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### Role of C: Reactive protein, total leucocyte count and ultrasonography in diagnosing acute appendicitis

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#### Abstract

**Introduction:** Acute appendicitis is the commonest surgical emergency. Many laboratory investigations and radiology aid in its diagnosis. Out of which CRP, TLC and USG are commonly used.

**Aim:** To study the role of CRP, TLC and USG in diagnosis of acute appendicitis

**Objective:** to prove that combined values of above aid in higher sensitivity in diagnosing appendicitis.

**Methodology:** Total 97 patients were included in study from period December 2012 to June 2014 in KIMS, Hubli.

**Results:** The combined values of CRP, TLC and USG has 100% sensitivity in diagnosing acute appendicitis.

**Keywords:** CRP, TLC, USG, acute, appendicitis

#### Introduction

Acute appendicitis is still one of the most-commonest surgical emergencies. <sup>[1]</sup> 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. <sup>[2]</sup> 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. <sup>[3]</sup> The definite diagnosis of appendicitis still remains a clinical decision, augmented by appropriate tests.

Appendectomy is one of the most common surgical procedures all over the world and despite the advancement in the diagnostic and laboratory methods, still the rate of negative appendectomy is 15-30% <sup>[4]</sup>. Health systems nowadays are driven by the cost effectiveness; thus, many studies evolved to find tests that could increase the accuracy of diagnosis and reduce the number of unnecessary operations. C-reactive protein (CRP) and Total Leucocyte count (TLC) are inflammatory markers used in the diagnosis of infection.

Total Leucocyte count (TLC) is one of the helpful investigations in diagnosis of acute appendicitis. Mild leucocytosis, ranging from 10,000 to 18,000 is usually present in patients with acute, uncomplicated appendicitis and is often accompanied by a moderate polymorphonuclear predominance <sup>[5]</sup>. The white blood cell count is elevated with more than 75% neutrophils in most patients. A completely normal leukocyte count and differential is found in about 10% of patients with acute appendicitis. A high white blood cell count (>20,000/mL) suggests complicated appendicitis with either gangrene or perforation. <sup>[6]</sup> The clinician must remember, however, that the TLC can be normal in patients with acute appendicitis, particularly in early cases. <sup>[7]</sup> Serial TLC measurements improve the diagnostic accuracy, with a rising value over time commonly seen in patients with appendicitis, but tends to fall in those without appendicitis. TLC count is raised in 25-70% of patients with other cause of acute right iliac fossa pain. <sup>[8]</sup> In women the diagnostic accuracy in acute appendicitis is usually as low as 60-70%. <sup>[9]</sup> CRP was first identified in 1930 by Tillet and Francis. It is an acute phase protein produced in the liver. It usually increases 8-12 h after infection or trauma. Production of CRP is controlled by interleukin-6. CRP is one of the strongest acute phase reactants with plasma concentration rising up to thousand-fold after myocardial infarction, stress, trauma, infection inflammation, surgery or neoplastic proliferation. Concentrations >5-10 mg/L suggest the presence of infection or inflammation <sup>[10]</sup>. Latex agglutination test is used to detect the CRP. Based on the principle of passive agglutination test, CRP can be measured with direct Immunonephelometric assay using antibody to CRP <sup>[10]</sup>

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Apart from laboratory investigations, radiology most commonly & the Ultrasonography (USG) is widely used in diagnosing acute appendicitis. The graded compression technique for ultrasound examination of the appendix was described by Julien Puylaert in 1986. Using a probe of at least 7 MHz over the point of maximum tenderness in the right iliac fossa pressure is gradually increased over the area to displace the bowel loops. The most sensitive sign is a non-compressible appendix with a diameter of 7 mm or greater (23). A sensitivity of around 55-96% and a specificity of 85-98% is recorded. [11]



**Image 1:** ultrasonographic picture of inflamed appendix with colour Doppler

Our aim and objective of this study is to know the sensitivity and specificity of CRP, TLC and radiology in the form of USG in diagnosing acute appendicitis.

**Methodology**

This study was performed on 97 of patients in Karnataka Institute of Medical Sciences from December 2012 to June 2014. These patients were diagnosed to have acute appendicitis and were operated. All patients having suspected appendicitis were studied and their TLC, CRP values and Radiology in the form of ultrasonography findings were recorded. Details of cases were recorded including history and clinical examination. Routine pre-operative investigations were performed in all patients suspected of having acute appendicitis. Ethical clearance was obtained.

For the study purpose the following variables were considered. Pre-operatively: Total leukocyte count of >10,000 cells/cmm C Reactive Protein of >6mg/L

Radiological intervention in the form of Ultrasonography of the abdomen: A Non-compressible appendix measuring >6 mm in the antero-posterior Diameter is demonstrated.

Post-operatively: The specimen was sent for Histopathological examination which was

Considered for the final confirmation of Acute Appendicitis.

