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Correlation Analysis of C - Reactive Protein as a Prognostic Indicator in Burns

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Abstract: ***Background: The assessment of mortality risk in burn patients aids in the development of a management protocol that improves prognosis. This study aims to determine that serum level CRP is a prognostic indicator in burns. Method: This study is a observational prospective study, conducted from July 1, 2023, to September 31, 2023, consisted of 55 patients. From the day 1 and then alternate - day serum CRP levels of all the patients included in the study were measured during their hospital stay. Patients were classified into two groups: nonsurvivors and survivors (discharged). The values and trend of change in of serum CRP were compared in both the groups. The factors that affect mortality in this study are alternate - day serum CRP level, age, TBSA, and hospital stay. Result: In our study, it was found out that CRP were significantly higher in critical burn patients. This parameter is also used to predict infection, sepsis, and ICU mortality, but there has been little research into their use in burn mortality, particularly in Indian scenarios [8]. According to the detection of serum - related cytokines, patients with sepsis after burns had more severe inflammatory responses than those without sepsis, which was reflected in the results that contents of serum CRP rose remarkably. Conclusion: In patients with burn injuries, rising trends of serum CRP values are associated with poor prognosis. Any value of serum CRP > 90 mg/L during hospitalization indicates poor prognosis with sensitivity 100% and specificity of 80.56% and 83.33%, respectively, and the likelihood of death increasing by 4.5 and 23.6 times, respectively. The trend of change in serum values of CRP can be used for prognostication of mortality and patient's response to treatment.***

Keywords: CRP, Burn patients, Sepsis.

1. Introduction

Burns are serious thermodynamic damage, which is caused by high temperature and flames and is accompanied by the carbonization of tissues and cells [1]. For patients with severe burns, a major cause of public health concern leading to notable cases of morbidity and mortality. Various biomarkers are indicated for making a proper diagnosis of assessment of burns due to the complexity of its pathophysiology. Scoring systems like Baux score, APACHE - II, Roi index and a body shape index (ABSI) are widely used assessment tools for making a prognosis in the burn patients [2]. The clinical values of crp in burn patients have been widely reported. For instance, crp is an independent risk factor for sepsis - induced acute kidney injury (SAKI), and the increase of its expression is related to the shortened survival time of patients [3]. Serum crp expression can be used as specific indicators for diagnosing sepsis, and the former can be used as an independent influencing factor to evaluate the prognosis of severe burn patients [4]. In previous studies on crp in sepsis, it has been confirmed that crp is over expressed in the serum of septic patients and can protect them from sepsis - induced multiple organ failure [5]. The assessment of mortality risk in burn patients aids in the development of a management protocol that improves prognosis. This study aims to determine that serum level CRP is a prognostic indicator in burns.

Patients and Methods

This study is a observational prospective study, conducted from July 1, 2023, to September 31, 2023, consisted of 55 patients. Written informed consent were obtained from all the study subjects and the study was conducted after obtaining approval from the institutional ethical committee.

Inclusion criteria—

- Age between 18 to 60 years
- Admitted within 48 hours of thermal burn injury of 25 to 65%
- Total burn surface area (TBSA) without inhalational injury

Exclusion criteria—

- Pregnancy
- Patients with associated injuries or co morbidities
- Acute kidney injury or myocardial injury secondary to sepsis
- Malignant tumours
- Cardiovascular or haematological diseases
- Lactating women
- Those who refused to participate in the study

Study Procedure

Elbow venous blood (2 mL) was collected from burn patients within 24 h after admission, and from control volunteers during physical examinations. After the serum was separated by centrifugation, contents of C - reactive

protein (CRP) were determined by the Siemens BN II automatic protein analyzer (Siemens, German).

Average serum concentration taken as a reference value are serum CRP: < 4 mg/dl.

Day 1 and then alternate - day serum CRP levels of all the patients included in the study were measured during their hospital stay. Patients were classified into two groups: nonsurvivors and survivors (discharged). The values and trend of change in of serum CRP were compared in both the groups. The factors that affect mortality in this study are alternate - day serum CRP level, age, TBSA, and hospital stay.

The smallest sample size required with a 5% level of significance was 35, with the required power of study being 75%. We considered the sample size of 55 to decrease the error.

Statistical Analysis -

The data and variables were entered into MS Excel spreadsheet, and SPSS 21.0 was used for the statistical analysis. Pearson correlation coefficient was used to assess CRP correlation with a time interval to assess CRP trends [6]. The cutoff values for serum CRP associated with risk of mortality were analyzed, utilizing the receiver operating characteristic (ROC) curve. Logistic regression and Cox proportional hazard regression were used to determine the association of risk factors with mortality. p - value < 0.05% was considered as statistically significant [7].

2. Results

Comparison of Groups

Out of 55 patients enrolled, 36 patients were discharged in a stable condition, and 19 patients expired, forming the survivor and nonsurvivor groups, respectively. Mean age and TBSA were significantly higher in nonsurvivor than survivors. Mean hospital stay was approximately nine days in both groups. Serum CRP were observed to be significantly higher in nonsurvivors than survivors during the study ([Table 1].

