



Research Paper

Examination of Magnesium, Calcium, Phosphorus, and Albumin Levels in Critically Ill Patients (intubated or admitted to the intensive care unit) Poisoned with Organophosphorus Poisons

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ABSTRACT

Background: Poisoning with organophosphates (OP), one of the most common types of poisoning, can lead to decreased levels of calcium, magnesium, phosphorus, and albumin. Lower levels of these elements may help improve patient outcomes and reduce mortality rates. Since few studies have explored how these serum element levels change in patients poisoned with OP, this study aims to examine magnesium, calcium, phosphorus, and albumin levels in critically ill patients poisoned with OP.

Methods: This cross-sectional study included 89 critically ill patients (intubated or admitted to the intensive care unit) poisoned with various OP agents (including Chlorpyrifos (CPF), Diazinon (DZN), Malathion (MLT), and others) and hospitalized at Khorshid Hospital in Isfahan from 2013 to August 2023. Demographic and clinical data, along with magnesium, calcium, phosphorus, and albumin levels on days 1, 3, and 5, were extracted from patients' records and documented.

Results: Examination of changes in magnesium, calcium, phosphorus, and albumin levels on days 1, 3, and 5 after hospitalization showed a significant downward trend in magnesium, calcium, and phosphorus levels in MLT poisoning (P-value < 0.001). In CPF poisoning, DZN levels decreased from day one to day three and then increased. Patients' albumin levels also declined significantly over five days of treatment in cases of CPF, DZN, and MLT poisoning (P-value < 0.05). Additionally, a calcium reduction within five days of hospitalization increased the risk of death by 3.983 times (P-value = 0.013). Magnesium reduction significantly raised the risk of death (OR: 1.621; P-value = 0.044). However, reductions in phosphorus and albumin did not show a significant relationship with mortality (P-value > 0.05).

Conclusion: Severe OP poisoning results in a reduction in magnesium, calcium, phosphorus, and albumin levels over a period of five days. The reduction was more pronounced in MLT poisoning. Additionally, decreased levels of calcium, magnesium, phosphorus, and albumin increased the risk of death, although this effect was only significant for calcium and magnesium.

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Introduction

Organophosphorus (OP) compounds are widely used in agriculture, household pest control, and chemical weapons [1]. Pesticide poisoning accounts for about one-sixth to one-eighth of suicides worldwide, with 60% of annual deaths in Asian villages caused by OP poisoning [2]. OP pesticides irreversibly inhibit cholinesterase enzymes, especially acetylcholinesterase (AChE) in synapses and on red blood cell membranes, and butyrylcholinesterase (BuChE) in plasma. This inhibition leads to the buildup of acetylcholine and the stimulation of cholinergic receptors in neuromuscular junctions, as well as in the autonomic and central nervous systems. The clinical features of OP pesticide poisoning vary depending on which cholinergic receptors are activated in different tissues [3]. Studies from 2007 and 2009 show that poisoning with certain OP pesticides can cause hypocalcemia [4, 5]. These poisonings are also associated with decreased levels of magnesium and phosphorus in animals such as rats and fish, although there are conflicting findings regarding serum phosphorus levels [6]. Some research suggests that magnesium levels may affect patient outcomes, with magnesium treatment reducing mortality rates [7-9]. Magnesium's ability to inhibit acetylcholine release from motor nerve terminals [11] and counteract the direct effects of OP on sodium-potassium ATPase [12] could explain its role in lowering mortality and reducing hospital stay duration.

