

## RIPASA Score with CRP: A Better Diagnostic Tool for Acute Appendicitis

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### Abstract

The mainstay of treatment of acute appendicitis is its early diagnosis and decide the need of surgical intervention. The aim of this study is to evaluate the RIPASA scoring system by replacing raised TLC with raised CRP. In the study, data was made in two groups; one with conventional RIPASA scoring system and other by replacing raised TLC with raised CRP and co-related with post operative histopathological examination (HPE) report. It was observed that validity of RIPASA scoring was improved by incorporating CRP. Also, significantly high CRP levels were associated with complicated appendicitis. So, we conclude that RIPASA score with CRP is better for diagnosis and deciding management in cases of acute appendicitis.

**Keywords:** RIPASA score; CRP; TLC; Acute Appendicitis; Histopathology; Diagnosis

### Introduction

Most common cause of acute abdomen in general surgery practice is acute appendicitis. Correct diagnosis is must for this condition as it requires prompt treatment. Mainstay of diagnosis of this condition is clinical. Acute appendicitis is a condition which if diagnosed on time and intervened earliest can be most safe and good in overall prognosis, while if there is delay in diagnosis or missed, it can be life threatening. On other side, removing a normal appendix is a relatively common surgical issue, defined as negative appendectomy. Negative appendectomy remains a concern in current surgical practice.

Modified Alvarado scoring system (MASS) is most commonly used scoring system for its diagnosis. But the diagnostic accuracy of MASS is questionable [1]. Appendicitis Inflammatory Response (AIR) score and Pediatric Appendicitis Score are also used by many practitioners. Sensitivity and specificity of these scoring systems has been found to be poor [2,3]. One of the newer scoring systems is RIPASA scoring system.

Reginald Heber Fitz, in 1886, published his work which emphasized on its diagnosis of acute appendicitis and early intervention so as to prevent mortality and morbidity as a consequence of its complication [4]. From that time, there are continuous research works going on AA for various aspects ranging from its etiology, to its management options.

A relatively newer scoring system, RIPASA scoring system was developed in 2008. It is abbreviation of Raja Isteri Pengiran Anak Saleha Appendicitis score for appendicitis. In Brunnei Darssalem, RIPAS Hospital, the study was done [5], to find a more reliable scoring system.

RIPASA score is a simple qualitative scoring system based on 14 fixed parameters (two demographic, five clinical symptoms, five clinical signs, and two clinical investigations, and one additional parameter FNRIC) (Table 1).

Parameter	Score
<b>Patient's Demographic</b>	
Female	0.5
Male	1.0
Age < 39.9 years	1.0
Age > 40 years	0.5
<b>Symptoms</b>	
RIF pain	0.5
Pain migration to RIF	0.5
Anorexia	1.0
Nausea and vomiting	1.0
Duration of symptoms < 48 hrs	1.0
Duration of symptoms > 48 hrs	0.5
<b>Signs</b>	
RIF tenderness	1.0
Guarding	2.0
Rebound tenderness	1.0
Rovsing's sign	2.0
Fever > 37°C, < 39°C	1.0
<b>Investigations</b>	
Raised WBC count	1.0
Negative urinalysis	1.0
<b>Interpretation</b>	
<5 score	Appendicitis unlikely
5-7 score	Appendicitis: Low probability
7.5-12 score	Appendicitis: High probability
>12 score	Appendicitis: Definite

**Table 1:** RIPASA scoring system.

Valuation of raised White Cell Counts also referred to as Total Leukocyte Count (TLC) is a must in case of suspected acute appendicitis. Any inflammation in the body will have raised TLC count. Leucocytosis is present in majority of patients with acute appendicitis [6,7]. But normal TLC does not rule the inflammatory changes of appendix i.e., it lacks specificity [8].

TLC in acute appendicitis rises progressively with advancement of disease process. If there is decrease in TLC then the probability of appendicitis will be less. Validity of sequential rise in TLC has been observed by many authors [8]. Normal range of TLC is 4000 to 11,000 per microliter. Increase in TLC above 11,000 per microliter is indicated of active inflammatory process in the body.

