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Original Research Article

Role of total leukocyte count and C-reactive protein in diagnosis of acute appendicitis

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ABSTRACT

Background: Acute appendicitis is still one of the most common surgical emergencies. This study was conducted to check the sensitivity and specificity of Total leukocyte count (TLC) and C Reactive Protein (CRP) of acute appendicitis. Aim and objectives were to check the sensitivity and specificity of total leukocyte count in diagnosis of acute appendicitis and to check the sensitivity and specificity of CRP in diagnosis of acute appendicitis. To determine TLC and CRP efficacy in diagnosis of acute appendicitis.
Methods: TLC and CRP were calculated in all patients who were planned to undergo appendectomy. Appendectomies were performed independent of results of TLC and CRP levels. For statistical purpose the patients were assigned into 2 groups- Group-A Patients with inflamed/perforated/gangrenous appendix, Group-B patients with Normal appendix. The normal TLC and CRP values, raised TLC, raised CRP, and raised both TLC and CRP values calculated in each of these groups. Sensitivity and Specificity were calculated. The cut off value for TLC was 11x106/L. This value was selected arbitrarily as it corresponds to the elevated TLC. The CRP levels were calculated and cut off value was taken as 1.7mg/dl.
Results: Out of 75 cases, 55 were male and 20 were female. Age ranged from 13 to 58 years. CRP was raised in 82.14% of inflamed appendix cases TLC was raised in 76.79% of inflamed appendix cases and both was raised in 92.5% of inflamed appendix cases.
Conclusions: TLC and CRP are useful in diagnosis of acute appendicitis. Negative appendicectomy rate can be decreased.

Keywords: CRP, TLC

INTRODUCTION

Acute appendicitis is still one of the most-commonest surgical emergencies.[1] The diagnosis is primarily clinical. A typical patient presents with right lower abdominal pain, nausea and vomiting with tenderness or guarding rigidity in right iliac fossa on examination.

However, these signs and symptoms are not very specific for appendicitis.[2] The picture is more confusing due to variable positions of appendix. Despite of advances in diagnostic modalities the diagnosis still doubtful in 30-40% of cases.[3] The definite diagnosis of appendicitis still remains a clinical decision, augmented by appropriate tests.

TLC has remained an important factor in definite diagnosis of appendicitis. Various studies have shown that this can be very nonspecific at times.[4] Recently interest has grown in other inflammatory markers which could be helpful in diagnosing appendicitis. CRP is one of them.

Various diagnostic modalities such as radiological, laparoscopy and laboratory methods have been reported to reduce the incidence of negative exploration. Leukocyte count has been useful adjunct for diagnosis; however, the utility of this test has been poorly characterized. A more recently suggested laboratory evaluation is determination of C-reactive protein level. CRP is an acute phase reactant synthesized by the liver in response to tissue injury. The measurement of CRP is available, easy to perform and economical. As CRP is an inflammatory marker, it is expected to rise in case of acute appendicitis. Many workers have investigated the value of CRP in improving the diagnostic accuracy of acute appendicitis. A multivariate analysis showed that serial CRP measurement can improve the accuracy of diagnosing acute appendicitis.[5]

This study was conducted to check the sensitivity and specificity of TLC and CRP in patients presenting with right iliac fossa pain and its efficacy in diagnosing acute appendicitis.

Aim and objectives were to check the sensitivity and specificity of total leukocyte count in diagnosis of acute appendicitis and to check the sensitivity and specificity of CRP in diagnosis of acute appendicitis. To determine TLC and CRP efficacy in diagnosis of acute appendicitis.

METHODS

The study was conducted in Department of Surgery at DPU Pune. The data was studied from January 2014 to January 2016. A total number of 75 cases were taken diagnosed as acute appendicitis. Patients above 12 years of age who were diagnosed as acute appendicitis on the basis of presenting symptoms and signs were enrolled. Those cases like patients with RIF pain treated conservatively. Patients with extreme age, Pain in RIF with pregnancy, immunocompromised status, pre-existing disease and patients suffering from other acute inflammatory condition were excluded from the study.

