammation. Findings in the CT abdomen among the LP category patients are: among the 39 patients under LP category, 61.5% are diagnosed with Acute Appendicitis (A) and 38.5% had other causes (Non-Appendiceal, NA) of abdominal pain.

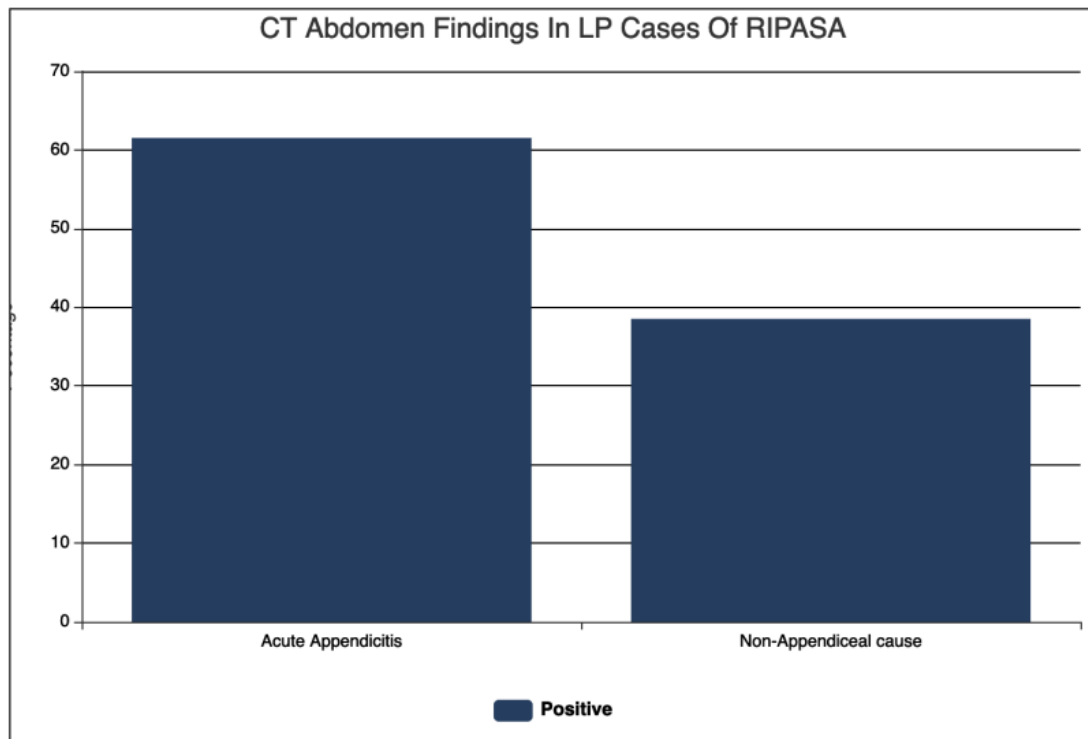


Fig-7: CT Abdomen results in LP category cases Of RIPASA Score

Among the 30 cases under HP/D category, 29 cases were operated with a diagnosis of appendicular inflammation. One case turned out to be a non-appendiceal cause, which is a Ruptured Right Ovarian cyst for which gynecologist referral was done.

Among 39 cases under LP category, CT abdomen was done for all cases. Out of all these cases, 24 cases are of acute appendicular inflammation but the remaining 15 cases are of non-appendix related causes. Out

of the 24 cases of acute appendicular inflammation, 17 cases underwent surgery and other cases were managed conservatively and were followed-up on OPD basis.

Among the 31 cases under U category, 7 cases were referred to other departments for further management, remaining all cases are non-appendiceal causes for abdominal pain and were treated conservatively, except for one case where right hemicolectomy was done for carcinoma caecum.