C-reactive protein is mostly produced in the liver during the transcriptional phase of the proinflammatory cytokine response. By up-regulating C/EBP $\beta$  and C/EBP $\delta$ , major transcription factors in this pathway, IL-6 appears to be the principal regulator, increasing de novo production of CRP. IL-6 signaling may also be aided by IL-1 and TNF, both of which boost CRP transcription rates [9].

CRP is marker of also a non-specific marker of inflammatory process in the body. It is produces by liver in response to acute infection or inflammatory process. It is indirect test of detecting inflammation and tissue injury. Advantage of CRP is that it has prognostic value especially in conditions like acute appendicitis. It rises within 6 hours of acute inflammation [10].

In the present study, RIPASA scoring system is evaluated system by replacing TLC with CRP among the patients of Acute appendicitis in M.M.I.M.S.R., Mullana.

### Ripasa scoring system

#### Materials and Methods

It is a duration-based study, conducted in a Tertiary Care Hospital. Duration of study was 18 Months. All the cases provisionally diagnosed with acute appendicitis that are posted for appendectomy were included in the study.

Pregnant females, patients with appendicular mass, known case of tuberculosis, patients with features of peritonitis were excluded from the study. It is a prospective study which included all cases of acute appendicitis that presented to OPD/Casualty at MMIMSR, Mullana and underwent Appendectomy. The patients were examined clinically, then hematological, biochemical and radiological investigations were done. Then the necessity of operative intervention was decided. Patients who were provisionally diagnosed with acute appendicitis and were posted for appendectomy were examined and RIPASA scoring was done. Correlation of HPE report and the RIPASA scoring system was done.

Conservatively managed patients were advised for follow-up after discharge form hospital, while for the patients who were treated surgically; the final diagnosis was confirmed by HPE report.

Data was made in two groups. First with conventional RIPASA score. Total score was calculated for each patient. In second group raised CRP was incorporated in place of raised TLC. In each group patients were sub-categorized into D (Definite appendicitis), HP (High probability to be appendicitis), LP (Low probability to be appendicitis) and U (Unlikely to be appendicitis). Patients with score 7.5 or more i.e., patients in D and HP categories were considered as positive case and score less than 7.5 i.e., patients in LP and U categories were taken as negative.

Based on the score and HPE report Sensitivity, Specificity, PPV and NPV of RIPASA were calculated.

### Results

Present study included 112 patients who underwent appendectomy. Patients of age group 18 - 65 years were included. The maximum number of patients belonged to the 2<sup>nd</sup> and 3<sup>rd</sup> decades. 37.5% of the patients belonged to the 18 - 25 years age group, followed by around 20% belonging to 25-35 years age group (Figure 1).

Age groups	No. of Patients	Percentage
18-25	42	37.5%
25-35	22	19.6%
35-45	20	17.8%
45-55	10	8.92%
55-65	18	16.07%
TOTAL	112	100

**Table 2:** Age-wise distribution of patients.

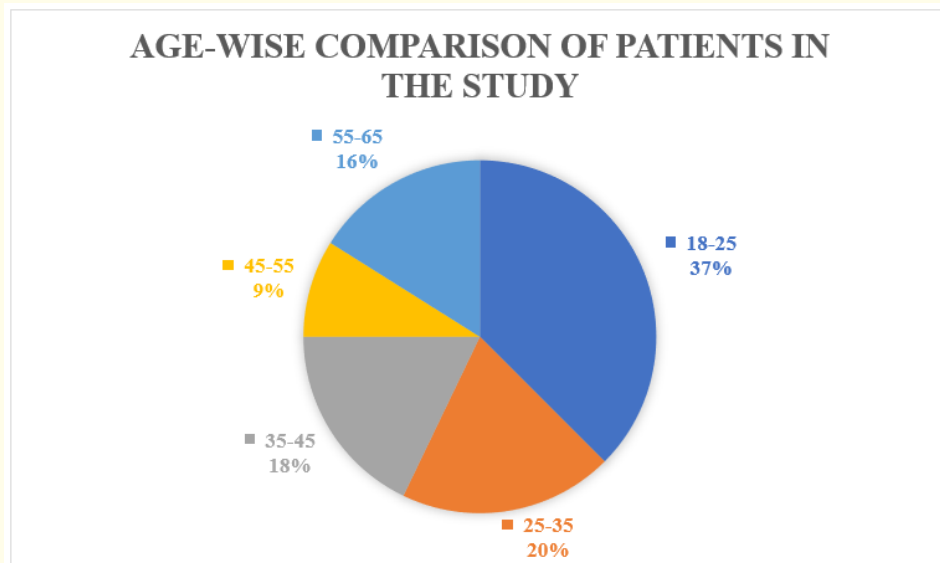


Figure 1: Age-wise comparison of patients in the study.

