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Assessment of Serum CRP in Predicting Disease Activity in Pulmonary Tuberculosis

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ABSTRACT

Pulmonary tuberculosis, caused by Mycobacterium tuberculosis, triggers an inflammatory response in the body, leading to the production of C-reactive proteins (CRP) by the liver. However, there is limited information in medical literature regarding the correlation between serum CRP levels and the severity of pulmonary tuberculosis. This study aims to assess the validity of serum CRP levels in relation to clinical manifestations, mortality, radiological severity and response to anti-tubercular therapy in patients with pulmonary tuberculosis. This study involved 89 newly diagnosed sputum-positive pulmonary tuberculosis patients and 67 healthy individuals for comparison. Patients underwent evaluation for clinical and radiological findings, which were then correlated with baseline CRP levels. CRP levels were measured at 2 months and after completion of treatment and their correlation with treatment outcomes was analysed. The mean baseline CRP levels in patients with pulmonary tuberculosis were significantly higher than that of healthy individuals. Patients with pulmonary tuberculosis who exhibited more symptoms and the need for ventilatory support had significantly higher CRP levels compared to those without these symptoms. There was a significant correlation between CRP levels and the extent of radiological disease. Baseline CRP levels were notably higher in patients who did not survive and it showed a progressive decline in successfully treated patients. Serum CRP levels before initiating anti-tubercular therapy demonstrated a positive correlation with various clinical features and radiological severity in pulmonary tuberculosis patients. Additionally, higher CRP levels were associated with increased mortality. Therefore, serum CRP levels could serve as a valuable surrogate marker for assessing the severity of pulmonary tuberculosis.

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Key Words
C-reactive protein, pulmonary tuberculosis, radiological severity

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INTRODUCTION

Tuberculosis (TB) is an infectious ailment caused by Mycobacterium tuberculosis, primarily impacting the lungs. The global prevalence of Mycobacterium tuberculosis infection is estimated to range between 19-43%[1]. C-reactive protein (CRP), synthesized by the liver in response to inflammation, exhibits elevated levels in individuals with pulmonary tuberculosis[2,3]. Presently, there exists insufficient data regarding the correlation between CRP levels and clinical manifestations, radiological severity and response to anti-tubercular therapy[4-6].

Identifying biomarkers predictive of adverse outcomes can facilitate risk stratification for timely intervention and improved patient care. Biomarkers capable of early detection of treatment failure during the initial phases of TB therapy may aid in promptly identifying and transitioning patients to alternative medications. In this study, we assess the viability of CRP as a biomarker by examining its association with clinical parameters, radiological severity and requirement for ventilator support, mortality rates, and treatment response. The measurement and monitoring of CRP values may serve as a valuable tool in evaluating disease severity and treatment efficacy.

In this study we aim to investigate the correlation between serum CRP levels and clinical parameters, radiological severity and response to anti-tubercular therapy in patients with pulmonary tuberculosis admitted to a tertiary care Indian Hospital.

MATERIAL AND METHODS

This study enrolled 89 patients diagnosed with new sputum-positive pulmonary tuberculosis at an Indian tertiary care hospital, with an additional 67 individuals from the healthy population serving as the control group. The diagnosis of pulmonary tuberculosis was based on clinical symptoms, X-ray findings and positive sputum smear microscopy for Mycobacterium tuberculosis.

Patients aged over 18 years with sputum-positive pulmonary tuberculosis were included, while patients aged under 18 years, individuals with HIV seropositive status, liver failure, chronic inflammatory conditions (such as autoimmune diseases, malignancies and inflammatory bowel disease) and those unwilling to provide informed consent were excluded from the study.

Baseline serum CRP levels were measured before treatment initiation and correlated with clinical and radiological findings, including age, BMI, presence of fever, dyspnea, hemoptysis, tachycardia, tachypnea, hypotension, respiratory distress and mortality. Serum CRP levels were re-evaluated at 2 months and 6 months and the values were correlated with treatment outcomes. Radiographic disease extent was graded using the U.S. National Tuberculosis and Respiratory Disease Association scheme, which classifies disease severity into three categories: minimal disease, moderate disease and advanced disease, based on the extent of radiological pathology and cavitations[7,8].

Statistical analysis was performed using SPSS (Version 19.0, SPSS Inc.) and Graph Pad Prism 5.03. Data were expressed as mean±SD and differences among groups were analyzed using one-way analysis of variance (ANOVA). A $p<0.05$ was considered significant.

RESULTS

In the study, 89 sputum-positive pulmonary TB patients were included, with a male predominance (76.40%) and a male-to-female ratio of 3.24:1 (Table 1). CRP levels were notably higher in patients presenting with fever, tachycardia, tachypnea, hypotension, respiratory distress, the need for ventilatory support, and mortality compared to those without these manifestations (Table 2).

