International Surgery Journal
Abhirup HR et al. Int Surg J. 2021 Oct;8(10):3002-3006
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20213984

Original Research Article

C-reactive protein, as a marker for predicting acute appendicitis and its severity in KVG medical college and hospital, Sullia

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Received: 15 August 2021
Accepted: 15 September 2021

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ABSTRACT

Background: Appendicectomy for suspected acute appendicitis is a common procedure. The rate of normal appendices unnecessarily removed remains high despite several techniques and investigations used to improve the diagnostic accuracy. This study emphasizes the value of C reactive protein (CRP) in three groups of patients operated for clinical suspicion of acute appendicitis with different finding at appendicectomy namely an un-inflamed appendix, uncomplicated acute appendicitis or complicated acute appendicitis.
Methods: This prospective study was performed on 100 consecutive patients who were operated on for treatment of acute appendicitis in KVG medical college and hospital between 01 August 2019 to 01 February 2021. Clinically proven by a surgeon, patients underwent appendicectomy. Serum CRP results of all patients were determined. Sensitivity, specificity, positive predictive value and negative predictive value were calculated. Statistical analysis will be made using descriptive statistic and SPSS version 21 was used for analysis.
Results: The percentage of negative laparotomies was 13% and surgeon 's clinical suspicion was true in 87%. Preoperative CRP values were false negative in 21 patients with appendicitis and false positive in 2 patients with normal appendix. The difference of true and false results between CRP tests and surgeon's diagnosis was statistically significant (p=0.001). Present study revealed, sensitivity=76%, specificity=87.5%, positive predictive value=96% and negative predictive value=41%.
Conclusions: Serum C reactive protein when elevated supports the surgeon's clinical diagnosis of acute appendicitis. It can be used frequently to diagnosis the acuteappendicitis, so that the complication rate and negative laparotomies can be avoided.

Keywords: C-reactive protein, CRP, Acute appendicitis, Appendicectomy

INTRODUCTION

Clinical assessment remains the most important first step in evaluating patients with an acute abdomen. However, clinical examination has been found to be accurate only in 47-76% of patients with acute abdominal pain.[1] Acute appendicitis is a common and urgent surgical illness with protean manifestations, frequent overlap with other clinical syndromes, with significant morbidity, which increases with diagnostic delay. Despite intense research and discussion, the diagnosis of acute appendicitis is still difficult and remains perhaps the most common problem in clinical surgery. On the one hand normal appendix at appendicectomy represents misdiagnosis; on the other hand a diagnostic delay of appendicitis may lead to perforation, peritonitis and septicemia.[2] The surgeon's goal is to evaluate a relatively small population of patients referred for suspected appendicitis and to minimize the negative appendicectomy rate without increasing the incidence of complications.[3,4] Although surgeons have been confronting acute appendicitis for more than 100 years, its diagnosis remains elusive. The

clinical assessment in diagnosing appendicitis by an experienced surgeon remains reliable and superior to either Alvarado score or CRP measurement. Nevertheless, Alvarado score and serum CRP measurements may be of value to the inexperienced surgeon, and a high Alvarado score and serum CRP should not be ignored.[5] Appendicitis in infancy and also elderly is a rare condition and associated with a high frequency of perforation and peritonitis. Diagnosis is often difficult because of variable and nonspecific clinical manifestations.[6] The morbidity and mortality rates associated with appendicitis are greatly increased when perforation ensues. Appendiceal perforation can also cause tubal infertility. Ruptured retrocecal appendicitis can present as extremely fulminant form of a common disease such as extensive retroperitoneal and right thigh abscess.[7] It is therefore obvious that the aim of the surgeon must be to prevent perforation. According to Malone appendix is considered as specialized structure useful in reconstructive surgeries on biliary, tubal injuries and in urology.[16] Negative appendicectomy therefore robs the patient of a useful asset. Diagnostic accuracy of acute appendicitis remains insufficient, with a high rate of unnecessary operations. Only the promotion of routine ultrasonography might contribute to an improvement in the near future.[8] Cost-effective and easily applicable diagnostic methods with prompt results are required to reduce negative appendectomy rates.[9] Use of laparoscopy, ultrasonography, barium enema examinations and CT scanning has improved diagnostic accuracy. However, diagnostic efficiency can be improved, and unnecessary surgery prevented, by performance of an appropriately selected combination of laboratory tests combined with evaluation of clinical symptoms.[4]

Aim of the study

The aim of present work is to study the CRP values in three groups of patients operated for a clinical suspicious of acute appendicitis with different finding at appendicectomy, an un-inflamed appendix, uncomplicated acute appendicitis, or complicated acute appendicitis.