Gender	No. of Patients	Percentage
Male	70	62%
Female	42	38%
TOTAL	112	100

Table 3: Gender distribution in the study.

Both sexes were affected with a male preponderance with 62% males (35 patients) and 38% females (21 patients) (Figure 2).

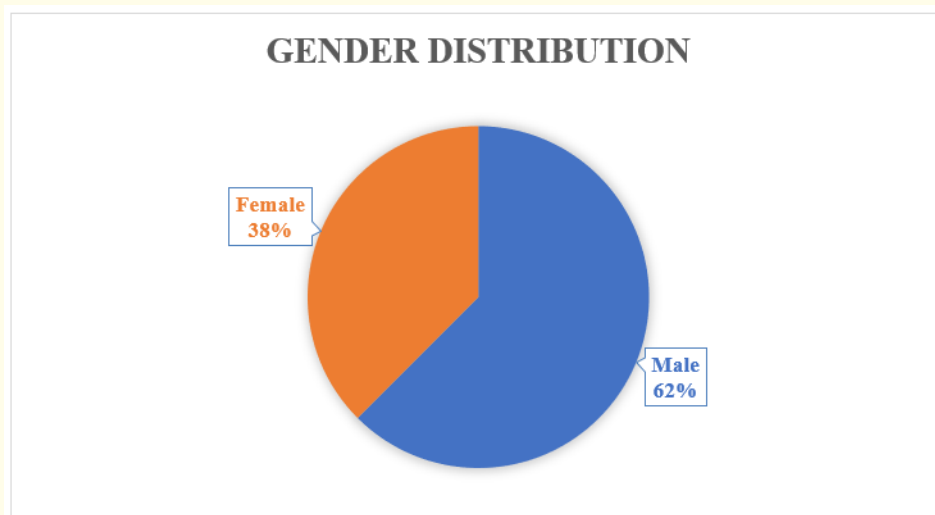
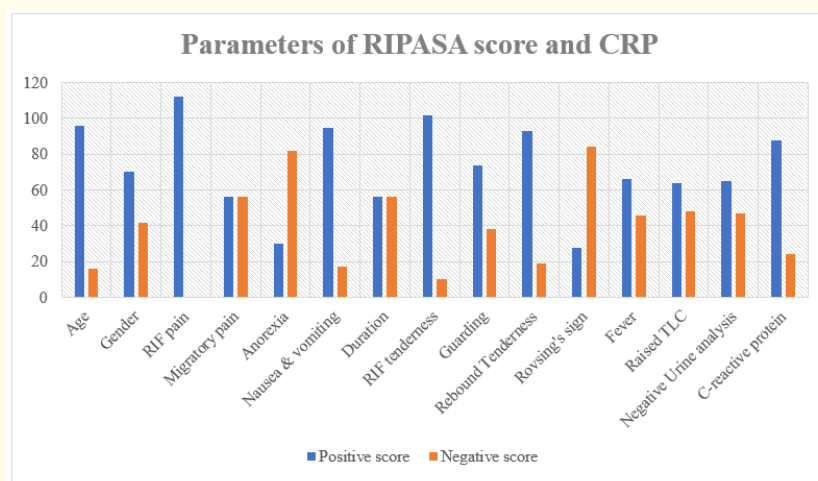


Figure 2: Gender Distribution in the study.

