

## **Role of Serum C-Reactive Protein In The Diagnosis of Acute Appendicitis**

<sup>1</sup>Dr. Vikhyath R Karamtoth, Senior Resident, Department of Surgery, Assam Medical College and Hospital

<sup>2</sup>Prof . Dr . Baburam Basumatary, HOD, Department of General Surgery

<sup>3</sup>Dr. Ranjib Konwar, Assistant professor, Department of Surgery, Assam Medical College and Hospital

<sup>4</sup>Dr. Abhigyan Borkotaky , MS General Surgery . JMCH, Jorhat

**Corresponding Author:** Dr. Vikhyath R Karamtoth, Senior Resident, Department of Surgery, Assam Medical College and Hospital.

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**Type of Publication:** Original research Article

**Conflicts of Interest:** Nil

### **Abstract**

**Objectives:** To determine sensitivity, specificity, the predictive value of the positive test, and predictive value of negative test of C Reactive Protein in acute appendicitis.

To determine the association of serum C - reactive protein with histopathological findings in acute appendicitis.

**Methodology:** A Hospital-based cross-sectional study was conducted in the Department of General Surgery, Assam Medical College and Hospital, Dibrugarh, Assam for one year. A total sample of 54 patients with the clinical diagnosis of acute appendicitis was included in the study calculated using the formula  $n = z^2pq/d^2$ .

**Results:** Serum CRP was elevated in patients with acute appendicitis and the level of CRP was even higher in patients with complications.

**Conclusion:** A measure of Serum CRP minimizes the error in diagnosis due to atypical symptoms and can also detect the complications of acute appendicitis.

**Keywords:** CRP, Serum, Alvarado score

### **Introduction**

The diagnosis of appendicitis remains a perplexity despite advances within the field of imaging and laboratory investigations (1). Several patients with appendicitis don't have a classical history. Arriving at a correct diagnosis is important, however, as a delay in diagnosis could enable progression to perforation and considerably increase morbidity and mortality. Perforation ranges from 50-90% in varied series (2, 3). Incorrectly diagnosing a patient with appendicitis, although not ruinous, often subjects the patient to an unnecessary operation (4).

Diagnostic scoring systems have been developed in an endeavor to improve the diagnostic accuracy of acute appendicitis (5, 6). The clinical assessment in diagnosing appendicitis by an experienced surgeon remains reliable and superior to either the Alvarado score or CRP measurement. Alvarado score and serum CRP measurements are also valuable to diagnosis, and a high Alvarado score and serum C - reactive protein must not be unheeded (7).

As often there is a dilemma or confusion amongst the residents or surgeons about the diagnosis of acute appendicitis, this study was undertaken to determine whether C - reactive protein is a good indicator for acute appendicitis and its complications.

#### Materials And Method

**Place of Study:** The study was conducted in the Department of General Surgery, Assam Medical College and Hospital, Dibrugarh, Assam

**Duration of Study:** One Year

**Period of Study :** 1<sup>ST</sup> June 2020 to 31<sup>st</sup> May 2021

**Type of Study:** Hospital-based cross sectional study

#### Study Population

Patients diagnosed with acute appendicitis attending Outpatient Department and Department of Casualty of The Department of General Surgery, Assam Medical College and Hospital, Dibrugarh Assam during the study period.

**Sample Size:** Sample size was calculated using the formula:

$$n = \frac{Z^2pq}{d^2}$$

Where

z = Constant, its value for a two-sided test is 1.96 for 95% confidence interval

p = Anticipated Proportion

q = 1-p

d = absolute precision required on either side of the proportion

For sample size calculation, p was taken as 0.9146 (91.46%) (8). Absolute precision 0.075 (7.5%) and z = 1.96 for 95% confidence interval yielded a sample size of 54.

#### Selection Criteria

##### Inclusion criteria

- 1) Patients diagnosed to have acute appendicitis on admission.
- 2) Patients >12 years of age.

##### Exclusion criteria

- 1) Concomitant conditions where CRP is raised like
  - a) Rheumatoid Arthritis
  - b) Systematic Lupus Erythematosus
  - c) Gout
  - d) Glomerulonephritis
  - e) Inflammatory Bowel Disease
- 2) Patients with co-morbid conditions like
  - a) History of Jaundice
  - b) Chronic Alcoholics
- 3) Patients admitted for interval appendicectomy.
- 4) Patients taking oral contraceptive pills and pregnant females as Serum C- reactive Protein are elevated in these patients.

#### Ethical Clearance

Ethical clearance for this was study was taken and granted by the Institutional ethics committee (Human) of Assam Medical College and Hospital, Dibrugarh, Assam for conducting the study.