METHODS

This prospective study was performed on 100 consecutive patients who were operated on for treatment of acute appendicitis in KVG medical college and hospital between 01 August 2019 to 01 February 2021. Current study was started after obtaining approval from institutional ethical committee. Patients with acute abdominal pain were examined by surgeon. For establishing the diagnosis careful patient history was obtained at first. Physical examination of the patient by a surgeon was followed by some routine laboratory tests and radiographs. As inclusion criteria, for all patient's diagnosis was established by detecting right lower quadrant tenderness, guarding and rebound tenderness at physical examination, which was repeated as needed. Thereafter, the surgeon decided if emergency laparotomy was necessary. As exclusion criteria, patients medical unfit for surgery and patients who were not willing were deferred. Serum CRP concentrations were measured before operation by CRP kit. Normal CRP levels range from 0 to 6 mg/L (negative). We did not take into account preoperative serum CRP concentrations for the decision of laparotomy to compare diagnostic accuracy of CRP levels with surgeon's clinical impression. Depending on results of the examination by a surgeon, patients underwent surgery for treatment of acute appendicitis. Operative findings and histopathological examination of appendectomy specimens established the exact diagnosis. According to operative findings, histopathology reports, true and false surgeon's clinical diagnosis, true and false positive or negative serum CRP results were determined. Sensitivity, specificity, positive predictive value and negative predictive value were calculated. Statistical analysis will be made using descriptive statistic and SPSS version 21 was used for analysis.

RESULTS

Statistics

Maximum number of (53%) patients was <20 years of age and least were in age group of above 50 years (6%).

Table 1: Age group distribution.

Age (years)	Frequency	Percentage (%)
<20	53	53
20-30	24	24
30-40	9	9
40-50	8	8
50-60	6	6
Total	100	100

Table 2: Sex distribution.

Sex	Frequency	Percentage (%)
Male	57	57
Female	43	43

Majority (57%) patients were males and females accounted for (43%).

Table 3: intraoperative finding and CRP cross tabulation.

Variables	CRP positive	CRP negative
Un-inflamed appendix	2	12
Uncomplicated inflamed appendix	32	22
Complicated inflamed appendix	32	0
Total	66	34

The 32 out of 66 of patients had CRP positive status and were diagnosed to have complicated and also uncomplicated inflamed appendix. The 22 out of 34 of CRP negative patients had uncomplicated inflamed appendix. P=0.001(significant)

Table 4: Sensitivity, specificity, positive predictive value andnegative predictive value.

Variables	Appendicitis (positive)	Appendicitis (negative)	Total
CRP, (positive)	64 (a)	2 (b)	66
CRP, (negative)	20 (c)	14 (d)	34
	84	16	

a=True positive, b=False positive, c=False negative and d=True negative.

Sensitivity (a/a+c)=64/84=76%, specificity (d/b+d)=14/16=87.5%, positive predictive value (a/a+b)=64/66=96% and negative predictive value (d/c+d)=14/34=41%.

Distribution of cases according to CRP values

The 12 (92.3%) out of 13 patients had CRP levels of less than 6 and 1 (7.69%) out of 13 patients had CRP levels more than 6, collectively in patients with uninflamed appendix.

Table 5: Uninflamed appendix.

CRP values (mg/l)	No. of patients	Percentage (%)
Negative (0-6)	12	92.3
6 and above	1	7.69
Total	13	100

Table 6: Uncomplicated inflamed appendix.

CRP values (mg/l)	No. of patients	Percentage (%)
Negative (0-6)	22	40.74
6-12	19	35.18
12-24	6	11.1
24-36	4	7.4
36-48	3	5.56
Total	54	100

The twenty-two (40.74%) out of 54 patients has uncomplicated inflamed appendix with CRP levels less than 6. The 19 (35.18%) out of 54 patients have uncomplicated inflamed appendix with CRP level varying from 6 to 12.

Seven (21.21%) out of 33 patients had complicated inflamed appendix with CRP levels ranging from 48 to 96.

Table 7: Complicated inflamed appendix.

