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A Comparative Study Of RIPASA And Modified Alvarado Scoring Systems For The Diagnosis Of Acute Appendicitis.

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ABSTRACT

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. We enrolled 180 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. It was found that RIPASA was better than MASS in terms of Specificity (96% v/s 89%) and Positive Predictive Value (93% v/s 80%), and also to some extent in terms of Diagnostic Accuracy (75% v/s 71%). Whereas the Sensitivity (49.4% in both) and Negative Predictive Value (69% v/s 67%) were similar in both. 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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INTRODUCTION

The abdomen is commonly compared to a Pandora's box, and for good reason. Since the abdomen contains within it innumerable viscera and other anatomical components, the diseases of the abdomen gives rise to a lot of clinical curiosity [1]. A meticulous examination of the abdomen and clinical correlation is one of the most important diagnostic tools and becomes cornerstone of management in many conditions presenting with abdominal pain. Despite the vast advances in the medical field in terms of imaging and other investigation modalities, the importance of clinical examination cannot be stressed upon enough [2]. Acute appendicitis is one of the commonest causes for acute abdomen in any general surgical practice. 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 aetiology, to its management options [3]. One of the most researched fields pertaining to appendicitis is the one involving diagnosis. Over the years various types of investigations including laboratory and radiological, have been studied in detail with the aid of trials [4]. These were conducted in the hope of finding the most sensitive test for diagnosing acute appendicitis. But in spite of the vast advances in the field of medicine, it has been time and again opined by various clinicians and author that appendicitis is one condition whose diagnosis relies mainly upon the clinical features [5]. As quoted by Bailey & 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. So much has been stressed about the various methods of diagnosis, only because the same is extremely important [6]. 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 [7]. Hence, having understood the importance for early and right diagnosis, and 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.[8] 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 [9]. This brought along the next problem, of finding the single best scoring system, or the scoring system with the maximum sensitivity and diagnostic accuracy [10]. As a result, multiple studies have been done with randomised controlled trials comparing various scoring systems in different parts of the world. To date, the most commonly used scoring system worldwide is the Alvarado and the Modified Alvarado scoring systems (MASS). In the present study, RIPASA and Modified Alvarado scoring systems (MASS) 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. Appendicitis is one of the routine conditions evoking emergency surgery worldwide as also in our hospital. The statistics of appendicitis in our hospital are as follows, and the sample size was calculated accordingly.

MATERIALS AND METHODS

This is a cross-sectional, comparative study conducted at Department Of General Surgery, Government Stanley Medical College & Hospital, Chennai, Tamil Nadu, India in the year 2020. The first 180 patients who presented to the Surgery OPD and Emergency Department with RIF pain were included in the study. Relevant history, examination and laboratory investigations done. Patients were scored according to both Modified Alvarado Scoring System (MASS) and RIPASA Scoring, and both were documented in the proforma. In both groups after final scoring, patients were categorized into 4 groups. Inclusion Criteria: All patients presenting with Right Iliac Fossa (RIF) pain. Exclusion Criteria: Critically ill patients, Pregnancy, K/c/o Tuberculosis, Age group <5 and >50 years.

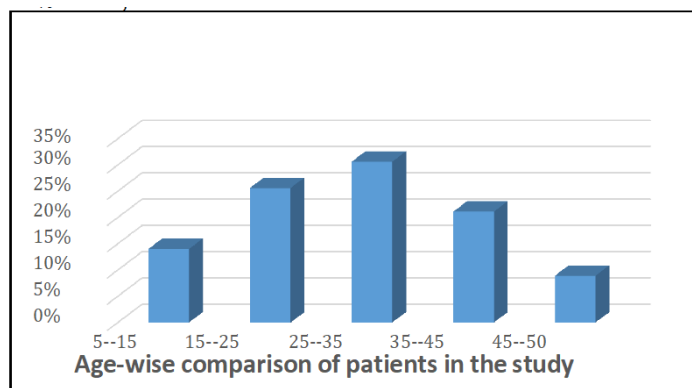
CATEGORY	RIPASA	MASS
D (Definite)	>12	>8
HP (High Probability)	7.5-12	6-7
LP (Low Probability)	5-7.5	5-6
U (Unlikely)	<5	<5