Additionally, hypoalbuminemia is recognized as a marker of poor prognosis, including increased mortality, morbidity, longer ICU stays, and overall hospital stays in various medical and traumatic conditions [12]. Literature indicates that hypoalbuminemia reflects the loss of vital albumin functions such as maintaining oncotic pressure, transporting ions and drugs, eliminating oxygen-free radicals, and acting as an antioxidant, which can lead to adverse outcomes [13]. One study also suggested that OP binds to albumin, potentially destroying and sequestering OP molecules and reducing their availability to react with AChE [14]. The primary detoxification pathway for OP involves hydrolysis by esterase enzymes, producing dialkyl phosphate, which does not inhibit AChE [15, 16]. Laboratory research has demonstrated albumin's pseudo-esterase activity, particularly in hydrolyzing chlorpyrifos and parathion metabolites [16]. Although some earlier studies suggest that OP compounds can accumulate or prolong hydrolysis, further exploration of serum albumin's potential therapeutic role, including its protective effects against OP poisoning, is necessary. Most

previous research has focused on the therapeutic effects of magnesium and calcium in treating these poisonings, with limited attention to changes in serum element levels such as albumin, magnesium, calcium, and phosphorus, especially in animal models. Overall, there is limited information on serum levels of calcium, phosphorus, magnesium, and albumin in patients with OP poisoning [17, 18]. Therefore, this study aims to investigate the trends of magnesium, calcium, phosphorus, and albumin levels in critically ill patients—such as those who are intubated or admitted to the ICU—who have been poisoned by OP compounds, including Chlorpyrifos (CPF), Diazinon (DZN), Malathion (MLT), and others, and who presented to Khurshid Hospital during 2013-2023.

Materials and Methods

The present study was a cross-sectional analysis. The statistical population included all records of patients poisoned with OP poisons who were hospitalized at Khorshid Hospital in Isfahan from 2013 to August 2023. The inclusion criteria covered the records of patients poisoned with OP poisons (such as CPF, DZN, MLT, etc.) who were either intubated or hospitalized in the ICU. Patients were excluded if they were diagnosed with drug poisoning, had combined drug and toxic poisoning, received treatment before hospitalization, or were taking supplements such as magnesium, calcium, phosphorus, and albumin. Patients with documented liver failure or nutritional problems were also excluded.

Additionally, patients were excluded if more than 20% of their records were incomplete or if levels of magnesium, calcium, phosphorus, and albumin were not recorded during hospitalization. Due to the limited number of individuals meeting these criteria, all eligible cases—comprising a total of 89 patients—were included in the study. After obtaining ethical approval from the ethics committee of Isfahan University of Medical Sciences and approval from Khorshid Hospital in Isfahan, the researchers reviewed the hospital archives and extracted cases registered with OP poisoning. Following the application of the inclusion and exclusion criteria, eligible cases were selected for analysis. Patients' demographic and clinical information—such as age, gender, employment status, marital status, type of OP poison, and mode of poisoning—along with levels of magnesium, calcium, phosphorus, and albumin on the first, third, and fifth days, were extracted from their records and recorded. Additionally, data on the length of ICU stay, duration of intubation, need for intubation, and patient outcomes—including complete recovery, recovery with complications, and death—were documented.

Statistical analysis

The collected data were entered into SPSS software (version 26). Data are presented as means \pm standard deviation (SD) or n (%). One-way analysis of variance (ANOVA) was used to compare the means of quantitative variables among different types of OP poisons at each follow-up time. To compare changes in quantitative variables over time within each type of OP poison, repeated measures ANOVA was employed. Additionally, the Chi-squared test was conducted to compare the frequency distribution of qualitative variables among various OP poison types. Finally, logistic regression was used to examine factors associated with patient mortality, and the odds ratio (OR) was reported. In all analyses, a significance level of less than 0.05 was considered.

