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Research Article

A STUDY ON BIOCHEMICAL PARAMETERS IN ASSESSING THE SEVERITY OF ACUTE ORGANOPHOSPHORUS POISONING

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ABSTRACT

Objectives: Organophosphorus (OP) poisoning is an important global health issue with increasing mortality rate for every year particularly in developing countries since its overuse in agricultural activity. The present study was performed to analyze the clinical profile and biochemical parameters such as serum cholinesterase, serum creatinine phosphokinase (CPK), liver enzymes, serum amylase, lipase, serum k+, troponin, serum urea, and creatinine on day 1 for correlation with clinical severity of poisoning.

Methods: A observational study was performed on 100 cases with OP poisoning at a tertiary care center. Peradeniya OP Poisoning Scale was applied to all cases at the time of admission and the severity was designated as mild, moderate, and severe taking into account 5 vital parameters such as miosis, fasciculations, respiration rate, bradycardia, and level of consciousness and data were statistically analyzed by SPSS.

Results: Rise in clinical severity of poisoning and substantial reduction in the level of serum cholinesterase was observed. The mean serum CPK, troponin T (Trop T), amylase, lipase, bilirubin, aspartate aminotransferase, and alanine aminotransferase showed marked elevation according to the severity of OP poisoning. In addition, serum potassium levels showed decreased level as per the severity level.

Conclusion: Initial serum cholinesterase and serum Trop T are strong predictors of the clinical severity of OP poisoning.

Keywords: Organophosphorus poisoning, Creatinine phosphokinase, Troponin T, Amylase, Lipase, Bilirubin, Aspartate aminotransferase, Alanine aminotransferase, Serum cholinesterase, Serum creatinine phosphokinase.

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INTRODUCTION

Organophosphorus (OP) compounds are the most common cause of insecticide poisoning with an annual mortality rate of 10–20% from the Asia Pacific region [1]. Thus, acute OP poisoning is an important global health issue with increasing mortality rate for every year, particularly in developing countries since its overuse in agricultural activity [2]. Based on the toxicity, the OP compounds are grouped into three categories such as high toxicity (tetraethyl pyrophosphate, parathion, and phosdrin), moderate toxicity (chlorpyriphos, coumaphos, and trichlorfon), and low toxicity (malathion, diazinon, and dichlorvos). The cardinal mechanism involved in OP poisoning is mediated by their active toxic metabolites which act as cholinesterase inhibitors and thus elevate the concentration of acetylcholine (ACh). ACh is an important neurotransmitter at pre- and post-ganglionic parasympathetic synapses, sympathetic preganglionic synapses, and neuromuscular junction. The toxic manifestations of OP poisoning are classified into 3 categories, muscarinic effects which include bradycardia, conduction abnormalities, hypotension, bronchorrhea, hyperventilation, increased salivation, vomiting, diarrhea, blurred vision, and urinary incontinence. Nicotinic effects include muscle twitching, cramps, hyporeflexia, tachycardia, and hypertension and central nervous system effects include anxiety, convulsion, coma, respiratory depression, and circulatory collapse [3]. The grading of OP poisoning is classified as mild, moderate, and severe [4-7]. The Peradeniya OP poisoning (POP) scale was suggested by Senanayake *et al*. [7] in 1993 and the severity is based on the clinical parameters without assessing the laboratory parameters. Further, during the assessment using POP scale, patient intervention is not required and it can be applied when the patient is in unconscious state. The management of severe OP poisoning is difficult and complicated due to the paucity of clinical trial evidence to guide treatment. Monitoring red blood cell cholinesterase activity though considered as only biomarker along with clinical signs to guide the duration of therapy, its measurement is technically difficult and rarely available in India. Especially for a limited-resourced country like India, an inexpensive and certainly measurable biomarker is the need of the time. Hence, this study was commenced to investigate the clinical profile and biochemical parameters such as serum cholinesterase, serum creatinine phosphokinase (CPK), liver enzymes, serum amylase, lipase, serum k+, troponin, serum urea, and creatinine on day 1 for correlation with clinical severity of poisoning.

