

Prognostic Significance of Admission CRP Levels as a Predictor of Mortality in Burn Patients

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Abstract

Objective: The objective of this study is to evaluate CRP's value as a biomarker of mortality in burn victims admitted to a burn unit.

Method: This prospective longitudinal observational study investigates the association between C-reactive protein (CRP) levels at admission and mortality in burn patients. Data were collected from 48 patients admitted to Sheikh Zayed Hospital between 16.02.2023 and 15.08.2023, focusing on demographics, burn characteristics, and laboratory findings. The study employed non-probability consecutive sampling and excluded individuals with certain medical histories. Descriptive statistics, correlation analyses, and logistic regression were used to explore the relationship between CRP levels and mortality, considering potential confounders.

Results: In a study of 48 burn patients, 87.5% survived, while 12.5% did not. Non-survivors had significantly higher total body surface area burned (41.3% vs 22.7%) and elevated C-reactive protein (CRP) levels at admission (23.5 mg/L vs 10.6 mg/L) compared to survivors. Electric and 4th-degree burns, fever at admission was higher, and hospital stays were shorter for non-survivors. No significant differences were found in age and gender. A strong positive correlation was observed between total burn surface area and CRP at admission. Logistic regression revealed significant predictors of mortality, with CRP at admission showing substantial significance (SE = 8.893, $p = 0.012$, Exp(B) = 1.657, 95% CI [.000, .000]).

Conclusion: The results showed that CRP level at admission was a significant predictor of mortality among burn victims. This study concluded CRP levels might be a helpful biomarker for determining the severity of burns and projecting patient outcomes. Future research should address the identified limitations to strengthen the evidence base on CRP's prognostic value in burn injuries.

Keywords: Burns, C-reactive protein, Biomarker, surface area.

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1. Introduction

Burn injuries are frequently underestimated and can be quite serious, even fatal. Numerous health issues, such as inflammation, metabolic alterations, distributive shock, and multiple organ failure, can be brought on by severe burns. Managing severe burns can be difficult and necessitates skilled care.¹ Burn injuries often confer long-term morbidity on survivors.^{2,3} Their therapeutic management must be timely and precise to reduce complications and improve outcomes. Biomarkers can offer important insight into the patient's reaction to injury and the possibility of consequences in addition to the clinical evaluation of burn severity. The use of biomarkers can aid in early diagnosis, the identification of patient populations at high risk of problems, and the tracking of disease progression—all of which are essential evaluations for selecting the most effective treatment and enhancing patient outcomes.⁴ Inflammation and infection risk are both elevated in the case of severe

burns. The severity of inflammation or infection is typically predicted using inflammatory biomarkers.⁵ Depending on the degree of the injury, inflammatory mediators play a crucial role in the hypermetabolic response, which intensifies following burn injury and may last for weeks.⁶ Biomarker searching is important for their prognostic value of patient progress in a severe burn. The findings from other diseases drove the interest to pursue the predictive ability of CRP in the burn area. CRP as an acute phase reactant has been studied for burns as early as 1974 in pediatric patients.⁷ Biomarkers research is important for their prognostic value of patient progress in a severe burn.⁸ In a variety of medical applications, the acute-phase reactant C-reactive protein (CRP) is frequently utilized as a biomarker of inflammation and infection.⁹ Specifically, investigations have revealed a positive correlation between C-reactive protein (CRP) and the severity of dengue infection.¹⁰ Additionally, a separate study utilized CRP as a predictive tool for assessing the severity of COVID-19 pneumonia.¹¹ Our current



study aims to contribute to this body of knowledge by examining the prognostic value of CRP in predicting mortality among burn patients. More specifically, we look into the relationship between CRP levels at admission and survival among burn patients. Finally, by giving clinicians a more trustworthy and objective tool for predicting survival in burn patients, this research has the potential to enhance patient care.

2. Materials & Methods

We conducted a prospective longitudinal observational study on the association of CRP level at admission and mortality in burn patients. We collected data from patients admitted to our centre between 16.02.2023 to 15.08.2023 after obtaining ethical approval from the Ethical Review Board of Sheikh Zayed Hospital. The data included age, gender, burned TBSA, mode of burn, degree of burn, CRP level at admission, fever, and mortality. We employed a non-probability consecutive sampling technique and all the patients enrolled during this period were analyzed. 48 consecutive patients above 18 years of age who had a verified diagnosis of burn injury with TBSA (Total Burn Surface Area) of more than 10% and were hospitalized in the burn unit within 24 hours of injury were included in the study after taking informed consent. The study did not include participants who had a history of immunodeficiency disorders or chronic inflammatory illnesses, a history of cardiovascular disease, pregnancy, metabolic syndrome and autoimmune disease since these diseases also cause derangements in CRP levels.

