Original Article

OPEN ACCESS

Elevated C-reative protein (CRP) as a surgical indication for appendicitis

Shahida Khatoon[1], Mujeeb ur Rehman[2], Sohail Ahmed Memon[3], Shahzad Asfandyar Haider [4], Juwereya Memon[5], Salaam Memon[6]

[1]Associate Professor, Department of General Surgery LUMHS, Jamshoro
[2]Consultant General Surgeon, Department of General Surgery BMC, LUMHS, Jamshoro
[3,6]Assistant Professor, Department of General Surgery LUMHS, Jamshoro
[4]Consultant General Surgeon, Department of General Surgery LUMHS, Jamshoro
[5]Senior Registrar, Isra University, Hyderabad,

Author`s Contribution

[1,2]Conception, data acquisition, revision, and approval of the final draft, Designing and drafting of work,
[4]Critical revision of intellectual content
[3,5,6]Conception and data acquisition, Data analysis and interpretation

Funding Source: None
Conflict of Interest: None

Received: Aug 28, 2020
Accepted: Dec 16, 2020

Address of Correspondent
Dr. Mujeeb ur Rehman
Consultant general surgeon
Department of General surgery
LUMHS/Jamshoro
doctormujeeb786@gmail.com

ABSTRACT

Objective: Role of C-reactive protein value in the diagnosis of appendicitis by correlating with severity of appendicitis on histopathological findings.

Methodology: This descriptive study was conducted at the department of general surgery Unit-IV, Liaquat University Hospital Hyderabad from March 2016 to February 2017.

All cases above 12 years of age with severe appendicitis based on presenting signs and symptoms were included. The patient underwent routine laboratory investigations including abdominal plain x-ray in an erect position and ultrasound abdomen. The blood sample was taken from each patient for C-reactive protein and was send to Hospital diagnostic laboratory. During surgery, a specimen of each patient was sent to a diagnostic laboratory for histopathology. All the data were record on Performa.

Results: A total of 305 patients were studied; their mean age was 35.7+9.7 years. Males were found in the majority (73%). 75.41% of patients had leukocytosis. C-reactive protein was raised among 26.22% of patients. On histopathological findings, 04.91% of patients had a normal appendix, while 69.83% had gross inflammation of the appendix, 19.67% patients had gangrenous appendix, and 05.57% patients had perforation and peritonitis. Elevated C reactive protein (CRP) and leukocytosis were significantly associated with the severity of appendicitis, p value 0.001.

Conclusion: C-reactive protein is a non-invasive and reliable indicator for surgical treatment of appendicitis. C-reactive protein and white blood cells (WBCs) were significantly associated with the severity of appendicitis.

Keywords: Appendicitis CRP, histological findings.

Cite this article as: *Khatoon S, Rehmna MU, Memon SA, Haider SA, Memon J, Memon S. Elevated C-reactive protein (CRP) as a surgical indication for appendicitis. Ann Pak Inst Med Sci. 2020; 16(4):190-193.*

Introduction

Acute appendicitis is the commonest surgical condition involving emergency surgical procedures, as 22.3% of cases of appendices were operated out of 29.1% surgical cases of alimentary tract disease.[1] In spite of the availability of all advanced investigations, diagnosis of appendicitis remains difficult and some controversies regarding its treatment still present at several health facilities and practice patterns throughout the world.[2] Misdiagnosis of appendicitis can present with life threatening surgical emergency that contributes to a vast number of mortalities.[3] Acute appendicitis can be accurately diagnosed by a careful history, clinical, laboratory as well as imaging investigations. C-reactive protein (CRP) is a protein synthesized by the liver with normal values of less than 10mg/I. The concentration of CRP is elevated in diseases, inflammatory arthritis, and other many stressful conditions.[4] CRP is routinely used by surgeons as an assist (ancillary laboratory test) in the diagnosis of acute abdominal conditions like appendicitis. Literature shows that CRP has 97% of the positive

