MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.8.145.149

OPEN ACCESS

Key Words
Organophosphate poisoning, early intervention, clinical signs, recovery outcomes, retrospective cohort study

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Received: 15 May 2024
Accepted: 18 June 2024
Published: 13 July 2024

Citation: Dinesh Singh Mahor, Divyansh Gupta and Ritesh Yadav, 2024. Assessing the Impact of Early Intervention and Clinical Variables on Recovery in Organophosphate Poisoning Cases. Res. J. Med. Sci., 18: 145-149, doi: 10.36478/makrjms.2024.8.145.149

Assessing the Impact of Early Intervention and Clinical Variables on Recovery in Organophosphate Poisoning Cases

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Abstract
Organophosphate (OP) poisoning is a significant global health issue, resulting in nearly 3 million cases and over 200,000 deaths annually. Understanding the factors influencing recovery outcomes is crucial for improving patient prognosis.This study aimed to evaluate the impact of early intervention and clinical variables on recovery outcomes in OP poisoning cases. A retrospective cohort study was conducted at a tertiary care center, analyzing medical records of patients aged 14 years and older with confirmed OP poisoning. Data were collected (June 2023-May 2024) on demographics, clinical signs, time to presentation, treatments administered, duration of hospital stay, and patient outcomes. Statistical analyses included descriptive statistics, chi-square tests, t-tests, correlation and regression analyses. The study included 78 patients, with a mean age of 28.92 years (SD=12.81) and a balanced gender distribution (52.56% males, 47.44% females). Early intervention, including the time to hospital presentation and administration of first aid, did not significantly impact patient recovery ($p>0.05$). Clinical signs such as heart rate, pupil size, aspiration and crepitations showed weak correlations with patient outcomes. These findings suggest that demographic factors and early interventions alone are not strong predictors of recovery. Demographic factors such as age and gender, along with early interventions, do not significantly influence recovery outcomes in OP poisoning cases. The weak correlation between clinical signs and patient outcomes indicates that other factors may play a more critical role in determining prognosis. Further research is needed to identify additional predictors and improve comprehensive management strategies to enhance patient outcomes and reduce the public health burden of OP poisoning.

INTRODUCTION

Organophosphate (OP) poisoning is a major global health problem, with nearly 3 million cases and over 200,000 deaths annually[1]. OPs are commonly used as insecticides, medications, and nerve agents[1]. Exposure can occur through ingestion, inhalation, or skin contact, leading to a buildup of acetylcholine and overstimulation of nicotinic and muscarinic receptors [2]. Symptoms include increased secretions, muscle weakness, confusion and respiratory depression[2-4]. Factors influencing recovery include the type of OP, amount of exposure, and promptness of treatment[5]. Mortality rates range from 3-25%, with complications like bronchorrhea and respiratory failure[5] Understanding these factors is crucial for improving outcomes in OP poisoning cases.

However, the existing literature on OP poisoning is often limited in scope, focusing on specific geographic regions or patient subgroups[4-5]. This restricts the generalizability of the findings and leaves crucial knowledge gaps regarding the broader epidemiological patterns and factors influencing the clinical course and outcomes of OP poisoning . To address these gaps, comprehensive multi-center studies are needed to analyze the demographic characteristics, exposure details, clinical presentations and treatment responses across diverse patient populations. Such research could elucidate critical determinants of prognosis, such as the type and route of OP exposure, comorbidities, and access to timely medical care [4-6]Identifying these key factors could inform the development of targeted prevention strategies, optimize treatment protocols and ultimately reduce the substantial public health burden associated with OP poisoning.

This study aims to fill these gaps by analyzing a large, diverse cohort of OP poisoning patients to identify critical factors influencing prognosis, such as age, gender, comorbidities and exposure characteristics [7,8]. The findings could inform targeted prevention strategies, optimize treatment protocols and ultimately reduce the burden associated with OP poisoning [2,6].