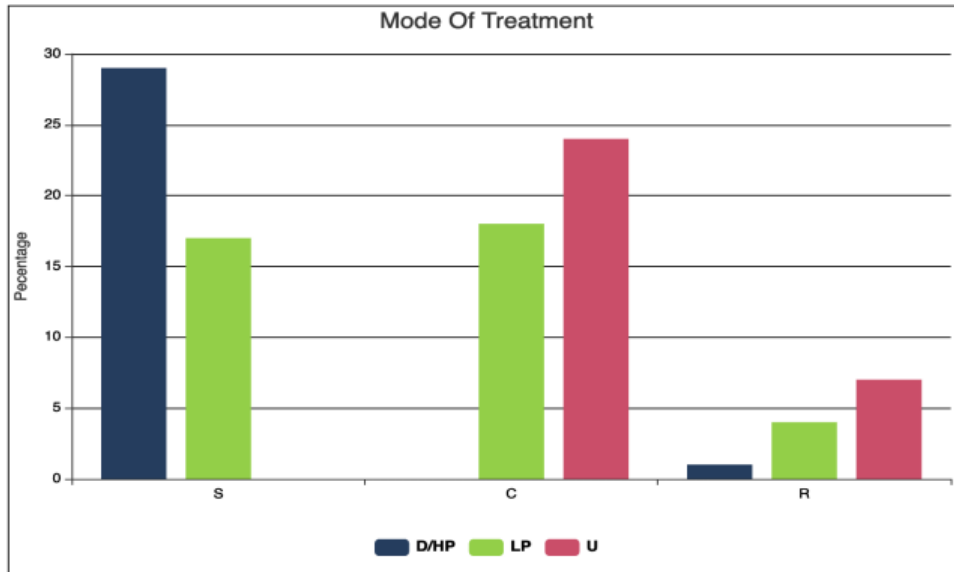


Fig-8: Final mode of management for the samples in the study
 D-Definite, HP-High Probability, LP-Low Probability, U-Unlikely
 S-Surgery, C-Conservative management, R-Referred to specialty dept.

Final diagnosis is confirmed by CT abdomen, Intra-operative findings and Post-operative Histopathological report. Out of the 113 sample patients, 100 under included in the study as the 13 patients were lost follow-up due to various reasons. Among these 100 patients, 51% patients had a final diagnosis of Acute Appendicular inflammation and the 49% patients are of non-appendiceal causes.

Final Diagnosis of the samples in the study

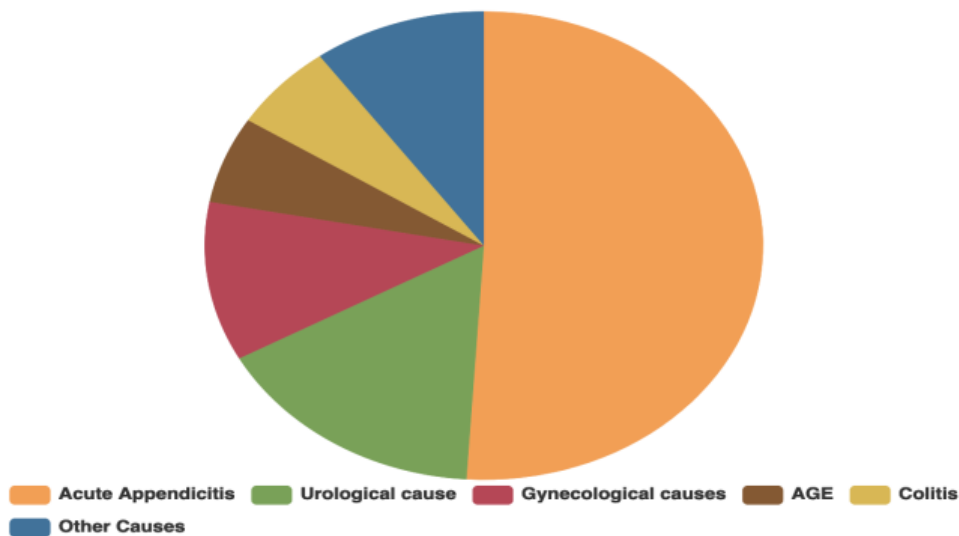


Fig-9: Proportion of Final Diagnosis of the sample in the present study
 Acute Appendicitis (51%), Urological causes (16%), Gynecological (11%), AGE (6%), Colitis (6%), Other causes (10%)

In retrospective comparison of the study between the final diagnosis of acute appendicular inflammation under the headings of HP/D, LP, U categories of RIPASA and MASS is depicted below:

RIPASAMASS

Category	A	NA	A	NA
D/HP	27	3	27	7
LP	24	15	15	5
U	0	31	10	37

Table 3: No. of cases under each category in RIPASA & MASS scoring systems

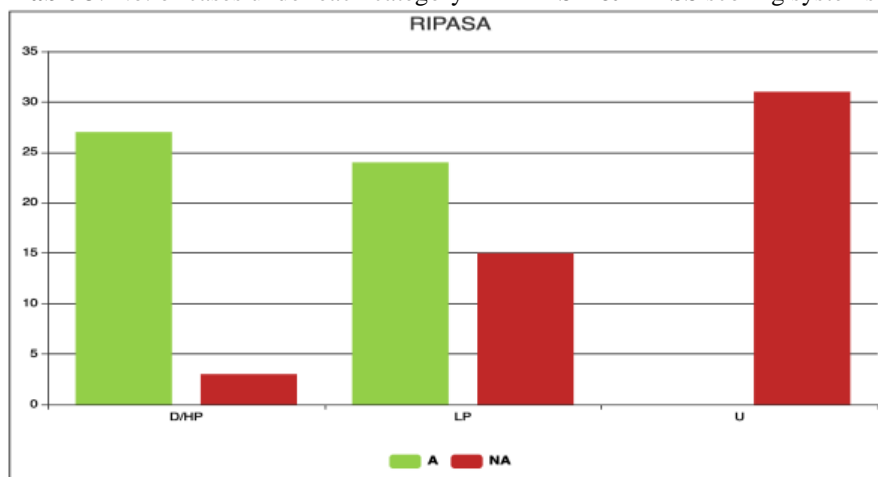


Fig-10: Cases under various categories under RIPASA

D/HP-Definitive/High Probability, LP- Low Probability, U- Unlikely

A- Appendicitis, NA- Non-Appendiceal cause

Statistical Analysis of RIPASA & MASS Scoring systems:

Parameter	RIPASA	MASS
Sensitivity	52.9%	50.98%
Specificity	93.8%	85.71%
Positive Predictive value	90%	78.78%
Negative Predictive value	65.71%	62.68%
Diagnostic Accuracy	73%	68%

Significance:

Sensitivity of both RIPASA & MASS are almost equal. There is a definitive upgrade seen in specificity and positive predictive value and also to a certain extent in the diagnostic accuracy in the RIPASA scoring system when compared to the MASS scoring system.

IV. Discussion

From the past few years of development of the concept of the systems of clinical scoring there were multiple studies done with respect to the high sensitivity, specificity, diagnostic accuracy in the scoring for aiding to the diagnosis of acute appendicular inflammation.

In 1986, “ALVARADO” scoring system is the well-known one and grossly studied score for acute appendicular inflammation. With its modification i.e. MASS which has gained popularity for its usage in the recent years. As it is the most popular and undocumented gold-standard system clinically used, this study is intended to compare it with the new clinical scoring system i.e. RIPASA in terms of Sensitivity, Specificity, PPV, NPV and Diagnostic accuracy.

This present study is on 100 patients (n=100), both RIPASA and MASS scoring systems are compared with the final diagnosis and scrutinized in relation to the CT Abdomen, Intra-operative findings, Post-op Histopathological reports. It was established that, both RIPASA and MASS have almost equal values with respect to sensitivity (52.9% & 50.9%, respectively). Specificity was more in RIPASA (93.8%) when compared to MASS (85.71%). The PPV of RIPASA (90%) is also more than MASS (78.78%). The NPV of RIPASA (65.71%) is also high when compared to MASS (62.68%). The Diagnostic accuracy was also slightly more in RIPASA (73%) when compared to MASS (68%).

On Analysis of both RIPASA and MASS, it was established that both the clinical scoring systems are easier to perform as they are mainly dependent on clinically related signs and symptoms along with simple blood investigations. As RIPASA scoring system has more number of parameters (14) in comparison to MASS, as per personalized level it felt as it collaborated the patient clinical scenario in a better manner. The time taken for the applications of both scoring system sheets was shorter and no delay was caused in the management of the subject patients.

Although, MASS is the routinely used clinical scoring system in the diagnosis of acute appendicular inflammation worldwide, it was found that it lacks sensitivity value and specificity value.

Hsiao et al⁶ had done a retrospective-study and found the sensitivity for Alvarado scoring of ≥ 7 score, is 60% and that for specificity was 61%⁶.

Bond et al⁷ has done a prospective study over 187 subjects suspected with acute appendicular inflammation and established the Alvarado score having a sensitivity & specificity of 90 & 72% respectively⁷.

