Section: Miscellaneous

Original Research Article

# ROLE OF C-REACTIVE PROTEIN IN ASSESSING PROGNOSIS OF ACUTE ORGANOPHOSPHORUS POISONING

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**ABSTRACT**

**Background:** WHO has estimated that around 300 million individuals are subjected to pesticide poisoning annually, leading to roughly 200,000 deaths each year in developing nations. C reactive protein is well known as an inflammatory indicator that is elevated in injury, trauma, infection, cancer and autoimmune diseases. However very little is known about the role of CRP on acute poisoning. **Objective of The Study:** 1. To assess the severity and prognosis of acute organophosphorus poisoning by C-Reactive Protein.
**Materials and Methods:** It is a prospective, observational study conducted from August 2022 to July 2024 at GIMS, Kalaburagi. Sample size included 100 individuals who were hospitalized due to organophosphorus poisoning to GIMS hospital during the study period. Patients were reviewed daily until discharge or death. C-Reactive Protein (CRP) levels were measured at admission, 72 hours post-admission and on day 7 or day of discharge /death.
**Results:** The mean CRP levels of the expired patients were significantly higher than those of the live patients at admission, at 72 hours and at discharge ($p<0.001$).
**Conclusion:** In conclusion, the present study revealed that changes in CRP was associated with the prediction of AOPP prognosis. Patients with severe acute organophosphorus pesticide poisoning show elevated levels of C-reactive protein, which play a significant role in predicting the severity and prognosis of the condition.
**Keywords:** Organophosphorus poisoning, C reactive protein.

## INTRODUCTION

Acute organophosphorus (OP) poisoning is a significant global health issue, particularly in agricultural regions, due to the widespread use of OP compounds as pesticides. The severity of OP poisoning can vary widely, from mild, transient symptoms to severe, life-threatening illness characterized by cholinergic crisis, respiratory failure, and multi-organ dysfunction.[1,2]
Early and accurate assessment of the severity of poisoning is crucial for guiding therapeutic interventions and for prognostic purposes. In recent years, various biomarkers and scoring systems have been investigated for their utility in predicting the outcome of acute poisoning cases. Among these, C-Reactive Protein (CRP) is notable for their potential roles in the clinical management of OP poisoning.[3]
C-Reactive Protein, a well-established marker of inflammation, has been linked to the severity and prognosis in various medical conditions, including infections, cardiovascular diseases, and sepsis. Its role in acute poisoning, however, particularly with OP compounds, is less well-defined. Recent studies suggest that elevated CRP levels upon admission may correlate with increased severity of poisoning and poorer outcomes, indicating its potential as a prognostic marker in this context.[4,5]
The prognostic value of this marker alone or in combination, in acute OP poisoning, has begun to draw attention in the medical community. This interest is driven by the potential to improve clinical outcomes through tailored treatment strategies based on early risk stratification. However, the literature

on the use of CRP levels in predicting the severity and prognosis of acute OP poisoning remains limited and somewhat fragmented. This article aims to consolidate existing research findings, elucidate the roles of CRP in this context and explore the potential mechanisms through which they may influence patient outcomes. Understanding these relationships is crucial for developing more effective management strategies for acute OP poisoning, ultimately reducing morbidity and mortality associated with this toxicological emergency.

**Objective of the Study**

1. To assess the severity and prognosis of acute organophosphorus poisoning by C-Reactive Protein.

## MATERIALS AND METHODS

A cross-sectional observational design was utilized for this study. The study population comprised 100 patients who had been admitted to GIMS, Kalaburagi, with a history of organophosphorus compound consumption during the study period from August 2022 to July 2024.

**Inclusion and Exclusion Criteria**

Patients were included if they had a history of consumption or exposure to OP compounds and presented with typical clinical manifestations and symptoms of OP pesticide poisoning. Exclusion criteria encompassed patients with a history of acute illnesses unrelated to OP poisoning, non-OP poisoning, and chronic inflammatory conditions.

