

ROLE OF C-REACTIVE PROTEIN IN DIAGNOSIS OF ACUTE APPENDICITIS

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Objective: The objective of this study is to determine the role of C-reactive protein in the diagnosis of acute appendicitis.

Material and Methods: Seventy patients with suspicion of acute appendicitis were collected for this study. The patients were collected on the basis of history, clinical examination and laboratory investigations. Operation was done in all patients and appendix was sent for histopathology. Histopathology was considered as gold standard.

Results: The mean age of patients was 22.40 ± 7.95 years. The mean C-reactive protein of the patients was $21.64 \pm 19.63 \mu\text{g/ml}$. There were 14.3% patients of C-reactive protein range of less than $6 \mu\text{g/ml}$ and 85.7% patients of C-reactive protein range of more than $6 \mu\text{g/ml}$. In the histopathology findings, there were 94.3% patients of acutely inflamed appendix and 5.7% patients of normal appendix. The sensitivity was found to be 86%, specificity 91%, and positive predictive value 86%, negative predictive value 87% and accuracy 89%.

Conclusion: A normal pre-operative serum CRP measurement in patients with suspected acute appendicitis is most likely associated with a normal appendix. Deferring surgery in the patients would probably reduce the rate of unnecessary appendectomies.

Key words: Acute appendicitis, C-reactive protein, appendix.

Introduction

Acute appendicitis is one of the most common intra-abdominal infections seen in patients presenting with acute abdomen in the surgical departments.¹ The reported lifetime prevalence is as high as one in seven.² According to an estimate 6% of population will suffer from acute appendicitis during their lifetime.³ The peak age group is 12 to 30 years in both sexes but slightly more common in males.⁴

Acute appendicitis remains an up to date issue, being the most frequent cause of surgical acute abdomen round the globe.⁵ Appendectomy is one of the commonest procedures in surgery.⁶ Despite the recent advances in diagnostic medicine, the diagnosis of appendicitis is still doubtful in a number of cases.⁷ Diagnostic accuracy of acute appendicitis remains insufficient with an unacceptable high rate of unnecessary operations.⁸ In spite of various investigations used to improve the accuracy of diagnosis the rate of normal appendices removed is still about 15-30%.⁶ Improving the diagnosis of acute appendicitis in order to prevent unnecessary surgery is crucial.⁹ Majority of clinicians rely on their clinical examination strengthened by the laboratory tests.⁷ Laboratory measurements such as leukocyte count and C-reactive protein (CRP) concentration are commonly used as diagnostic aids in patients with suspected acute appendicitis.¹⁰

C-reactive protein measurement has been shown to give valuable information in the diagnosis of acute appendicitis.¹¹ An elevated level of C-reactive protein, is one of the many downstream indicators of inflammation.¹² C-reactive protein is an acute phase protein that is produced in large amounts by hepatocytes during an acute inflammatory process.¹³

C-reactive protein levels serve as an early marker of the magnitude of inflammation in events such as acute appendicitis.¹² C-reactive protein measurement can increase the diagnostic accuracy in acute appendicitis.¹⁴ A normal pre-operative serum CRP measurement in patients with suspected acute appendicitis is most likely associated with a normal appendix and deferring surgery in this group of patients might reduce the rate of unnecessary appendectomies.¹⁵

The role of inflammatory markers in the diagnosis of acute appendicitis has not been clearly defined. Laboratory tests of the white cell count, neutrophil count and C-reactive protein are more effective in supporting a clinical diagnosis of acute appendicitis in patients with typical clinical features than in excluding the diagnosis.¹⁷

The purpose of this study was to analyze the diagnostic accuracy of CRP and its possible advantage in diagnosing acute appendicitis in patients presenting with pain in right iliac fossa.