After this, the management of the patient was carried out according to the RIPASA Scoring system. Patients who fell under HP/D category, were taken up for surgery immediately. Patients who fell under LP category were subjected to CT scanning for diagnosis. Patients who fell under U category were worked up for other causes of pain abdomen, other than appendicitis, by means of imaging and other

appropriate laboratory studies. Conservatively managed patients were discharged and followed up in the OPD, while for the patients who were operated upon directly, diagnosis was confirmed by intraoperative findings and HPE report. With the final diagnosis confirmation got from either CT scan or Intra-operative finding, or Post-operative HPE report, an analysis was done comparing both RIPASA and MASS.

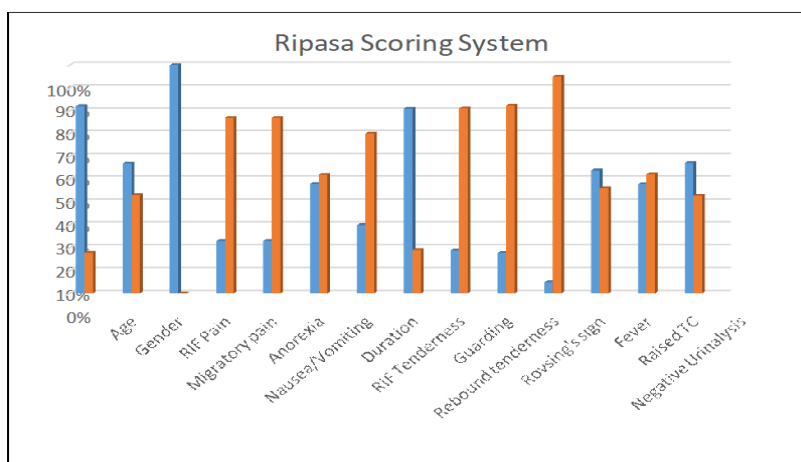
RESULTS

Graph 1: Age Group Distribution



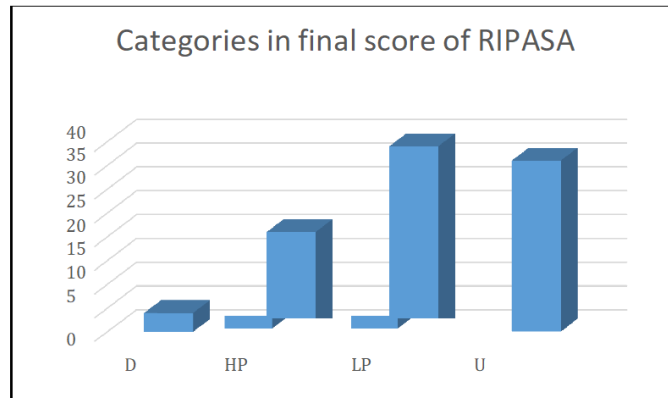
In the present study, patients of age group 5-50 years were included, with the mean age being 28+/- 11.6 years. The maximum number of patients belonged to the 2nd and 3rd decades .31% of the patients belonged to the 25-35 years age group, followed by 26% belonging to 15-25 years age group, while only 9% belonged to the age group above 45 years. Both sexes were affected with a slight male preponderance (57% males and 43% females).