## RESULTS

Upon meeting the inclusion criteria 100 patients were selected for the study following the provision of valid written consent. The study was described in detail to the patients, emphasizing its importance, and information sheets in the vernacular language were provided. Informed written consent was obtained from each participant. A detailed medical history and clinical examination were conducted according to a pre-defined proforma to confirm the eligibility of the patients for the study. Clinical data, including laboratory investigations were assessed at the time of admission. Patients were reviewed daily until discharge or death. C-Reactive Protein (CRP) levels were measured at admission, 72 hours post-admission and on day 7 or day of discharge /death. These tests were integral to evaluating the patients' health status, facilitating the determination of the OP poisoning severity, and assisting in prognostication based on CRP levels. Statistical data was analysed by IBM SPSS 25.0 version software. Collected data were spread on excel sheet and prepared master chart. Through the master chart, tables and graphs are constructed. For quantitative data analysis mean and standard deviations will be calculated, t-test and ANOVA test, correlation coefficient, regression analysis were applied. For qualitative data analysis Chi-square test, Fisher exact test and spearman rank correlation are applied for statistical significance. If P-value was less than 0.05 considered as significant.

Study observes that, 24 (24.0%) were belongs to the age group of 31—40 years, followed by 23 (23.0%) of patients were belongs to the age group of 41—50 years, 20 (20.0%) of patients were belongs to the age group of 20—30 years and 16 (16.0%) of patients age in the range of >60 years. Minimum age of patient was 20 years and maximum age of patient was 76 years. The mean age of patients was 44.16 years. [Table 1]

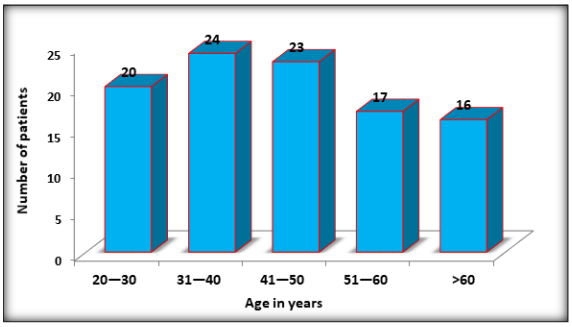


**Figure 1: Multiple bar diagram represents age wise distribution of patients**

Study observed that; Male patients were 51 (51.0%) and 43 (43.0%) of patients were females. Male to Female ratio was 1.04:1. [Table 2]

Study observed that; Majority of patients 73 (73.0%) does not seen any chronic health condition. Whereas 13 (13.0%) of patients were seen hypertension, 12 (12.0%) of patients were seen diabetes mellitus, 4 (4.0%) of patients were seen hypothyroidism, each 2 (2.0%) of patients were seen anaemia and asthma respectively. [Table 3]

The mean CRP levels increased with prognosis and over time, suggesting a correlation between prognosis and CRP levels ($P<0.001$). The mean score increased significantly with prognosis, indicating a strong association between prognosis and CRP levels with different time intervals. [Table 5]

The mean age of the expired patients was significantly higher than that of the live patients ($P<0.05$). The mean CRP levels of the expired patients were significantly higher than those of the live patients at admission, at 72 hours and at discharge ($P<0.001$). [Table 6]

There was statistically significant association of respiratory rate and Fio2 between survival and non-survival groups of patients were seen higher respiratory rate and Higher FiO2 as compare to survival group ($P<0.05$) and ($P<0.001$) respectively.

The mean Glasgow_coma_scale were seen significantly less in non-survival group as compare to survival group ($P<0.05$)

There was statistically not significant association of mean temperature, MAP, arterial pH, heart rate,

PaCO2, serum sodium, serum potassium, serum creatinine, haematocrit, WBC and AaO2 between survival and non-survival groups (P>0.05). [Table 7]

Study reveals that; univariate and bivariate logistic regression analyses comparing patients as predictors of prognosis. The overall logistic regression model was statistically significant (X2 = 58.95, P = 0.001), indicating that the predictor variables included in the model reliably differentiated between subjects regarding prognosis. [Table 8]

**Table 1: Age wise distribution of OP poisoned. Patients**

| Age in years | Number of patients | Percentage |
|---|---|---|
| **20—30** | 20 | 20.0 |
| **31—40** | 24 | 24.0 |
| **41—50** | 23 | 23.0 |
| **51—60** | 17 | 17.0 |
| **>60** | 16 | 16.0 |
| **Total** | 100 | 100.0 |
| **Mean ± SD** | 44.16 ± 14.66 | |