By elucidating the relationships between patient demographics, clinical manifestations and outcomes, this research could provide valuable insights to guide healthcare providers in recognizing high-risk groups, tailoring interventions and improving the overall management of OP poisoning cases [7-9]. Addressing these knowledge gaps is essential for mitigating the significant public health impact of this global issue.

MATERIALS AND METHODS:

Study Design and Population: This retrospective cohort study from June 2023-May 2024 was conducted to evaluate the impact of various factors on the recovery outcomes of patients diagnosed with Organophosphorus (OP) poisoning. The study was carried out at a tertiary care center, analyzing patient records from those admitted with OP poisoning over a defined period. The inclusion criteria were patients aged 14 years and older who presented to the emergency department with confirmed OP poisoning. Exclusion criteria included patients younger than 14 years, those with non-OP poisoning, and cases where the patient was deceased upon arrival.

Data Collection: Data were meticulously extracted from medical records, focusing on:

- **Demographic Information:** Age and sex.
- **Clinical Signs:** Noted signs included miosis or mydriasis, aspiration and crepitations.
- **Time to Presentation:** Recorded as less than 6 hours or more than 6 hours from the onset of symptoms to hospital presentation.
- **Treatment Administered:** Documentation of any treatment provided.
- **Duration of Hospital Stay:** Recorded as the total number of days spent in the hospital.
- **Patient Outcomes:** Classified as discharged or deceased.
- **First Aid:** Noted whether first aid was administered prior to hospital presentation.

This comprehensive approach was designed to capture a detailed profile of each patient, ensuring a robust dataset for analysis.

- **Statistical Analysis:** The statistical evaluation comprised both descriptive and inferential techniques:
- **Descriptive Statistics:** Computed for demographic variables with summary measures (mean, standard deviation, median, interquartile range) for age and frequency counts for sex. These statistics were tabulated to outline the demographic distribution of the study population.
- **Chi-Square Tests:** Utilized to determine the relationship between categorical variables such as gender, first aid administration and patient outcomes.
- **T-Test:** Conducted to compare the mean duration of hospital stay between those who presented within 6 hours versus those who presented after 6 hours.
- **Correlation Analysis:** Performed to explore the relationships between various clinical signs and the numeric outcome measure (e.g.,heart rate, pupil size and the outcome severity score).
- **Regression Analysis:** Employed to assess the predictive value of various clinical and demographic factors on patient outcomes. This included fitting a logistic regression model with

outcomes as the dependent variable and clinical signs, demographic data and treatment details as independent variables.

RESULTS AND DISCUSSIONS

(Table 1) provides a comprehensive overview of the demographic characteristics of the study population. The mean age of the patients was 28.92 years, with a standard deviation of 12.81 years, indicating a relatively young population with considerable variability in age. The median age was 25 years, with an interquartile range (IQR) of 13.75 years, suggesting that half of the patients were between 18.13 and 31.88 years old. The study population consisted of 41 males (52.56%) and 37 females (47.44%), reflecting a nearly balanced gender distribution. These descriptive statistics provide a foundation for understanding the demographic profile of patients affected by Organophosphorus poisoning.Impact Analysis.

In (Table 2), we assessed the impact of gender on patient outcomes using a chi-square test. The chi-square value was 0.1884 with a p-value of 0.6643 and the degrees of freedom were 1. This analysis revealed no statistically significant difference in outcomes between male and female patients, suggesting that gender does not significantly influence the likelihood of recovery or mortality in cases of Organophosphorus poisoning.

Table 3 examines the effect of receiving first aid on patient outcomes. The chi-square test yielded a value of 0.1000 with a p-value of 0.7510 and the degrees of freedom were 1. The lack of statistical significance in this analysis indicates that the administration of first aid did not significantly impact the overall outcomes of patients with Organophosphorus poisoning. This suggests that while first aid is crucial, it may not be a decisive factor in the final patient outcomes in this dataset.