All patients were subjected to routine blood investigations in addition to pre-operative imaging like ultrasonography. Informed consent was obtained from all registered cases. TLC and CRP were evaluated in all patients who planned for appendectomy. Appendectomies were performed independent of results of TLC and CRP levels. The laboratory staff were blinded. Appendix specimen sent to histopathological examination.

The records of all patients were accessed from pathology department with histopathological results. This was used to get the incidence of negative appendectomy and then on these features patients were divided into two groups as.

- *Group A:* Inflamed/perforated/gangrenous appendix
- *Group B:* Normal appendix

For statistical purpose this 2 groups were used. The normal TLC and CRP values, raised TLC, raised CRP, and raised both TLC and CRP values calculated in each of these groups. The sensitivity and specificity of these tests were calculated according to following formulas.

Sensitivity = true positive/true positives = false positives

Specificity= true negative/true negatives = false positives

The Cut off value for TLC $11X10^6$/L. This value was selected arbitrarily as it corresponds to elevated TLC. The CRP levels were calculated and cut off value was taken1.7mg/dl.[5]

RESULTS

Age and sex distribution among 75 cases of operated appendicectomy in this study, 20(20.67%) were female and 55(73.33%) were male. Patients age group ranged from 13 years to 58 years. Maximum group of patients belonged to 21-30 years (25 patients i.e., 33.34%).

Table 1: Age and sex distribution.

Age	Male	Female	Total
12-20	14	06	20
21-30	20	05	25
31-40	14	07	21
41-50	05	01	06
51-60	02	01	03
Total	55	20	75

Chi square=1.53, P>0.05

Table 2: Distribution of cases.

Histopathology of appendix	No. of patients	Percentage
Group A	56	74.67%
Group B	19	25.33%
Total	75	100%

Distribution of cases by histopathology a total of 56 patients. Group A had inflamed appendix (74.67%), out of which 4% cases were complicated. The negative appendicectomy rate in this study is 25.33% (19) Group B.

Table 3: Distribution of cases by histopathology correlation in sex.

HPE type	Number	Male	Female
Group A	56	40	16
Group B	19	15	04
Total	75	55	20

Chi square=0.41, P>0.05

Distribution of cases by histopathology correlation in sex Group A 71.43% (40) males and 28.57% (16) females

had inflamed appendix. Group B 78.95% (15) males and 21.05% (4) females had normal appendix.

Table 4: CRP and histopathology correlation.

	CRP		Total
	Raised	Normal	
Group A	46	10	56
Group B	05	14	19
Total	51	24	75

Sensitivity-82.14%; Specificity-73.68%; PPV-90.19%; NPV-58.33%; Accuracy-80%; Chi square=20.32, P<0.0001

CRP and histopathology correlation Among 56 Inflamed appendix cases, CRP was found to be raised in 46(82.14%) cases and normal in 10 (17.86%) cases. among 19 normal appendix cases, CRP was found to be raised in 5 (26.32%) cases and normal in 14 (73.68%) cases.

Table 5: TLC and histopathology correlation.

	TLC		Total
	Raised	Normal	
Group A	43	13	56
Group B	06	13	19
Total	49	26	75

Sensitivity-76.79%; Specificity-68.42%; PPV-87.76%; NPV-50%; Accuracy-74.67%; Chi square=12.80, P<0.0001

TLC and histopathology correlation among 56 inflamed appendix cases, TLC was found to be raised in 43 (76.79%) cases and normal in 13 (23.21%) cases. Among 19 normal appendix cases, CRP was found to be raised in 6 (31.58%) cases and normal in 13 (68.42%) cases.

Table 6: Correlation between TLC and CRP in combination with histopathology report.

	TLC and CRP		Total
	Raised	Normal	
Group A	37	04	40
Group B	03	11	15
Total	41	15	55

Sensitivity-90.24%; Specificity-78.57%; PPV-92.50%; NPV-73.33%; Accuracy-82.27%; Chi square=24.92, P<0.0001

Correlation between TLC and CRP in combination with histopathology report in total of 75 cases studied, 55(73.33%) cases CRP and TLC in combination was either raised (74.55%) or normal (25.55%). Three (5.45%) cases of normal appendix had raised CRP and TLC in combination.