Rezak et al⁸ had done a study retrospectively and concluded a higher sensitivity and specificity values being 92% & 82% respectively, this study also concluded, patients with scores more than 7, if treated directly by appendectomy without undergoing CT Abdomen, there is a reduction in 27% of CT abdominal scans⁷.

Owen et al⁹, studied prospectively by evaluating about 215 samples and concluded the sensitivity and specificity of the Alvarado score was 93% & 81%⁹ respectively.

Shreef et al¹⁰ in the recent times in 2010 had done a prospectively a dual centered study by reviewing about 350 subjects and concluded the sensitivity and specificity of the Alvarado score was 86% and 83%¹⁰ respectively.

Chong et al¹¹ after the development of the RIPASA scoring had continued to assess the new scoring system in a prospective manner by registering about 200 adult & children age group patients for the comparison of both the ALVARADO & RIPASA scoring systems. They concluded that RIPASA was statistical wise a higher-level when compared to Alvarado scoring system in sensitivity (98% & 68%), Negative predictive value (97% & 71%), Diagnostic Accuracy (92% & 87%) respectively. The Specificity and also the positive predictive value are almost equal in between the two scoring systems¹¹.

N.N. Mohammad et al¹² has done a comparison between RIPASA & Alvarado scoring systems, concluding RIPASA is a more suitable, precise scoring system. Sensitivity being 96% and 58%. Specificity being 90% & 85% respectively¹².

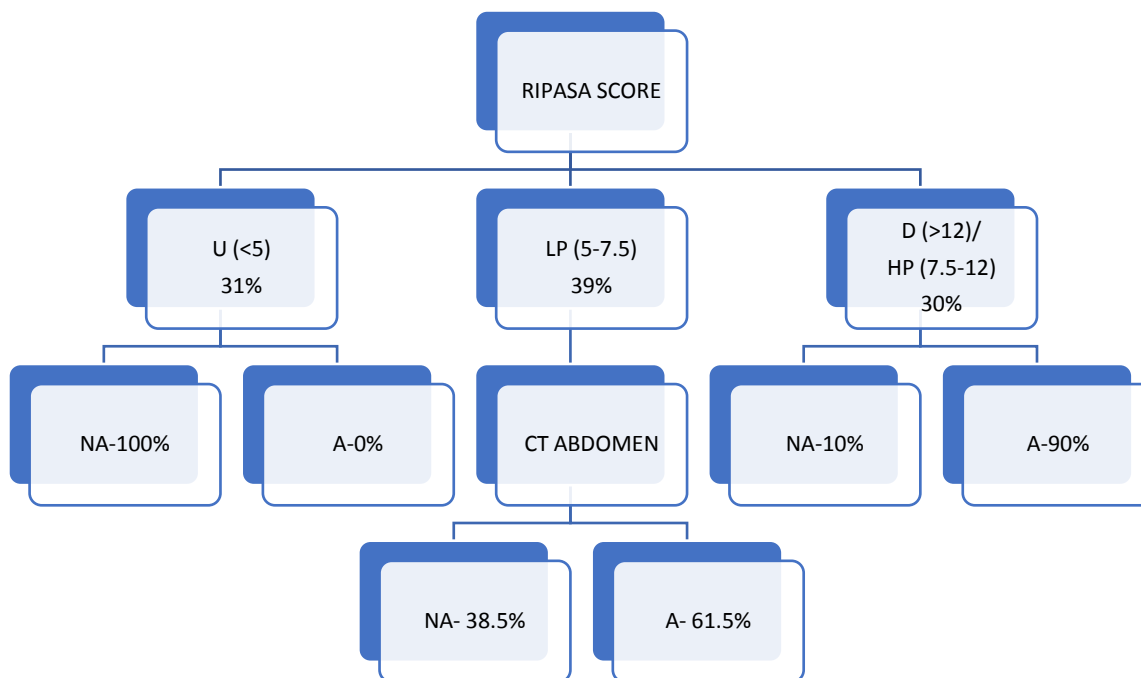
By remembering all the above mentioned components, this study had been analyzed by categorization. On retrospective analysis, the proved acute appendicitis patients having the scores, it was established that in D/HP categorization, RIPASA scoring had selected 90% of the cases as the high probable cases of acute appendicitis with respect to MASS which had only picked up 78% cases under this category. Hence, by using the RIPASA scoring all the cases coming under D/HP categorization can be planned for surgery confidently with no backup with imaging modality.