Results

The findings of this study indicated that 89 critically ill patients were poisoned with OP agents and hospitalized at Khorshid Hospital from 2013 to 2023. These patients had a mean age of 44.28 ± 20.54 years,

comprising 64 (71.9%) men and 25 (28.1%) women. Furthermore, 89.9% of the poisonings were intentional, 6.7% were unintentional, and for 3.4%, the purpose behind the poisoning was unknown. The causes of poisoning included CPF in 11.2%, DZN in 18%, MLT in 13.5%, and other OP agents in 57.3%. DZN poisoning was associated with the highest average age, at 20.83 ± 52.06 years, while CPF and MLT poisonings had the lowest averages, at 19.91 ± 40.40 and 17.08 ± 40.42 years, respectively. This difference was statistically significant ($P < 0.05$). However, there were no significant differences among patients with different types of OP poisoning concerning other demographic factors such as gender, marital status, employment, education level, or place of residence ($P > 0.05$). Regarding clinical characteristics, although the duration of hospitalization and intubation was shorter for MLT poisoning compared to CPF and DZN, this difference was not statistically significant ($P > 0.05$). Overall, 20 patients (22.5%) died, while 69 (77.5%) recovered and were discharged. The death rates for CPF, MLT, and other poisonings were 10%, 25%, and 23.5%, respectively ($P > 0.05$) (Table 1).