Data was collected from medical records, including demographics, medical history, burn characteristics (TBSA, depth), laboratory findings (including CRP at admission), and outcome (mortality within 30 days). Standard laboratory procedures were used to determine the CRP levels and white cell count in the blood samples.¹² CRP is measured as the average serum level, which is less than 3 mg/dl.¹³ Total Burn Surface Area (TBSA) was measured using Wallace's rule of nine.¹⁴

Descriptive statistics were used to compare participant characteristics between survivors and non-survivors. For example, means and standard deviations were calculated for continuous variables like age and CRP, while frequencies and percentages were used for categorical variables like gender and cause of burn. Spearman's rank correlation coefficient or Pearson's correlation coefficient was used to assess the unadjusted association between CRP at admission and mortality. Logistic regression was then used to examine the independent association between CRP at admission and mortality, adjusting for potential confounding variables

identified as significantly different between the two groups in the descriptive analysis. The study recognized and addressed potential limitations, such as selection bias or missing data, in the interpretation of results, ensuring a rigorous and ethical approach throughout the research process.

3. Results

Out of the 48 patients, 42(87.5%) were survivors and 6(12.5%) were non-survivors of burn injuries as mentioned in Table 1. The non-survivors had significantly higher total body surface area (TBSA) burned (41.3% vs 22.7%), higher C-reactive protein (CRP) levels at admission (23.5 mg/L vs 10.6 mg/L), and a higher proportion of electric (66.7% vs 19.0%) and 4th degree (66.7% vs 19.0%) burns than the survivors. The non-survivors also had more fever at admission (33.3% vs 4.8%) and shorter duration of hospital stay (83.3% vs 59.5% stayed less than a week).

Table 1: Demographic profile of burn patients totals (48)

VARIABLE	Survivors (M ± SD or N (%))	Non-Survivors (M ± SD or N (%))
Age	28.8±10.0	31.5±15.5
TBSA	22.7±9.1	41.3±6.5
CRP at admission	10.6±5.6	23.5±9.6
Gender		
Male	14 (33.3%)	4(66.7%)
Female	28(66.7%)	2(33.3%)
Type of burn injury		
Thermal	18(42.9%)	2(33.3%)
Electric	8(19.0%)	4(66.7%)
Scalds	16(38.1%)	0(0%)
Degree of burn		
2nd degree	24(57.1%)	0(0%)
3rd degree	10(23.8%)	2(33.3%)
4th degree	8(19%)	4(66.7%)
Fever at admission		
Yes	2(4.8%)	2(33.3%)
No	40(95.2%)	4(66.7%)
Duration of hospital stay		
Less than a week	25(59.5%)	5(83.3%)
1-2 weeks	12(28.6%)	0(0%)
Up to 4 weeks	5(11.9%)	1(16.7%)

There was no significant difference in age and gender between the two groups. The most common type of burn injury among the survivors was thermal (42.9%), followed by scalds (38.1%) and electric (19.0%). The most common degree of burn among the survivors was 2nd degree (57.1%), followed by 3rd degree (23.8%) and 4th degree (19.0%). A correlation analysis was conducted to examine the association between total burn surface area and CRP at admission in burn patients. A

strong positive correlation between the two variables ($r = .711$, $p < .01$) was observed, indicating that higher CRP levels at admission tend to be associated with a larger burn surface area. The correlation was found to be statistically significant at the 0.01 level (2-tailed), based on a sample size of 48 patients. A binary logistic regression model was used to analyze the relationship between mortality and Total burn surface area, degree of burn, fever at admission, CRP at admission, and hospital stay. The model was statistically significant ($\chi^2(7) = 18.002$, $p = .012$), indicating that the predictors as a set reliably distinguished between survivors and non-survivors. The model explained 31.3% of the variance in mortality (Cox & Snell $R^2 = .313$, Nagelkerke $R^2 = .591$). The Hosmer and Lemeshow test was not statistically significant ($\chi^2(6) = .755$, $p = .993$), indicating that the model fit the data well. Among the predictors, only Total Burn Surface Area, fever at admission and CRP at admission stay were entered into the model. The results showed that CRP at admission was a significant predictor of mortality (SE = 8.893, $p = 0.012$, Exp(B) = 1.657, 95% CI [.000, .000]).