## Consent

Informed, written and valid consent was taken from each patient to volunteer after explaining in detail about the study.

## Outcome Parameters

**Primary Outcome:** An increased value of serum C Reactive Protein along with signs and symptoms compliments the diagnosis of acute appendicitis as well as its complications i.e. perforation and gangrene.

**Secondary outcome:** Serum C - reactive protein varies indirectly with the negative appendicectomy rate.

## Data collection methods and tools

Patients presenting with acute abdominal pain were examined and a careful history was taken from the patient or the attendant. It was then followed by a general examination and systemic examination of the patient and finally followed by blood and radiological examinations.

Serum C - reactive protein, Total Leukocyte counts, and differential counts were done in every patient. Abdominal Ultrasonography was done in every case to confirm the diagnosis and rule out other causes of acute abdomen. Finally, the excised specimen of the appendix was sent for histopathological examination which was taken as the gold standard.

No special preparation of the patients was done before taking the blood samples for analysis. CRP was analyzed by the fixed point immunosate method using VITROS 5600 integrated system. Blood was collected from the patient and processed within 4 hours. Values more than 1mg/dl were considered raised whereas values less than or equal to 1mg/dl were considered normal.

The histopathologically positive cases with raised CRP were considered True Positive and the histopathologically negative cases with raised CRP were

considered false positive. Similarly, histopathologically positive cases with normal CRP were considered false negatives whereas histopathologically negative cases with normal CRP were considered true negatives. Similarly, Total Leucocyte Count, Differential Counts and ultrasonography were classified as a true positive, true negative, false positive, and false negative.

## Statistical Methods

The data were analyzed using standard statistical methods. The data of all the patients were entered into Microsoft Excel and analyzed using SPSS software version 16. Fishers exact test was used appropriately to find the significant association of increased serum C - reactive protein with acute appendicitis. The p-value of  $< 0.05$  is considered statistically significant.

## Results

Figure 1: Distribution of patients by age

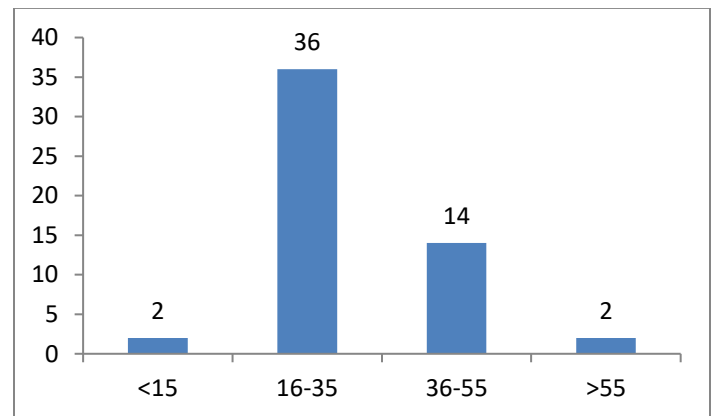


Figure 2: Distribution of Patients according to sex

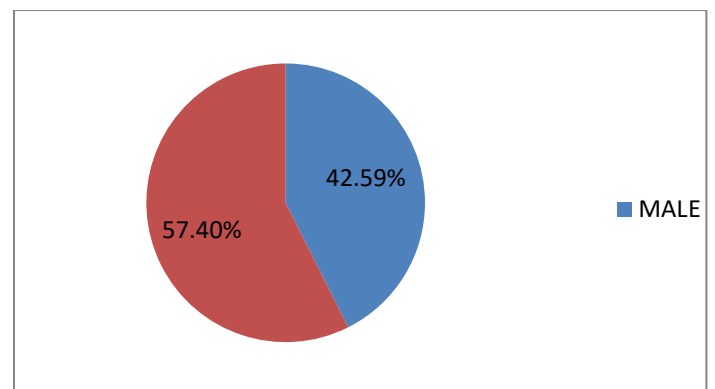


Table 1: Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value of CRP

	Diseased Appendix*	Normal Appendix*
CRP Raised	45(a)	1(b)
CRP Normal	2(c)	6(d)

\*According to Histopathological Report

Sensitivity (a/a + c) = 45 / (45+2) = 45/47 = 95.74%

Specificity (d/b + d) = 6 / (6+1) = 6/7 = 85.71%

Positive predictive value (a/a + b) = 45 / (45+1) = 45/46 = 97.82%

Negative predictive value (d/c + d) = 6 / (6+2) = 7/8 = 85%

Table 2: Post Appendicectomy patient distribution

Histopathology Report	Appendicectomy with CRP Positive	Appendicectomy with CRP Negative	p value *
Inflamed Appendix	45	2	.000*
Normal Appendix	1	6	

\*Calculated using fishers exact test.

