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Original Research Article

Correlation of Severity of Organophosphorus Poisoning as Assessed by Peradeniya Organophosphorus Poisoning Scale with Serum CPK and Random Blood Sugar Levels

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Abstract

Background: Organophosphorus (OP) compounds are a major contributor to poison-associated morbidity and mortality in India. The present study was undertaken to assess severity of OP poisoning according to Peradeniya organophosphorus poisoning (POP) scale and correlate severity with serum CPK and random blood sugar levels (RBSL).

Method: A total 104 patients of OP poisoning were enrolled in the study. They were initially subjected to POP severity scale and classified as mild, moderate, and severe. All cases were investigated for serum cholinesterase, serum CPK, and RBSL. These investigations then compared with POP severity scale and outcome of disease as mortality were observed.

Results: Most of the patients belonged to age group between 21-30 years (32.69%), males (55.77%), farmers (36.5%), from rural region (77.88%) and illiterate (60.6%). Most common compound consumed was monocrotophos (31%). The commonest symptom was vomiting (85.58%), and commonest sign was miosis (70.19%). Most of the patients were in mild POP severity category (44.23%) followed by moderate (34.62%) and severe (21.15%) category. The relationship between severity of poisoning with serum cholinesterase was statistically significant showing more the severity of poisoning more the depression of serum cholinesterase levels. However, the relationship between severity of poisoning with ventilator requirement and mortality was statistically significant showing that higher the CPK and RBSL levels were associated with more severity, ventilator requirement and more mortality of patients.

Conclusion: POP Scale can be used as good prognostic scale for OP poisoning patients. CPK and RBSL may be considered as routine investigation as it is a good prognostic marker for assessing severity of OP poisoning and ventilator requirement and outcome of patients.

Keywords: Organophosphate poisoning; POP scale; CPK; RBSL; Monocrotophos; Miosis.

Introduction

Organophosphorus insecticides are one of the most common causes of poisoning in India. It has a high mortality rate and accounts for a third of suicidal deaths in south-east Asia [1]. There are hundreds of these OP compounds but most commonly used in our country are

monocrotophos, malathion, parathion, fenthion, diazinon, dimethoate, chlorpyrifos, paraoxon, etc. Apart from the clinical diagnosis of OPC poisoning, various laboratory investigations are available for its diagnosis [2]. Most commonly used laboratory investigation is serum cholinesterase level. But estimation of serum AchE is costly and not available everywhere. There are newly diagnosed markers like Creatine Phosphokinase (CPK), Lactate Dehydrogenase (LDH) and serum immunoglobulins (IgG, IgA). But Immunoglobulins are costly and difficult to perform in most laboratories, and they are often unreliable CPK is secreted in the serum as a result of muscular damage i.e., rhabdomyolysis which occurs in muscle weakness and respiratory failure. CPK was found to be elevated in many acute OP poisoning cases [3]. However, the several studies state that serum level of CPK is elevated in OP poisoning, and it may be used as a biomarker.

There is a clinical scale i.e., POP scale to assess the severity of organophosphorus poisoning. It is a simple effective scale to determine the severity of poisoning. Five common clinical manifestations of OP poisoning have been selected as parameters, each to be assessed on a 3-point scale varying from 0 to 2. Poisoning can then be classified as mild (score 0-3), moderate (score 4-7) or severe (score 8-11) [4].

Moreover, OP insecticides also increase reactive oxygen species level which results in oxidative stress. It contributes to cell membrane lipid peroxidation, DNA damage and cell death which in turns present as hyperglycemia. So that raised blood sugar level correlates with more oxidative stress and a greater number of cell death and poor prognosis. Another mechanism by which OPCs cause hyperglycemia is stimulation of nicotinic receptors on adrenal medulla due to OPC [5]. So, the present study was carried out to assess the severity of organophosphate poisoning as assessed by POP scale as mild, moderate, and severe and comparing each class with serum CPK and RBSL levels to provide alternative prognostic biomarkers for OPC poisoning.

Material and Methods

This hospital-based prospective observational study was conducted on 104 patients of age above 12 years with a history of OP poisoning and admitted within 24 hours in a tertiary care hospital of Vidarbha region during a period of 2 years from 1 Nov 2016 to 31 Oct 2018. Patients with a history of OP poisoning mixed with any other poison or consumption of poison with alcohol, previous illness and conditions of patients affecting CPK and RBSL levels like– chronic alcoholics, diabetes mellitus, thyroid disorder, epilepsy, psychiatric illness, autoimmune disease, malignancy, trauma, sepsis, liver disease, pancreatic diseases, endocrine diseases, renal disease, heart disease, myocardial infarction, myocarditis, myopathy, recent trauma or IM injection and ANC patients, history of drug intake causing deranged CPK and RBSL levels like statins, fibrates, steroids, diuretics amphotericin b, protease inhibitors, calcineurin inhibitors, anticoagulants, antiplatelet, beta blockers, ART, oral hypoglycaemic agents, insulin therapy and patients who received dextrose containing IV fluids outside and referred patients who have been already treated at other centers were excluded from the study.

After fulfilment of inclusion and exclusion criteria, patients admitted to the emergency ward with organophosphorus compound poisoning within 24 hours were selected. Written informed consent of the patients or caregiver was taken. A detailed history, complaints and other details was entered in a pre-designed proforma. The clinical and biochemical examination was done. The eligible patients were initially subjected to

Peradeniya OPP severity scale and classified as mild, moderate, and severe. POP grading-Mild (0 to 3), moderate (4 to 7) and severe (8 to 11).

