

A Study on C-Reactive Protein as a Diagnostic Parameter in Acute Appendicitis

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ABSTRACT

Background: Even though appendectomy is the most regularly performed emergency surgery, its diagnosis remains uncertain, with a high probability of negative investigations. The study's goal was to investigate the relevance of CRP measurement accuracy in the diagnosis of acute appendicitis and to reduce morbidity by avoiding negative exploration.

Materials and Methods: The present investigation included 30 patients who were clinically diagnosed by surgeons as having acute appendicitis and were sent for an emergency appendectomy at the General Surgery Department, JSS Hospital Mysuru, between the 1st of December 2020 and the 1st of May 2021. Preoperative blood was sent for CRP estimation; postoperative, all specimens were sent for histopathological evaluation; CRP values were correlated with HPE reports to evaluate their function in the diagnosis of acute appendicitis.

Results: In the current study, CRP had the highest sensitivity and specificity of 90% and 80%, respectively, with a positive predictive value of 90%. As a result, it was demonstrated that CRP levels can be used to rule out negative appendicitis, allowing surgery to be postponed in these patients and lowering the rate of negative appendectomies.

Conclusion: We continue to highlight the importance of a professional surgeon's history and clinical examination in detecting acute appendicitis. CRP, on the other hand, significantly reduces the rate of negative appendectomy and, as such, should always be included in the diagnostic workup of acute appendicitis.

Keywords: c-reactive protein, acute appendicitis, double-blind study.

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INTRODUCTION

Acute appendicitis is a leading cause of right iliac fossa discomfort and a leading cause of the surgical emergency. The diagnosis is made based on the surgeon's clinical impression based on the patient's history, clinical evaluation, and laboratory tests.^[1-3]

Many inflammatory and non-inflammatory disorders can resemble the symptoms of acute appendicitis, resulting in atypical presentations.

The typical triad of an acute appendicitis-like history, pain at McBurney's point, and leucocytosis have a diagnostic accuracy rate of less than 80%. Even when radiological procedures like ultrasonography and computer tomography are used, the accuracy does not normally exceed 90%. This is more common in females because of the prevalence of pelvic inflammatory disease (PID) and other common obstetrical and gynaecological disorders, as well as at the extremes of age.^[4,5]

These characteristics contributed to a rather high percentage of negative investigations for acute appendicitis, ranging from 15 to 30 percent. And the post-operative morbidity related to these unfavourable investigations ranges from 5 to 15%.

On the one hand, a normal appendix at appendicectomy is a misdiagnosis; on the other hand, a delayed diagnosis of appendicitis might result in perforation and peritonitis.

As a result, surgeons have generally tolerated a greater percentage of needless appendicectomies to reduce the risk of perforations. In today's evidence-based medical era, this method is being called into doubt. The high rate of negative appendicitis explorations is a burden not only for the general surgeon, but also for the patient and society as a whole, because appendicitis surgery, like any other operation, has a socio-economic impact in the form of hospital expenses, lost working days, and declining productivity. The goal of surgical treatment is to remove an inflamed appendix before perforation with as few negative appendicectomies as possible.^[6,7]

To summarise, acute appendicitis can mimic many other acute abdominal conditions/illnesses, and despite extensive clinical study and discussion, diagnosing acute appendicitis remains difficult. And appropriate care necessitates a precise diagnosis.

In reaction to tissue injury, C-reactive protein (CRP) and other acute-phase proteins increase. Many studies have looked into the value of elevated serum CRP levels in enhancing the diagnosis of acute appendicitis.

In this study, we examined serum CRP levels in the histology of the excised appendix. This study emphasises the role of normal blood C-reactive protein rather than elevated serum C-reactive protein in lowering the rate of negative explorations.

Aims and Objectives

- To determine specificity, sensitivity and predictive value of the positive test and predictive value of negative test of CRP in the diagnosis of acute appendicitis.
- To compare it with the surgeon's clinical diagnosis.
- To interpret how this investigation can be used effectively to improve the diagnosis and decision making of acute appendicitis and hence reduce negative appendicectomies.

MATERIALS & METHODS

Patients presenting to the General Surgery Department at JSS Hospital, with clinically confirmed acute appendicitis were the subjects of this double-blind study. They were enrolled after being informed about the study and giving their signed consent.

Inclusion Criteria

All the patients who will be admitted to JSS Hospital during the study period with a diagnosis of acute appendicitis and posted for surgery are included in the study.

Exclusion Criteria

- Children below 12 years and the elderly above 50 years will be excluded as the CRP response is not optimal.
- Patients who are managed conservatively are excluded from this study.
- Patients with a history of jaundice, signs and symptoms of liver disease, and chronic alcoholism are excluded as CRP is exclusively produced in the liver.
- Females taking the oral contraceptive pill or pregnant are excluded as CRP is elevated in these individuals.

Method of collection of data:

A surgeon evaluated a patient who had a history of acute stomach pain. First, a thorough medical history was acquired to establish the diagnosis. The surgeon performed a physical examination on the patient, which was followed by some usual laboratory testing and radiographs.