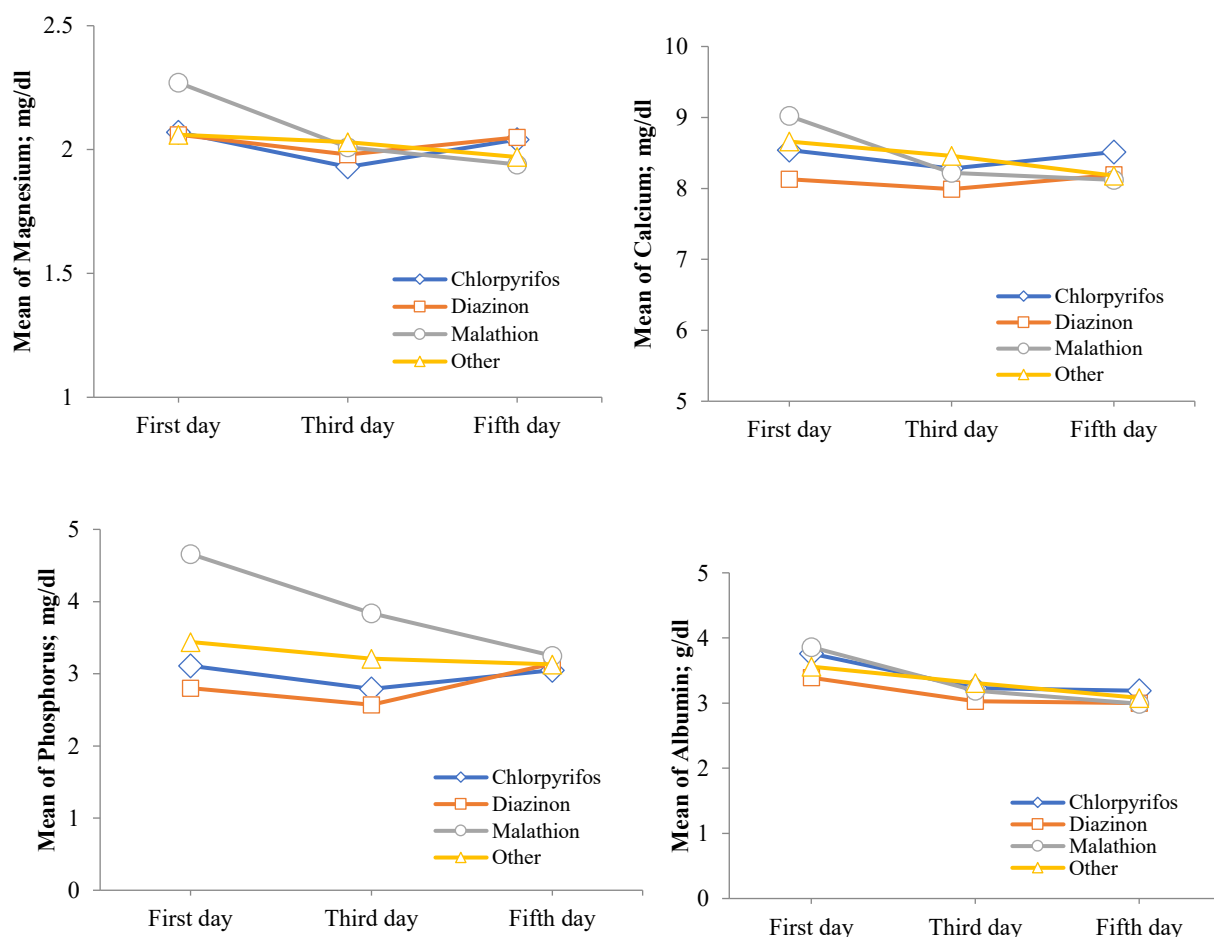


Figure 1. The average levels of magnesium, calcium, phosphorus, and albumin in poisoned patients by type of OP poisons...

Table 1. Basic and clinical features of poisoned patients by type of OP poison

Characteristics	Total (n=89)	CPF (n=10)	DZN (n=16)	MLT (n=12)	Other (n=51)	P-value
Sex						
Male	64(71.9%)	6(60.0%)	14(87.5%)	9(75.0%)	35(68.6%)	0.398
Female	25(28.1%)	4(40.0%)	2(12.5%)	3(25.0%)	16(31.4%)	
Age; year	44.28±20.54	40.40±19.91	52.06±20.83	40.42±17.08	43.47±12.25	0.037
Married						
Married	67(75.3%)	7(70.0%)	12(75.0%)	11(91.7%)	37(72.5%)	0.555
Single	22(24.7%)	3(30.0%)	4(25.0%)	1(8.3%)	14(27.5%)	
Location						
City	74(83.1%)	5(50.0%)	15(93.8%)	11(91.7%)	43(84.3%)	0.050
Village	15(16.9%)	5(50.0%)	1(6.3%)	1(8.3%)	8(15.7%)	
Job status						
Self-Employee	50(56.2%)	6(60.0%)	10(62.5%)	8(66.7%)	26(51.0%)	0.875
Employee	5(5.6%)	0(0.0%)	1(6.3%)	1(8.3%)	3(5.9%)	
Unemployed	34(38.2%)	4(40.0%)	5(31.3%)	3(25.0%)	22(43.1%)	
Education status						
Illiterate	19(21.3%)	4(40.0%)	2(12.5%)	2(16.7%)	11(21.6%)	0.576
<=Diploma	66(74.2%)	6(60.0%)	14(87.5%)	9(75.0%)	37(72.5%)	
University degree		0(0.0%)	0(0.0%)	1(8.3%)	3(5.9%)	
Addiction	21(23.6%)	3(30.0%)	4(25.0%)	6(50.0%)	8(15.7%)	0.084
Hospitalization; day	9.88±3.78	12.30±9.55	12.19±12.86	10.00±9.74	8.65±8.78	0.517
Duration of intubation: day	10.69±9.18	12.00±8.48	13.00±8.61	11.10±10.16	9.51±9.44	0.724
Cause of intubation						
Decreased consciousness	57(64.0%)	7(70%)	11(68.7%)	8(66.7%)	31(60.8%)	0.864
Oxygen Saturation drop	8(9.0%)	0(0.0%)	1(6.3%)	1(8.3%)	6(11.8%)	
Apnea	8(9.0%)	1(10%)	2(12.5%)	1(8.3%)	4(7.8%)	
Other	16(18.0%)	2(20%)	2(12.5%)	2(16.7%)	10(19.6%)	
History of suicide	16(18.0%)	2(20.0%)	4(25.0%)	3(25.0%)	7(13.7%)	0.662
Family history of suicide	5(5.6%)	0(0.0%)	0(0.0%)	1(8.3%)	4(7.8%)	0.534
Poisoning						
Intentional	80(89.9%)	10(100.0%)	14(87.4%)	12(100.0%)	44(86.3%)	0.715
Unintentional	6(6.7%)	0(0.0%)	1(6.3%)	0(0.0%)	5(9.8%)	
Unknown	3(3.4%)	0(0.0%)	1(6.3%)	0(0.0%)	2(3.9%)	
Way of poisoning						
Oral	85(95.5%)	10(100.0%)	15(93.7%)	12(100.0%)	48(94.1%)	0.710
Unknown	4(4.5%)	0(0.0%)	1(6.3%)	0(0.0%)	3(5.9%)	
Outcome						
Death	20(22.5%)	1(10.0%)	4(25.0%)	3(25.0%)	12(23.5%)	0.794
Improved	69(77.5%)	9(90.0%)	12(75.0%)	9(75.0%)	39(76.5%)	