Graph 2: Analysis Of RIPASA Scoring



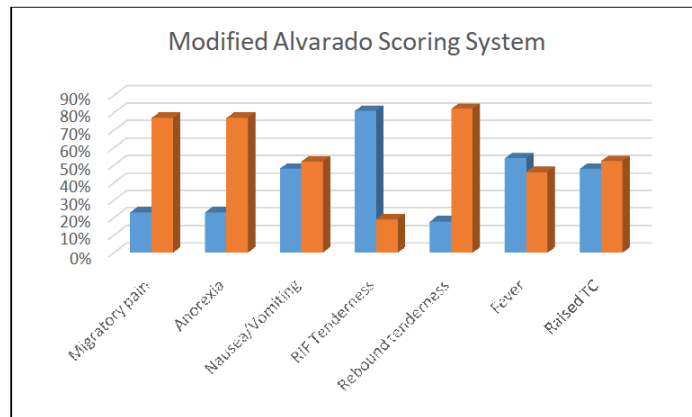
82% belonged to the age group below 40 years, and 18% above. Gender differentiation was 57% male and 43% female. 30% presented within 48 hours of onset of symptoms and 70% after. 100% of the patients had RIF pain, as was the inclusion criteria of the study. 81% of them had RIF tenderness, 57% had a negative urinalysis, 53% had fever and 47% had a raised TC. 48% of the patients had nausea or vomiting. Finally, out of the total score, the patients were categorized under 4 categories. 4% of the patients had a score of >12 and were categorized as D, 21% with a score of 7.5-12 fell under the category HP, 39% had a score of 5- and were categorized as LP and 36% with a score <5 was termed U.

Graph 3: categories in final score of RIPASA



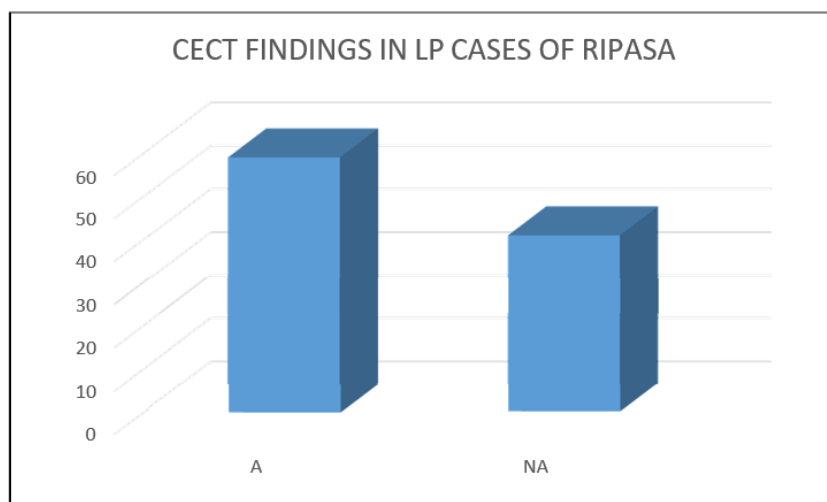
D- Definite, HP- High Probability, LP- Low Probability, U- Unlikely

Graph 4: Analysis Of Mass



81%,53%,47% and 48% had RIF tenderness, fever, raised TC and nausea/vomiting respectively. 23% patients had migratory pain and anorexia and about 17% had rebound tenderness. With the final score, patients were classified into 4 categories. 12% with score >8 fell under D,16% with 6-7 were under HP,19% with score 5-6 were under LP, and 53% with score <5 was under U.

