ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 16, Issue 8, 2023

Online - 2455-3891
Print - 0974-2441

Research Article

BIOCHEMICAL PROFILE OF PATIENTS WITH ORGANOPHOSPHORUS POISONING: REPORT FROM A RURAL-BASED TEACHING HOSPITAL IN EASTERN INDIA

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Received: 26 December 2022, Revised and Accepted: 12 April 2023

ABSTRACT

Objective: Organophosphorus (OP) poisoning is a very common form of poisoning, especially in rural areas due to the use of OP poisons for agricultural purposes. There is high mortality and morbidity among patients with a history of consumption of this poison. This study aimed to find various biochemical test parameters among patients with OP poisoning admitted to a hospital in the state of West Bengal, India.

Methods: This was an observational and cross-sectional study and conducted from January 2020 to July 2021. During the study period, any patients admitted to general medicine with a history of OP poisoning were included in the study. Aseptically collected venous blood was collected on admission, 12 h, 24 h, and 48 h of admission and immediately sent to the central laboratory for analysis in an automated analyzer.

Results: A total of 100 patients were analyzed. Among them, 80 patients were alive and 20 patients died. The majority of the patients were young adults (21–30 years [53%]). Among the patients, 64% were male, 91% were rural inhabitants, and 43% were a farmer by the profession. The level of hemoglobin was higher, total WBC count was lower, liver enzymes were lower, and urea and creatinine were lower among the patients who survived. However, the sodium, potassium, and calcium were not significantly different between dead and alive patients.

Conclusion: In the management of OP poisoning, the biochemical profile of blood may help identify the patients at risk, and appropriate management can be started accordingly. The biochemical profile also helps in the prognostication of OP poisoning.

Keywords: Farmers, Poisons, Organophosphorus, Biochemical, Liver enzymes.

 DOI: http://dx.doi.org/10.22159/ajpcr.2023v16i8.47815. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Due to the advancement of agricultural fields in developed as well as developing countries, pesticides are being used to control the damage to the crop. Although it is helping farmers for increasing their productivity, the environment is being suffered by the use of pesticides [1]. Organophosphorus (OP) is a group of pesticides that are commonly used for agricultural purposes. Hence, it is easily available in rural households where farming is the occupation of the majority of the inhabitant [2]. Hence, the poisoning by consumption of OP poisons is a common form of poisoning in India [3]. As the OP poisons inhibit the acetyl and butyrylcholinesterase, the symptoms of poisoning include both muscarinic and nicotinic types and are found as increased salivation, lacrimation, urination, defecation, weakness in the muscle, fasciculation, and deranged blood pressure [4].

In India, the majority of the population resides in the rural area. Hence, the overall incidence of OP poisoning is higher in rural India. About 8040 patients with pesticide poisoning were admitted to the hospital in Southern India between 1997 and 2002. The death rate for all cases was 22.6%. According to data from 2002, 96% of patients who intentionally poisoned themselves were under 30 years old, 57% of them were men [5]. According to estimates from the World Health Organization, there are 2 million suicide poisonings with OP pesticides and roughly 1 million accidental poisonings per year [6]. The chemical toxicity of OP is influenced by several variables. The molecular structure, the point of Contact, its relationship to the body's biotransformation and detoxification systems are the crucial ones. Through eating or inhalation, they enter the body and the chemical has a brief half-life in circulation, while it occasionally might last for several days [7].

The liver is where OP compounds undergo bioactivation and metabolism and they are primarily eliminated through the renal system. Hence, these two systems are affected to get rid of the poisonous effect on the body. Following OP poisoning, the profile of hepatic transaminases, antioxidant enzymes, and trace elements is significantly impacted. After an acute OP poisoning, the human liver exhibits centrilobular necrosis, congestion, fatty alterations, and sinusoidal dilatation as histological findings [8,9]. Hence, liver and kidney functions may be deranged in OP poisoning cases.

With this background, we aimed to observe the level of biochemical parameters in patients admitted with OP poisoning in our teaching hospital and track the changes in 48 h period to find if the parameters are related to the prognosis of the patients.

METHODS

Ethics

This study was approved by the Institutional Ethics Committee of Midnapore Medical College and Hospital, Paschim Medinipur, West Bengal, India. The informed consent for participation in this study was obtained from the patients where possible but obtained from the patient's legal representative in all the cases. We have conducted this study by maintaining the highest ethical standard as suggested by the WMA Declaration of Helsinki, updated in 2013.

Study type and setting

This was a hospital-based, observational, and cross-sectional study where we recruited patients admitted with OP poisoning in the inpatient department of general medicine, in the tertiary care hospital. The study period was from January 2020 to July 2021.

Research participants

We aimed to collect data from 100 patients for scalable sample size in the study period. All patients with OP poisoning aged between 13 and 65 years and patients who have been exposed to OP poison in the last l2-h period were included in the study. However, patients who consumed multiple poisons, had taken alcohol with OP compound, are pregnant or lactation, or had pre-existing cardiac, renal, or other comorbidity were excluded from the study.

