



## COMPARITIVE STUDY OF RAJA ISTERI PENGIRAN ANAK SALEHA APPENDICITIS (RIPASA) AND MODIFIED ALVARADO SCORING SYSTEM (MASS) IN REDUCING NEGATIVE APPENDECTOMY

### General Surgery

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### ABSTRACT

**INTRODUCTION:** Reginald Fitz first described the acute abdominal condition of appendicitis in 1886. Since then multiple research studies have been conducted on this subject although the timely diagnosis of appendicitis has been of prime importance. This study compares a newly developed Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score with a well-established Modified Alvarado scoring system (MASS) to find out which is a better diagnostic tool for acute appendicitis.

**AIMS AND OBJECTIVES:** This is a comparative hospital-based study aimed to equate two scoring systems RIPASA and MASS. It will help establish the superior scoring system which is more effective in reducing negative appendectomy.

#### MATERIAL & METHODS

Data of 60 patients clinically suspected of appendicitis was collected. Both RIPASA and MASS were applied to them, but management was carried out as per RIPASA score. The final diagnosis was confirmed either by CT scan, intra-operative finding, or post-operative HPE report. The final diagnosis was analysed against both RIPASA and MASS with IBM.SPSS statistics software 23.0 Version. Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic Accuracy was calculated for both RIPASA and MASS.

**RESULTS & CONCLUSION:** RIPASA was found to be superior to MASS in terms of sensitivity (50% v/s 15.8%), specificity (95.5% v/s 86.4%), positive predictive value (95% v/s 66.7%), negative predictive value (52.5% v/s 37.3%). The diagnostic accuracy of RIPASA was 66.7% v/s MASS 41.7%. Therefore we conclude this study by stating that RIPASA is a more specific and accurate scoring system when compared to MASS. Hence the usage of this scoring system can lead to a precise diagnosis resulting in a decrease of missed appendicitis cases.

### KEYWORDS

RIPASA, MASS, Negative appendectomy

#### INTRODUCTION

Appendix, the vestigial organ of the abdomen of the human body has been known to lead to an acute condition called Appendicitis. The abdomen, being the human body's Pandora box contains multiple anatomical components which can lead to innumerable acute conditions.

Appendicitis, an acute abdominal condition was first described by Reginald Heber Fitz in 1886 and since then it has always been a source of discussion for researchers, clinicians and surgeons<sup>1</sup>.

Diagnosis of acute appendicitis has always been critically dependent on clinical diagnosis and judgement.

When there is inadequate evaluation of acute abdominal pain done before surgery it can lead to Negative Appendectomy. To reduce Negative Appendectomy incidence (9.5%) which was found to be higher among females at (64.3%) v/s (35.7%) in males<sup>2</sup> it is important to develop a clinical scoring system. Scoring systems have been established as a valuable integral part for clinically distinguishing between acute appendicitis and nonspecific abdominal pain.

The earliest score to be developed was the Alvarado score by Alvarado A<sup>3</sup> in 1986 which could be easily applied in an outpatient setting. The Alvarado score comprises of the diagnostic characteristics like temperature elevation, nausea, anorexia, tenderness in the right iliac fossa, migration of pain, rebound pain, leukocytosis and the shift of WBC count to the left.

With the advancing years, a single scoring system has evolved into multiple scoring systems which include modifications to the existing scoring systems based on the local demographics or by adding more factors. This has complicated the matter further as many surgeons used different scores to diagnose appendicitis as there was no definite scoring system with maximum sensitivity and diagnostic accuracy. Over the years, Alvarado and the Modified Alvarado scoring systems<sup>4</sup> (MASS) have come up to be the most commonly used scoring systems. MASS's scoring comprises of migratory right iliac fossa pain, nausea or vomiting, anorexia, rebound tenderness in the RIF, tenderness at

right iliac fossa, fever and leukocytosis.