predictive value with a diagnostic accuracy of 86% for appendicitis.[5] Some studies show that if the CRP value is normal then appendicitis is unlikely, so it is suggested by authors that the CRP can be used as a supportive diagnostic tool for acute appendicitis.[6] The elevated CRP level enhances the diagnostic accuracy for acute appendicitis because diagnostic accuracy almost equal to white blood cells and neutrophil percentage.[7] However a combined diagnosis of WBC, neutrophil percentage, and C-reactive protein for acute appendicitis may significantly increase the accuracy.[7] The purpose of this research was to analyze the contribution of CRP values, so that the role of negative appendectomies can be minimized. Several studies had been done on this topic but no such study has been done in our institute, therefore this study has been conducted to assess the role of elevated C-reactive protein in the diagnosis of appendicitis by correlating it with the severity of appendicitis on surgical findings.

Methodology

This hospital based descriptive study was conducted in all surgical emergency units of Liaquat University Hospital Hyderabad after taking ethical approval. The study duration was 1 year from March 2016 to February 2017. All cases above 12 years of age, diagnosed as severe appendicitis based on presenting signs and symptoms comprising abdominal wall localized rigidity, right lower quadrant tenderness and rebound tenderness were included. Patients below 12 years of age or patients with hypertension, diabetes mellitus, tuberculosis, bleeding disorders, and those who refused to enroll in the study and also pregnant women were excluded. Informed consent was taken from all the patients. The patient underwent routine laboratory investigations including abdominal plain x-ray in erect position and abdominal ultrasound. 5ml blood sample was taken from each patient and was sent to the Hospital diagnostic laboratory for C-reactive protein level. C-reactive protein >6 mg/L was defined as positive. Patients underwent surgical treatment and surgeries were carried out by experienced surgeons having minimum 5 years' experience. During surgery, a specimen was taken from each patient and was sent to a laboratory for histopathological findings. All the data was recorded in the self-made proforma. Data analysis was performed by SPSS version-20. Quantitative variables like patients' age were represented by mean ± standard deviation. Frequencies and percentages were calculated for qualitative data like gender. Chi-square test was applied and a p-value <0.05 was considered as significant.

Results

Mean age of patients was 35.7+9.7 years with range of 22-43 years. Males were found in majority 73% as compared to female 27%. 100% patients had pain at right iliac fossa, 57.37% patients had anorexia, while 83.60% patients had nausea and vomiting, 65.90% had tenderness in right iliac fossa, 72.45% had rebound tenderness and 63.93% patients had raised temperature. (Table I)

Table I: Demographic characteristics of Cases (n=305)

	N (%)
Age groups	
12-30	50(16.39%)
31-45	190(62.29%)
46-60	65(21.31%)
Gender	
Male	83(27.2%)
Female	222(72.8%)
Clinical presentation	
Pain at RIF	305 (100.0%)
Anorexia	175 (18.8%)
Nausea, vomiting	255 (12.5%)
Tenderness in right iliac fossa	201 (31.2%)
Rebound tenderness	221 (18.8%)
Fever	195 (12.5%)
AGE (mean±SD)	35.7±9.7 years

C- reactive protein level was raised among 73.75% of patients. According to ultrasound assessment, perforation was found in 8.5% patients, the inflamed appendix was in 84.3% of patients and 7.25% of cases had no appendicitis. Among 24.59% of patients, leukocyte counts were normal, while 75.41% of patients had raised leukocytes. (Table II)

Table II: Patient's distribution according to leukocytosis, ultrasound findings and CRP level (n=305)

Variables	N (%)
Leukocytes	
Normal	75(24.6%)
Raised	230(75.4%)
Ultrasound findings	
Normal	22(7.2%)
Inflamed	257(84.3%)
Perforated	26(08.5%)
CRP level	
Normal	80(26.3%)
Raised	225(73.7%)

According to histopathological reports, 04.91% patients had normal appendix, while 69.83% patients had gross inflammatory appendix, 19.67% patients had gangrenous and 05.57% patients had perforation and peritonitis. (Figure 1)

Elevated C reactive protein was significantly associated with severity of appendicitis, p value 0.001. WBCs were also positively linked with the severity of appendicitis, p value 0.001. While ultrasound findings were also highly associated with appendicitis, but in inflamed appendicitis ultrasound findings were mostly normal, (p= 0,06). (Table III)