Examining the changes in magnesium, calcium, phosphorus, and albumin levels on the first, third, and fifth days after hospitalization revealed that, overall,

there was no significant difference in mean magnesium levels across different types of OP poisons at any of the three time points (P>0.05). However, magnesium levels exhibited a significant downward trend in MLT

Table 2. Trends in magnesium, calcium, phosphorus, and albumin levels in poisoned patients by type of OP poison

Variables	Total (n=89)	CPF (n=10)	DZN (n=16)	MLT (n=12)	Other (n=51)	P-value ¹
Magnesium level; mg/dl						
First day	2.09±0.34	2.07±0.34 ^a	2.06±0.36 ^a	2.27±0.37 ^a	2.06±0.33 ^a	0.293
Third day	2.01±0.33	1.93±0.24 ^a	1.98±0.40 ^a	2.01±0.24 ^a	2.03±0.35 ^s	0.816
Fifth day	1.98±0.28	2.04±0.30 ^a	2.05±0.31 ^a	1.94±0.23 ^a	1.97±0.29 ^a	0.665
P-value ²		0.474	0.645	<0.001	0.125	
Calcium level: mg/dl						
First day	8.60±0.79	8.54±0.69 ^{ab}	8.13±0.55 ^b	9.02±0.84 ^a	8.66±0.80 ^{ab}	0.021
Third day	8.32±0.43	8.28±0.58 ^a	7.99±0.63 ^a	8.22±0.92 ^a	8.46±0.72 ^a	0.140
Fifth day	8.21±0.71	8.51±0.38 ^a	8.19±0.77 ^a	8.12±0.85 ^a	8.18±0.70 ^a	0.551
P-value ²		0.544	0.463	<0.001	<0.001	
Phosphorus level; mg/dl						
First day	3.45±1.26	3.11±1.24 ^b	2.80±0.75 ^b	4.66±2.35 ^a	3.44±0.78 ^b	0.001
Third day	3.13±1.12	2.79±0.55 ^b	2.57±0.59 ^b	3.84±2.06 ^a	3.21±0.93 ^{ab}	0.016
Fifth day	3.19±1.17	3.05±0.62 ^a	3.14±1.57 ^a	3.25±2.01 ^a	3.13±0.82 ^a	0.623
P-value ²		0.585	0.269	0.046	0.054	
Albumin level; g/dl						
First day	3.59±0.67	3.76±0.61 ^a	3.39±0.53 ^a	3.86±0.57 ^a	3.56±0.72 ^a	0.240
Third day	3.24±0.63	3.23±0.54 ^a	3.03±0.45 ^a	3.19±0.62 ^a	3.31±0.69 ^a	0.484
Fifth day	3.07±0.59	3.19±0.58 ^a	3.00±0.56 ^a	2.99±0.46 ^a	3.08±0.64 ^a	0.853
P-value ²		0.003	0.001	<0.001	<0.001	

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1: The significance level obtained from the ANOVA test comparing the mean variable among the types of poisons in each of the follow-up times

2: The significance level obtained from the repeated measures ANOVA comparing the mean variable over time in each of the poison types