(Table 4) explores the relationship between the time before presentation to medical care and recovery outcomes. Patients presenting within 6 hours had a mean hospital stay of 5.89 days (SD = 3.01), while those presenting after 6 hours had a mean stay of 5.97 days (SD = 3.10). The t-statistic for this comparison was -0.13 with a p-value of 0.8994, indicating no significant difference in recovery times based on the time of presentation. This suggests that early presentation did not significantly affect the duration of hospital stay in this patient population.

(Table 5) presents the correlation coefficients between various clinical signs and patient outcomes. The correlations between heart rate, pupil size, aspiration, crepitations and outcome were generally low, indicating weak relationships. Specifically, heart rate had a correlation of 0.072 with outcomes, pupil size had -0.035, aspiration had -0.121 and crepitations had -0.064. These low correlation values suggest that individual clinical signs may not strongly predict patient outcomes in cases of Organophosphorus poisoning.

(Table 6) provides the results of a logistic regression analysis predicting patient outcomes based on various clinical variables. The regression model included variables such as age, heart rate, pupil size, aspiration, crepitations and sex. The coefficient for the constant was -2.3087 (p=0.0063), indicating a significant baseline effect. Age had a coefficient of 0.0078 (p=0.6105), heart rate 0.0092 (p =0.2811), pupil size -0.0248 (p=0.6701), aspiration -0.5512 (p= 0.3512), crepitations 0.6313 (p=0.2274) and male sex -0.3925 (p =0.3449). None of the clinical variables were significant predictors of outcomes, as indicated by their p-values. This regression analysis suggests that, in this patient population, these specific clinical indicators do not strongly predict mortality or recovery outcomes.

This study aimed to evaluate the impact of early intervention and various clinical variables on the recovery outcomes of patients diagnosed with Organophosphorus (OP) poisoning. In this retrospective cohort study conducted at a tertiary care center, data from patients aged 14 years and older with confirmed Organophosphorus (OP) poisoning were analyzed. The study focused on demographic information, clinical signs, time to presentation, treatments administered, duration of hospital stay and patient outcomes. The results indicated that demographic factors such as age and gender did not significantly influence recovery outcomes in OP poisoning cases. Early intervention, including the time to hospital presentation and the administration of first aid, showed no significant impact on patient recovery. Additionally, clinical signs like heart rate, pupil size, aspiration, and crepitations had weak correlations with patient outcomes.

Demographic Influences on Outcomes

The demographic analysis revealed a relatively young patient population, with a mean age of 28.92 years and a balanced gender distribution (52.56% males and 47.44% females). This finding is consistent with global trends, as highlighted by Jeyaratnam (1990), where OP poisoning predominantly affects younger individuals, particularly in agricultural settings where these substances are prevalent [10]. However, Peter *et al.* (2014) suggested possible gender-related susceptibility differences, which were not observed in our study [11]. The lack of significant impact of gender on recovery outcomes (chi-square value=0.1884, p= 0.6643) suggests that occupational exposure and not gender-related biological differences may influence the risk and severity of OP poisoning.

Early Intervention and Patient Outcomes: The analysis showed no significant impact of early intervention (time to presentation) on recovery outcomes

Table 1: Frequency Distribution

Variable	Category	Frequency (N)	Percentage (%)
Sex	Male	41	52.56
	Female	37	47.44
Age Group	0-10	0	0.00
	11-20	15	19.48
	21-30	33	42.86
	31-40	18	23.38
	>40	11	14.29

Table 2: Impact of Gender on Outcomes

Statistic	Value
Chi-Square	0.1884
p-Value	0.6643
Degrees of Freedom	1

Table 3: Impact of Receiving First Aid on Outcomes

Statistic	Value
Chi-Square	0.1000
p-Value	0.7510
Degrees of Freedom	1

Table 4: Impact of Time Before Presentation on Recovery

Group	Mean Duration of Stay	SD Duration of Stay	t-Statistic	p-value
<6 hours	5.89	3.01	-0.13	0.8994
>6 hours	5.97	3.10		

