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Association of Serum C Reactive Protein, White Blood Cell Count, and Neutrophil Percentage with Acute Appendicitis: A Cross Sectional Study

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Abstract

Aim: To assess the association of serum C reactive protein, white blood cell count, and neutrophil percentage with acute appendicitis

Study design: Cross sectional study

Place and duration: This study was conducted at Liaquat University of Medical Health Sciences Jamshoro, Pakistan, from February to 2020 to February 2021.

Methodology: The study included 173 people who had surgery for acute appendicitis. Before surgery, their white blood cell count (WBC), neutrophil percentage (NP), and c reactive protein (CRP) levels were measured. A macroscopic examination was done after the surgery. All of the subjects in this research had an appendectomy and a histological examination. It was assessed whether there was a link between the two factors by comparing the gross description to the histology data.

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Result: There were a total of 173 patients operated on, with an observational accuracy of 87.3 percent compared to 85.5 percent for histopathological accuracy. According to the histology findings, 25 individuals (14.5%) had normal appendices, whereas 148 patients (85.5%) had highly inflammatory, gangrenous, or perforated appendicitis. WBC levels were observed to be altered in 77.5 percent of patients, NP levels in 72.3 percent, and C-reactive protein levels in 76.2 percent. CRP and WBC levels were elevated in 126 (72.8%) of patients with positive appendicitis, although NP levels were higher than 75% in 117 patients with positive appendicitis (67.6 percent). The total sensitivity, specificity, and positive predictive values of the three tests, according to the results, were 95.3 percent, 72.2 percent, and 95.3 percent, respectively.

Conclusion: According to the findings of the study, a high level of CRP was shown to be directly connected to the degree of inflammation. The use of CRP observing improves the accuracy of the diagnosis of acute appendicitis in suspected appendicitis patients. The diagnostic accuracy of CRP is not statistically significantly than the combined diagnostic accuracy of WBC and NP. When these three tests are used together, their accuracy improves dramatically. Elevated serum CRP levels, according to our findings, confirm the surgeon's clinical diagnosis.

Keywords: acute appendicitis, C- reactive protein, correlation, white blood count, neutrophils, histopathology

Introduction

Acute appendicitis is the most frequent surgical emergency, accounting for around 5 percent of all surgical emergencies. (1-3). Medical records, clinical investigation, and physical exam are often used to diagnose it .(4) White blood cells, differential counts and C-reactive protein are some of the laboratory tests that are used in this procedure as a diagnostic tool (CRP). (5, 6) Between 76% and 92% of the time, the clinical diagnosis of acute appendicitis is accurate.(7-9) As a result, accurate identification of acute appendicitis remains a challenge. (10, 11) Perforation rates and the frequency of negative appendectomies are both high. (12) The incidence of negative appendectomies has reduced. (13-15) with the advent of ultrasound scans in the previous two decades and computed tomography (CT) in the last decade, but the perforation rate has remained high (22 percent to 62 percent).(16, 17) Because appendectomy, like any other therapy, has socioeconomic consequences in the form of missed work days and poorer productivity, negative appstomies are a burden on general surgeons as well as patients and society at large. C-reactive protein (CRP) is a non-specific inflammatory measure often used in hospitals to help diagnose patients with acute abdominal pain. The liver produces acute phase protein. This level is considered normal 8–12 hours after infection or trauma; but in practice, it is more crucial to monitor liver CRP levels. Interleukin-6 (IL-6) governs the production of CRP, which may increase by a factor of 10 to 1,000 in a matter of minutes. Several conditions such as infections, inflammatory arthritis, autoimmune illnesses, neoplasia, pregnancy, and old age all cause elevated CRP levels.(18-20)

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The relevance of a high serum CRP measurement in enhancing the diagnosis of acute appendicitis has been studied in a number of studies. (21) More tests are required to increase diagnosis accuracy and minimize the number of needless procedures. In reaction to tissue damage, C-reactive protein (CRP) and other acute-phase proteins increased.(22) The aim of this study was to explore the accurate diagnosis of acute appendicitis compared CRP levels to other parameters like WBC, NP & histopathological findings.