Data collection

We collected the demographics of the patients from the bed head tickets and interviewed the patients' relatives who brought them to the hospital. A detailed history of health was obtained from the patients when the patients were alert, conscious, and cooperative. If the data could not be collected from patients, the same was collected from the patients' relatives. Venous blood was collected aseptically from the antecubital vein in a commercial vacutainer and immediately transferred to the laboratory for testing. The blood was collected on admission, 12 h, 24 h, and 48 h of admission.

Statistical analysis

We used both descriptive and inferential statistics for analyzing the data. We used Microsoft Excel 2010 (Microsoft Inc, USA) and GraphPad Prism 6.1 (GraphPad Software, USA) for data analysis. $P<0.05$ was fixed to consider the statistical significance. The blood test parameters on admission, after 12 h, after 24 h, and after 48 h were tested between alive and dead statistically by Mann–Whitney U-test (non-parametric test).

Table 1: Demographic details of the patients

Variable	Category	N
Age (years)	≤20	2
	21–30	53
	31–40	27
	41–50	15
	51–60	3
Sex	Male	64
	Female	36
Residence	Rural	90
	Urban	10
Marital status	Married	64
	Unmarried	36
Occupation	Farmer	43
	Housewife	20
	Other	12
	Student	25

The total patient was 100, hence, the number is indicating the percentage

RESULTS

A total of 100 patients were analyzed and among them, 64% were male. The age, sex, and other demographics-wise patient characteristics are shown in Table 1. Among the patients, 80 survived and 20 patients died. The majority of the patients were in the age group of 21–30 years (53%).

The pattern of changes in hemoglobin, total WBC count, capillary blood glucose level, sodium, potassium, and calcium in 48 h in dead or alive patients is shown in Table 2. The level of hemoglobin was higher and the total WBC count was lower among the patients who survived. There were no such changes observed in sodium, potassium, or calcium level.

The liver enzymes on admission, after 12 h, after 24 h, and after 48 h are shown in Table 3. There was a lower level of liver enzymes in patients who survived.

The urea and creatinine level changes over time in dead and alive patients are shown in Table 4. The level of urea and creatinine was lower among the patients who survived.

DISCUSSION

To find the hematological and biochemical parameters in patients admitted with OP poisoning, we found several important aspects which would add to the existing literature on OP poisoning. We found that more than 50% of patients were in the age group of 21–30 years followed by the 31–40 years group (27%). This is supportive of the finding by Harika *et al*. who reported that the young population is presenting with OP poisoning in Andhra Pradesh [10]. Furthermore, we found that OP poisoning was more common in males. This finding is similar to the study conducted by Divekar *et al*. [11]. In our study, among the patients, 90% were rural inhabitants. The underlying reason for this finding may be due to the geographical location of the hospital where we conducted this study. The majority of the patients were a farmer in the profession who has easy access to the poisons due to their usage for agricultural needs. Farmers are already exposed to OP due to accidental or improper handling during use [12,13].

When we analyzed the blood test parameters, we found that patients dying due to OP poisoning had a lower level of hemoglobin, higher leukocyte count, and higher capillary blood glucose. In OP poisoning, the cells suffer from oxidative stress although there is an exaggerated antioxidant defense mechanism. The production of free radicals is too high that cannot be handled by the increased antioxidant mechanism. The decreased level of hemoglobin may be due to less production or binding of OP on iron which makes iron unavailable to hemoglobin synthesis. The higher increment of WBC count may be due to the

Table 2: Blood test parameters among the patients on admission, 12 h, 24 h, and 48 h of admission expressed in mean and standard deviation

Variable	0 h		12 h		24 h		48 h	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Hemoglobin (g/dL)	13.23±0.71	10.96±0.61	12.77±1.05	10.26±0.66	12.82±1.16	9.76±0.52	13.09±0.92	9.49±0.31
	<0.0001*		<0.0001*		<0.0001*		<0.0001*	
Total WBC count (/µL)	8215±1775.58	8255±2451.95	8100±1937.56	9245±2499.78	7867.5±1841.42	9460±2783.49	8145±1665.88	10040±2948.76
	0.93		0.03*		0.003*		0.0002*	
Capillary blood glucose (mg/dL)	135.29±19.94	161.65±41.37	134.03±14.89	235.1±30.05	134.34±19.02	258.45±35.65	135.89±20.34	258.45±35.65
	0.0001*		<0.0001*		<0.0001*		<0.0001*	
Sodium (mEq/L)	131.68±7.42	129.15±7.58	129.15±7.58	127.8±7.82	132.35±7.22	129.55±5.9	132.86±6.49	128.65±8.34
	0.18		0.003*		0.11		0.02*	
Potassium (mmol/L)	3.54±0.71	3.65±0.74	3.52±0.71	3.42±0.75	3.54±0.7	3.5±0.78	3.52±0.72	3.17±0.8
	0.53		0.59		0.79		0.06	
Calcium (mg/dL)	4.78±0.2	4.83±0.18	4.81±0.19	4.82±0.19	4.8±0.2	4.81±0.16	4.8±0.19	4.86±0.19
	0.33		0.79		0.89		0.26	

*Statistically significant p-value of Mann–Whitney U-test. WBC: White blood cell

Table 3: Liver function test parameters among the patients on admission, 12 h, 24 h, and 48 h of admission expressed in mean and standard deviation