From the table above, 6 appendicectomies could have been prevented if CRP was used as a basis for decision making.

Negative Appendicectomy (%) =  
 Total Number of negative appendicectomies performed  
 ----- X 100

Total Number of appendicectomies performed  
 6  
 = ----- X 100 = 11.11%  
 54

Table 3: Association of serum CRP values with Intra-Operative finding in appendicitis

CRP (mg/dl)	Appendix Inflamed	Appendix Normal	p-Value
>1	45	1	.000*
≤1	2	6	

\*Calculated using Fishers exact test

Table 4: Mean and standard deviation of CRP values

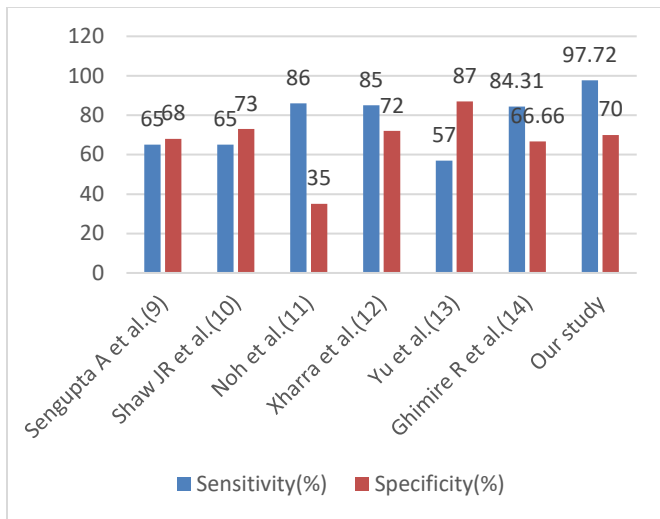
	Number	Mean	Standard Deviation
Uninflamed Appendix	4	1.43	0.14
Uncomplicated Inflamed appendix	20	8.46	3.45
Complicated inflamed appendix	20	24.73	2.4

**Discussion**

With the onset of an infection, there's an increase in the synthesis of some of the hepatic proteins as an acute phase response. The serum concentrations of these acute-phase proteins augment in 8 – 12 hours after the onset of infection. Amongst these, CRP is a marker of acute phase response and can be used as an indicator of disease. Elevation of serum concentrations of CRP indicates the presence of acute appendicitis and the complications that arise due to acute appendicitis which includes appendicular perforation and gangrenous appendicitis.

Measurement of C - reactive protein was done in all the patients who underwent appendicectomy. The sensitivity, specificity, positive predictive value and the negative predictive value of C reactive protein is 97.72%, 70%, 93.47%, and 87.50% respectively.

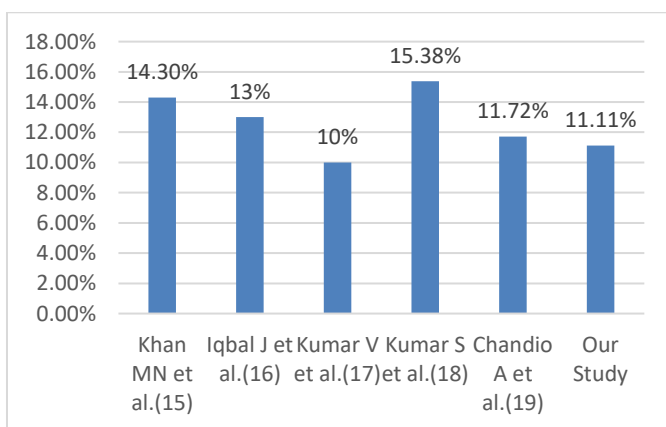
Figure 3: Comparison of C-Reactive protein sensitivity and specificity in different studies



In our study, the sensitivity and specificity of serum levels of C-reactive protein in the diagnosis of acute appendicitis are comparable to the results found by other researchers. So, it is concluded from different studies that the serum C-reactive protein test is highly sensitive and specific in making a diagnosis of patients who truly had acute appendicitis.

#### Negative Appendectomy Rate

Figure 4: Comparison of negative appendectomy rates in different studies



Hence from this we can say that serum C - reactive protein estimation complements the clinical diagnosis of a skilled surgeon and helps us in reducing the number of negative appendectomies performed.

#### Conclusion

Elevated Serum C-reactive protein supports the surgeon's clinical diagnosis of acute appendicitis.

A measure of CRP minimizes the error in diagnosis due to atypical symptoms and can detect the complications of acute appendicitis which includes appendicular perforation and gangrenous appendicitis.

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