

## Correlation of C-reactive protein and total leukocyte count in acute infections: A single center study

Sumera Shaikh, Erum Salim, Pushpa Vali Ram, Shaima Sultana Memon, Adnan Zubairi, Shahnwer Ali Khawaja, Areebah Asim

**Received:**  
16th June, 2018

**Accepted:**  
17th August, 2019

### Abstract:

**Objective:** C-reactive protein (CRP) is one of the many diagnostic markers used to detect an infection. However, it is non-specific and its usefulness is therefore limited, especially for diagnostic purposes. An alternative is to monitor total leukocyte count (TLC) along with absolute neutrophil count (ANC). The objective of this study was to examine the relationship between CRP and TLC in patients with acute infections and to determine their usefulness as inflammatory markers.

**Materials and Methods:** A total of 100 patients presenting in different out patient departments (OPDs) of our hospital, with complaints of fever and no history of antibiotic use were included in this study. Complete blood count (CBC) samples were collected in EDTA tubes and measured on Cell Dyn Ruby Abbot Analyzer. CRP estimation of the samples was done by Rx Daytona analyzer, based on immune-turbidimetric assay.

**Results:** High White Blood Cell (WBC) count was seen in 78% of patients and normal or low WBC count was seen in 22% of the patients. Absolute Neutrophil Count (ANC) was raised in 60% of the patients and normal or low in 40% of the patients. CRP was raised (> 5mg/dl) in 93% of the cases and normal or low in 5% of the cases.

**Conclusion:** CRP and TLC including ANC are valuable markers in acute bacterial infections as they have a positive correlation with each other. When they are measured together, it increases their diagnostic value because of their feasibility and sensitivity.

**Keywords:** C-reactive protein, total leukocyte count, neutrophils, infection

### Introduction:

Invasion of body tissue by a disease causing microbiological agent along with their multiplication in the host tissue is known as an infection. Bacteria are classified as one of the most common pathogens, causing infection of nearly all body tissues in both community as well as nosocomial settings. Despite enormous advancements in the field of health care, acute infections caused by bacteria, viruses, parasites, fungi and helminthes play a major role in morbidity and mortality. Various diagnostic modalities, such as total leukocyte count (TLC), neutrophil count, C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), Prolactin and blood culture tests, are required to detect infection. However, to date, CRP has been used as an effective

marker for detecting and distinguishing bacterial infections from viral ones, as it is increased in bacterial and to a lesser extent in viral infections. CRP is an inflammatory marker; therefore it is raised in patients with acute infections. It is also an acute phase protein which increases in connective tissue disorders and neoplastic diseases.<sup>1-4</sup>

CRP, is however non-specific and its usefulness is therefore limited, especially for diagnostic purposes. Sensitivity and specificity of CRP is also less for bacterial infections as this is an inflammatory marker, synthesized from the liver in response to any form of tissue injury. An alternate method is to monitor TLC along with absolute neutrophil count (ANC) for infections

Ziauddin University  
Hospital, Karachi

S Shaikh  
E Salim  
A Zubari  
SA Khawaja  
A Asim

Dow Medical College,  
DUHS, Karachi

PV Ram  
SS Memon

### Correspondence:

Dr. Shaima Sultana Memon  
Assistant Professor  
& Consultant  
Histopathologist  
Dow Medical College,  
DUHS, Karachi  
Cell: 0333 2342095  
Email: shaimanabeel@  
yahoo.com

Table-1: Correlation of C-reactive protein (CRP) with total leukocyte count (TLC)

		TLC	CRP
TLC	Pearson Correlation	1	0.249*
	Sig. (2-tailed)		0.012
	N	100	100
CRP	Pearson Correlation	0.249*	01
	Sig. (2-tailed)	0.12	
	N	100	100

\*Correlation is significant at the 0.05 level (2-tailed). TLC = Total Leukocytes Counts CRP = C-Reactive Protein

Table-2: Correlation of C-reactive protein (CRP) with absolute neutrophil count (ANC)

		TLC	CRP
ANC	Pearson Correlation	1	0.321**
	Sig. (2-tailed)		0.001
	N	100	100
CRP	Pearson Correlation	0.321**	01
	Sig. (2-tailed)	0.001	
	N	100	100