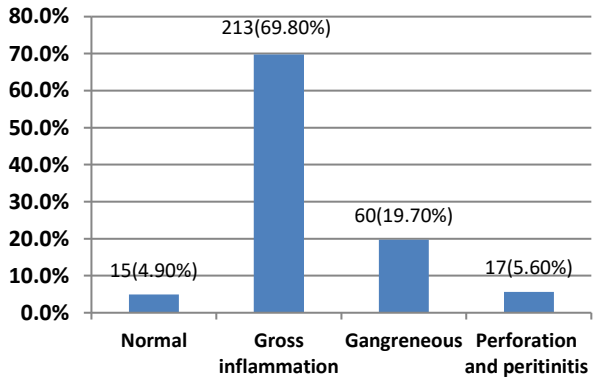

Figure I. Operative and pathological findings of appendicitis (n=305)

Discussion

Acute appendicitis is one of the commonest emergencies of Hospital admission. Health systems nowadays are driven by the cost effectiveness; thus, many studies evolved to find tests that could increase the accuracy of diagnosis and decrease the rate of unnecessary operations. CRP and WBC are inflammatory markers that may be used in the diagnosis of acute appendicitis. In this study, mean age was 35.7+9.7 years. Similar results were seen in the study of Yeboha et al.[8] In this study males were in majority, similarly, Halbhavi SN et al[9] also found males in the majority (104 out of 150). Saaiq M et al[10] also found similar findings regarding gender. In this series most of the patients had pain around the umbilicus and right iliac fossa, tenderness in the right iliac fossa, nausea, and vomiting, and fever, these findings were similar to the study conducted by Ngowe NM, et al.[11] Shrestha AL et al[12] stated that common clinical conditions to have a patient peri-umbilical pain subsequently localizing to right iliac fossa including vomiting, nausea, and fever. Halbhavi SN et al[9] reported that the commonest symptoms were pain at right iliac fossa 100% and anorexia 80%, further, he concluded that clinical diagnostic accuracy was 96%. In this study, leukocytosis was among 75.41% patients, which was comparable with Doraiswamy et al, as they reported leukocytosis in 42% cases and neutrophilia in 96%.[13] Saaiq M et al[10] reported that 67.38% of patients of appendicitis had leukocytosis.

In this study, serum CRP was significantly raised in 73.78% of patients having appendicitis, which was similar to the study of Pruekprasert, P et al[14] and Asfar S, et al[15]. Ghimire R et al[16] reported that CRP was significantly elevated in the highly inflamed appendix and further he stated that highly elevated C-reactive protein i.e >85 mg/dl was among them, most were a histopathologically gangrenous type. These findings are correlated with our findings as among 17 histopathologically perforated cases 16 were with elevated CRP level. Serum CRP is promptly evolving as a prognostic tool with an established application as well as being a sever phase reactant, CRP can be raised in further settings too, and therefore, the specificity of CRP

Table III: CRP, WBCs and US according to operative findings of appendicitis (n=305)

	Surgical findings				
	Normal (n=15)	**Inflamed** (n=213)	**Gangrenous** (n=60)	**Perforation n=17)**	**P-value**
CRP					
Normal	14	45	20	01	
Raised	01	168	40	16	0.001
WBCs					
Normal	15	51	07	02	
Raised	00	168	47	15	0.001
USG findings					
Normal	04	12	05	01	
Inflamed	10	193	39	08	0.001
perforated	01	08	16	08	

is low, however, it is a best inflammatory indicator due to its dramatic escalation in response to inflammation/infection and is always correlated with pathological disease. C-reactive protein level enhances the diagnostic accuracy of appendicitis at acute level. However, diagnose of the acute appendicitis mostly remains clinically and raised C-reactive protein can support the surgeon with clinical diagnosis.[17] Delay in the diagnosis of acute appendicitis is linked to raised complications and misdiagnosis of appendicitis may lead to unnecessary surgeries. However still the clinical diagnosis including history and the clinical examination remained the basis of the diagnosis, but many researchers have been focused on diagnosis values of the laboratory markers for acute appendicitis.[18] Hence, finally, it must be underlined that serum CRP estimation does not substitute clinical prognosis, however, it is a helpful adjunct prognostic tool in appendicitis.