Parameter of RIPASA Score and C-Reactive Protein	Positive Score	Negative Score
Age	96	16
Gender	70	42
RIF pain	112	0
Migratory pain	56	56
Anorexia	30	82
Nausea and vomiting	95	17
Duration	56	56
RIF tenderness	102	10
Guarding	74	38
Rebound Tenderness	93	19
Rovsing's sign	28	84
Fever	66	46
Raised TLC	64	48
Negative Urine analysis	65	47
C-reactive protein	88	24

**Table 4:** Number of patients with positive and negative parameters of RIPASA score.

Parameters of RIPASA SCORE and C-reactive protein (Figure 3):



**Figure 3:** Parameters of RIPASA score with C-reactive protein in the sample of present study.

85.7% (96 patients) belonged to the age group below 40 years, and around 14% (16 patients) above. Gender differentiation was 62% male and 38% female. 50% presented within 48 hours of onset of symptoms and 50% after. 100% of the patients had RIF pain. 91% (102 patients) of them had RIF tenderness, 76.7% (86 patients) had a negative urinalysis, 59% (66 patients) had fever and 69.6% (78 patients) had a raised TLC. Around 84% (94 patients) had nausea or vomiting. C-reactive protein was raised in 80% (90 patients).

Finally, out of the total score, the data was made in 2 groups. In first group was according to conventional RIPASA scoring system and second group was according to RIPASA scoring system by replacing TLC with raised CRP.

In first group, 16 patients had a score of > 12 and were categorized as D (Definite appendicitis), 78 patients had score of 7.5 - 12 fell under the category HP (High probability to be appendicitis), 18 patients had a score of 5 - 7.5 and were categorized as LP (Low probability to be appendicitis) and 0 patients had score < 5 was termed U (Unlikely to be appendicitis).

In second group, 16 patients had a score of > 12 and were categorized as D, 80 patients had score of 7.5 - 12 fell under the category HP, 16 patients had a score of 5 - 7.5 and were categorized as LP and 0 patients had score < 5 was termed U (Figure 4).

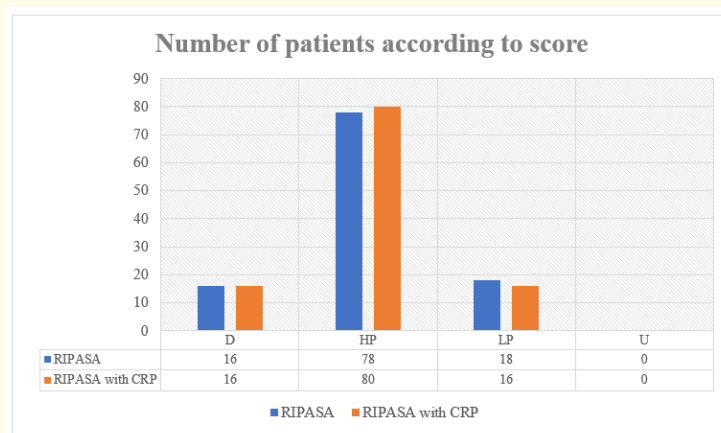


Figure 4: Categories in RIPASA scoring system.

As decided, patients with RIPASA score 7.5 or more were considered as positive case and score less than 7.5 were taken as negative.

In first group, among 112 cases operated, 94 cases were positive i.e., RIPASA score was  $\geq 7.5$  and 18 cases were negative i.e., RIPASA score was  $\leq 7.5$ . And in second group 96 cases were positive and 16 cases were negative.

Out of 112 operated cases, Histopathological examination (HPE) of 94 patients were acute appendicitis. Based on reports; sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic value were calculated.

Statistical analysis was done with the help of OpenEpi, Version 3.01. Results were as follows-

Ripasa	Final Diagnosis Acute Appendicitis	Final Diagnosis -Not Acute Appendicitis	Total
Score Positive	87	7	94
Score Negative	7	11	18
Total	94	18	112

Table 5: Analysis of RIPASA Scoring System.

RIPASA	Final Diagnosis Acute Appendicitis	Final Diagnosis -Not Acute Appendicitis	Total
Score Positive	90	6	96
Score Negative	4	12	16
Total	94	18	112

Table 6: Analysis of RIPASA Scoring System with raised CRP.