\*\* Correlation is significant at the 0.01 level (2-tailed). ANC = Absolute Neutrophil Count, CRP = C-Reactive Protein

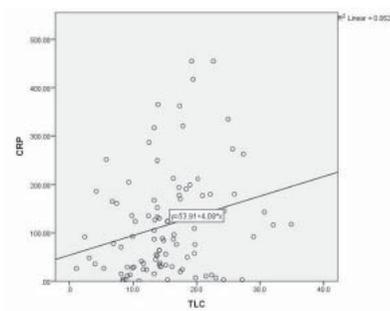


Fig. 1: Correlation of C-reactive protein (CRP) with total leukocyte count (TLC)

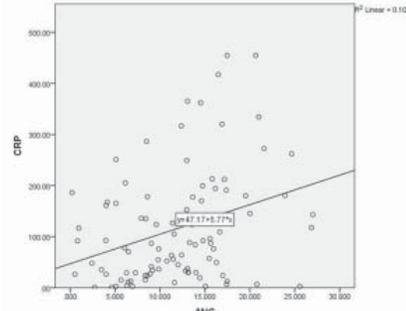


Fig. 2: Correlation of C-reactive protein (CRP) with absolute neutrophil count (ANC)

since neutrophils are also raised in infections. Various studies have demonstrated a positive correlation between CRP, TLC, and ANC, in different types of infections and inflammatory disorders.<sup>1-4</sup> Correlation between CRP, TLC and ANC in acute infections will be extremely beneficial for practicing doctors in different fields in deciding empirical therapeutic options. Moreover, this correlation will allow the clinician to treat his/her patient in a better manner, preventing further complications. It may also reduce health care cost by reducing the number of unnecessary surgeries. For example, if CRP and TLC are not raised in a patient suspected of having acute appendicitis, then, an unnecessary

appendectomy may be prevented.<sup>2</sup> It may also impact length of stay in the hospital, thereby decreasing the burden on the health care system.<sup>5</sup>

The objective of this study was to examine the relationship between CRP and TLC in patients with acute infections and to determine their usefulness as inflammatory markers.

### Material and Methods:

This retrospective, cross-sectional study was performed on 100 patients who presented in different OPD's of Ziauddin hospital, with complaints of fever during the period from August 2017 to December 2017. To maintain confidentiality, patients' identification was coded. Approval was taken from the Institution's ethical review committee. Complete blood counts (CBCs) and CRP levels were determined on first visit. Patients with fever and no history of antibiotic use were included in this study. Those who had a history of antibiotic use were excluded. CBC samples were collected in EDTA tubes and were analyzed on Ruby Abbot analyzer. For CRP estimation, the yellow top, i.e. serum separator tubes were utilized and later centrifuged at 3000 rpm for 10-15 minutes. CRP levels were determined by immuno-turbidimetry technique on Rx Daytona analyzer. Both results of CBC and CRP of the same patient were analyzed for correlation on the basis of ANC and TLC.

### Results:

In this study, 100 patients who presented in Ziauddin Hospital, Clifton branch, with suspected acute infections, were included. Based on their condition, a CBC and CRP were performed. Mean age of the patient population was 50±12.4 years. There were 57 (57%) males and 43 (43%) females out of 100 patients. Ratio of male to female was 1.3:1. In this study, we found high TLC, i.e. > 10 × 10<sup>9</sup>/L in 78 cases (78%) out of 100 patients and normal or low TLC, i.e., ≤ 10 × 10<sup>9</sup>/L in 22 cases (22%). ANC was raised i.e. > 10 × 10<sup>9</sup>/L, in 60 patients (60%) and normal or low in 40 patients (40%) out of 100 cases. CRP was raised (≥ 5mg/dl) in 93 cases (93%) and normal or low in 5% patients. A Pearson correlation was performed to assess the rela-

relationship between CRP and TLC and CRP and ANC. A positive correlation was demonstrated between both the variables  $r=0.249$ ,  $N=100$ ,  $p=0.012$  (significant at 0.05) and  $r=0.321$ ,  $N=100$ ,  $p=0.001$  (significant at 0.01), respectively (tables 1 and 2). A scatter plot summarizes the results in Figures 1 and 2.

#### **Discussion:**

Acute infections are mostly comprised of bacterial origin, in which CBC shows raised TLC, ANC and CRP levels.