Conclusion

This study concluded that C-reactive protein is a non-invasive good indicator for surgical treatment of appendicitis. C reactive protein and WBCs were significantly associated with the severity of appendicitis; these are good diagnosis criteria for diagnosis and severity of appendicitis.

References

1. JG M, SA K, LJ A, EA A. Intestinal Obstruction Caused By Appendicitis: A Systematic Review. J West Afr Coll Surg. 2017;7(3):94.
2. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, Boermeester M, Sartelli M, Coccolini F, Tarasconi A, de' Angelis N. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2020;15:1-42.
3. Spangler R, Van Pham T, Khoujah D, Martinez JP. Abdominal emergencies in the geriatric patient. Int J Emerg Med. 2014 ;7(1):43.
4. Sproston NR, Ashworth JJ. Role of C-reactive protein at sites of inflammation and infection. Frontiers in immunology. 2018 ;9:754.
5. Siddique K, Baruah P, Bhandari S, Mirza S, Harinath G. Diagnostic accuracy of white cell count and C-reactive protein for assessing the severity of paediatric appendicitis. JRSM short reports. 2011 Jul;2(7):1-6.
6. Panagiotopoulou IG, Parashar D, Lin R, Antonowicz S, Wells AD, Bajwa FM, Krijgsman B. The diagnostic value of white cell count, C-reactive protein and bilirubin in acute appendicitis and its complications. Ann R Coll Surg Engl. 2013;95(3):215-21.
7. Xharra S, Gashi-Luci L, Xharra K, Veselaj F, Bicaj B, Sada F, Krasniqi A. Correlation of serum C-reactive protein, white blood count and neutrophil percentage with histopathology findings in acute appendicitis. World J Emerg Surg. 2012 Dec;7(1):27.
8. Ohene yeboah M, Abantanga FA. Incidence of acute appendicitis in Kumasi, G hana. West Afr J Med 2009;28:1225.
9. Halbhavi SN, Lamni YP, Goudar BV, Kalburgi EB, Sushant PT. Comparison of clinical accuracy v/s investigations in the diagnosis of acute appendicitis. Int Surg J. 2018;5:838-42.
10. Saaiq M, Niaz-Ud-Din JA, Zubair M, Shah SA. Diagnostic accuracy of leukocytosis in prediction of acute appendicitis. J Coll Physicians Surg Pak. 2014 ;24(1):67-9.
11. Ngowe NM, Mahop BJ, Atangana R, Eyenga VC, PisohTangnym C, Sosso AM. Current clinical features of acute appendicitis in adult in Yaounde, Cameroon. Bull Soc Pathol Exot.2008;101(5):398-9.
12. Shrestha AL, Shrestha G. An Ulcerated Ileal Gastrointestinal Stromal Tumor Disguised as Acute Appendicitis. Case reports in surgery. 2018;2018.
13. Doraiswamy NV. The neutrophil count in childhood acute appendicitis. Br J Surg. 1977;64(5):342-4.
14. Pruekprasert P, Maipang T, Geater A, Apakupakul N, Ksuntigij P. Accuracy in diagnosis of acute appendicitis by comparing serum C-reactive protein measurements, Alvarado score and clinical impression of surgeons. J Med Assoc Thai.2004;87(3):296-303.
15. 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 Coll Surg Edinb. 2000;45(1):21-4.
16. Ghimire R, Sharma A, Bohara S. Role of C-reactive Protein in Acute Appendicitis. Kathmandu Univ Med J 2016;54(2):130-3.
17. Raja MH, Elshaikh E, Williams L, Ahmed MH. The value of CRP in enhancing diagnosis of acute appendicitis. J Curr Surg. 2017;7(1-2):7-10.
18. Bozlu G, Akar A, Durak F, Kuyucu N. Role of mean platelet volume-to-lymphocyte ratio in the diagnosis of childhood appendicitis. Arch Argent Pediatr. 2019;117(6):375-380.