Inclusion Criteria:

1. Cases presenting with Right iliac fossa tenderness.
2. Age more than 14 years
3. Patients with no medical illnesses.
4. Exclusion Criteria
5. Age less than 14 years
6. Patients with pain in the abdomen other than right iliac fossa tenderness.
7. Patients with other medical illnesses like DM, liver diseases.

**Procedure**

2ml of venous blood sample was collected. TLC and CRP was determined.

TLC was determined with the automated cell count analyser in the Department of Pathology.

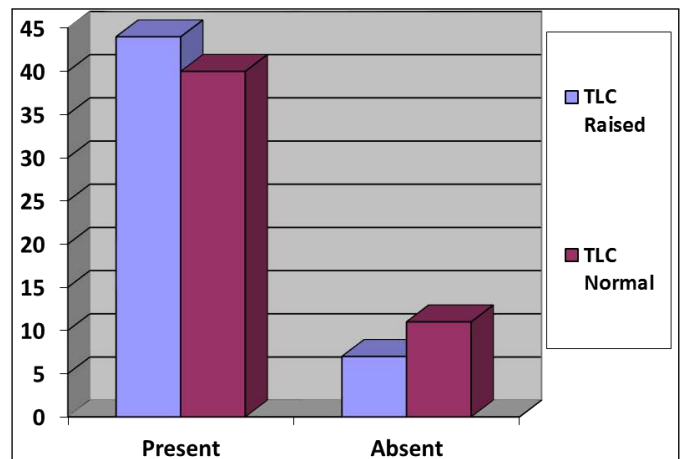
CRP was determined with the help of Latex agglutination test. With value of >6mg/dl agglutination was observed and the test was considered positive.

USG was performed by Radiologist in the Department of Radiology using a linear probe with a frequency between 7-12 MHz

Post operatively specimen was sent for histopathological examination.

**Results**

In this study, from a total of 97 patients, maximum number of patients belonged to the age group of 21-30 years i.e. 44 patients followed by 27 patients in the less than 21 years age group. Just 5 patients were present in the above 40 years age group. A total of 97 cases were included in the study, of which 68 were males and 29 were females.



**Graph 1:** TLC in Acute Appendicitis

**Table 1:** TLC in Acute Appendicitis

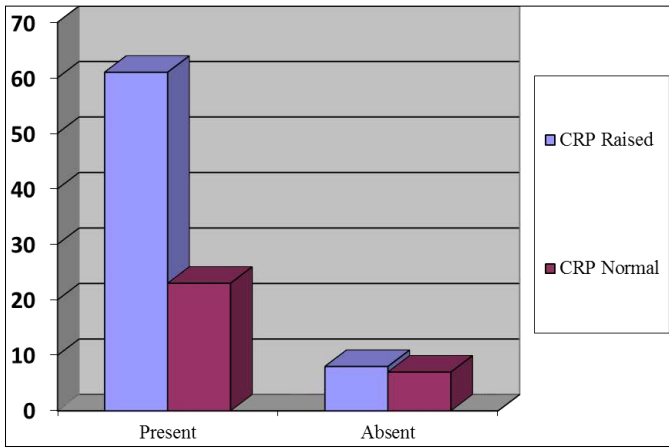
TLC	Acute appendicitis		Total
	+	-	
Raised	44	7	51
Normal	40	6	46
Total	84	13	97

Sensitivity: 52.4%, Specificity: 46.2%, Positive predictive value: 86.3%, Negative predictive value: 13.0%. This test is not significant with p value of 0.92.

Total leukocyte count was found to be increased i.e. 10,000 cells/cmm in 51 patients of which 44 patients had features of acute appendicitis and the rest 7 patients did not have features of acute appendicitis. Of the patients with acute appendicitis 40 patients had normal TLC.

**Table 2:** CRP in Acute Appendicitis

CRP	Acute Appendicitis		Total
	+	-	
Positive	61	8	69
Normal	23	5	28
Total	84	13	97

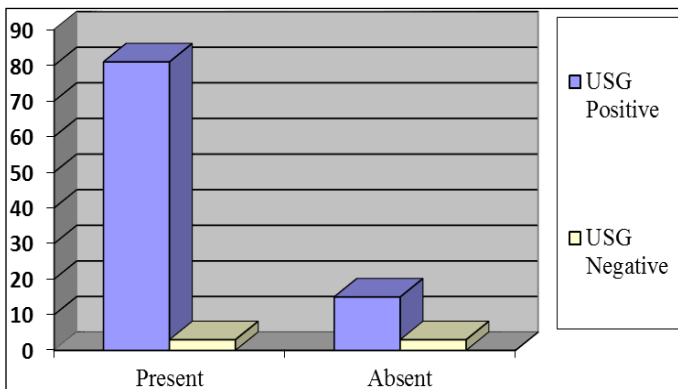


**Graph 2:** CRP in Acute Appendicitis

Sensitivity: 72.61%, Specificity: 38.5%, Positive predictive value: 88.4%, Negative predictive value: 17.9%. The test is not significant with p value of 0.41. CRP alone was elevated in 69 patients out of 97 patients but only 61 patients had features of acute appendicitis and CRP was normal in 8 patients in patients with acute appendicitis.