Table 5: Correlation Between Clinical Signs and Outcomes

Variable	Heart-Rate	Pupil-Size	Aspiration	Crepitations	Outcome-num
Heart-rate	1.000	0.189	-0.001	0.117	0.072
Pupil-size	0.189	1.000	0.109	0.210	-0.035
Aspiration	-0.001	0.109	1.000	0.072	-0.121
Crepitations	0.117	0.210	0.072	1.000	-0.064
Outcome-num	0.072	-0.035	-0.121	-0.064	1.000

Table 6: Regression Analysis Predicting Outcomes

Variable	Coefficient	Std. Error	z-value	p-value
AGE	0.0078	0.0153	0.509	0.6105
Heart-rate	0.0092	0.0085	1.078	0.2811
Pupil-size	-0.0248	0.0582	-0.426	0.6701
Aspiration	-0.5512	0.5917	-0.932	0.3512
Crepitations	0.6313	0.5231	1.207	0.2274
Sex-m	-0.3925	0.4154	-0.945	0.3449

(t-statistic =-0.13, p=0.8994), contrasting with conventional toxicology wisdom that emphasizes rapid decontamination and treatment. Studies by Karalliedde *et al.* (2006) emphasized that early intervention is crucial in cases involving nerve agents and certain OP insecticides to prevent irreversible neurological damage [12]. However, our findings align with those of Eddleston *et al.* (2003), who reported that the timing of hospital presentation did not significantly alter mortality rates, suggesting that the severity of poisoning and the specific OP compound involved might be more critical factors [13].

In contrast, a study by Sungur and Güven (2001) found that patients presenting within the first two hours of exposure had significantly lower mortality rates (8.6%) compared to those presenting after two hours (28.6%) [14]. This highlights the variability in outcomes based on different study populations and OP compounds, suggesting a complex interplay of factors influencing prognosis.

Clinical Signs and Prognosis: The weak correlations between individual clinical signs (heart rate, pupil size, aspiration and crepitations) and patient outcomes (correlation coefficients: 0.072, -0.035, -0.121, -0.064, respectively) suggest that these signs are not strong predictors of recovery. This finding is supported by Rehiman *et al.* (2008), who found that serum cholinesterase levels and clinical scores at presentation had limited predictive value for severity and outcomes [15]. Conversely, Thiermann *et al.* (1999) argued that certain clinical signs are essential for diagnosing OP poisoning and initiating appropriate antidotal treatments early [16]. The discrepancy could be due to variations in study designs, patient populations, or the specific OP agents involved.

Other studies have shown mixed results regarding clinical signs. For example, Balali-Mood and Shariat (2008) reported that miosis and muscle fasciculations were significant early indicators of OP poisoning severity and were correlated with higher morbidity and mortality [17]. However, these signs' predictive power may diminish with time and depend on the specific OP compound involved.

Comparison with Other Studies: Our study's findings regarding the limited predictive value of early intervention and clinical signs contrast with several other studies. For instance, Buckley *et al.* (2004) emphasized the importance of immediate medical

intervention and standardized treatment protocols in reducing mortality[18]. Furthermore, Eyer *et al.* (2003) reported that human parathion poisoning cases with rapid medical response had better outcomes [19]. These differences highlight the need for further research to explore the roles of specific OP compounds, doses, and antidotal therapies in improving patient outcomes.

Limitations and Implications for Future Research Despite providing valuable insights, our study has limitations, including its retrospective design and the single-center setting, which may limit the generalizability of the findings. Multi-center studies involving diverse populations, as suggested by Buckley *et al.* (2004), are crucial for understanding variable responses to OP poisoning and developing universally effective treatment protocols [18]. Additionally, future research should focus on the long-term outcomes of OP poisoning survivors and the effectiveness of different treatment regimens.

CONCLUSION

This study highlights that demographic factors such as age and gender, as well as early interventions like timely hospital presentation and first aid administration, do not significantly influence recovery outcomes in Organophosphorus (OP) poisoning cases. The weak correlation between clinical signs and patient outcomes suggests that these variables alone are not strong predictors of recovery. Future research should focus on identifying additional factors and improving comprehensive management strategies to enhance prognosis and reduce the public health burden of OP poisoning.

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