Material and Methods

It was Cross sectional comparative study, done at surgical unit 1 services hospital Lahore from June 2006 to November 2006. Seventy patients with clinical suspicion of acute appendicitis were included in the study by Non-probability convenience sampling. All patients with right iliac fossa pain, having suspicion of acute appendicitis on the basis of history and clinical examination, patients of both genders, age of 12 years and above were include in the study. Exclusion criteria was, pregnant patients, patients with a mass in right iliac fossa, known cases of right sided renal calculi, patients with hepatic dysfunction. All seventy patients with suspicion of acute appendicitis fulfilling the inclusion criteria were enrolled from the emergency department of Surgical Unit-I Services Hospital Lahore. Informed consent was obtained from the patients.

Detailed history of present illness was recorded. Symptoms of the patients e.g., site of onset, duration of onset, radiation, nausea, vomiting, fever anorexia, and diarrhea were noted. The signs of acute appendicitis e.g., tenderness, muscle guarding, rebound tenderness, rovsing sing, psoas sign and obturator sign were also noted. The laboratory investigations e.g., complete blood count, urine examination, C-reactive protein and abdominal ultrasonography were also done. Operation was done and appendix was sent for histopathology. Histopathology was considered as gold standard to establish the diagnosis of acute appendicitis.

All this information was collected through prescribed Proforma.

The collected data was entered into SPSS version 11 and analyzed accordingly. The study variables to be analyzed were age, sex, presenting complaints, symptoms, examination findings, haemoglobin, C-reactive protein, white blood cell, ultrasonography

findings, histopathology findings, and operative findings. Descriptive statistics was calculated. Means and standard deviations were calculated for age, haemoglobin, white blood cell and C-reactive protein. Proportions and percentage was calculated for sex, presenting complaints, symptoms, examination findings, ultrasonography findings, histopathology findings and operative findings. Role of C-reactive protein was determined by calculating sensitivity, specificity, positive predictive value, negative predictive value and accuracy. Histopathology was taken as a gold standard to establish the diagnosis of acute appendicitis.

Results

The mean age of patients was 22.40 ± 7.95 years. There were 37 (52.9%) patients of age range of 12-20 years, 22 (31.4%) patients of age range of 21-30 years, 10 (14.3%) patients of age range of 31-40 years and 1 (1.4%) patients of age range of 41-50 years of age. There were 32 (45.7%) males and 38 (54.3%) females. The mean C-reactive protein of the patients was $21.64 \pm 19.63 \mu\text{g/ml}$. There were 10 (14.3%) patients of C-reactive protein range of less than $6 \mu\text{g/ml}$ and 60 (85.7%) patients of C-reactive protein range of more than $6 \mu\text{g/ml}$ (**Table 1**).

In the ultrasound findings, there were 20 (28.5%) patients of inflamed appendix and 50 (71.5%) patients of normal. scan. In the histopathology findings, there were 66 (94.3%) patients of acutely inflamed appendix, and 4 (5.7%) patients of normal appendix (**Table 2**).

In the operative findings, there were 66 (94.3%) patients of acutely inflamed appendix, 2 (2.9%) patients of perforated appendix and 2 (2.9%) patients of normal appendix. The sensitivity was found to be 86%, specificity was found to be 91%, positive predictive value was found to be 86%, negative predictive value was found to be 87% and accuracy was found to be 89%. (**Table-3**)

Table-1: Distribution of patients by signs and symptoms (n=70).

Sign and Syptoms	Yes		No	
	No	%	No	%
Radiation	518	25.7	52	74.3
Vomiting	33	47.1	37	52.9
Anorexia	56	80.0	14	20.0
Fever	19	27.1	51	72.9
Diarrhoea	05	7.1	65	92.9
Nausea	31	44.3	39	55.7
Tenderness	70	100.0	0	0

Rebound Tenderness	64	91.4	06	8.6
Muscle Guarding	32	45.7	38	54.3
Rovsing Sign	09	12.9	61	87.1
Psoas Sign	0	0	70	100.0
Obturator Sign	0	0	70	100.0

Table-2: Distribution of patients by C-reactive protein (n=70).

C-reactive protein (ug/ml)	No	Percentage
<6	10	14.3
>6	60	85.7
Mean±SD	2.64±19.63	

Table-3: Distribution of patients by histopathology (n=70).