Variable	0 h		12 h		24 h		48 h	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
SGOT (u/L)	33.41±9.27 <0.0001*	93.3±16.4	32.4±11.0 <0.0001*	102.8±24.84	32.41±9.5 <0.0001*	108.1±21.11	33.18±10.2 <0.0001*	121.7±24.23
SGPT (u/L)	33.7±9.29 <0.0001*	95.3±16.74	32.9±12.43 <0.0001*	105.45±25.11	33.09±12.23 <0.0001*	116.7±32.79	32.88±10.16 <0.0001*	117.75±28.71
ALP (u/L)	69.73±16.55 <0.0001*	132.3±7.64	71.33±16.4 <0.0001*	153.5±45.67	71.58±16.13 <0.0001*	198.95±57.9	70.51±17.13 <0.0001*	229.65±55.9
Amylase (u/L)	68.94±13.78 <0.0001*	128.9±7.63	68.84±15.85 <0.0001*	129.85±6.42	69.45±14.25 <0.0001*	130.65±6.1	69.83±13.67 <0.0001*	128.45±6.79
Lipase (u/L)	66.51±14.1 <0.0001*	129.45±5.94	69.46±15.98 <0.0001*	130.65±4.84	69.1±13.79 <0.0001*	128.15±7.16	70.68±13.67 <0.0001*	129.2±6.08

*Statistically significant p-value of Mann–Whitney U-test. SGOT: Serum glutamic-oxaloacetic transaminase, SGPT: Serum glutamic pyruvic transaminase, ALP: Alkaline phosphatase, u/L: international unit per liter

Table 4: Kidney function test parameters among the patients on admission, 12 h, 24 h, and 48 h of admission expressed in mean and standard deviation

Variable	0 h		12 h		24 h		48 h	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Urea (mmol/L)	15.18±2.93 <0.0001*	29.1±5	15.13±3.11 <0.0001*	27.7±5.1	15.33±3.94 <0.0001*	28±4.92	15.33±3.63 <0.0001*	27.8±4.96
Creatinine (mg/dL)	0.86±0.21 <0.0001*	1.15±0.46	0.85±0.18 <0.0001*	1.77±0.4	0.87±0.19 <0.0001*	1.99±0.18	0.91±0.31 <0.0001*	2.04±0.19

*Statistically significant p-value of Mann–Whitney U-test

activation of the immune defense mechanism. Patients with chances of mortality would have cellular damage higher than those with less chance of mortality [14].

The liver enzymes were higher among the patients who died due to OP poisoning. The level gradually increased after admission. This may be because the liver is the primary organ for metabolizing many substances, including poisons, chemicals, and medications, which the body finally excretes [15]. A study by Senarathne *et al*. showed that the liver markers may indicate the severity of OP poisoning. They found a positive association between liver transaminases and the length of hospital stays [16]. Apoptosis, mitochondrial and microsomal metabolism, oxidative stress, disruptions in the antioxidant defense system, and other important biological processes have all been linked to hepatotoxicity. The majority of research demonstrates that antioxidants can lessen oxidative stress and the resulting alterations in liver function [17].

The kidney function test was also found to be deranged more in patients who died due to OP poisoning when compared to those who survived. We used two important parameters – serum urea and creatinine for quantifying kidney functions. Acute kidney injury has been reported by Zafar *et al*. [18]. The reason for this may be due to a higher burden on the kidney in the excretion of poisonous substances from the body. However, the exact mechanism is yet to be explored in the future [19].

Novelty and limitation of the study

The finding of this study would add to the current demographics and biochemical profiling of OP poisoning patients. This would enrich the current literature. However, this study has some limitations. This study was a single-center and small-scale study conducted in the eastern part of India. Moreover, we used a convenience sample with inclusion and exclusion criteria. All hospital-based study has this limitation. As convenience sampling is not suitable for conclusions for the population, this study's results lack generalizability. Hence, readers are suggested to interpret the study results with caution.

CONCLUSION

From the finding of this study, we conclude that in the management of OP poisoning, the hematological and biochemical profile is of great importance for the recovery of the patients. The most important parameters are hemoglobin level, total WBC count, liver enzymes, and urea and creatinine. Early detection of these parameters would help the physicians to detect the prognosis and helps to identify the patients at risk. Accordingly, the doctors can plan appropriate management. However, as this was a single-center study with a small sample size, further multicenter large-scale research on this topic would provide a more generalizable result.

AUTHOR CONTRIBUTIONS

Utsab Roy: Conceptualization, literature searching, investigation, data collection, formal analysis; Biplab Kumar Gayen: Investigation, validation, manuscript reviewing and editing; Jugal Kishore Kar: Supervision, investigation, validation, manuscript reviewing; Aparup Dhua: Literature searching, coordination, manuscript writing, reviewing and editing; Umakanta Mahapatra: Validation, manuscript reviewing and editing; and Manas Patra: Data analysis, manuscript writing and reviewing.

CONFLICTS OF INTEREST

There is no conflicts of interest.

AUTHORS' FUNDING

Nil.

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