International Journal of Health Sciences and Research
Vol.13; Issue: 3; March 2023
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

The Diagnostic and Prognostic Value of C-Reactive Protein in Patients with Severe Bacterial Infection

Fathima Shahana Sherin[1], Kavitha M K[2]

[1]Department of Medical Microbiology, CIHS, Thalassery, Kannur, Kerala, India
[2]Professor & HOD, Department of Medical Microbiology, CIHS, Thalassery, Kannur, Kerala, India

Corresponding Author: Kavitha M K

DOI: https://doi.org/10.52403/ijhsr.20230301

ABSTRACT

C-reactive protein (CRP) is an established biomarker for the assessment of inflammation and its severity in patients who present to hospitals and can be used as a reliable, fast and cheap indicator of the infection. Increase in the level of C-reactive protein and other acute phase protein contribute to defense mechanism in several ways. The present study shows the importance of diagnostic and prognostic function of C – reactive protein in patients with severe bacterial infection. The detection of CRP was done on automated chemical analyzer AGAPPE MISPA- i2. All the statistical analyses were performed using SPSS version 20. A total of 102 samples of patient who had severe infections were processed. In all these cases, Pair 1, that mean CRP in first day and CRP in 9th or 10th day of hospital admittance was having a mean value of 138.32mg/L and 15.48mg/L respectively. The mean value of Pair 2, that means CRP in first day and 4th or 5th day were 117.66 mg/L and 56.31mg/L respectively. And Pair 3 means CRP in 4th or 5th day and 9th or 10th day, the mean values are 66.56mg/L and 15.48mg/L respectively. The mean value obtained from the data shows the reduction in both CRP and infection simultaneously; from the onset of illness to curing of the disease. To conclude, the value of CRP can be used as a diagnostic and prognostic tool which indicate the severity of the infection during the early stages and the curing of infection in the late stages.

Keywords: [C-reactive protein, biomarker, acute phase protein]

INTRODUCTION

C-reactive protein (CRP) is an established biomarker for the assessment of inflammation and its severity in patients who present to hospitals [1] and can be used as a reliable, fast and cheap indicator of the infection.

C-reactive protein was discovered by Tillett and Francis in 1930. The name CRP arose because it was first identified in the serum of patients with acute inflammation that reacted with the "c" carbohydrate antigen of the capsule of *Pneumococcus*. [2]

When an infection sets in, there will be changes in the serum protein level and those changes were collectively called as Acute phase response (APR) and the proteins whose concentrations changed during the acute phase of an illness is called Acute phase proteins. Liver is one of the major sites of APR protein synthesis and the proinflammatory cytokines. Production of these cytokines are one of the early response of phagocytes. Increase in the level of C-reactive protein and other acute phase protein contribute to defense mechanism in several ways. Thus, CRP is a component of innate immunity. [3]

There are several causes of an elevated C-reactive protein including acute and chronic conditions. However, elevated levels of CRP are often associated with an infectious cause. [4] As an acute-phase protein, the plasma concentration of CRP deviates by at

least 25% during inflammatory diseases. [1] The highest concentrations of CRP are found in serum, with some bacterial infections increasing up to 1,000-fold. [5] However, when the stimuli end, CRP values decrease exponentially over 18–20 hours. [6] CRP has a half-life of about 19 hours and due to this physiological behavior, CRP is used for prognosis of a patient with chronic bacterial infection.

The present study shows the importance of diagnostic and prognostic function of C – reactive protein in patients with severe bacterial infection.

AIM

To determine the diagnosis and prognostic value of C-Reactive protein in patients with severe bacterial infection.

OBJECTIVE

- To determine consecutive CRP values of patients tested positive for bacterial infection.
- To analyze the variation of CRP values for the same patient on consecutive days from the data obtained.
- To determine how the value of CRP is important in identification of bacterial infection and providing the prognosis of infection.

LITERATURE REVIEW

CRP is commonly used by clinicians in acute bacterial diseases for both the detection of the inflammatory process and for the quantization of its intensity. [7] Furthermore, CRP is used to guide antibiotic treatment [8] and for the identification of the resolution of the inflammatory process. [9]

Ridker P M *et al*. studied that the majority of CRP research has focused on the role of CRP and its isoforms on cardiovascular disease and stroke. CRP is used as a clinical marker of inflammation, with elevated serum levels being a strong independent predictor of cardiovascular disease in asymptomatic individuals. [6] Thiele J R *et al*. stated that although studies have shown that CRP levels increase during infections and inflammatory diseases, the precise role of CRP isoforms in their development and progression remains largely unknown. Thus, urgent investigations are required to determine the effects of each CRP isoform on specific cellular processes during disease development. [10]

MATERIALS & METHODS

The present study was conducted during 1st October 2022 to 31st December 2022 at a Tertiary care hospital in North Kerala in the Department of Microbiology and was based on the retrospective data collected for a period of seven months from case records of patients.