In this study, we examined 100 patients with acute bacterial infections (proven positive for bacterial cultures) and CRP and CBC was performed to correlate in acute infections. In our study, out of 100 cases, 78(78%) patients showed high TLC and 60(60%) cases showed high ANC levels. CRP was raised in 93(93%) cases. This shows that in acute bacterial infections, there is a positive correlation between CRP and TLC. If CRP is raised, there is 60% possibility of raised ANC. The findings of various international and local studies are similar to our study.

Kaya et al studied 120 cases of acute infections in a pediatric population and they showed that CRP and ANC were significantly raised in acute bacterial infections.<sup>6</sup> They were very rapid and strong diagnostic tools with moderate diagnostic value. Our study also shows positive correlation between TLC and ANC and CRP. However we included all age groups while in their study patients of only the pediatric age group were included.

Another study conducted in the pediatric population in Iran showed correlation between WBC count, ANC, CRP and interleukin.<sup>6,7</sup> They found that IL-6 and CRP are actually better markers for predicting serious bacterial infections as compared to WBC count and ANC.

Even older studies have shown that CRP is a useful diagnostic tool in evaluation of children with febrile illness.<sup>8</sup> In contrast to this, however, another older study found that CRP value added

to ANC is of little diagnostic value as compared to ANC alone in screening occult bacterial infections in children.<sup>9</sup>

A study conducted on patients with acute appendicitis in the Nepalese population by Agrawal et al demonstrated a correlation between ANC and CRP with histological findings of appendicitis.<sup>16</sup> They concluded that both parameters were significantly raised in inflammatory diseases, i.e. acute appendicitis, which is consistent with our own study.<sup>3</sup> This is useful as it may guide the surgeon on necessity for surgery. If TLC and ANC are not raised in a patient suspected of having acute appendicitis then appendectomy may not be considered and the patient may rather be managed conservatively. This is beneficial in many ways; firstly it will reduce the rate of negative appendectomy, reducing length of hospital stay and thereby reducing health care services costs. It will also dramatically improve patient outcome and reduce risk of complications due to unwarranted surgeries.<sup>2,3</sup>

Another Indian study conducted on patients with acute appendicitis also found that sensitivity and specificity of WBC count and differential leucocyte count was enhanced with the addition of CRP in diagnostic workup.<sup>10</sup> Other studies on patients with acute appendicitis also found that CRP monitoring enhances the diagnostic accuracy.<sup>11,12</sup> A local Pakistani study conducted by Ali et al had similar findings.<sup>13</sup> An Indian study that looked at the correlation between the clinical course and bio-chemical analysis in odontogenic space infections, found CRP to be the best indicator of clinical course/ recovery of the patient, followed by WBC count and ESR.<sup>14</sup> CRP has also been found to be useful as a diagnostic tool in predicting chorio-amnionitis in pre-term pre-mature rupture of membranes (PPROM).<sup>15</sup> Links have also been found between raised CRP, TLC and serum resistin levels in patients with hypertension and coronary artery disease.<sup>16,17</sup> In fact, the CRP/ albumin ratio was found to be significantly higher in patients with coronary artery disease.<sup>18</sup>

**Conclusion:**

CRP and TLC including ANC are valuable markers in acute bacterial infections as they have a positive correlation with each other. When they are measured together, it increases their diagnostic value because of their feasibility and sensitivity.

**Conflict of interest:** None

**Funding source:** None

**Role and contribution of authors:**

Dr Sumera Shaikh, collected the data, references and did the initial writeup

Dr Erum Saleem, helped in collection of data, and also helped in introduction writing

Dr Pushpa Vali Ram, helped in collecting the references and helped in methodology writing

Dr Shaima Sultana Memon, critically review the article and made the useful changes

Dr Adnan Zubairi, helped in collecting the data and abstract writing

Dr Shahnwer Ali Khawaja, helped in collecting the data, references and also helped in discussion writing

Dr Areebah Asim, collected the references, and helped in discussion and conclusion writing.