Methodology

During the study, all operated patients (173) who were suspected of having acute appendicitis at the Department of Surgery were included. Permission was taken from the ethical review committee of the institute. On admission, the surgeon confirmed the presence of acute appendicitis and the duration of the patient's symptoms. Direct right lower quadrant discomfort, percussion and rebound soreness, localized stiffness, and wide abdominal wall rigidity were all seen in the patient's medical history. Clinical symptoms must have at least one clinical sign in order to be considered positive. Hospital observation time was documented in all patients until the operation was done.

On admission, blood samples were taken for regular laboratory tests. The Hematology Analyzer was used to count white blood cells and differential counts (HARIBA ABX Micros 60). In our lab, a typical WBC number is 0–10 x 10^9/L. Above-normal levels were defined as those above 10 x 10^9/L. When the proportion of neutrophils was more than 75%, it was termed high. In non-diluted serum Latex agglutination slides were used to measure C-reactive protein concentrations for qualitative and semi-quantitative purposes. Serum dilutions were produced with 0.9 percent sodium chloride, according to the manufacturer's directions, for semi-quantitative analysis. Each dilution was examined using the qualitative approach outlined above until no more agglutination was found. Serum CRP values were not used to make surgical intervention decisions or to compare them to the surgeon's clinical diagnosis. Furthermore, the clinical results, choices, and consequences were not communicated to the laboratory personnel (double blind study).

Hematoxylin and eosin staining was used to examine the appendixes, which had been removed and preserved in 4% formalin. Group A normal appendix, Group B inflamed appendix (simply appendicitis), and Group C perforated/gangrene-infected appendix were the three groups of appendix excised from the individuals. The surgeon's macroscopic examination and histology were utilized to reach the final diagnosis. Only surgical diagnoses were given access to the patients' medical and laboratory records.

To find out which of the two groups differed most, we examined every single attribute. It was possible to determine which laboratory indicators had the greatest sensitivity and specificity by looking at how much of an area under the receiver-operating characteristic (ROC) curves of examined laboratory indicators**.**

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Results:

A total of 148 (85.55%) people were diagnosed positive for acute appendicitis according to histopathologic abnormalities. The remaining 25 (14.45 percent) patients had their normal appendix removed: men (N = 90), females (N = 83), and children (N = 68). The male-to-female ratio was 1.09:1. Patients varied in age from 5 to 59 years old, with a mean (SD) of 19.7 years (9.5), whereas 83.5 percent were under 30 years of age. Group A comprised 25 patients with a normal appendix, whereas Group B had 148 patients with an inflammatory appendix, according to histological data. Acute uncomplicated appendicitis accounted for 36 (20.81%) of patients with a positive appendicitis, whereas a ruptured/perforated/gangrenous appendix accounted for 112 (64.74%). (Group-C, complicated appendicitis). Appendicitis with perforation was determined to be 12.1 percent of the time (As shown in Table 1).

Nonspecific abdominal discomfort (15.7 percent), perforated ovarian cysts (4.3 percent), mesenteric lymphadenitis (5.9%), and urine infection were the most prevalent diagnoses linked with initial negative appendectomy in Group A patients (1.7 percent). In 22 individuals with acute appendicitis, serum CRP levels were normal. As a result, CRP had a false-negative rate of 12.71 percent and an accuracy of 83.2 percent in this study. The CRP diagnosis was correct in 87.28 percent (N = 151) of patients and incorrect in 12.72 percent based on surgeons' clinical opinion.

The WBC counts in Group A ranged from 5.3 to 14.7, with a 4.62 percent false positive rate and a 12.72 percent false negative rate, yielding a positive predictive value of 94 percent and an accuracy of 82.6 percent. The proportion of neutrophils in Groups A, B, and C ranged from 54.2 to 88.6, with a sensitivity of 79.1% and a specificity of 68%. In 126 (85.1%) of the patients with positive histology, the WBC and CRP levels were increased (Groups B and C). Total 18 of the 25 patients with a negative appendix had normal CRP, and 17 of them had normal WBC. The combined sensitivity, specificity, and positive predictive value of all three indicators (WBC, CRP, and percentage of neutrophil count) was 95.3 percent (As shown in Table 2)

Table 1: Histopathology features of appendix

Histopathology features	Males	Females	Number	Percentage
Group A	5	20	25	14.2
Group B	0	2	2	1.2
Non complicated appendicitis	11	23	34	19.6
Group C	60	31	91	52.6
Perforated appendicitis	14	7	21	12.2
Total	90	83	173	100
	52	48	100	

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Table 2: Indices of diagnostic values