Table 1: Comparison of survivors and nonsurvivors **Trends and Correlations**

	Mean ± SD		p - value
	Nonsurvivor	Survivor	
Abbreviations: CRP, C - reactive protein; SD, standard deviation; TBSA, total burn surface area.			
Patient demography			
Age	41.53 ± 12.11	25.62 ± 7.84	0.012
TBSA	49.67 ± 8.55	41.71 ± 10.21	< 0.0001
Hospital stay	9.87 ± 6.48	10.08 ± 5.48	0.574
Serial levels of mean CRP			
CRP1	81.34 ± 7.09	66.72 ± 24.38	< 0.0001
CRP3	86.77 ± 2.61	61.45 ± 25.49	< 0.0001
CRP7	71.35 ± 3.81	44.61 ± 23.28	0.0001
CRP9	77.43 ± 8.21	61.2 ± 20.78	0.002
CRP11	73.85 ± 11.99	51.17 ± 18.68	0.002
CRP13	76 ± 7.55	45 ± 13.04	0.021
CRP15	85 ± 10.15	53.77 ± 12.09	0.02
CRP17	86 ± 2.83	46 ± 12.7	0.05
Pearson coefficient of CRP trend			
CRP trend	– 0.03 ± 0.76	– 0.93 ± 0.37	< 0.0001

Survivors had significant negative CRP trends with the Pearson correlation coefficient of – 0.93, respectively. Nonsurvivors had a nonsignificant negative CRP trend with a Pearson correlation coefficient of – 0.03. CRP's trend difference in nonsurvivor and survivor groups were highly significant (p - value < 0.0001) ([Table 1]).

Table 2: Pearson correlation coefficient among the variables

Variables		95% CI for mean	Pearson correlation coefficient	p - value
Abbreviations: CI, confidence interval; CRP, C - reactive protein				
CRP trend	Nonsurvivor	– 0.653 to 0.633	– 0.03	0.968
CRP trend	Survivor	– 0.853 to – 0.576	– 0.93	< 0.0001

First - day values of CRP correlated to TBSA with the Pearson coefficient of 0.853, respectively (p - value < 0.001).

3. Discussion

In our study, it was found out that CRP were significantly higher in critical burn patients. This parameter is also used to predict infection, sepsis, and ICU mortality, but there has been little research into their use in burn mortality, particularly in Indian scenarios [8]. According to the detection of serum - related cytokines, patients with sepsis after burns had more severe inflammatory responses than those without sepsis, which was reflected in the results that contents of serum CRP rose remarkably [9].

Sepsis is a leading cause of death in burn patients. The need for a agressive management of such patients with appropriate antimicrobial therapy is the most significant isolated factor for the septic patient's survival, and any

hourly delay is correlated with an increase in mortality [10]. It is also critical to reducing the likelihood of microbial resistance developing. Selecting the appropriate drug to target the microbiological agent, limiting the length of treatment to the absolute minimum to avoid antibiotic resistance, and selective pressure on microorganisms are also essential [11]. It is critical to identify biomarkers that can predict mortality, so that timely intervention can be initiated to improve prognosis.

Barati et al in 2008 found that raised CRP was better indicator of sepsis in burn patients than white blood cell (WBC) counts, erythrocyte sedimentation rate (ESR). For burn patients with serum CRP ≥ 2 ng/mL, the risk for mortality was 3.163 times more than those with < 2 ng/mL. CRP level was directly proportional to the TBSA involved and depth of burns [12]. CRP levels were normal at admission, peaked at 48 hours, and started to reduce by the sixth day post burn. The CRP production response was greater and prolonged when associated with infections [13].

In our study, higher value of CRP was associated with an increased risk of mortality. Increasing trends in CRP denote increased chances of mortality. Higher CRP was found to be associated with higher TBSA. Our study also showed that nonsurvivors had higher average CRP levels. The higher value of CRP on day 1 is associated with an increase in mortality. Only TBSA, however, was discovered to be an independent risk factor for mortality. CRP was found to correlate with TBSA. As a result, more research is needed to determine the effect of TBSA on CRP and their impact on mortality [14].

Thus, based on the current study and the previous studies, it is possible to conclude that both physical and laboratory investigations are relevant for burn prognosis. These findings can be used to prognosticate the patients and modify the management.

The increasing trend in serum CRP levels can be used not only for the prognostication of burn mortality, but also monitoring patients' response to the management protocol or in deciding if there is any need for change in management plan [15]. Hence, this study shows the trend in prognostication in burns. A larger sample size study is needed to validate the results. Further studies are warranted to examine the role of various interventions, in order to improve the prognosis and their relation with PCT and CRP levels.

4. Conclusion

In patients with burn injuries, rising trends of serum CRP values are associated with poor prognosis. Any value of serum CRP > 90 mg/L during hospitalization indicates poor prognosis with sensitivity 100% and specificity of 80.56% and 83.33%, respectively, and the likelihood of death increasing by 4.5 and 23.6 times, respectively. The trend of change in serum values of CRP can be used for prognostication of mortality and patient's response to treatment.

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