During the physical examination, all instances were diagnosed by detecting right quadrant pain, guarding, and rebound soreness. Following that, the surgeon determined whether or not an emergency appendectomy was required. Blood samples were taken from all patients who were clinically diagnosed with acute appendicitis for regular testing as well as CRP estimate. All patients' serum CRP levels were sent before the operation, which was done using the latex agglutination method. A normal value of serum CRP is 0.1 to 0.8 mg/dl, while values above 2.5mg/dl indicate a continuing inflammatory process and were regarded positive. Patients with CRP values less than 2.5mg/dl were classified as negative.

The results of CRP level measurement were not made available to surgeons and were not considered for surgery to evaluate the diagnostic accuracy of CRP levels with surgeons' clinical impressions.

Appendix specimens were sent to the Department of Pathology at JSS Hospital for histological investigation; surgical findings and histopathological examination of appendectomy specimens verified the final and exact diagnosis.

True and erroneous surgeons' clinical diagnoses, as well as true and false positive or negative serum CRP findings, were determined as a result. The specificity, sensitivity, and accuracy of serum CRP concentrations were estimated using these data.

RESULTS

In our study 30 cases were included who were diagnosed as having acute appendicitis clinically by surgeons. They were told about the study and informed consent was taken.

Table 1: Age distribution

Age in years	No. of patients	Percentage
0-10	-	-
11-20	09	30 %
21-30	12	40%
31-40	05	16.66%
41-50	4	13.33%
>50	-	-

In present series age of patient varied from 12-50 years. Maximum number of patients were in age group 21-30 years i.e. 21patients that forms about 40% of study group.

Table 2: Sex ratio

	No. of patients	Percentage
Male	19	63.33%
Female	11	36.64 %

In 30 cases that were included in our study 11 were females, and 19 were males i.e. 36.64% of females and 63.33% of males were studied.

Table 3: Signs and symptoms Clinical features

Signs & symptoms	No. of patients	Percentage
Abdominal pain		
Right iliac fossa	20	86.66%
Umbilical	04	13.33%
Vomiting	25	83.33%
Fever	19	63.33%
Diarrhoea	2	6.66%
McBurney tenderness	26	86.66%
Rebound tenderness	21	70%
Shifting tenderness	09	30%

- All the patients in our study presented with pain abdomen i.e.100%. Most common site of pain being right iliac fossa (86.66%).
- Fever as a presenting complaint was present in 19 patients (63.33%)
- Vomiting as presenting complaint was seen in 83.3% of patients (25 study patients)
- In 86.66 % of patients McBurneys point tenderness noted. Rebound tenderness noted in 80% of patients. Shifting tenderness was noted in very few patients. Only 20% of patient showed shifting tenderness.

Table 4: Position of appendix

Position of appendix	No. of patients	Percentage
Retrocaecal	22	73.33%
Pelvic	8	26.66%
Paracaecal	5	16.66%
Sub-caecal	1	3.33%
Preilial	1	3.33%
Post ilial	1	3.33%

Per operatively most common position of appendix was found to be retrocaecal in 30 patients, which form 73.33% of our study patients.

- It corresponds to the most common site of appendix anatomically.
- Next common position was pelvic and it formed 20% of total study cases.
- Other sites such as paracaecal, subcaecal, preilial, post ilial were found to be least common positions in our study.

Table 5: Histopathology results

Histopathology of appendix	No. of patients	Percentage
Normal histology	5	16.66%
Ac. Suppurative	24	80.0 %
Ac.catarrhalm	4	13.33%
Ac gangrenous	5	16.66%

In our study the appendix specimen was sent for histopathological examination to Department of Pathology, JSS Hospital, Mysore. Out of 30 patients, 5 patients had normal histopathological picture of appendix so our negative appendectomy rate was 16.66%.

Histopathologically 16.66 % of patients had acute suppurative appendicitis. Remaining patients showed either acute catarrhal or acute gangrenous type of appendicitis.

Table 6: Correlation between CRP levels and histopathological findings

CRP level	CRP test				Total
	True		False		
	Positive	Negative	Positive	Negative	
Elevated	24	-	1	-	25
Normal	-	3	-	2	5
	27		3		30

In present series 25 patients had elevated serum CRP level (>2.5 mg/dl) which is 86% of total study group. In these patients only one patient had high serum CRP level inspite of normal appendix that was proved histologically. The cause of raised serum level of CRP in this patient was mesenteric lymphadenitis which was found preoperatively.

5 patients had normal serum CRP values i.e. 16.6% of patients. In these patients 3 i.e. 85.7% had normal appendix on histopathological examination, whereas in 1 patient it was proved by histopathological examination that appendix was inflamed even though levels of CRP was normal in serum.

In our present study 90% of the CRP tests done are true whether level was raised or it was normal only 3(10%) of the tests done for CRP level estimation gave false report.

DISCUSSION

In study of “C-reactive protein as a diagnostic parameter in acute appendicitis – A double blind study”, the diagnostic value of serum CRP levels in patients with clinically suspected acute appendicitis was investigated. Emergency appendicectomy was done on patients with acute appendicitis based on clinical impression of the surgeon. After the study it is noted that negative appendicectomy rate was 14%.