Method of diagnosis	Diagnostic accuracy	Sensitivity	Specificity	PPV (%)
C reactive protein	83.1	85.1	72	94.6
PN	77.6	78.1	68	93.5
WBC	82.5	85.1	68	94
CPR+ PN	90.1	92.5	75	95.8
CPR+ LEU	91.1	94.3	72	95.2
CPR+ LEU+ PN	91.8	95.2	91.9	95.2
LEU +PN	87.1	89.9	71.4	94.6

Discussion

It is more accurate to diagnose with a high CRP than a high WBC or neutrophil count. (8) In a double-blind experiment, Asfar et al. (2000) discovered that CRP had a sensitivity and specificity of 86.6 percent and 93.6 percent, respectively. They got to the conclusion that a healthy, non-inflamed appendix is indicated by a normal CRP test. (12). As compared to WBC and neutrophil counts, it is a more sensitive test and its usage in combination considerably increases accuracy and sensitivity. Erkassap (2000) discovered that the CRP had a sensitivity and specificity of 96% and 78%, respectively, and a positive predictive value of 100% in a positive examination of 102 patients. (23) (24).

The risk of complex appendicitis at hospital admission was quite high in our study. A burst, perforated, or gangrenous appendix was found in 112 (64.7%) of the patients. Perforated appendicitis affected 12.1 percent of people. In remote areas, skilled medical practitioners misdiagnosed patients, delaying their reporting to surgery and treating them with gastroenteritis, bladder infection, and other conditions.

The CRP's accuracy (83.2%) is not considerably higher than the WBC's (82.6%) or the NP's (82.6%). When all of these factors are included, the accuracy rises to 91.9 percent. Anderson (2000) found that the WBC and neutrophil count are the superior criterion for future exams in a prospective trial of 420 patients with a questionable diagnosis of appendicitis (25) CRP and WBC levels were within normal limits in 22 of 148 participants with acute appendicitis in our study (12.72 percent). Simple acute appendicitis (Group B) had considerably higher CRP than normal appendix (Group A) (p 0.001), while complex acute appendicitis (Group C) had significantly higher CRP than normal appendix and uncomplicated acute appendicitis (p 0.0001). When inflammation is more intense, the percentages of white blood cells and neutrophils are likewise greater (p >0.05). The results of any of these tests may be slightly off. CRP or leukocyte count protect against a negative appendectomy, but it is not the only one. CRP and leukocyte counts are not reliable indicators of acute appendicitis in children. (26) The most impacted age

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group, according to our findings, was 10–19 years old (50.3 percent). CRP levels as a diagnostic tool for acute appendicitis did not vary significantly across age groups or genders.

The CRP levels in our study correlate to a series with a high proportion of complex appendicitis, which is characteristic of rural hospitals and healthcare systems in disarray. Other investigators, however, have shown a link between CRP levels and the severity of appendicitis.

Different clinical classifications for acute appendicitis are in use(27), the appendix's gross appearance and pathological stage were combined in the categorization we used. (28)since the link of CRP levels with histopathological findings was explored. Nonsurgical therapy of acute appendicitis with catarrhal is changes or phlegmonous changes has been demonstrated to be safe and effective. (29, 30)

The severity of acute appendicitis may be reliably predicted by CRP, according to our results and those of earlier studies. When it comes to diagnosing and treating appendicitis, we believe that the CRP test is not a specific test; therefore, clinicians must rely on the structural interpretation of subjective experience, clinical information, and diagnostic tools like laboratory tests, ultrasound, and computed tomography (31). (32) (33) Finally, laboratory testing in conjunction with imaging diagnostic methods may still be utilized to rule out alternative causes of severe abdominal pain and identify acute appendicitis..

Conclusion

The CRP's diagnostic accuracy is comparable to that of the WBC and Neutrophils. CRP levels have been demonstrated to be linked to the severity of inflammation. In acute appendicitis, a combination of CRP, WBC, and neutrophil percentage increases diagnostic accuracy. Despite the fact that this preoperative combination reduces false positive and false negative diagnoses, none of these tests are 100% accurate in detecting acute appendicitis. Greater serum CRP levels support the surgeon's clinical diagnosis, according to our findings. CRP measurement is recommended as a regular laboratory test in those who have suspected acute appendicitis.

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It was taken from the ethical review committee of the institute
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Conflict of interest:
None

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