Table 2: Binary logistic regression analysis with mortality-dependent variable

Predictor	SE	p-value	Odds Ratio	95% CI
Total burn surface area	1.356	0.820	1.361	0.095 - 19.392
Fever at admission	1.613	0.734	1.730	0.073 - 40.831
CRP at admission	8.893	0.012	1.657	0.000 - 0.000

4. Discussion

This research aimed to shed light on the potential of CRP at admission as a prognostic marker for mortality in burn patients, contributing valuable insights to clinical practice and burn care management. The results showed that CRP level at admission was a significant predictor of mortality among burn patients with higher CRP levels at admission associated with lower odds of survival. Our study evaluated the correlation between 48 burn patients' demographic data, CRP levels, and the severity of their burn injuries.

Numerous research has looked at the clinical usefulness of particular biomarkers for identifying sepsis and treating seriously unwell patients, as shown by a meta-analysis.¹⁵ Research conducted in the USA concluded that CRP levels in burns in the pediatric (20 years old) and geriatric (60 years old) groups were significantly different ($p 0.05$) when compared to the adult group with

ages ranging from 20 to 60 years old. Patients older than 60 years old had significantly increased CRP levels.¹⁶ However, the current study did not show any significant difference among survivors and non-survivors based on age. The results of this investigation are in line with earlier studies that have demonstrated a connection between CRP levels and the severity of burn injuries. Kohut et al. (2021) conducted a study to look into the relationship between serum CRP levels and the severity of burn injuries. In the current study the mean CRP at admission was 23.5 ± 9.6 among those who died of burn injury and CRP levels above 3 mg/L are associated with a 2-fold increased risk of all-cause mortality, according to a study by Zacho et al.¹⁷ A cross-sectional investigation discovered that the highest CRP concentrations were seen in severe burns ($>80\%$ TBSA) $p < 0.05$,¹⁸ Research has also revealed that fluctuations in CRP levels were strongly related to mortality results. Chua et al. studied the relationship between serum CRP levels, the time it takes for burn wounds to heal, and the length of hospital stays. According to the study, greater CRP levels are linked to slower wound healing and longer hospital stays.¹⁹ The current study shows 25(59.5%) of the burn survivors were discharged within a week of hospital stay. In a systematic analysis that investigated the diagnostic performance of various biomarkers for the early identification of sepsis in hospitalized burn patients, C-reactive protein was shown to have high sensitivity (86%) but low specificity (54%). According to a prospective study carried out in Romania, PSP (preseason) and CRP had reasonable sensitivity and specificity in predicting the beginning of hemodynamic instability in patients with severe burns, with PSP having stronger predictive values than CRP.²⁰ Our study established that higher values of CPR at admission are significantly associated with an increase in burn-related mortality. The current study shows as TBSA increases, CRP.0 levels also tend to increase. This finding is consistent with previous research, which has shown that CRP levels are elevated in patients with larger burns.²¹

5. Conclusion

In conclusion, this study found that CRP level at admission was a useful biomarker for monitoring burn patients' outcomes, as it was significantly associated with patient mortality. This finding suggests that the CRP level at admission could be used as a prognostic indicator for mortality in burn patients and help guide

clinical decisions and interventions. Larger, more severe burn injuries and poorer outcomes were associated with higher CRP levels. Understanding the role of CRP can help medical professionals make more informed decisions about patient care, risk stratification, and treatments. The mechanisms relating CRP to unfavourable outcomes and novel therapeutic strategies for the management of burn injuries require more study. Limited generalizability due to a single healthcare facility, a small sample size, the lack of a control group, a brief follow-up period, and possibly unmeasured confounding variables are all limitations of this study. These drawbacks highlight the need for more research to resolve these issues and develop a thorough grasp of the prognostic value of CRP as a biomarker for burn patients.

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M.S, Q.J, I.H.S, S.S.S, S.I, S.Z - Conception of study

I.H.S, S.I, S.Z - Experimentation/Study Conduction

Q.J, S.S.S - Analysis/Interpretation/Discussion

M.S, Q.J, S.S.S, S.I, S.Z - Manuscript Writing

M.S, I.H.S, S.S.S, S.I, S.Z - Critical Review

M.S, Q.J, I.H.S, S.S.S - Facilitation and Material analysis

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