**Table 2: Gender wise distribution of OP poisoned patients**

| Gender | Number of patients | Percentage |
|---|---|---|
| **Males** | 51 | 51.0 |
| **Females** | 49 | 49.0 |
| **Total** | **100** | **100.0** |

**Table 3: Chronic health conditions wise distribution of OP poisoned patients**

| Chronic health conditions | Number of patients | Percentage |
|---|---|---|
| **None** | 73 | 73.0 |
| **Diabetes mellitus** | 12 | 12.0 |
| **Hypertension** | 13 | 13.0 |
| **Hypothyroidism** | 4 | 4.0 |
| **Anaemia** | 2 | 2.0 |
| **Asthma** | 2 | 2.0 |
| **COPD** | 1 | 1.0 |
| **CVA** | 1 | 1.0 |
| **CAD** | 1 | 1.0 |

**Table 4: Classification of non-survivor and survivor wise distribution of patients**

| Outcome | Number of patients | Percentage |
|---|---|---|
| **Non-survivors** | 23 | 23.0 |
| **Survivors** | 77 | 77.0 |
| **Total** | 100 | 100.0 |

**Table 5: Comparison CRP with prognosis of OP poisoned patients**

| Time interval | Severity | No. of patients | CRP Mean ± SD | | P-value & significance |
|---|---|---|---|---|---|
| **At admission** | **Survivors** | 77 | 9.73 ± 2.61 | | |
| | **Non-survivors** | 23 | 13.10 ± 3.85 | t = -4.832 | P = 0.00, HS |
| | **ANOVA, P-value** | | **F = 2.83, P = 0.046, S** | | --- |
| **At 72 hours** | **Survivors** | 77 | 12.15 ± 4.21 | | |
| | **Non-survivors** | 23 | 25.33 ± 15.74 | t = -6.654 | P = 0.000, HS |
| | **ANOVA, P-value** | | **F = 2.91, P = 0.037, S** | | -- |
| **At Discharge** | **Survivors** | 77 | 13.90 ± 11.42 | | |
| | **Non-survivors** | 23 | 31.35 ± 23.56 | t = -4.885 | P = 0.000, HS |
| | **ANOVA, P-value** | | **F = 3.125, P = 0.009, HS** | | --- |

**NS= not significant, S=significant, HS=highly significant**

**Table 6: Comparison of variables with mortality**

| Variables | Survivors Mean ± SD | Non-survivors Mean ± SD | P-values |
|---|---|---|---|
| **Age** | 43.05 ± 13.80 | 47.86 ± 14.05 | **t = 2.052, P = 0.046, S** |
| **CRP at admission** | 9.73 ± 2.61 | 13.10 ± 3.85 | **t = 4.832, P = 0.000, HS** |
| **CRP at 72 hours** | 12.15 ± 4.21 | 25.33 ± 15.74 | **t = 6.654, P = 0.000, HS** |
| **CRP at discharge** | 13.90 ± 11.42 | 31.35 ± 23.56 | **t = 4.885, P = 0.000, HS** |

**Table 7: Comparison of other variables with mortality**

| Variables | Survivors Mean ± SD | Non-survivors Mean ± SD | P-values |
|---|---|---|---|
| **Temperature** | 37.13 ± 2.12 | 37.39 ± 2.76 | **t =-0.474 , P = 0.636, NS** |
| **Mean Arterial pressure** | 92.15 ± 17.19 | 91.26 ± 18.04 | **t = 0.217, P = 0.829, NS** |