It was observed that RIPASA scoring system has sensitivity of 92.55%, specificity of 61.11%, Positive Predictive Value 92.55% and Negative Predictive Value 61.11% with Diagnostic Accuracy of 87.5%.

On contrary, RIPASA score by incorporating raised CRP showed sensitivity of 95.74%, Specificity of 66.67%, Positive Predictive value of 93.75% and Negative Predictive Value of 75% with Diagnostic accuracy of 91.07%.

	RIPASA Scoring System	RIPASA Scoring System with Raised CRP
Sensitivity	92.55%	95.74%
Specificity	61.11%	66.67%
PPV	92.55%	93.75%
NPV	61.11%	75%
Diagnostic Accuracy	87.5%	91.07%

Table 7: Comparison of RIPASA score with RIPASA score with raised CRP.

Histopathology report of 94 patients were acute appendicitis. Out of those cases 24 cases had perforated appendix, 6 cases were necrotizing appendicitis, 7 cases were gangrenous appendicitis, 10 cases were suppurative appendicitis. So complicated appendicitis included perforated, gangrenous and necrotizing and were total 37 in number. Uncomplicated appendicitis included inflamed and suppurative cases and were 57 in number (Figure 5).

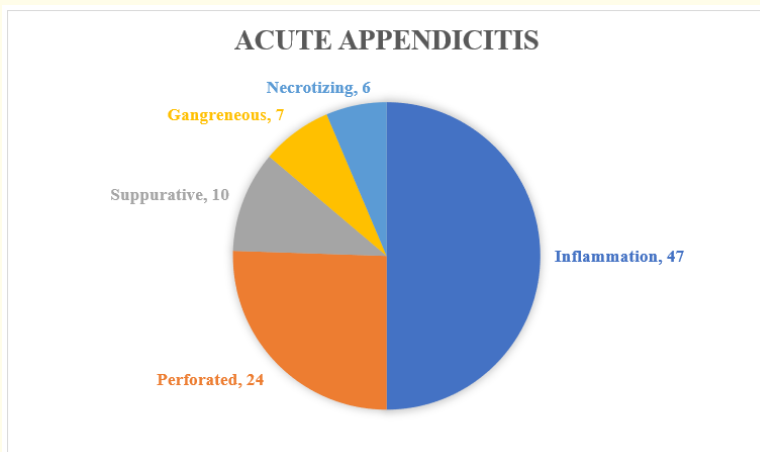


Figure 5: Variations in acute appendicitis

Out of 37 complicated appendicitis, CRP was raised 34 cases and out of 57 uncomplicated appendicitis CRP was raised in 50 cases. Out of 37 complicated appendicitis, TLC was raised in 26 cases and out of 57 uncomplicated appendicitis TLC was raised in 34 cases (Figure 6).