Graph 5: CECT Findings In LP Of RIPASA



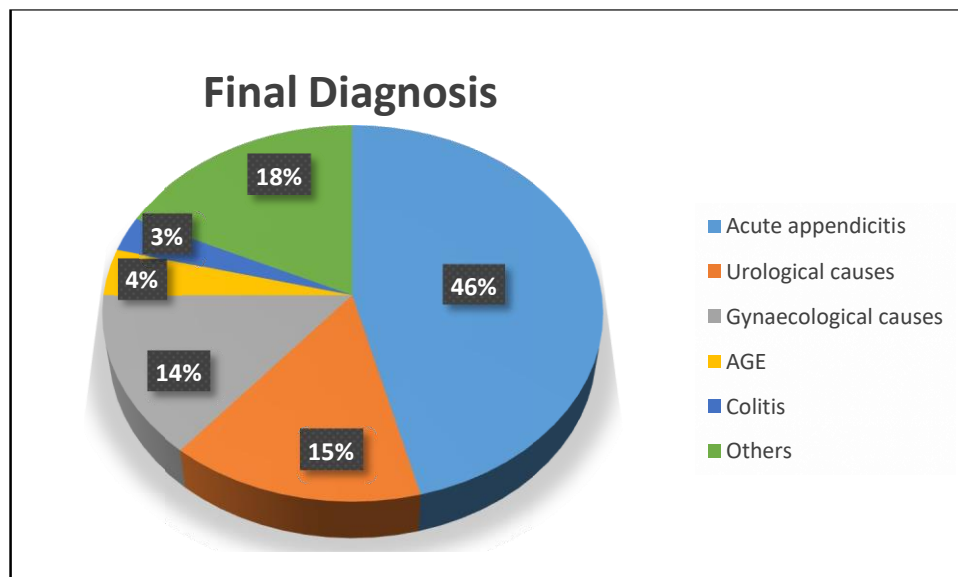
As decided in the protocol, plan of management was carried out as per RIPASA score. Patients with U were

subjected to USG scanning and other investigations to find out cause for pain abdomen and were either conservatively managed or referred to other specialist departments based on the diagnosis. Patients with LP were subjected to CECT Abdomen since it has a high sensitivity and specificity for diagnosis of appendicitis. The findings in the CT scan among the LP patients were as follows- Among the 71 patients who fell under LP category of RIPASA, 59% were diagnosed with appendicitis (A) and 41% had other non-appendiceal (NA) causes of pain abdomen.

The total number of cases that underwent surgery (S), conservative management (C) and referrals (R) according to their categories are as follows-

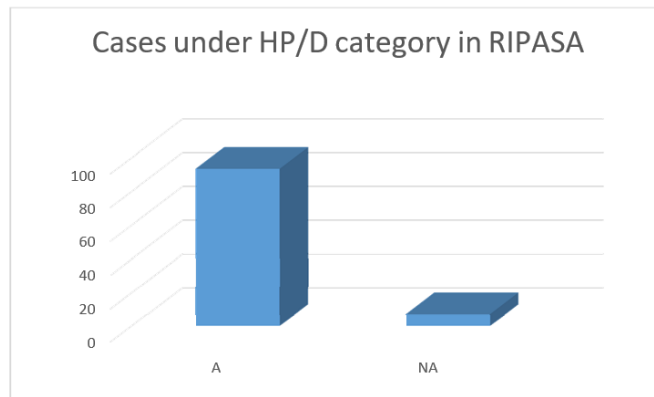
Among the 44 cases that fell under HP/D, 43 were operated upon with a diagnosis of appendicitis, among which 2 cases turned out to be non-appendiceal causes- one was omental torsion, for which omentectomy and appendicectomy was done (Case No.60), and the other was a case of Meckel's diverticulitis for which Resection Anastomosis and appendicectomy was done (Case No.165). 1 case had a polycystic ovary along with appendicitis, for which OBG consult was sought and was opined to manage conservatively for the PCOD and appendicectomy was carried out (Case No. 148). 1 case was intra-operatively found to be right ovarian torsion (appendix was normal), and right oophorectomy was carried out (Case No. 69). Among the 71 cases that fell under LP, CECT abdomen was done for all cases. 42 were diagnosed with appendicitis. Out of these 42 cases, 25 cases underwent appendicectomy. 5 cases diagnosed to have appendicular mass were initially managed conservatively according to Ochsner Sherren regimen and taken up for interval appendicectomy after 6 weeks (Cases No. 107, 128, 145, 170, 176). 17 cases with proven non-obstructive pathology on CECT, were chosen to be managed conservatively due to delayed presentation (>72 hours) and resolving symptoms. They were followed up on OPD basis regularly up to 6 weeks period, among which 14 cases did not have recurrence, 2 cases were lost to follow up and 1 case had a recurrence and underwent interval appendicectomy (Case No. 134). Final diagnosis was confirmed with CECT, intra-operative findings and post-operative histopathology report. Among the 180 cases in the study, 46% had a final diagnosis of appendicitis and the remaining 54% had varied causes of pain abdomen – urological, gastrointestinal, gynaecological, and non-specific.