A need for a new scoring system has been seen as Alvarado and Modified Alvarado were found to have poor sensitivity and specificity in Middle Eastern and Asian population. This led to the establishment of a new scoring system RIPASA (Raja Isteri Pengiran Anak Saleha Appendicitis) Score, was created by Dr William Chong<sup>5</sup> in 2008. This novel scoring system included parameters like age, gender, RIF pain, the migration of pain to the right iliac fossa, nausea and vomiting, anorexia, the duration of symptoms, RIF tenderness, guarding, rebound tenderness, Rovsing's sign, fever, elevated white cell count and negative urinalysis.

A delay in surgery can lead to multiple complications like perforation, peri-appendicular abscess, wound infection, and intraabdominal adhesions.

Therefore, to prevent complications it is important to make a timely diagnosis which is mostly based on the clinical evaluation by the surgeon. Hence in this study, we will be comparing the MASS to RIPASA score to reduce negative appendectomy.

#### MATERIAL & METHODS

The study included 60 patients presenting with right iliac fossa pain. The study was conducted in the Department of Surgery, Mahatma Gandhi Medical College and Hospital, Jaipur, India. It was undertaken from January 2019 to June 2020. The study was approved by the institutional Ethical Committee. The purpose and the nature of the study were explained to all the patients and were enrolled only after obtaining informed and written consent.

The patients that were unwilling for surgery, pregnant, malignancy, inflammatory disease of the gastrointestinal tract, infants and neonates were excluded.

All included patients are admitted, detailed history taking, general physical examination, systemic examination and all routine investigations were carried out. Patients were scored according to both MASS and RIPASA Scoring and both groups after final scoring are categorized into 4 groups (table 1)

**Table 1 - Category**

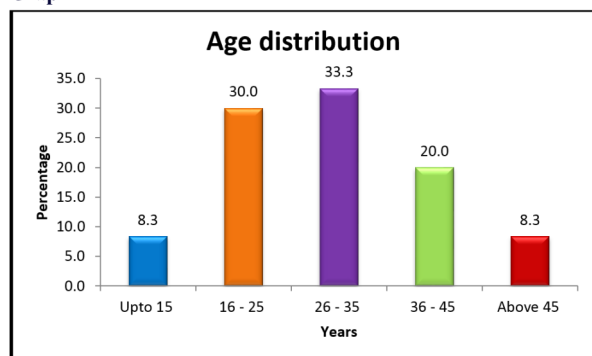
| CATEGORY              | RIPASA | MASS |
|-----------------------|--------|------|
| D (Definite)          | >12    | >8   |
| HP (High Probability) | 7.5-12 | 6-7  |
| LP (Low Probability)  | 5-7.5  | 5-6  |
| U (Unlikely)          | <5     | <5   |

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 the 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, using imaging and other appropriate laboratory studies. The final diagnosis of Appendicitis was based on either CT scan or Intra-operative finding, or Post-operative HPE report. An analysis was done comparing both RIPASA and MASS.

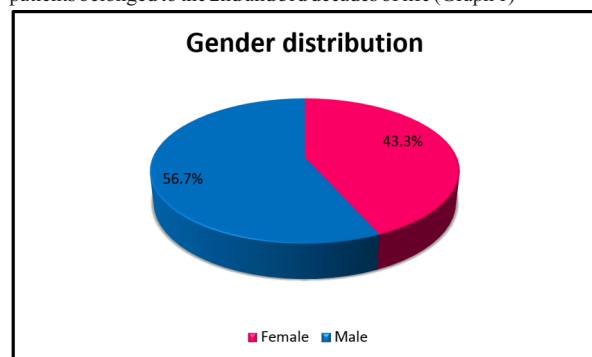
### STATISTICAL ANALYSIS

Data will be entered in Microsoft Office Excel worksheet. The collected data were analyzed with IBM.SPSS statistics software 23.0 Version. The Receiver Operator Characteristic (ROC) curve analysis was used with Sensitivity, Specificity, PPV and NPV to find the efficacy of the scoring systems. In the above statistical tools, the probability value .05 is considered as a significant level.