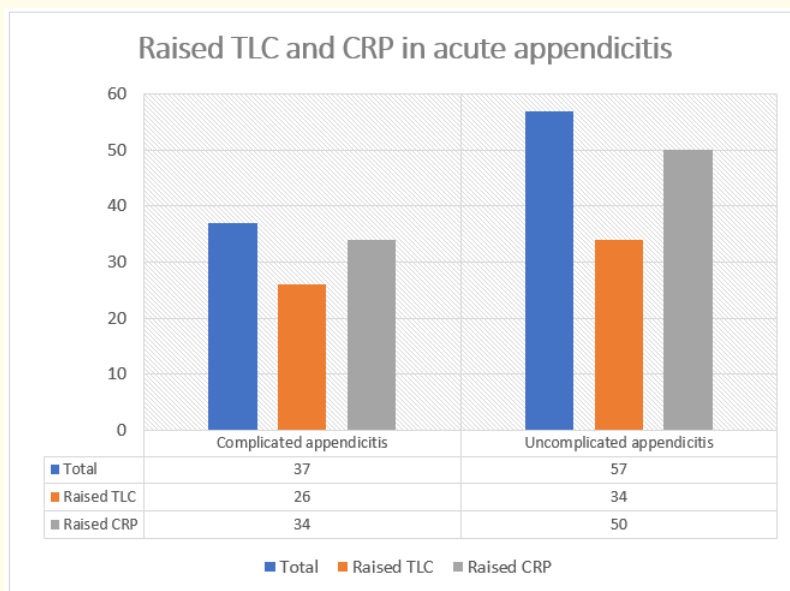
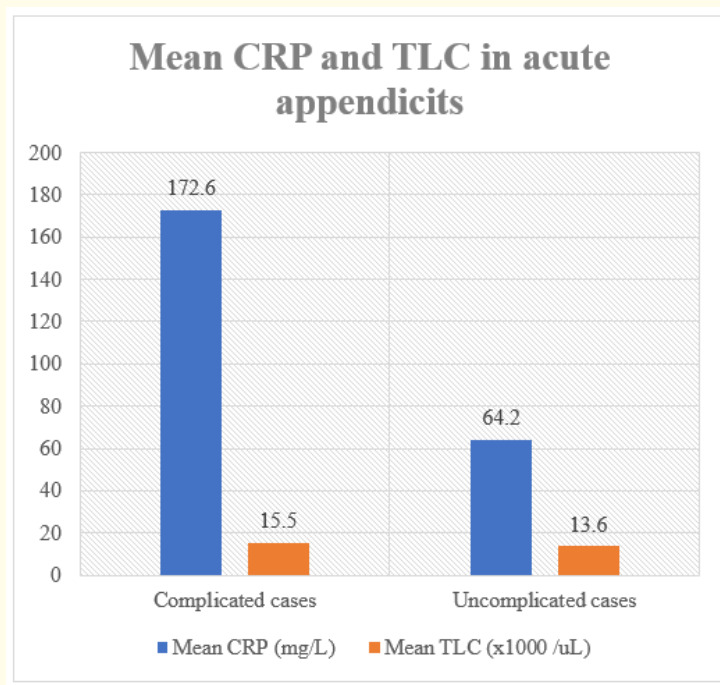


Figure 6: Raised TLC and CRP in acute appendicitis.

In complicated cases, mean CRP was 172.6 mg/L and in Uncomplicated cases, mean CRP was 64.2mg/L. On contrary, mean WCC in complicated cases  $15.5 \times 10^3/\mu\text{L}$  and in uncomplicated cases mean WCC was  $13.6 \times 10^3/\mu\text{L}$  (Figure 7).



**Figure 7:** Mean CRP in acute appendicitis.

## Discussion

As there are innumerable vital structures, any pathology of the abdomen leads to series of dilemma for its diagnosis and further management. When patient presents with pain in abdomen, a meticulous examination and clinical correlation is must for accurate diagnosis and deciding further management of the condition. Clinical examination remains the mainstay for diagnosis, despite of the improvement in laboratory and radiological investigations facility. A surgeon should always keep in mind, the diagnosis of acute appendicitis when patient presents with clinical features which are representing the pathology of appendix. It is a condition which if diagnosed on time and intervened earliest can be most safe and good in overall prognosis, while on the other end if there is delay in diagnosis or missed, it can be life threatening. As the diagnosis of this condition is difficult, the negative appendectomy rate varies from 12.4% in males and 33.3% in females [11]. So traditionally surgeons have accepted a higher incidence of unnecessary appendicectomies in order to decrease the incidence of perforations. This approach is being increasingly questioned in today's era of evidence-based medicine. The high rate of negative explorations for appendicitis is a burden faced not only by the general surgeon, but also by the patient and the society as a whole, since appendicectomy like any other operation results in socioeconomic impact in the form of hospital expenses, lost working days and declining productivity. The goal of surgical treatment is removal of an inflamed appendix before perforation with a minimal number of negative appendicectomies.