Graph 6 Final Diagnosis

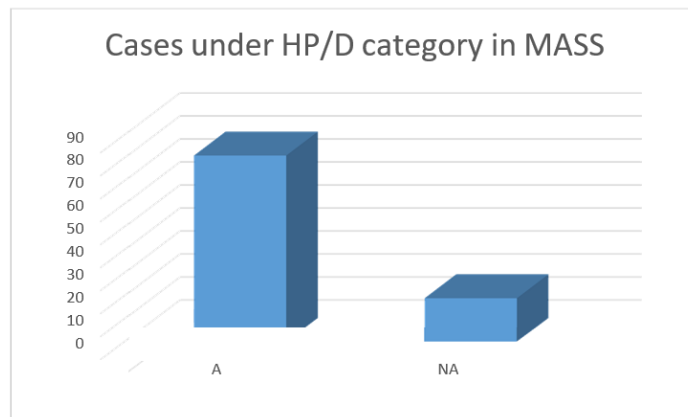


To further compare RIPASA and MASS, category-wise analysis was done among the 46% of finally diagnosed appendicitis cases. In retrospective comparison between final diagnosis of appendicitis and HP/D categories of RIPASA and MASS, it was seen that 93% of HP/D among RIPASA were appendicitis whereas only 81% of HP/D categories under MASS were appendicitis.

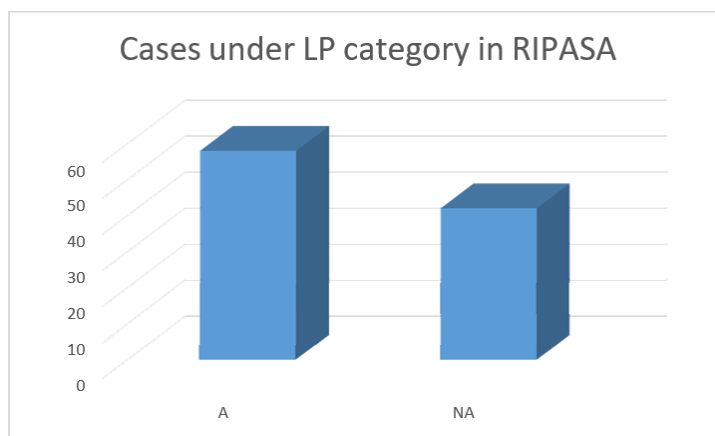
Graph 7: Cases Under HP/D Category In RIPASA



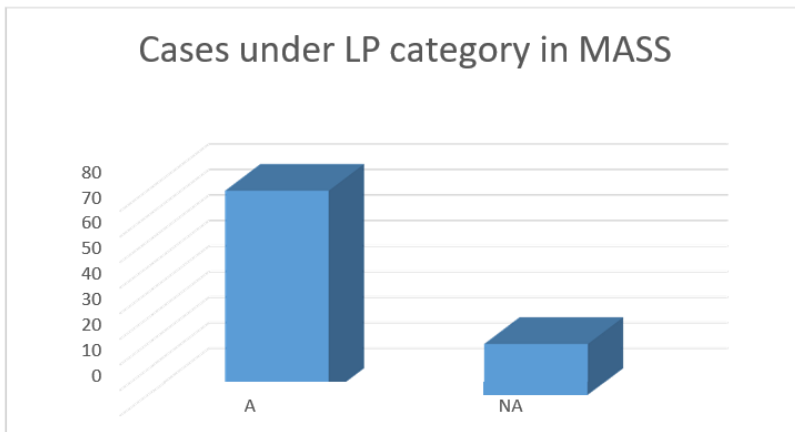
Graph 8: Cases Under HP/D Category In MASS