### OBSERVATIONS AND RESULT

**Graph 1**

This present study has patients ranging from age 5 - 70 years of age with 30 being the mean age with +/- 12 years. The maximum number of patients belonged to the 2nd and 3rd decades of life (Graph 1)

**Graph 2**

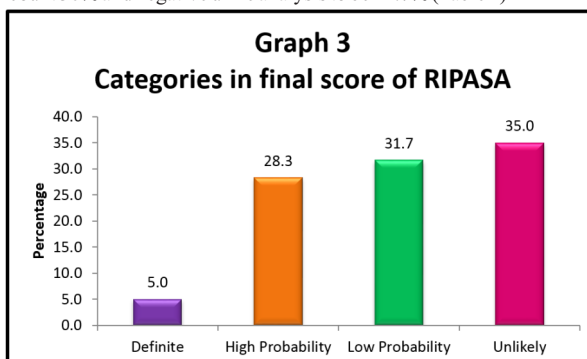
Gender distribution showed the frequency to be higher in males showing 56.7% and female being 43.3%. Gender differentiation was 57% male and 43% female (Graph 2)

### The analysis of RIPASA scoring system:-

| TABLE 2<br>RIPASA Scoring System |                  |                  |
|----------------------------------|------------------|------------------|
|                                  | Negative Score % | Positive Score % |
| Age                              | 15.0             | 85.0             |
| Sex                              | 43.3             | 56.7             |
| RIF Pain                         | 1.7              | 98.3             |
| Migratory Pain                   | 61.7             | 38.3             |
| Anorexia                         | 71.7             | 28.3             |
| Nausea/Vomiting                  | 61.7             | 38.3             |

|                     |      |      |
|---------------------|------|------|
| Duration            | 66.7 | 33.3 |
| RIF Tenderness      | 11.7 | 88.3 |
| Guarding            | 73.3 | 26.7 |
| Rebound Tenderness  | 81.7 | 18.3 |
| Rovsing's Sign      | 95.0 | 5.0  |
| Fever               | 58.3 | 41.7 |
| WBC Count           | 70.0 | 30.0 |
| Negative Urinalysis | 58.3 | 41.7 |

The age category was subdivided into two groups. 85 % belonged to age group <40 years and 15% >40 years of age. 33.3 % presented with the onset of symptoms within 48 hours and 66.7% presented with the onset of symptoms after 48 hours. Other specific symptoms occurring were migratory pain 38.3%, anorexia 28.3 %, nausea and vomiting 38.3 %, right iliac fossa tenderness 88.3%, guarding 26.7 %, rebound tenderness 18.3 %, Rovsing's sign 5 %, fever 41.7%, raised WBC count 30% and negative urine analysis to be 41.7% (Table 2)

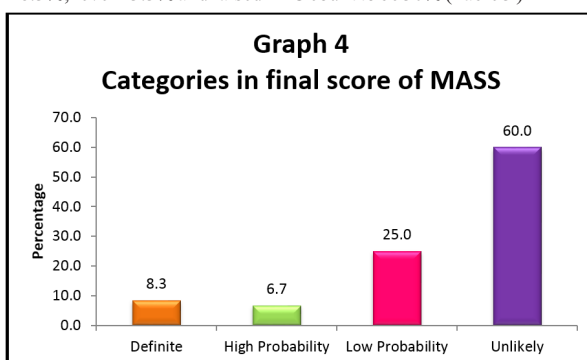


According to RIPASA scoring patients were further divided into four categories where 5 % of patients had a score of >12 belonging to the definite category, 28.3% of patients were of HP category having a score ranging from 7.5-12, 31.7 % of patients fell into the LP category and 35 % were part of the unlikely category (Graph 3)

### The analysis of mass scoring system:-

| TABLE 3<br>MASS Scoring System |                  |                 |
|--------------------------------|------------------|-----------------|
|                                | Negative Score % | Positive Score% |
| Migrated Pain                  | 53.3%            | 46.7%           |
| Anorexia                       | 71.7%            | 28.3%           |
| Nausea/Vomiting                | 61.7%            | 38.3%           |
| RIF Tenderness                 | 11.7%            | 88.3%           |
| Rebound tenderness             | 81.7%            | 18.3%           |
| Fever                          | 56.7%            | 43.3%           |
| Raised TLC                     | 70.0%            | 30.0%           |