Identical letters in each line indicate the absence of a significant difference between the means of the variables in the two-by-two comparison of poisons, and non-identical letters in each line indicate the presence of a significant difference between the means of the variables in the two-by-two comparison of poisons in each of the follow-up times.

poisoning (P<0.001). In contrast, magnesium levels in CPF and DZN poisoning decreased from day one to day three and then increased; however, these changes were not statistically significant (P>0.05). On day one, the

highest calcium level was observed in MLT poisoning, with a mean of 9.02±0.84, while the lowest was in DZN poisoning, with a mean of 8.13±0.55 (P-value = 0.021). There was no significant difference in calcium levels

Table 3. Examining risk factors associated with mortality in patients poisoned by OP agents

Risk factors	Alive (n=69)	Death (n=20)	OR (95% CI)	P value
Sex				
Male	45 (65.2%)	19 (95.0%)	Ref.	
Female	24 (34.8%)	1 (5.0%)	0.259 (0.025-0.684)	0.010
Age; year	38.81±17.63	63.84±18.52	1.070 (1.030-1.111)	<0.001
Addiction	16 (23.2%)	5 (25.0%)	3.937 (0.671-23.102)	0.129
Duration of intubation: day	10.08±8.02	12.25±14.47	1.011 (0.913-1.066)	0.729
Type of organophosphate				
CPF	9 (13.0%)	1 (5.0%)	0.734 (0.049-11.029)	0.823
DZN	12 (17.4%)	4 (20.0%)	0.714 (0.082-6.216)	0.760
MLT	9 (13.0%)	3 (15.0%)	0.996 (0.106-9.378)	0.997
Other	39 (56.5%)	12(60.0%)	Ref.	
Calcium reduction	0.33±0.66	0.59±0.88	3.983 (1.344-11.803)	0.013
Albumin reduction	0.46±0.95	0.54±0.50	2.405 (0.563-10.278)	0.236
Phosphorus reduction	0.08±0.46	0.11±0.37	1.395 (0.057-2.727)	0.346
Magnesium reduction	0.18±1.98	0.49±1.17	1.621 (1.019-1.946)	0.044

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among the different poisons on the third and fifth days ($P>0.05$). Additionally, calcium levels in MLT poisoning showed a significant downward trend ($P<0.001$). It was also found that phosphorus levels in MLT poisoning were significantly higher than in other poisons on days one and three, with means of 2.35 ± 4.66 and 2.06 ± 3.84 , respectively ($P=0.001$, 0.016). Furthermore, phosphorus levels in MLT poisoning exhibited a significant downward trend ($P=0.046$). Albumin levels in patients notably decreased over the five days of treatment across CPF, DZN, MLT, and other poison groups ($P\text{-value}<0.05$). However, there was no significant difference among the different OP poisons in terms of albumin levels at any follow-up time ($P\text{-value}>0.05$) (Table 2, Fig. 1).

Examining the factors related to death in critically ill patients poisoned with OP agents showed that although the likelihood of death was higher in MLT poisoning (OR: 0.996) than in CPF (OR: 0.734) and DZN (OR: 0.734), the type of OP poison generally did not have a significant relationship with death incidence ($P\text{-value} > 0.05$). Additionally, while the duration of intubation and addiction increased the chance of death, these factors did not significantly affect mortality ($P\text{-value} > 0.05$). Furthermore, the risk of death was significantly lower in women than in men (OR: 0.259; $P\text{-value} = 0.010$). Conversely, increasing age raised the risk of death by 1.068 times ($P\text{-value} < 0.001$). In analyzing changes in blood parameters such as magnesium, calcium, phosphorus, and albumin, it was found that a reduction in calcium within five days of hospitalization increased the chance of death by 3.983 times ($P\text{-value} = 0.013$). Magnesium reduction also significantly increased the likelihood of death (OR: 1.621; $P\text{-value} = 0.044$). Although reductions in phosphorus and albumin increased the risk, these relationships were not statistically significant ($P\text{-value} > 0.05$) (Table 3).