The detection of CRP was done on automated chemical analyzer AGAPPE MISPA- i2. The lowest detection points or sensitivity of the test was 0.5mg/ml and the highest detection point was 320 mg/ml. The cut-off value was considered as 6.0mg/ml.

Categorical variables were presented as number and were compared using the Paired t-test. The continuous variables were reported as means with standard deviations.

To test the performance of the numerical parameters, the CRP was categorized into three pairs;

Pair 1 - CRP in first day and CRP in 9th or 10th day,

Pair 2- CRP in first day and 4th or 5th day and

Pair 3 - CRP in 4th or 5th day and 9th or 10th day.

STATISTICAL ANALYSIS

All the statistical analyses were performed using SPSS version 20.

RESULT

A total of 102 samples of patient who had severe infections were processed. All 102 samples had two CRP values and only 34 samples had three CRP values in the day of 4th or 5th day and 9th or 10th day respectively. The data was divided into 3 pairs based on the CRP test performed.

Pair 1 – CRP first day and CRP 9th or 10th day
Pair 2 – CRP first day and CRP 4th or 5th day
Pair 3 – CRP 4th or 5th day and CRP 9th or 10th day

Table 1: PAIRED SAMPLE STATISTICS

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	CRP_FirstDay	138.324118	34	47.2748765	8.1075744
	CRP_9thor10th_day	15.484706	34	11.9303339	2.0460354
Pair 2	CRP_FirstDay	117.665490	102	54.4590000	5.3922445
	CRP_4thor5th_day	56.317157	102	32.6498313	3.2328150
Pair 3	CRP_4thor5th_day	66.567941	34	30.5572052	5.2405175
	CRP_9thor10th_day	15.484706	34	11.9303339	2.0460354

Table 2: PAIRED SAMPLES CORRELATION

Paired Samples Correlations				
		N	**Correlation**	**Sig.**
Pair 1	CRP_FirstDay & CRP_9thor10th_day	34	.578	.000
Pair 2	CRP_FirstDay & CRP_4thor5th_day	102	.871	.000
Pair 3	CRP_4thor5th_day & CRP_9thor10th_day	34	.607	.000

Table 3: PAIRED SAMPLE TEST

Paired Samples Test									
		Paired Differences					**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	**Upper**			
Pair 1	CRP_FirstDay - CRP_9thor10th_day	122.8394118	41.5320819	7.1226933	108.3481833	137.3306402	17.246	33	.000
Pair 2	CRP_FirstDay - CRP_4thor5th_day	61.3483333	30.5403916	3.0239494	55.3496312	67.3470354	20.287	101	.000
Pair 3	CRP_4thor5th_day - CRP_9thor10th_day	51.0832353	25.1626383	4.3153569	42.3035757	59.8628949	11.838	33	.000

In this the p value is 0.000 that is less than 0.05 ($p < 0.05$), therefore the study is statistically significant.

DISCUSSION

In all these cases, Pair 1 that mean CRP in first day and CRP in 9 th or 10th day of hospital admittance was having a mean value of 138.32mg/L and 15.48mg/L respectively. The mean value of Pair 2, that means CRP in first day and 4th or 5th day were 117.66 mg/L and 56.31mg/L respectively. And Pair 3 means CRP in 4th or 5th day and 9th or 10th day, the mean values are 66.56mg/L and 15.48mg/L respectively.

The mean value obtained from the data collection shows the reduction in both CRP and infection simultaneously; from the onset of illness to curing of the disease. Similar studies done by Keshet R *et al*. shows that the initial serum CRP level has an important role in diagnosis and prognosis of patients admitted to the department medicine. [11]

The highest amount of CRP was observed on the patients with bacterial infection and slightly lower value of CRP represents the cardiovascular disorders and viral infections. According to the study, "Diagnosing wound infection: the use of C – reactive Protein" conducted by Kingsley A and Jones V, tested whether CRP could be used to distinguish different types of infections. They discovered that mean CRP levels in a spreading infection were higher than those in other colonized, critically colonized, and locally infected groups. All cases of infection showed an increase in CRP levels compared to non-infected controls, but CRP levels could not distinguish between the infection types, showing that it is infection in general that causes CRP levels to increase, rather than the type of infection. [12]