The analysis of MASS scoring system showed the most common symptom patient presented with was right iliac fossa tenderness occurring at 81.7%. The other symptoms were migrated pain at 46.7%, anorexia 28.3%, nausea and vomiting 38.3%, rebound tenderness 18.3%, fever 43.3% and raised TLC count to be 30% (Table 3)

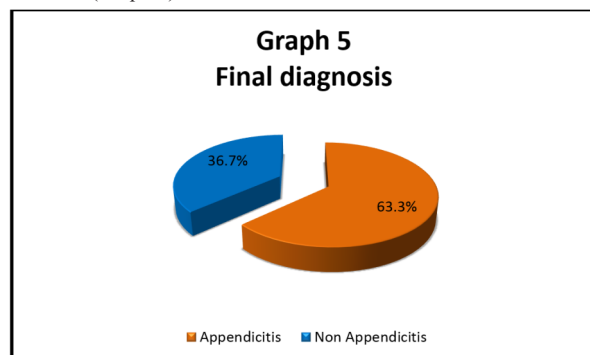


According to the final score of MASS system patients were categorized into 4 categories being <5 unlikely to be appendicitis (U), 5-6 low probability to be appendicitis (LP), 6-7 high probability to be appendicitis (HP) and >8 definite appendicitis (D). 8.3% of patients came into the category of D, 6.7% in HP, 25% in LP and 60% in U (Graph 4)

### MODE OF TREATMENT:-

The plan of management was carried out under the decided protocol as per RIPASA score. Patients having < 5 scores in the RIPASA scoring system came under the category of unlikely to be appendicitis (U) underwent further investigations like sonography and CECT.

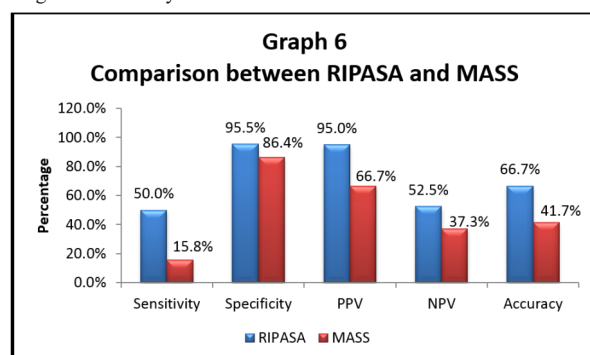
65% of patients were operated on and the other 35% were managed conservatively. The final diagnosis was established by CECT, intra-operative findings or post-operative histopathological report. Among the total 60 cases in this study, 63.3 % had a final diagnosis of appendicitis and 36.7 % had other pathologies behind pain in the abdomen (Graph 5)



RIPASA scoring system was found to be highly significant with  $p < 0.01$  level with 95% C.I. In this study RIPASA score displays Sensitivity of 50% and specificity was 95.5%. Positive Predictive Value (PPV) showed an estimate of 95% and the Negative Predictive Value (NPV) displayed as an estimate of 52.5%. RIPASA showed a diagnostic accuracy of 66.7% (Graph 6).

The MASS scoring system was found to be not significant at  $p > 0.05$  level with 95% C.I. In this study MASS score displays Sensitivity of 15.8% and specificity was 86.4%. Positive Predictive Value (PPV) showed an estimate of 66.7%. The Negative Predictive Value (NPV) displayed an estimate of 37.3% and a diagnostic accuracy of 41.7% (Graph 6).

When both the RIPASA and MASS are compared, there is a significant upgrade in sensitivity, specificity, positive predictive value, and diagnostic accuracy.



### DISCUSSION

Identifying the condition of acute appendicitis can be perplexing due to its varied presentation. Multiple conditions mimic the state of acute appendicitis leading to further difficulty in the diagnosis.

For our present study which was conducted on 60 patients, RIPASA had a higher sensitivity and specificity compared to MASS which was 50% v/s 15.8% and 95.5% v/s 86.4% respectively. Additionally, the positive predictive value and the negative predictive value was higher in RIPASA as compared to MASS at 95% v/s 66.7% and 52.5% v/s 37.3% respectively. The diagnostic accuracy was higher in RIPASA related to MASS being 66.7% v/s 41.7% respectively.