Graph 9: Cases Under LP Category In RIPASA

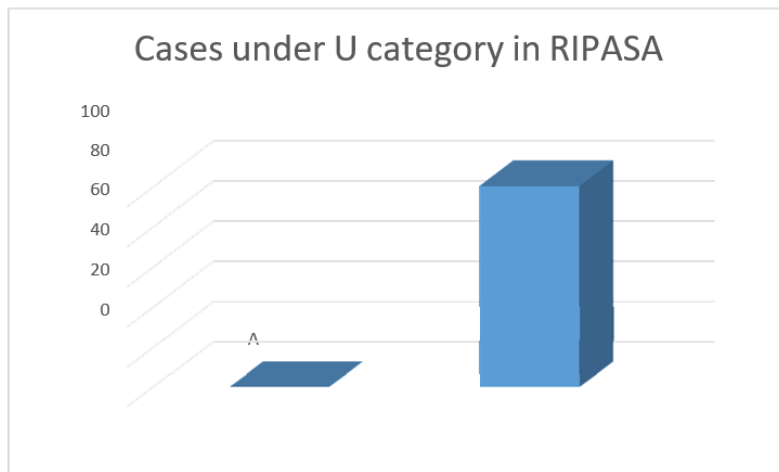


Graph 10: Cases Under LP Category In MASS

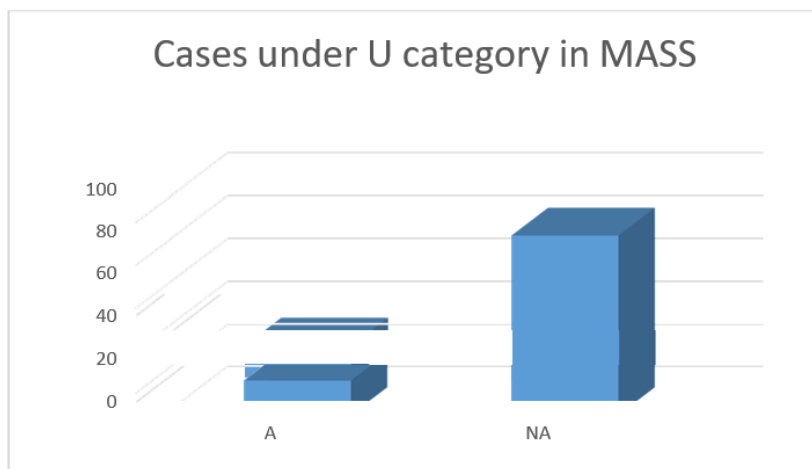


Cases under LP category in MASSA-Appendicitis, NA-Non-Appendiceal cause

Graph 11: Cases Under U Category In RIPASA



Graph 12: Cases under U category in MASS



RIPASA Scoring System

Table 1. Diagnostic evaluation of RIPASA with Final diagnosis

RIPASA	Final Diagnosis- A	Final Diagnosis - NA	Total
Score Positive	41	3	44
Score Negative	42	94	136
Total	83	97	180

Final Diagnosis- A: Appendicitis as confirmed by CECT/Intraop findings/Postop HPE report

Final Diagnosis- NA: Non-Appendiceal cause as confirmed by CECT/Intraop findings/Postop HPE report

Score Positive- Score>7.5, under HP/D categories.

Score Negative- Score<7.5, under LP & U categories.