Many surgeons and practioners have studied and researched on clinical scoring systems for diagnosing acute appendicitis and have emphasized on making a single most effective tool for deciding management and prognosis. When the RIPASA score was first studied, it was observed that with a cut-off score of 7.5 in RIPASA score, there was sensitivity, specificity, PPV and NPV of 88%, 67%, 93% and 53% respectively, while diagnostic accuracy was 81% [12]. Chong, *et al.* studied RIPASA score and validated it after observing better diagnostic accuracy than Alvarado score in 200 patients of mixed age groups. They also commented on superiority of RIPASA over Alvarado score [13]. In 2018, Maximos Frountzas, *et al.*, based on a meta-analysis of randomized trials in which twelve studies were included which en-



rolled 2161 patients; exhibited that the RIPASA scoring system caught true positives cases with AA more effectively than Alvarado scoring system, but on the other it captured less true negatives [14]. C.Z.Díaz-Barrientos, in 2018, compared modified Alvarado score and RIPASA score and inferred that RIPASA scoring system has no advantages over the modified Alvarado score when applied to patients presenting with suspected Acute Appendicitis [15]. Nanjundaiah N., *et al.* compared RIPASA Score and Alvarado Score in November 2020 and concluded that RIPASA scoring system is reliable scoring system for Indian sub-continent than Alvarado scoring system [16].

Many previous studies have shown that the CRP level improves the diagnosis of acute appendicitis, but not surgical indication. In a study by S Eriksson., *et al.* the negative appendectomy rate was reduced by 8% if surgery was deferred in patients with CRP levels and white blood cell counts within normal limit [17]. Another prospective study by AA Mohammed., *et al.* [18] has shown that it is important to measure serial CRP levels and white blood cell counts in patients with suspected appendicitis. The sensitivity of CRP levels for diagnosis of acute appendicitis was 60% on admission and increased to 100% by the fourth blood sample while WCC showed a sensitivity of 95% on admission, but dropped to 75% by the fourth sample. CRP provides more accurate information than WBC count for differentiation between bacterial and viral infection. WBC values are not consistent enough to be used to monitor the effect of antimicrobial treatment in bacterial infection [19].

R E Andersson., *et al.* showed the importance of CRP along with TLC, DLC and clinical features for diagnosis of acute appendicitis [20]. In a study, Bulent Kaya., *et al.* concluded that CRP is sensitive marker for acute appendicitis but an increase in CRP levels alone is not sufficient to make the diagnosis of acute appendicitis [21]. Sheikh Muzamil Shafi., *et al.* in their study observed that positive predictive value of diagnosis of acute appendicitis improved by combining TLC, CRP and Neutrophil count. MK Joshi., *et al.* conducted a 5 years study on negative appendectomy rate and observed that false positive diagnosis can be minimized by using CRP and CT scan for diagnosis of acute appendicitis [22].

In this background, CRP is an important parameter for the diagnosis of acute appendicitis. In the current study, conducted on 112 patients, RIPASA score was calculated by incorporating raised CRP in place of raised TLC and final score was co-related with post-operative HPE reports. When the RIPASA scoring system was examined, it was discovered that it was simple to use because it depended mostly on clinical symptoms and signs, as well as basic laboratory examinations, and did not require sophisticated investigations. The current study clearly suggested that adding CRP leads to precise prediction of the severity of acute appendicitis for treatment.

However, CRP is not specific for appendicitis, and one should consider the presence of other diseases such as a diverticulum, inflammation of the ileum, or urogenital and gynecological disorders.

Therefore, before using the scoring system for surgical indication, clinicians interpreting clinical information must depend on their subjective experience and modalities such as computed tomography and ultrasonography to establish a diagnosis of appendicitis, and must exclude other causes of symptoms. If clinical symptoms and image examinations indicate that a patient has appendicitis, a patient with a high score should undergo surgery immediately. And, if the score is low, then a patient could be managed by non-surgical treatment.

The current study was broken down into categories after considering all of the elements. When we looked at the scores for proved appendicitis cases, we saw that in RIPASA score calculated by considering raised CRP instead of TLC; the sensitivity, specificity, PPV, NPV and Diagnostic Accuracy were improved.

### Conclusion

The current study suggests that the RIPASA score has a decent Positive Predictive Value and Diagnostic Accuracy in the diagnosis of acute appendicitis which can further be improved by using CRP. It provides a clearer categorization of RIF pain management for clinicians, indicating that patients in the high probability category can be taken up for surgery without any delay by doing additional imaging, patients in the low probability category would benefit the most from the radiological imaging and patients in the unlikely appendicitis category can be more investigated for diagnosis apart from acute appendicitis. Also, in patients with significantly raised CRP, early surgical intervention should be done as it was associated with complicated cases.

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