Table 3 and Fig. 1 illustrate a significant correlation between mean baseline CRP levels and the radiological severity of the disease. Table 4 compares serum CRP levels before, at 2 months and after treatment completion between cured patients and the treatment failure group. Cured patients showed a progressive reduction in CRP levels after treatment initiation. Conversely, the treatment failure group initially experienced a decrease in CRP levels, which later increased by the end of treatment. While mean baseline and 2-month CRP levels were higher in the treatment failure group the difference was not statistically significant. However, there was a statistically significant difference in CRP levels at the end of treatment (Table 4).

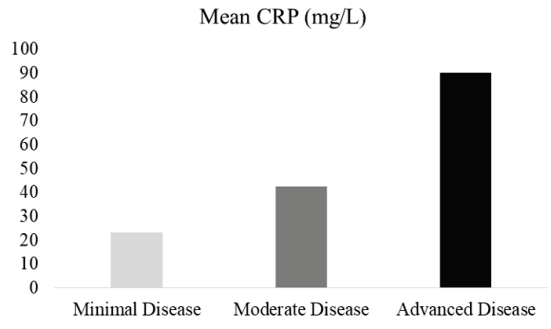

Fig. 1: Association between mean CRP levels with radiological severity

Table 1: General characteristics of study patients

Variable	Value	Percentage
Age (years) mean±SD	37.5±11.8	
Male 68	76.40	
Female	21	23.60
Cavitatory disease	21	23.60
Fever 62	69.66	
Hemoptysis	5	5.62
Hypotension	18	20.22
Miliary TB	4	4.49
Mortality	11	12.36
Need for ventilatory support	5	5.62
Tachycardia	59	66.29
Tachypnea	50	56.18
Haemoglobin (gm dL^{-1}) mean±SD	9.6±1.3	
BMI (Kg m^{-2}) mean±SD	16.5±1.7	
Baseline CRP levels before initiating treatment (mg L^{-1}) mean±SD	56.2±33.7	
CRP levels in treatment failure cases (mg L^{-1}) mean±SD	34.2±8.7	
CRP levels in cured cases (mg L^{-1}) mean±SD	5.9±1.2	

Table 2: Association of CRP levels with clinical features

	CRP (mg L^{-1}) Mean±SD		
Symptoms	Presentage	Absent	p-value
Fever	68.20±35.92	28.93±12.19	<0.05
Hemoptysis	50.00±28.31	54.72±33.85	0.69
Hypotension	107.20±21.35	41.60±22.12	<0.05
Mortality	114.50±19.18	48.11±25.84	<0.05
Need for ventilatory support	130.67±15.39	49.45±28.50	<0.05
Respiratory distress	95.60±27.15	38.63±17.48	<0.05
Tachycardia	71.18±32.30	27.47±6.53	<0.05
Tachypnea	78.18±30.17	28.50±6.72	<0.05

Table 3: Association of CRP levels with radiological severity of pulmonary TB

Radiological disease severity	CRP (mg L^{-1}) Mean±SD	No.	p-value
Minimal disease	23.20±4.26	18	<0.05
Moderate disease	42.45±17.98	39	
Advanced disease	90.25±29.55	32	

Table 4: Association of CRP levels with outcomes of treatment

CRP levels (mg L^{-1}) Mean±SD	Treatment failure (n = 5)	Cured (n = 73)	p-value
Before starting treatment	62.40±29.10	43.50±25.30	0.39
After 2 months of treatment	20.80±6.20	13.00±5.20	0.11
At completion of treatment	36.80±8.50	6.20±2.00	0.04

DISCUSSIONS

In our study, CRP levels were markedly elevated in patients diagnosed with pulmonary tuberculosis compared to those in the healthy population, aligning with findings from Peresi *et al*.[9] and Abakay *et al*.[10]. Analysis revealed that baseline CRP levels were notably higher in patients presenting with fever, dyspnea, tachycardia, tachypnea, respiratory distress, hypotension and the need for ventilatory support, in contrast to patients lacking these symptoms. Caner *et al*.[11] demonstrated significantly elevated CRP levels in febrile patients, while Kaminskaia *et al*.[12] observed a similar association between the degree of intoxication and CRP levels. However, the correlation between CRP levels and the presence or absence of hemoptysis did not reach statistical significance.

Comparison of mean CRP levels between survivor and non-survivor groups in our study mirrored trends observed by Chong Whang Kim *et al*.[5], with statistically significant results. Statistical significance was also evident when correlating baseline CRP levels with radiological disease severity, consistent with findings by Chong Whang Kim[5]. Evaluation of serum CRP levels before, during, and after treatment revealed a progressive decrease in CRP levels among patients responding to anti-tubercular treatment, contrasting with the treatment failure group, where CRP levels initially decreased but subsequently rose by the end of treatment. Although baseline and 2-month CRP levels were higher in the treatment failure group, statistical significance was not reached. However, the disparity in CRP levels at the end of treatment was statistically significant, consistent with results reported by previous studies[9,13-15].

CONCLUSION

Patients with sputum-positive pulmonary TB had elevated serum CRP levels at diagnosis, correlating with disease severity markers like fever, tachycardia, and mortality. Successful treatment normalized CRP levels, while treatment failure resulted in persistently high CRP levels. CRP can serve as a marker for disease severity and treatment response in pulmonary tuberculosis.

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