This was also noted by Healy B and Freedman A, who showed that CRP levels can be used only as a method of detecting infection, rather than distinguishing it. [13]

The studies conducted by Karasahin O *et al*.

shows that the value of C - reactive protein level in the diagnosis and prognosis of infection in elderly patients. The initial CRP value alone does not have prognostic value, but changes observed in serial CRP measurement are a valid indicator of prognosis. Among the patients with infection, there was no difference between those who died and those who survived in terms of baseline CRP level, but a significant difference emerged in CRP level at 48 and 96 hours. [14]

CONCLUSION

The present study mainly focused on the CRP value observed for the patient with heavy to scanty bacterial infection. The study concludes about the importance of using CRP as the diagnostic and prognostic tool to determine the status of infections.

The total of 102 culture samples of patient who had severe bacterial infections were processed. The mean value obtained from the data collection shows the reduction in both CRP and infection simultaneously; from the onset of illness to curing of the disease.

To conclude, the value of CRP can be used as a diagnostic and prognostic tool which indicate the severity of the infection during the early stages and the curing of infection in the late stages.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: Mr. Ratheesan K, Lecturer in Biostatistics, MCC, Thalassery, Kannur, Kerala, India

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Gabay C and Kushner I. Acute-phase proteins and other systemic responses to inflammation. *N Engl J Med*. 1999; 340 (6): 448–454.
2. Tillet W S and Francis T. Serological reactions in pneumonia with a non - protein somatic fraction of Pneumococcus. *J Exp Med*. 1930; 52: 56.
3. Kindt T, Goldsby R A, Osborne B A and Kuby J. Kuby immunology. 6th ed. New York: W. H. Freeman; 2007. 55-61.
4. Du Clos T W and Mold C. C-reactive protein: an activator of innate immunity and a modulator of adaptive immunity. *Immunol Res.* 2004; 30 (3): 261– 277.
5. Thompson D, Pepys M B and Wood S P. The physiological structure of human C-reactive protein and its complex with phosphocholine. 1999; *Struc*.7: 169- 177.
6. Ridker P M. Clinical application of C-reactive protein for cardiovascular disease detection and prevention. 2003; *Cir*.107: 363–369.
7. Wyllie D H and Wyllie D. Bacteremia prediction in emergency medical admissions: Role of C reactive protein. *J of Clinl Path*, 2005; 58: 352–356.
8. Cals J, Butler C, Hopstaken R, Hood K and Dinant G. Effect of point of care testing for C reactive protein and training in communication skills on antibiotic use in lower respiratory tract infections: Cluster randomised trial. *Br. Med. J.* 2009; 338: 1112 –1116.
9. Povoa P, Teixeira-Pinto A and Carneiro A. C-reactive protein as an early marker of sepsis resolution: Results from the Portuguese Community - acquired Sepsis Study (SACiUCI study). *Crit. Care*, 2011; 15: 272.
10. Thiele J R, Habersberger J, Braig D, Schmidt Y, Goerendt K, Maurer V. Dissociation of pentameric to monomeric C-reactive protein localises and aggravates inflammation: in vivo proof of a powerful proinflammatory mechanism and a new anti-inflammatory strategy. 2014; *Cir*. 130: 35–50.
11. Keshet R, Boursi B, Maoz R, Shnell M and Guzner-Gur H. Diagnostic and Prognostic Significance of Serum C-Reactive Protein Levels in Patients Admitted to the Department of Medicine. *Am J Med Sci*. 2009; 337: 248 - 255.
12. Kingsley A and Jones V. Diagnosing wound infection: the use of C - reactive protein. *Wounds UK*. 2008; 4 (4): 32 – 46.
13. Healy B and Freedman A. Infections. *Br Med J*. 2006; 332 (7545): 838 – 841.
14. Karasahin O, Tasar P T, Timur O, Yıldırım F, Binici D N and Sahin S. The value of C-reactive protein in infection diagnosis and prognosis in elderly patients. *Aging Clin Exp Res*. 2018; 30 (6): 555 - 562.

How to cite this article: Fathima Shahana Sherin, Kavitha M K. The diagnostic and prognostic value of C-reactive protein in patients with severe bacterial infection. *Int J Health Sci Res.* 2023; 13(3):1-4. DOI: *https://doi.org/10.52403/ijhsr.20230301*

******