METHODS

This was an observational study conducted on 100 patients admitted as inpatient to Department of Medicine as confirmed OP poisoning at a tertiary care center in Odisha who were included in the study. The cases of mixed poisoning, chronic alcoholism, liver disease, malignancy, autoimmune diseases, renal disease, cardiac disease, pancreatitis, and myopathy were excluded from the study. They were subjected to a detailed history taking, thorough clinical examination, and biochemical investigations including serum cholinesterase assay. POP scale was applied to all the study subjects at the time of admission and the severity was designated as mild, moderate, and severe taking into account 5 vital parameters such as miosis, fasciculations, respiration rate, bradycardia, and level of consciousness. After collection, data were statistically analyzed by SPSS for Windows version 25.0 software.

RESULTS

In the present study, out of 100 patients, majority (41 out of 100) were in the age group between 15 and 29 years followed by 30–44 years (32 patients). The results were shown in Table 1.

The type of OP poisoning consumed among the patients is shown in Table 2. Chlorpyriphos was the most common type of OP compound used for poisoning in 26 patients followed by phorate in 23 patients and diphorate in 16 patients.

The grading of POP scale according to biochemical parameters is shown in Table 3. There was a marked increase in clinical severity of poisoning and it was reflected by substantial decrease in the level of serum cholinesterase. In our study, among the OP poisoning cases, the mean serum CPK, troponin T (Trop T), amylase, lipase, bilirubin, aspartate aminotransferase (AST), and alanine aminotransferase (ALT) showed marked elevation according to the severity of OP poisoning. In addition, serum potassium levels showed decreased level as per the severity level. Meanwhile, there was no marked change in creatinine and ALP level and their values were within the normal limits.

In this study, Pearson's correlation coefficient was used to study the association among POP scale and biochemical parameters. It was observed that there was a strong-negative correlation (r=−0.664) among severity of poisoning (POP scale) and serum cholinesterase and was found to be significant (p=0.000). There was a strong-positive correlation among clinical severity and troponin T values and it was statistically significant (p=0.000). Serum CPK showed moderate-positive correlation (r=0.380) and it was statistically significant (p=0.000). There was a weak-positive correlation between severity of poisoning and biochemical parameters such as serum amylase (r=0.158), serum lipase (r=0.193), serum bilirubin (r=0.122), serum AST (r=0.188), serum ALT (r=0.215), and serum creatinine (r=0.186) but the correlation was not significant, except for serum ALT which showed significant (p=0.03). The result is shown in Table 4.

Table 1: Age-wise and gender-wise distribution of the patients

Age	15–29 years	30–44 years	45–59 years	>59 years
Male	15	14	12	7
Female	26	18	4	4
Total	41	32	16	11

Table 2: Distribution of study subjects as per type of organophosphorus poisoning consumed

Poison consumed	No. of cases	Percentage
Chlorpyriphos	26	26
Phorate	23	23
Diphorate	16	16
Dichlorvos	7	7
Dimethoate	12	12
Profenofos	2	2
Monocrotophos	7	7
Diphos	6	6
Acephate	1	1