Scrutinizing both RIPASA and MASS, it was found that both RIPASA and MASS were easy to perform as they mainly banked upon clinical symptoms and signs, along with a few basic laboratory investigations. This avoids the need for expensive highly elaborative investigations.

As RIPASA had more variables compared with MASS, subjectively it felt like it summarized the patient's clinical condition better. The time taken to apply the scores was minimal and did not cause any undue postponement in management.

Even though MASS is a routinely used scoring system for the diagnosis of acute appendicitis worldwide, it is lacking in its sensitivity and specificity. 187 patients with suspected appendicitis were prospectively studied by Bond, Alvarado score was found to have a sensitivity and specificity of 90% and 72% respectively<sup>(6)</sup> The specificity and sensitivity for an Alvarado Score were found to be  $\geq 7$  were 61% and 60% respectively in a study piloted by Hsiao.<sup>(7)</sup>

Macklin showcased the sensitivity and specificity of MASS to be 76.3% and 78.8% respectively.<sup>(8)</sup> Meltzer et al conducted a prospective observational study on 261 patients in which MASS was found to have poor sensitivity and specificity at 72% and 54% respectively.<sup>(9)</sup>

RIPASA, during its development by Chong et al, was found to have a sensitivity and specificity of 88% and 67% respectively<sup>(5)</sup>. Subsequently, multiple studies were done which showed better results. Butt MQ et al conducted a cross-sectional study on 267 patients and concluded RIPASA score to have a sensitivity and specificity of 96.7% and 93% respectively. The Positive predictive value was 98% and the negative predictive value was 95%. He concluded that RIPASA was an advantageous tool in the diagnosis of appendicitis.<sup>(10)</sup>

After developing RIPASA score, Chong continued his evaluations by prospectively enrolling 200 adults and children for the comparison of the RIPASA and Alvarado Scores. RIPASA was found to be statistically superior to the Alvarado Score in Sensitivity (98% vs. 68%), NPV (97% vs. 71%) and accuracy (92% vs. 87%). The two scores showed similar specificity and PPV values.<sup>(11)</sup>

N.N. Mohammed compared 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 and Specificity - 90% and 85% respectively.<sup>(12)</sup>

There is no way of knowing when the inflammatory process of the appendix will resolve. Therefore, delaying the diagnosis might lead to further hurdles and complications like appendicular perforation, rupture, appendicular abscess, portal pyemia. This can lead to high negative appendectomy rate. Perforated appendicitis has an occurrence of 25.8% where the highest rates of perforation are in 5 years of age and patients above 65 years at 45% and 51% respectively.<sup>(13)</sup>

Considering all these factors, our present study was analyzed category wise. We found that among the HP/D categories, RIPASA picked up 95% cases as a high probability of appendicitis, whereas MASS picked up only 66% as high probability cases.

The Lower probability category in RIPASA showed that 47.5% of them turned out to be acute appendicitis when compared to the 63% in MASS.

Under the U category of RIPASA, 35% of the cases were unlikely. Meanwhile, MASS had 60% cases under the unlikely category which were finally diagnosed as appendicitis. This displayed the number of missed cases are higher in MASS.

The interference obtained in this study displays RIPASA to be better than MASS clinically as well as statistically

### CONCLUSION

Our present study accomplishes that RIPASA score is more sensitive and specific than Modified Alvarado Score. RIPASA also displays a higher Positive Predictive Value and Diagnostic Accuracy. For the clinician, these scoring systems act as an invaluable tool in categorizing the management of patients presenting with right iliac fossa pain.

RIPASA is easy and simple to apply as the majority of the parameters can be obtained from a routine history and clinical examination. The use of RIPASA also reduces the occurrence of negative appendectomy cases. We conclude this study by stating that RIPASA is clinically and statistically a better scoring system for the diagnosis of acute appendicitis as compared to MASS.

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