In our study serum CRP level was elevated in 90 % of the patients and this rate corresponds to study done by Abu et al 2004 where CRP levels were elevated in 85.7% of patients with acute appendicitis,^[7] also with study done by Afsar et al where 90% of patients had elevated CR P levels. But in contrast to our study according to Mikaelson et al and Tmompson et al elevation.^[8,9,13]

In our study of serum CRP levels were found in only 47% and 72% of patients respectively.

Serum CRP levels increases after the onset of inflammatory pathology, so the levels might be normal until about 12hrs after the onset of symptoms of acute appendicitis.^[11] So the time interval between the appearance of symptoms and the actual testing of serum CRP levels had some bearing on the result shown by Mickaelson et al and Calder et al in their studies.^[10,13]

According to our study the sensitivity and specificity of serum levels in diagnosis of acute appendicitis is comparable to the results given by other researchers.

So it is derived from different studies that serum CRP test is highly sensitive and specific in making diagnosis of patients who truly had acute appendicitis.

In our study predictive accuracy of serum CRP estimation test for positive test is 90 % and for negative test is 80 %.

- Errickson et al showed in their study that predictive value for positive test is 99.44% and negative predictive value of 96.79%.

- In our study surgeon's clinical diagnosis was correct in 25 patients i.e. in 83.30% of patients, whereas the serum CRP estimation test was true in 27 patients that is 96% of patients.

This distinction underlines the importance of preoperative serum CRP measurement in the clinical diagnosis of acute appendicitis.

According to our statistical study, if we had used serum CRP levels to decide whether to do appendicectomies, six unnecessary appendicectomies may have been averted, as well as substantial morbidity and economic burden on the patient and our health system. As a result, serum CRP estimation does not diminish the relevance of a professional surgeon's clinical diagnosis but rather complements it.

CONCLUSION

There is no question that a surgeon's clinical diagnosis based on time-tested clinical indicators is useful in detecting acute appendicitis. However, elevated serum CRP levels support the surgeon's diagnosis, reducing the possibility of misdiagnosis due to unusual presentations. Furthermore, in patients with suspected acute appendicitis, a normal preoperative serum CRP level is most often related to a normal appendix on histological inspection. As a result, a normal blood CRP level 12 hours after the onset of symptoms should be used as a foundation for deferring surgery to reduce the rate of negative appendicectomies and also to reduce the burden on both the patient and the health system.

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REFERENCES

1. Gray's anatomy-The Anatomical Basis of Clinical practice Susan Standring (Ed); 39th ed; Elsevier Churchill Livingstone; 2008; p 1366-7.
2. Zuidema: Shackelford's Surgery of the Alimentary Tract, 5th ed.
3. Bernard M Jaffe and David H. Berger ; The appendix; In: Schwartz's principles of surgery; F. Charles Brunicaudi, MD, FAS (Ed); 9th edition; Mc Graw Hill; 2010; p1073-90.
4. Douglas S. Smink/David I. Soybel; Appendix and appendectomy; In Maingot's abdominal operations; Michel J, Zinner (Ed); 11th ed; McGraw-Hill; 2007; pp. 589-608.
5. Schumpelick V, Dreua B, Ophoff K et al. Appendix and caecum: Embryology, anatomy and surgical applications. *Surg Clin North Am* 2000;80:295-318.
6. John Maa, MD, Kimberly S, Kirkwood, MD. The Appendix. In: Sabiston text book of surgery: Courtney M. Townsend (Ed); 18th ed; Saunders; 2008. I:1333- 46.
7. Albu E, Mifier BM, Choi Y, Lakhanpal S, Murthy RN, Gerst PH. Diagnostic value of C-reactive protein in acute appendicitis. *Dis Colon Rectum*. 1994 Jan;37(1):49-51.
8. Asfar S, Safar H, Khoursheed M, Dashti H, al-Bader A. Would measurement of C-reactive protein reduce the rate of negative exploration for acute appendicitis? *J R Coil Surg Edinb*. 2000 Feb;45(1):21-4.
9. Thompson MM, Underwood MJ, Dookeran KA, Lloyd DM, Bell PR. Role of sequential leucocyte counts and C-reactive protein measurements in acute appendicitis. *Br J Surg*. 1992 Aug;79(8):822-4.
10. Calder JD, Gajraj H. Recent advances in the diagnosis and treatment of acute appendicitis. *Br J Hosp Med* 1995;54:129-33.

11. Davies AH, Bernau F, Salisbury A, Souter RG. C-reactive protein in right iliac fossa pain. *J R Coil Surg Edinb.* 1991 Aug;36(4):242-4.
12. Eriksson S, Granstrom L, Caristrom A. The diagnostic value of repetitive pre- operative analyses of C-reactive protein and total leucocyte count in patients with suspected acute appendicitis. *Scand J Gastro Enterol* 1994; 29:1145-9.
13. Mikaelsson C, Arnbjornsson E. The value of C-reactive protein (CRP) determinations in patients with suspected acute appendicitis. *Ann Chir Gynaecol.* 1984;73(5):281-4.