CRP values	No. of patients	Percentage (%)
Negative (0-6)	0	0
6-12	3	9.09
12-24	4	12.12
24-36	1	3.03
36-48	5	15.15
48-96	7	21.21
96-126	6	18.18
126-192	3	9.09
192-384	4	12.12
Total	33	100

Table 8: Mean and standard deviation of CRP values.

Variables	Total (n)	Mean	S. D.
Un-inflamed appendix	13	1.846	4.328
Uncomplicated inflamed appendix	54	7	10.115
Complicated inflamed appendix	33	78.36	78.587

SD of patients with uninflamed appendix was 4.328, SD of patients with uncomplicated inflamed appendix was 10.115 and SD of patients with complicated inflamed appendix was 78.587.

We performed negative laparotomies of 13%. Surgeon's clinical impression was true up to 87%. In 87 patients of acute appendicitis serum CRP was elevated in 63 and normal in 24. Of the 13 patients with normal appendix serum CRP levels were normal in 12 and elevated in two patients. Preoperative CRP values were false negative in 21 patients with appendicitis and false positive in two patients with normal appendix. The difference of true and false results between CRP tests and surgeon's diagnosis was statistically significant (p=0.001). Present study reveals CRP sensitivity of 76%, specificity of 87.5%, positive predictive value of 96% and Negative predictive value of 41%.

DISCUSSION

In this study the diagnostic value of the serum CRP levels in patients with clinical suspicion of acute appendicitis was investigated. Following the onset of the infection, an increase occurs in the synthesis of some hepatic proteins as an acute phase response. Serum concentrations of acute phase proteins augment in 8-12 hours after the onset of infection. One of these, CRP, is a marker of acute phase response can be used as an indicator of disease. Elevation of serum concentrations of CRP indicates the presence of acute appendicitis. In our study the second measurement of the CRP concentrations was made only 3 hours which could explain our negative

results. Indeed, several studies have reported that serum CRP increase is delayed 12 to 24 hours from the onset of inflammation symptoms.[10] In patients with acute appendicitis the decision of emergency laparotomy is based generally on the clinical impression of the surgeons. Present study reveals the negative laparotomy rate is 13%, which is near (16%) to study which was conducted by Blair et al with review of 2216 appendectomy specimens, which was confirmed by pathological diagnosis.[11] In present study serum CRP were elevated in 63 patients and normal in 24 patients of 87 patients with acute appendicitis whether it may be complicated or not. Mean CRP level in patients with complicated appendicitis was 78.36. Serum CRP levels were between 48 mg/L to 384 mg/L in 60.6% of complicated appendicitis group patients. Serum CRP levels were between 6 mg/L to 48 mg/L in 59.24% with uncomplicated appendicitis. We also suggest that the CRP values between 6 mg/L and 48 mg/L support the clinical diagnosis in patients having suspected clinical manifestation and signs of acute appendicitis, without increasing the risk of perforation or gangrene. Wu et al concluded that the change in the serum parameters could point for simple appendicitis when the increase in CRP is more than 118 mg/L.[12] Present study shows, CRP values are negative in 12 patients and positive in 2 patients with normal appendix. So, routine performance of CRP test can prevent the negative laparotomies. Present study is showing sensitivity of 76% specificity of 87.5%, positive predictive value of 96%, negative predictive value of 41%. Thirteen laparotomies might have been avoided if we would have relied on CRP values. The measurement of CRP is practical, easily applicable and cost effective. The previous studies have demonstrated a sensitivity of 40 to 94% and a specificity of 38 to 87% for CRP measurement.[13-15] The main limitation of our study was that the of patients were limited to the patients admitted to our hospital. Specifically, the association of CPR levels with the predication of acute appendicitis and its severity may provide inspiring ideas for large-scale prospective studies concerning faster diagnosis and treatment of patients with acute appendicitis.

CONCLUSION

Serum CRP when elevated supports the surgeon's clinical diagnosis of acute appendicitis. It can be used frequently to diagnose the acute appendicitis, so that the complication rate and negative laparotomies can be avoided. It is advisable to observe atypical patients with serial clinical examinations and CRP tests when there is doubt about the diagnosis with normal CRP levels.

ACKNOWLEDGEMENTS

Author would like to thanks Dr. K. V. Chidananda (Prof. in department of general surgery, KVG medical college and hospital).

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Abhirup HR, Priyanka K, Aishwarya KC. C-reactive protein, as a marker for predicting acute appendicitis and its severity in KVG medical college and hospital, Sullia. Int Surg J 2021;8:3002-6.