Table 2: Statistical Analysis of RIPASA

Parameter	Estimate	Lower - Upper 95% CIs
RIPASA		
Sensitivity	49.40%	(38.91, 59.94 ¹)
Specificity	96.91%	(91.3, 98.94 ¹)
Positive Predictive Value	93.18%	(81.77, 97.65 ¹)
Negative Predictive Value	69.12%	(60.92, 76.27 ¹)
Diagnostic Accuracy	75%	(68.2, 80.76 ¹)
Method: Wilson Score		

Interpretation: In this study, Sensitivity was 49.4% with 95% confidence interval (38.91, 59.94), and specificity was 96.91% with 95% confidence interval (91.3, 98.94). Positive Predictive Value (PPV) showed an estimate 93.18% with 95% confidence interval (81.77, 97.65). Diagnostic accuracy of RIPASA is also high (75%).

Modified Alvarado Scoring System

Table 3: Diagnostic evaluation of MASS with Final diagnosis

MASS	Final Diagnosis- A	Final Diagnosis - NA	Total
Score Positive	41	10	51
Score Negative	42	87	129
Total	83	97	180

Final Diagnosis- A: Appendicitis as confirmed by CECT/Intraop findings/Postop HPE report

Final Diagnosis- NA: Non-Appendiceal cause as confirmed by CECT/Intraop findings/Postop HPE report

Score Positive- Score>6, under HP/D categories.

Score Negative- Score<6, under LP & U categories.

Table 4: Statistical analysis of MASS

Parameter	Estimate	Lower - Upper 95% CIs
MASS		
Sensitivity	49.40%	(38.91, 59.94 ¹)
Specificity	89.69%	(82.05, 94.3 ¹)
Positive Predictive Value	80.39%	(67.54, 88.98 ¹)
Negative Predictive Value	67.44%	(58.95, 74.92 ¹)
Diagnostic Accuracy	71.11%	(64.1, 77.24 ¹)
Method: Wilson Score		

Interpretation: In this study, Sensitivity was 49.4% with 95% confidence interval (38.91, 59.94), and specificity was 89.69% with 95% confidence interval (82.05, 94.3). Positive Predictive Value (PPV) showed an estimate 80.39% with 95% confidence interval (67.54, 88.98). Diagnostic accuracy of MASS is 71.11%.

Table 5: Comparison Between RIPASA And MASS

PARAMETER	RIPASA	MASS
Sensitivity	49.40%	49.40%
Specificity	96.91%	89.69%
Positive Predictive Value	93.18%	80.39%
Negative Predictive Value	69.12%	67.44%
Diagnostic Accuracy	75%	71.11%

Significance

Sensitivity of both RIPASA and MASS are comparable, but there seems to be a definite upgrade in specificity, positive predictive value, and to a certain amount in diagnostic accuracy as well in RIPASA scoring over MASS.

DISCUSSION

From the time the concept of clinical scoring systems have been introduced, multiple studies have been done in search of the most sensitive, specific and diagnostically accurate clinical score to aid in the diagnosis of acute appendicitis. Since, its introduction in 1986, Alvarado is one of the most well-known and studied scores for acute appendicitis [11]. Its modification MASS has been equally in common use. As this is the most popular and commonly used scoring system, we planned to compare the newer scoring system (RIPASA) with it, and study its efficacy in terms of sensitivity, specificity and diagnostic accuracy among other factors [12]. In the present study conducted on 180 patients (n=180), RIPASA and MASS were compared, and final diagnosis was analysed in relation to CECT/intra-operative findings/ post-operative HPE reports. It was found that both RIPASA and MASS had equal sensitivity (49.4%), but specificity was higher in RIPASA (96.9%) as compared to MASS (89%). Also the Positive predictive value of RIPASA (93%) was higher than MASS (80%). The negative predictive value of RIPASA and MASS were comparable (69% and 67% respectively). The diagnostic accuracy was also slightly higher in RIPASA than MASS (75% and 71% respectively). Analysing both RIPASA and MASS, it was found that both RIPASA and MASS were