In the Low Probability category in RIPASA, CT abdomen scan is done for all the patients that fell under this category, 61.5% had acute appendicular inflammation when compared to 75% with MASS which points out that RIPASA scoring system will differentiate low probable cases superior to MASS scoring. From this, it is inferred that patients in the Low probable category (RIPASA score between 5-7.5) benefitted from a CT abdominal scanning.

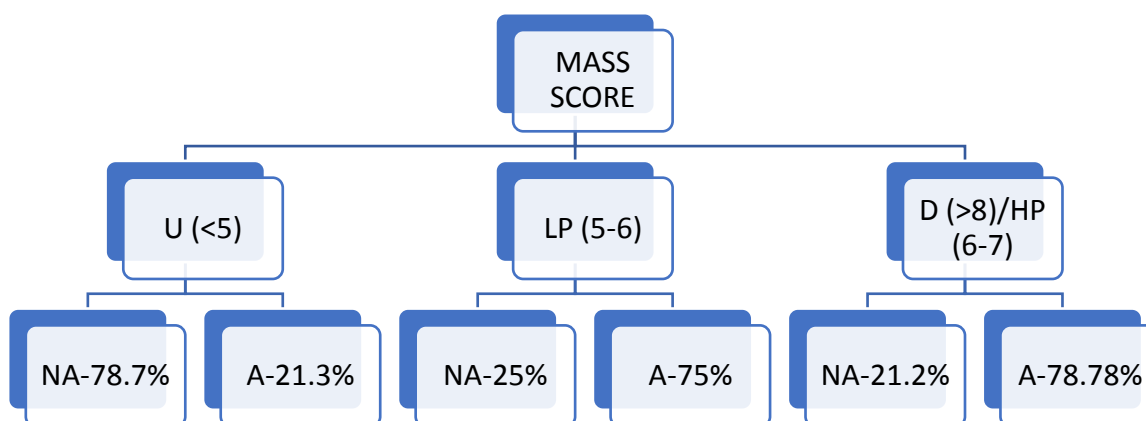
In the 'U'- Unlikely cause of acute appendicitis category, RIPASA scoring has given "0" acute appendicitis cases from the study. This means, RIPASA scoring had proved 100% cases under this category are unlikely of having appendicitis. When compared to MASS scoring system, it had 21% cases with acute appendicitis, with higher number of missed cases seen under this scoring system.

V. Summary Of The Study:

This study was done to find out a more reliable and suitable clinical scoring system for diagnosing the acute appendicular inflammation cases early. The study was conducted in the Department of General Surgery, SRM College Hospital & Research Centre for a period of 18months with total sample being 100. The first 100 patients among the ages 15-50years those presenting with chief complaint of Right Iliac Fossa pain are enrolled in the study after proper counselling. Mean age being 30 +/- 9.386 years. Slight Male predominance seen with both sexes being affected. RIPASA and MASS scoring was done for all the included patients and the further treatment was done based on the RIPASA scores. Results are mentioned below:



- Summary of the Results of MASS:



Atlast, it is found that RIPASA score was superior statistically with respect to MASS score in terms of the Specificity value (93.8% vs 85.71%), PPV being (90% vs 78.78%) with some extent to Diagnostic Accuracy (73% vs 68%). The Sensitivity and NPV of both RIPASA & MASS are almost similar statistically.

VI. Conclusion:

- Hereby concluding that in the present study, in diagnosing Acute Appendicitis the RIPASA scoring system is more superior and specific when compared to Modified Alvarado Scoring System, by having High Specificity & Positive Predictive value.
- In view of the clinician, this scoring system is giving a focused proceedings with the management of the patients when presenting with Right Iliac Fossa pain by proper categorization.
- Under the category of Definite (D)/High Probability (HP) category, the patient can be straightly taken up for surgical management without waiting for the need for imaging study.

- Under the category of Low Probability (LP), the patients would benefit from CT Abdomen scan.
- Under the Unlikely (U) category, patient is further worked-up for other non-appendicular causes.
- This RIPASA scoring system helps in reducing the number of “Missed-Appendicitis” cases.
- Thereby, winding-up by concluding that RIPASA scoring system is statistic-wise and clinical-wise a superior & a better clinical scoring system in diagnosing cases of Acute Appendicitis in comparison to MASS.

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