**Table 3:** USG in Acute Appendicitis

USG	Acute Appendicitis		Total
	+	-	
Inflamed	81	10	91
Not visualized	3	3	6
Total	84	13	97

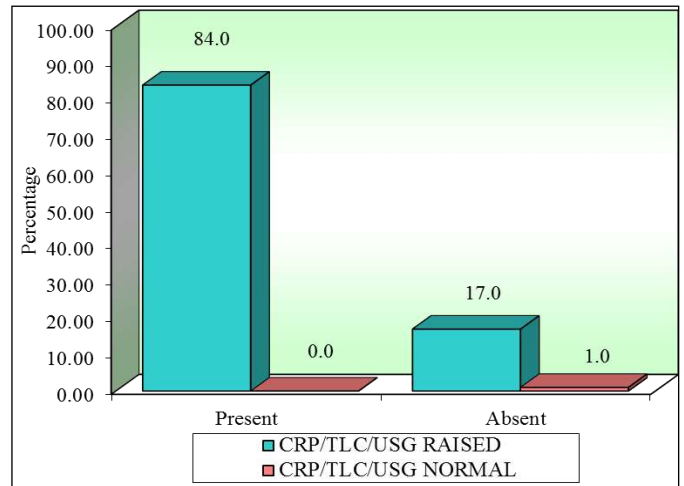


**Graph 3:** USG in Acute Appendicitis

Sensitivity: 96.4%, Specificity: 23.1%, Positive predictive value: 89.0%, Negative predictive value: 50.00%. This test was significant with p value of 0.006. Ultrasonography was done on these patients which demonstrated inflamed appendix in 91 patients and the rest 6 patients though intraoperatively had inflamed appendix, those were not visualized on ultrasonography. Of the 91 patients who on Ultrasonography had acute appendicitis, only 81 patients on histopathology had acute appendicitis. The rest 10 patients on histopathology did not have features of acute appendicitis.

**Table 4:** CRP/TLC/USG in Acute Appendicitis

CRP/TLC/USG	Acute Appendicitis		
	+	-	Total
Raised	84	12	96
Normal	0	1	1
Total	84	13	97



**Graph 4:** CRP/TLC/USG and Acute Appendicitis

Sensitivity: 100%, Specificity: 7.7%, Positive predictive value: 87.5%, Negative predictive value: 100%. The test is significant with p value of 0.03. When all three were combined i.e. a positive CRP, raised TLC and USG showing acute appendicitis, it had the highest sensitivity of 100, showing that the combined tests along with clinical judgement can detect acute appendicitis case in emergency ward more accurately.

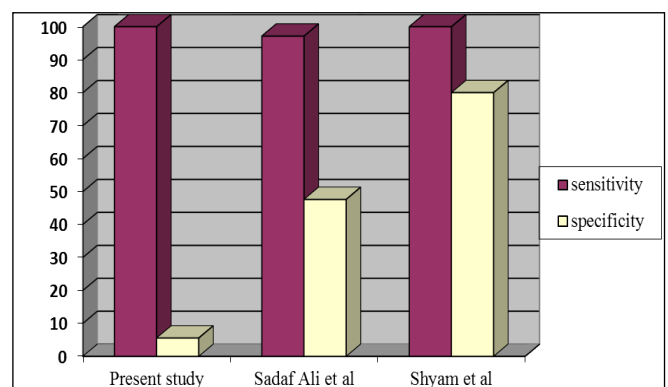
**Discussion**

Although acute appendicitis is considered as one of the commonest surgical emergencies, still the diagnosis could be difficult and appendectomy for normal appendix usually ranges from 15 to 30%.

In the period between December 2012 and June 2014, 97 patients admitted in Karnataka Institute Of Medical Sciences, suspected of acute appendicitis were evaluated and operated upon. Patients were evaluated with CRP, Total Leukocyte Count and USG. When these three were separately evaluated they had less sensitivity, specificity, PPV, NPV. But when all three were combined they had 100% sensitivity which was comparable with below given studies.

**Table 5:** CRP/TLC/USG in Acute Appendicitis Comparison with Other Studies

	Present Study	Sadaf Ali <i>et al.</i> [12]	Shyam <i>et al.</i> [13]
Sensitivity	100%	97.15%	100%
Specificity	7.7%	47.61%	80%



**Graph 5:** CRP/TLC/USG AND Acute Appendicitis Comparison with Other Study

The sensitivity of the present study and those conducted by Sadaf Ali *et al.* and Shyam *et al.* is comparable with value nearing 100% in present study and the one conducted by Shyam *et al.* The specificity is lower and as such is comparable to other two studies mentioned.

### Conclusion

Since appendicitis is the commonest surgical emergency and appendectomy is the most common emergency surgical procedure, many laboratory investigations and radiological imaging aid in the diagnosis. So, by our study we conclude that when CRP, TLC and USG are combined together there is high likely chance of being appendicitis and thus we can avoid negative appendectomies.

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