easy to perform as they mainly relied upon clinical symptoms and signs, along with basic laboratory investigations, and they did not need elaborate investigations [13]. As RIPASA had more number of parameters compared with MASS, subjectively it felt like it summarized the patient's clinical condition better. The time taken to apply the scores (both RIPASA and MASS) were minimal, and did not cause any undue delay in management [14]. Even though MASS is a routinely used scoring system for the diagnosis of acute appendicitis worldwide, it has found to be lacking in its sensitivity and specificity [15]. This study also suggested that if patients with scores >7 been managed directly by appendectomy without CT evaluation, this would have caused a 27% reduction in CT scanning [16]. RIPASA score, continued to evaluate their new score by prospectively enrolling 200 adults and children in a comparison of the RIPASA and Alvarado Scores. In this group of patients, the RIPASA was statistically superior to the Alvarado Score in Sensitivity (98% vs. 68%), NPV (97% vs. 71%) and accuracy (92% vs. 87%). Specificity and PPV were similar between the 2 scores [17]. RIPASA and Alvarado and found RIPASA to be a more convenient, accurate and specific score with the resulting comparative values of RIPASA and Alvarado as follows- Sensitivity - 96% and 58% respectively, Specificity - 90% and 85% respectively [18] As compared to literature, in the present study, RIPASA was found to have a sensitivity, specificity, PPV and NPV of 49.4%, 96.9%, 93% and 69% respectively. Over the last few years, since the advent of newer imaging systems, and due to the varied clinical accuracy of scoring systems, studies have also been done to evaluate the use of imaging techniques like CT scanning in diagnosis of appendicitis [19]. Although studies show that CT scanning has maximum sensitivity and specificity in diagnosis of acute appendicitis, this has not been very widely in use, at least in a developing country like India. This is due to multiple factors- not only universal factors like risk of radiation exposure, but also other economic and practical causes like cost and availability. Hence some studies were done to try and find out which group of patients benefitted from CT scan, to try and filter the available resources [20]. Keeping all these factors in mind, the present study was analysed category-wise. When we retrospectively analysed the proven appendicitis cases with the scores, we found that among the HP/D categories, RIPASA picked up 93% cases as high probability of appendicitis, whereas MASS picked up only 81% as high probability cases. Hence, we understood that by using the RIPASA score, cases that fall under HP/D category can be more confidently taken up for surgery, without the need for any imaging modality [21]. Under the LP category in RIPASA, CT scan was done for all patients, and 58% of them turned out to be acute appendicitis, as compared to 80% in MASS. This further strengthens the point that RIPASA filters out low probability cases better than MASS. Hence, it can be inferred that the patients who fall under the LP category (RIPASA 5-7.5) will benefit the most from a CT scan [22]. Under the U category, or "Unlikely to be appendicitis" category, RIPASA had 0 appendicitis cases. That means, it proved that 100% of the cases were unlikely. Meanwhile, MASS had 16% cases under unlikely category which were finally diagnosed as appendicitis. Hence, the number of missed cases would have been higher in MASS. Hence, in the present study, comparatively RIPASA seems to be better than MASS clinically as well as statistically [23-25]

CONCLUSION

The present study concludes that, in the diagnosis of acute appendicitis, RIPASA score is more specific than Modified Alvarado Score, and also has a higher Positive Predictive Value and Diagnostic Accuracy. For the clinician, it gives a clearer categorization of management of patients with RIF pain- suggesting that in most cases, patients in HP/D category can straight away be taken up for surgery without any extra imaging modality, patients in LP category would benefit the maximum from CT imaging and that patients in the U category can be worked up for non-appendiceal diagnoses. RIPASA also reduces the number of "missed appendicitis" cases. Hence, RIPASA is clinically and statistically a better scoring system for the diagnosis of acute appendicitis, as compared to MASS.

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