Discussion

The 10-year review of poisoned patients' files in this study reported 89 poisonings involving various types of OP poisons, including 11.2% with CPF, 18% with DZN, 13.5% with MLT, and 57.3% with other OP agents. More than 70% of the patients were male, with a mean age of 20.54 ± 44.28 years.

According to this study's findings, Elyas and Ardhapurkar's research revealed that men experienced more OP poisoning than women, and most patients were in the 30-39 age group. The most common poisons were MLT (42.6% in men and 36.5% in women), followed by DZN (32.4% in men and 30.8% in women) [19].

The evaluation of changes in magnesium, calcium, phosphorus, and albumin levels on the first, third, and fifth days after hospitalization showed that there was no significant difference in the mean magnesium level among different OP poisons. However, magnesium levels exhibited a significant downward trend in MLT poisoning. Additionally, calcium levels were reported to be the highest in MLT poisoning and the lowest in DZN poisoning on the first day; however, there was no significant difference in calcium levels among the different poisons on the third and fifth days. Moreover, calcium levels showed a significant downward trend in MLT poisoning. On the first and third days, phosphorus levels were significantly higher in MLT poisoning compared to those in other poisonings. Furthermore, a significant downward trend in phosphorus levels was observed in MLT poisoning. The patients' albumin levels also decreased significantly over time within five days of hospitalization for CPF, DZN, and MLT poisons, and no significant difference was found among the types of OP poisons in terms of albumin levels at any follow-up time.

In this context, Mukerjee et al. demonstrated that the average magnesium levels on the first and fifth days were 1.2 and 1.6 mg/dL, respectively. They also found a negative correlation between the magnesium serum level on the first day of admission and the severity of acute OP poisoning. However, no correlation was observed between magnesium serum levels on the fifth day and the severity of acute OP poisoning. Additionally, the median albumin level in their study was 4 mg/dL, and it had no significant association with the severity of acute OP poisoning [20]. Another study by Rahul et al. suggested that magnesium levels measured on the first day could predict the severity of OP poisoning. However, magnesium levels on the fifth day were not considered useful [21].

Magnesium plays a crucial role in protein, fat, and carbohydrate metabolism, acting as a cofactor for the ATPase enzyme. Magnesium ions release acetylcholine and block extracellular synaptic transmission. It has been observed that hypokalemia levels are linked to hypomagnesemia levels. If hypokalemia worsens due to OP consumption, it can disrupt neuromuscular synaptic function already affected by the toxin, potentially causing arrhythmia and negatively impacting the patient's outcome [34, 35]. Although hypokalemia or arrhythmia was not evaluated in this study, the relationship between magnesium and sodium levels can support these findings.

According to the results of Peebles et al.'s study, OP bound to albumin can serve as a new biomarker for OP exposure in humans. This protein has a long half-life

(20 days) in human circulation. The long half-life of OP-labeled proteins differs from the short half-life of OP and OP metabolites in urine. This difference is a key advantage for a method that uses OP-labeled proteins to detect OP exposure. The binding of OP to albumin can be used to neutralize OP molecules, thereby reducing the amount of OP available to react with AChE. The affinity of different OPs for albumin probably varies, so the effectiveness of albumin as an OP sorbent likely depends on the specific OP [22].

Tripathi et al. also reported hypocalcemia, hypophosphatemia, and hypomagnesemia in male Wistar rats exposed to CPF for eight weeks. An increase in serum calcium and phosphate levels was observed over time. Additionally, the hyperactivity of C cells became evident after six and eight weeks, as shown by the enlarged nucleus and the decreased staining response of these cells. The hyperactivity of C cells can be attributed to the increased release of the hypocalcemic factor (calcitonin) to counteract the rise in serum calcium levels observed during these periods.