Histopathology findings	No	Percentage
Acutely inflamed appendix	66	94.3
Normal Appendix	04	5.7
Total	70	100.0

Table-4: Comparison of C-reactive protein versus histopathology (n=70)

C-reactive Protein	Histopathology (gold standard)		Total
	Positive	Negative	
Positive	60 (TP)	6 (FP)	66
Negative	10 (FN)	64 (TN)	74
Total	70	70	140

Key: TP: True Positive, FP: False Positive, FN: False Negative, TN: True Negative

Discussion

Appendectomy for suspected acute appendicitis is a common procedure. The rate of normal appendices unnecessarily removed remains as high as 15-30% despite several techniques and investigations used to improve the diagnostic accuracy. Many studies investigated the role of raised C-reactive protein in improving the diagnosis of acute appendicitis. In patients with histopathologically proven acute appendicitis both the WBC count and serum CRP level were significantly raised.¹⁸

In our study the mean age of the patients was 22.40 ± 7.95 years which is comparable to the study of Jehangir et al¹⁹ in which mean age of patients was

20 years. In the study of Khan et al²⁰ the mean age of the patients was 24 years which is also comparable with our study. In our study 45.7% of patients were male and 54.3% were females. As compared with the study of Stefanutti et al²¹, there were 55% males and 45% females which were comparable with our results. In our study, CRP was high in 85.7% patients and low in 14.3% patients and mean CRP was $21.64 \pm 19.63 \mu\text{g/ml}$. According to Iqbal²² CRP was high in 61% and low in 39% with mean $14.53 \pm 13.16 \mu\text{g/ml}$. In another study of Fernando et al²³ CRP was high in 78% of cases included in the study. So our results are comparable with the study of Fernando et al.²³ In a study of Asfar et al¹⁸ serum C-reactive protein level was normal in 16.7% explorations. As compared with our study, the C-reactive protein was normal in 14.3% patients which is comparable with the above study.

Another study conducted by Amallesh et al⁶ described that C-reactive protein was normal/negative in 7.3% patients and positive in 92.7% patients. As in our study CRP was high in 85.7% patients and CRP was low in 14.3% patients, which is not different with the study of Amallesh et al⁶, the minor difference is due to number of patients, as our sample is much less as compared to the number of patients of Amallesh et al.⁶

In our study, on the basis of histopathology report, there were 94.3% positive appendicitis and 5.7% negative appendicitis patients. As compared with the study of Amallesh et al⁶ on the histopathology report was normal/negative in 17% patients and 83% positive patients, which is not different with above study. The minor difference is due to number of patients, as our sample is much less as compared to above study's number of patients.

In our study, the sensitivity was found to be 86%, specificity was found to be 91%, positive predictive value was found to be 86%, negative predictive value was found to be 87% and accuracy was found to be 89%. As compared with the study of Alamesh et al⁶ the specificity and sensitivity was 42% and 91% respectively. The predictive value of a positive (raised CRP) and negative (normal CRP) test is 88% and 48%

respectively. According to the study of Asfar et al¹⁸ the sensitivity of serum CRP was 86.6% and 93.6%, respectively. As compared with our study the specificity and sensitivity was 91% and 86% which is comparable with the above study.

In another study conducted by Shoshtari et al¹⁶ 89.7% had acute appendicitis whereas 10.3% were normal with no sign of inflammation on histological examination. Whereas in our study, 94.3% were positive appendicitis and 5.7% were negative appendicitis patients, which were same and comparable with the above study. In a study conducted by Shoshtari et al¹⁶ sensitivity was 80%, specificity was 89.7%, positive predictive value was 97.5% and accuracy was 88.7% patients. While in

our study, sensitivity was 86%, specificity was 91%, positive predictive value was 86%, and accuracy was 89%. So our results are same and comparable with the above study.

Conclusion

A normal pre-operative serum CRP measurement in patients with suspected acute appendicitis is most likely associated with a normal appendix. Deferring surgery in the patients would probably reduce the rate of unnecessary appendicectomies.

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