DISCUSSION

OP poisoning was observed more in younger age groups in our observation. Similar study result was also observed in previous reports by Raddi and Anikethana [8] where the mean age of the study participants was 33 years and in Rangaswamy *et al*. [9] study where mainstream of the poisoning cases, 44% were under 30 years. In this study, chlorpyriphos was the utmost common type of OP compound used for poisoning in 26% of the patients followed by phorate and diphorate. Other OP compounds consumed were dichlorvos, dimethoate, profenofos, monocrotophos, diphos, and acephate. Similarly, in a study done by Banerjee *et al*. [10], 19.72% of the cases consumed chlorpyriphos and in Gagarin and Rajagopal [11] study, 22% of the patients consumed chlorpyrifos. With increasing severity of poisoning, there was a decrease in mean value of serum cholinesterase and rise in mean value of serum CPK and troponin T which were statistically highly significant and hence can be used as prognostic biomarker. In a study conducted by Bhattacharyya *et al*. [12], there was a marked elevation in CPK level which is OP patients even during the lack of intermediate syndrome as a result of cardiac muscle fiber necrosis and if the muscle damage persists, there will be further elevation in CPK and then normalizes in 5–6 days. In a study done by Rangaswamy *et al*.'s [9] OP patients, there was a significant increase in the level of cardiac enzymes and it showed correlation with severity of the poisoning and ICU stay and thus serves as a marker to predict prognosis in poisoning patients. Serum amylase, serum lipase, serum bilirubin, serum AST, and serum ALT showed increasing mean value as the clinical severity increased; but mean value of serum bilirubin was within normal limits. The mean value of serum potassium showed decreasing trend as per severity but values were within normal limits and showed undefined trend according to clinical severity of poisoning. The correlation among clinical severity of OP poisoning and serum cholinesterase was found to be strongly negative which was statistically highly significant whereas serum CPK showed moderate-positive correlation which was highly statistically significant. Even Trop T showed strong-positive correlation with POP scale having high statistical significance whereas serum ALT had statistical significant weak-negative correlation with clinical severity. The weak-negative correlation of serum potassium was just significant statistically. There was statistically insignificant correlation of POP scale of severity with serum lipase, amylase, serum bilirubin, serum AST, and serum creatinine that were very weakly positive. In a study done by Sujata and Vijay [13], there was a significant decline in serum cholinesterase with increasing grades of intoxication along with raised level of hepatic enzymes and amylase. In another study done by Patil and Vasepalli [14], POP scale, serum cholinesterase, and serum amylase values showed significant correlation with severity of poisoning predominantly in terms of need for ventilatory support.

Table 3: Peradeniya organophosphorus poisoning scale as per biochemical parameters values

POP score	Mild (0–3) (n=37)	Moderate (4–7) (n=54)	Severe (8–11) (n=9)
S. ChE (mean±SD)	4608.8 (2464.99)	1366.2 (1132.028)	877.93 (899.58)
S. CPK (mean±SD)	986.35 (1629)	2287.25 (2659.96)	4243.44 (3280.97)
S. Amylase (mean±SD)	64.18 (44.04)	67.59 (37.43)	97.88 (48.30)
S. Lipase (mean±SD)	57.18 (42.10)	61.11 (35.90)	85.29 (38.24)
S. Trop. T (mean±SD)	0.0071 (0.0055)	0.0188 (0.0275)	0.055 (0.0324)
S. Bilirubin (mean±SD)	0.691 (0.370)	0.782 (0.597)	1.10 (0.61)
S. AST (mean±SD)	50.07 (53.86)	59.80 (71.32)	81.83 (48.39)
S. ALT (mean±SD)	43.71 (39.85)	46.31 (37.89)	81.72 (47.17)
S. ALP (mean±SD)	213.54 (38.64)	232.36 (79.41)	224.38 (42.98)
S. Creatinine (mean±SD)	0.801 (0.215)	0.778 (0.220)	1.03 (0.244)
S. Potassium (mean±SD)	3.72 (0.27)	3.56 (0.318)	3.48 (0.468)

CPK: Creatinine phosphokinase

Table 4: Correlation between biochemical variables and peradeniya organophosphorus scale (severity)

Variables	Pearson's coefficient (r)	p-value
AChE	−0.664	0.000*
CPK	0.380	0.000*
Amylase	0.158	0.117^{NS}
Lipase	0.193	0.054 ^{NS}
Troponin T	0.518	0.000*
Bilirubin	0.122	0.226^{NS}
AST	0.188	0.060^{NS}
ALT	0.215	0.032*
Creatinine	0.186	0.064^{NS}
Potassium	−0.197	0.049*

*Denotes significant (p<0.05), NS: Non-significant, Ach: Acetylcholine

CONCLUSION

In our study, initial serum cholinesterase and serum Trop T are strong predictors of clinical severity of OP poisoning. Initial serum CPK has moderate-positive correlation with clinical severity. Serum cholinesterase, serum CPK, serum Trop T, serum amylase, and serum lipase can be used as prognostic biomarker. Although we have found strong conclusions in this study, better vision regarding the assessment of biochemical parameters in clinical severity and prognostic significance of OP poisoning can be revealed by including more no of samples in further studies.

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CONFLICTS OF INTEREST

Nil.

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