**References:**

1. Ana P, Draginja K, Dimitrije M, Ivan M and Mariola S. The Markers of Systemic Inflammation in Patients with Chronic Periodontitis: Leukocytes, C-reactive Protein and Fibrinogen. *JPM*; 2013, 1(3): 43-49.
2. Dnyanmote A, Ambre SR, Doshi F, Ambre S, Role of total leukocyte count and C reactive protein in diagnosis of acute appendicitis. *Int Surg J*; Mar 2018, 5(3): 883-887.
3. Agrawal C, Adhikari S, Kumar M. Role of serum C- reactive

- protein and leukocyte count in the diagnosis of acute appendicitis in Nepalese population. *NMCJ*; 2008, 10(1): 11-15.
4. Bali R, Sharma P, Ghanghas P, Gupta N, Tiwari JD, Singh A et al. To compare the efficacy of CRP and TLC as markers for monitoring the course of odontogenic space infections. *J Maxillofac. Oral Surg*; (July – Sept 2017), 16 (3): 322-327.
5. Heim N, Wiedemeyer V, Rudolf H, Reich H, Martini M. The role of CRP and WBC count in the prediction of length of stay in hospital and severity of odontogenic abscess. *Journal of Cranio-Maxillo-Facial Surgery*; 2018; 46 2220-2226.
6. Kaya Z, Küçükcongür A, Vuralı D, Emeksiz H and Gürsel T. Leukocyte Populations and C-Reactive Protein as Predictors of Bacterial Infections in Febrile Outpatient Children. *Türk J Hematol*; 2014, 31(1): 49-55.
7. Zarkesh M, Sedaghat F, Heidarzadeh A, Tabrizi M, Moghadam KB, and Ghesmati S. Diagnostic Value of IL-6, CRP, WBC, and Absolute Neutrophil Count to Predict Serious Bacterial Infection in Febrile Infants. *Acta Medica Iranica*; 2015, 53(7): 408-411.
8. Putto A, Ruuskanen O, Meurman O, Ekblad H, Korvenranta H, Mertsola J, Peltola H, Sarkkinen H, Viljanen MK and Halonen P. C reactive protein in the evaluation of febrile illness. *Archives of Disease in Childhood*; 1986, 61(1): 24-29.
9. Isaacman DJ and Burke BL. Utility of the Serum C-reactive Protein for Detection of Occult Bacterial Infection in Children. *Arch Pediatr Adolesc Med*; 2002, 156(9): 905-910
10. Sahu S, Kumar P, Chaubey D, Shashi K, Mundu M and Baxla R. Accuracy of C-reactive Protein, Neutrophil Count, Total Leukocyte Count and Ultrasonography in diagnosis of Acute Appendicitis. *International J Scientific Study*; 2014, 2(7): 191-197.
11. Xharra S, Gashi- Luci L, Xharra K, Veselaj F, Bicaj B, Sada F. Correlation of CRP, WBC and neutrophil percentage with histopathology finding in acute appendicitis. *World J of Emergency Surgery*; 2012, 7(27).
12. Ahmed QA, Maneera MJ, Rasool MI. Predictive value of TLC and CRP in the diagnosis of acute appendicitis. *Annals*; 2010, 16(2): 16-119.
13. Ali N, Rasul S, Mehmood Z and Khan A. Value of total leukocyte count in C-reactive proteins in the diagnosis of acute appendicitis. *JSP*; 2009, 14 (4):153-156
14. Kaur A, Sandhu A, Kaur T, Bhullar RS, Dhawan A, Kaur J. Correlation between clinical course and biochemical analysis in odontogenic space infections. *J. Maxillofac. Oral Surg*; 2019, 18(2): 203-209.
15. Evaluation of and role of CRP as an early predictor of chorioamnionitis in PPROM Aggarwal A, Pahwa S. *Int J Reprod Contracept obstet Gynecol*. 2018; 7 (4): 1351-1356
16. Niaz S, Latif J, Hussain S. Serum Resistin: A possible link between inflammation, Hypertension and coronary artery disease. *Pak J of Med Sci*. 2019, 35 (3): 641-646.
17. Tajfard M, Sany SB, Avan A, Latif A et al. Relationship between serum high sensitivity CRP with angiographic severity of Coronary artery disease and traditional cardiovascular risk factors. *J Cell Physiol*. 2019; 234(7): 10289-10299.
18. Karabag Y, Cagdas M, Rencuzogullari I, et al. Relationship between CRP/ Albumin ratio and CRP severity in patients with stable angina pectoris. *J Clin Lab Anal*. 2018; 32:e 22457