DISCUSSION

A total of 75 patients were included in this study. Patients with extreme age, pregnancy, immunocompromised status, preexisting disease and patients suffering from other acute inflammatory conditions were excluded from the study. Out of 75 patients,20 (22.67%) were female and 55 (73.33%) were male. Maximum group of patients belonged to 21-30 years (25 patients i.e., 33.34%). Appendicitis is mainly a disease of adolescents and young adult .[6]

Clinical diagnosis was found to be correct in 74.67% of cases and negative appendicectomy rate was 25.33% in this study. A high degree of accuracy is required to reduce the incidence of negative appendicectomies which still remain around 20%.[7]

CRP and acute appendicitis

In this study, the CRP has a sensitivity of 82.14%, specificity of 73.68%. This is comparable to the study done by Asafar where sensitivity and specificity were 86.6% and 93.6% respectively.[8]

Study found sensitivity of 93.5% and specificity of 80% and pointed that normal CRP is mostly associated with normal appendices, deferring surgery would probably reduce unnecessary appendicectomies.[9]

In this study, none of the case with appendicular perforation had normal CRP. This observation is supported by the study done by Gronroo's.[10]

In this study, 17.86% of cases had normal CRP levels even though HPE was positive. So, it was advised by thimsen in his study that if the symptoms are present for more than 12 hours and CRP was negative, acute appendicitis was unlikely.[11]

False negative reactions usually occur early in the infective episode, the reasons are due to technical pitfalls in laboratory testing. Because CRP levels can increase very rapidly and dramatically, the latex agglutination assay is subject to false negative reactions due to a prozone-type phenomenon in which all of the antibody combining sites on the latex particles are bound to as excess of CRP, so no crosslinking (agglutination) can occur.

Thus, at the end it should be stressed that serum CRP estimation does not replace clinical diagnosis but is useful adjunct in diagnosis of acute appendicitis. Serum CRP value should be interpreted in combination with clinical findings and leukocyte count.

TLC and acute appendicitis

The sensitivity, specificity, predictive value of positive test and predictive value of negative test of TLC in our study is 76.79%, 68.42%, 87.76% and 50% respectively. These results were in accordance with study by Yang et al indicating high association between TLC and acute appendicitis.[12]

According to study done by Goonroos JM et al TLC was the test of choice in diagnosing uncomplicated acute appendicitis, however it's a poor predictor of protracted inflammation.[13] This supported in study by David and Berchley et al.[14] The TLC count when done individually distinguishes normal appendix from uncomplicated acute appendicitis. But does not distinguish uncomplicated from complicated appendicitis. Colemen C et al reported that TLC is a poor predictor of severity of disease.[15] Vermenum et al after evaluating 221 patients concluded that TLC count did not significantly influence the surgical decision making.[16]

The role of combining TLC and CRP in diagnosis of acute appendicitis

In this study author correlated the TLC and CRP in combination with histopathology and found sensitivity and specificity of 90.24% and 78.57% respectively. This had better significance than individual TLC or CRP.[12]

When combined value of CRP, WBC and raised neutrophil count is taken into consideration negative value was important. Avoiding surgery in these cases can reduce negative appendicectomy rate considerably. Marchand et al in their study suggested that combination of these tests has 100% sensitivity and 50% specificity in the diagnosis of acute appendicitis.[17,18]

CONCLUSION

TLC and CRP are useful in diagnosis of acute appendicitis. Appendicitis is common in adult and children. In the present study association of CRP and acute appendicitis has shown to be significant, but it cannot replace surgeon's clinical acumen.

Combining the TLC and CRP increases sensitivity, specificity, positive predictive value, negative predictive value. The negative predictive value in our study is 73.33% that is if TLC and CRP are negative, deferring surgery in this group is recommended. Therefore, unnecessary appendicectomy in the 11 patients in whom the test was true negative could be avoided, thereby decreasing the rate of negative laparotomies and also associated morbidity.

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