The parathyroid gland performs its hypercalcemic function by mobilizing calcium from exchangeable calcium stores, primarily through bone resorption. Reports have shown decreased bone formation after OP exposure and reduced bone density following DDT exposure. Bone demineralization has also been observed in carp exposed to cadmium and is seen as a mechanism to restore plasma calcium levels [23-25].

Tripathy et al. studied the clinical features of OP poisoning and found that the most common OP compounds were Monocrotophos (36%), followed by Dimethoate (Roger) (19%), DZN (6%), MLT (2%), and Parathion (1%). Additionally, they noted that disorders of serum electrolytes (Na, K⁺, Ca⁺⁺) were statistically insignificant and did not help in predicting the prognosis of OP poisoning [26].

Furthermore, 22.5% of patients poisoned with OP died, while 77.5% recovered and were discharged. The death rates were 10% in CPF poisoning, 25% in DZN and MLT poisoning, and 23.5% in other poisonings. There was no significant difference in patient outcomes regarding hospital stay, intubation duration, and mortality rate among patients poisoned with different OP poisons. In this context, evaluating factors related to death in critically ill patients poisoned with OP revealed that women had a higher likelihood of death than men, and the risk increased with age. Although the possibility of death was higher in MLT poisoning compared to CPF and DZN, the type of OP poison generally did not significantly impact mortality. Additionally, analysis of changes in magnesium, calcium, phosphorus, and albumin levels over a five-

day period of hospitalization showed that decreases in calcium and magnesium levels increased the risk of death. While reductions in phosphorus and albumin were also associated with higher mortality, these relationships were not statistically significant.

Aravindan et al.'s study also showed that clinical severity, length of hospital stay, coma, need for ventilation, and mortality rate were associated with lower serum magnesium levels [27]. Magnesium inhibits the release of acetylcholine in the central nervous system, peripheral sympathetic, and parasympathetic synapses. This action blocks calcium channels in presynaptic nerve terminals that release acetylcholine and enhances the breakdown of some pesticides. As a result, it decreases arrhythmias associated with OP compounds and atropine, reduces excessive stimulation in the central nervous system caused by OP compounds, and reverses neuromuscular weakness in the peripheral nervous system [28].

Another study indicated that serum albumin levels were significantly higher in the survival group compared to the non-survival group. Mortality rates were 68.8% in the hypoalbuminemia group (serum albumin <3.5 g/dL) and 15.1% in the normoalbuminemic group (serum albumin ≥3.5 g/dL). Therefore, it can be concluded that hypoalbuminemia is associated with 30-day mortality in OPI poisoning patients [29].

Xu et al. examined clinical features for early prediction of mortality risk in patients with acute shock caused by OP poisoning. They observed that blood lactate, ALT, Cr, cTNI, BNP, and Cl levels were significantly higher in the shock group. Conversely, calcium levels and pH values were notably lower in the group without shock [30].

Although this study has not examined a wide range of laboratory factors involved in these patients' hospitalization and outcomes, and few studies have explored this area, most previous research has concentrated on the therapeutic effects of medicinal supplements. It seems that OP poisoning and patient outcomes can be linked to blood parameters such as magnesium, calcium, and albumin, which could be a key strength of this study. Given its limitations, including its retrospective design and small sample size, further research is necessary to achieve more comprehensive results that can be more reliably generalized to the population. Additionally, future studies should compare patients poisoned with organophosphates who have normal electrolytes to those with electrolyte imbalances, examining differences in disease progression, complications, and outcomes.

Conclusion

According to the study results, magnesium, calcium, and phosphorus levels exhibited a downward trend in MLT poisoning, decreasing from the first to the third day, followed by an increase in CPF and DZN poisoning. Patients' albumin also significantly declined over time in cases of CPF, DZN, and MLT poisoning within five days of treatment. Additionally, the reduction of calcium and magnesium significantly increased the risk of death. However, the decrease in phosphorus and albumin had no significant association with patients' mortality.

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Conflicts of Interest

The authors report there are no competing interests to declare.

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