| | | | |
|---|---|---|---|
| **Arterial pH** | 7.42 ± 0.14 | 7.43 ± 0.15 | **t = 0.114, P = 0.910, NS** |
| **Heart Rate** | 90.72 ± 19.26 | 83.91 ± 15.56 | **t = 1.550, P = 0.124, NS** |
| **Respiratory Rate** | 22.44 ± 7.99 | 27.39 ± 8.09 | **t = -2.598, P = 0.014, S** |
| **PaCO2** | 38.59 ± 3.53 | 38.95 ± 2.78 | **t = -0.447, P = 0.656, NS** |
| **Serum Sodium** | 139.32 ± 10.53 | 140.30 ± 12.18 | **t = -0.377, P = 0.707, NS** |
| **Serum Potassium** | 4.37 ± 1.16 | 4.37 ± 1.02 | **t = -0.006, P = 0.995, NS** |
| **Serum Creatinine** | 1.24 ± 0.58 | 1.51 ± 0.61 | **t = -1.432 , P = 0.108,NS** |
| **Hematocrit** | 40.36 ± 11.33 | 42.30 ± 8.77 | **t =-0.931, P = 0.549, NS** |
| **White Blood cell count** | 9.92 ± 4.88 | 10.80 ± 4.39 | **t =-0.731, P = 0.682, NS** |
| **Glasgow_coma_scale** | 12.84 ± 2.14 | 10.56 ± 2.40 | **t = 2.103, P = 0.041, S** |
| **FiO2** | 28.79 ± 11.24 | 63.13 ± 16.89 | **t =-4.932, P = 0.000, HS** |
| **A-aO2** | 91.81 ± 10.37 | 85.60 ± 14.88 | **t = 1.832, P = 0.082, NS** |

**Table 8: Logistic regression analysis of the effect of multiple factors on prognosis**

| Variables | β-coefficient | S.E | Wald | P-value | Odds Ratio | 95% CI for odds ratio | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| **CRP atb72 hours** | 0.05 | 0.163 | 0.129 | 0.165 | 1.471 | 0.792 | 2.531 |
| **Age** | -0.024 | 0.061 | 0.684 | 0.503 | 0.956 | 0.852 | 0.993 |
| **sex** | 0.482 | 1.621 | 0.089 | 0.785 | 0.782 | 0.150 | 3.021 |
| **Marital status** | 0.385 | 1.345 | 0.078 | 0.645 | 0.816 | 0.092 | 1.049 |

## DISCUSSION

The current research revealed that CRP levels rose with the severity of AOPP. Furthermore, CRP levels increased over time in patients with severe AOPP, while they decreased in patients who survived. This could be attributed to the level of toxicity.[6] Patients with a favourable outcome, such as those who survived, showed reduced acetylcholine stimulation of cholinergic nerves, stress responses, organ lesions, and inflammation, resulting in relatively low plasma CRP levels.[7] In contrast, patients with an unfavourable outcome, such as non-survivors, experienced severe tissue and organ poisoning, multiple organ failure, and intense inflammation, leading to relatively high plasma CRP levels.[8] Results from the current study using logistic regression analysis found that patients with plasma CRP levels exceeding median values were more likely to exhibit other clinical symptoms and experience reduced treatment effectiveness, resulting in a poorer prognosis. A previous study indicated that patients with OP poisoning had higher plasma CRP levels compared to normal subjects, and these levels increased with the severity of the poisoning. An acute rise and fall pattern of CRP has been observed in patients with poisoning who are unlikely to have an infection.[9,10]

**Limitations of our study**

CRP is a good indicator, but optimal cut-off points should be developed for a specific population. So any generalization in these patients should be made with caution because a different prevalence of risk factors, quantity of the compound, and concurrent subclinical infections could alter the CRP concentration. It is dubious in our study as to which of these risk factors are considered as confounders and which might actually be mediators of any CRP effect. Our study was a single centre prospective study and the results may lack wider applicability, missing data and small sample size are other limitations. In the future, we need a larger prospective sample size to validate CRP as a predictive factor for mortality.

## CONCLUSION

In conclusion, the present study revealed that changes in CRP was associated with predicting acute organophosphorus poisoning prognosis. Increased levels of C-reactive protein in patients with severe acute organophosphorus pesticide poisoning are significant for the prediction of severity and prognosis. Our study also demonstrated a positive correlation between serial CRP measurements in patients with acute organophosphorus poisoning, suggesting these as potential markers for assessing prognosis.

**Summary**

A prospective study was done at Gulbarga Institute of Medical Sciences, Kalaburgi, Karnataka among 100 organophosphate pesticide poisoning patients. From the present study, changes in the CRP plasma levels help in predicting the prognosis of acute organophosphorus poisoning. CRP is positively correlated in OP poisoning patients.

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