Blood samples of the patients were drawn aseptically by a single prick at time of admission from a peripheral vein and investigated for serum cholinesterase, serum CPK, and RBSL Levels. Then these investigations were correlated with POP severity Scale and outcome of disease in the form of discharge and death. The prognostic criteria considered were requirement for ventilator support and mortality during the study period.

Statistical Analysis

Collected data were analysed using SPSS 16.0 version. The comparison of qualitative data was done using chi square test. Using this software, frequencies, percentage, mean, standard deviation, x2, 'p' values and ANOVA test wherever appropriate were calculated.

The confidence limit for significance was fixed at 95% level with p-value < 0.05.

Observations and Results

A total 104 patients of OP poisoning were studied from a period of 1 November 2016 to 31 October 2018 for 2 years. Maximum number of patients belonged to age group between 21-30 years (32.69%), males (55.77%), farmers (36.5%), from rural region (77.88%) and illiterate (60.6%). Maximum number of patients reported within 3 hours to the hospital. More time lag between poison exposure and treatment was associated with higher mortality. The relation was statistically significant, (Table 1).

Table 1: Socio-demographic profile of the patients and time lag between consumption of poison and treatment

Socio-demographic data		No. of cases	Percentage
Age group in years	12-20	09	8.65
	21-30	34	32.69
	31-40	24	23.08
	41-50	15	14.42
	51-60	16	15.38
	61-70	06	5.77
Gender	Male	58	55.77
	Female	46	44.23
Educational status	Illiterate	63	60.6
	Primary School	12	11.5
	Secondary School	08	7.7
	High School	14	13.5
	Graduation	07	6.7
Occupation	Farmer	38	36.5
	Labourer	23	22.1
	Housewife	21	20.2
	Employee	13	12.5
	Student	09	8.7
Area	Rural	81	77.88
	Urban	23	22.12
Time in hours	<3	43	41.3
	3-6	32	30.8
	>6	29	27.9

Most common compound consumed associated with poisoning was monocrotophos (31%) followed by chlorpyriphos (13.5%) and quinolphos (7.7%) as depicted in figure 1.

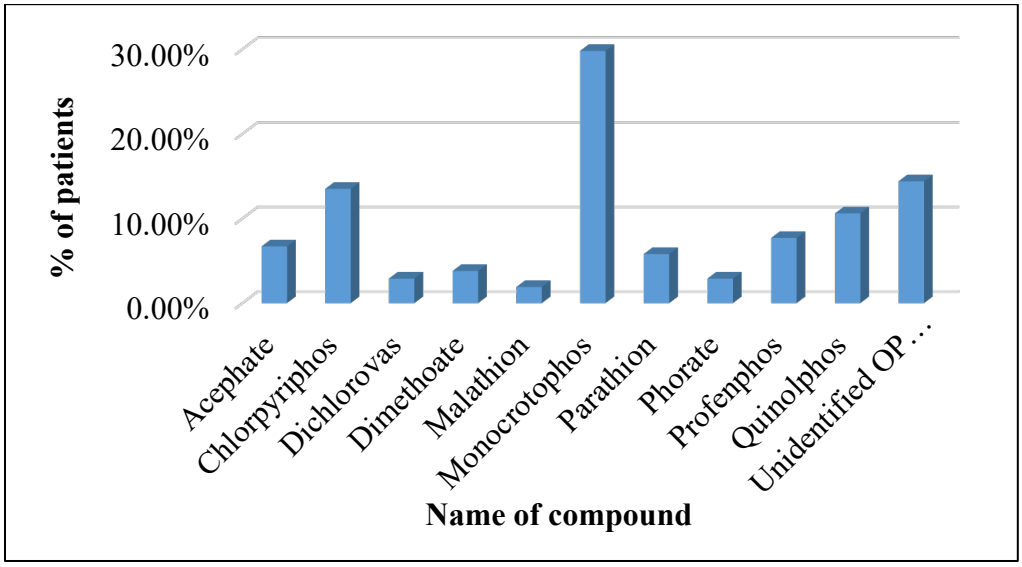

Figure 1: Distribution of cases according to compound consumed

The most common symptom was vomiting (85.58%), other features of presentation were excessive breathlessness in 60.57%, sweating in 44.23%, abdominal pain in 41.35%, generalized weakness in 39.42%. Among different clinical signs most common sign seen was miosis in 70.19% followed by smell of OP poison in 68.27% and fasciculations in 67.31%, (Table 2).

Table 2: Sign and symptoms of patients

Sign and symptoms		No. of cases	Percentage
Symptoms	Abdominal Pain	43	41.35
	Altered Sensorium	33	31.73
	Blurring of Vision	17	16.35
	Breathlessness	63	60.58
	Convulsions	03	2.88
	Excessive Salivation	26	25.0
	Excessive Sweating	46	44.23
	Generalised Weakness	41	39.42
	Loose Motions	34	32.69
	Vomiting	89	85.58
Clinical Sign	Bradycardia	59	56.73
	Fasciculation	70	67.31
	Miosis	73	70.19
	Respiratory Failure	29	27.88
	Smell of Op Poison	71	68.27
	Tachycardia	24	23.07
	Tachypnoea	34	32.69

The maximum number of patients were in mild POP severity category (44.23%) followed by moderate (34.62%) and severe (21.15%) category, (Figure 2).

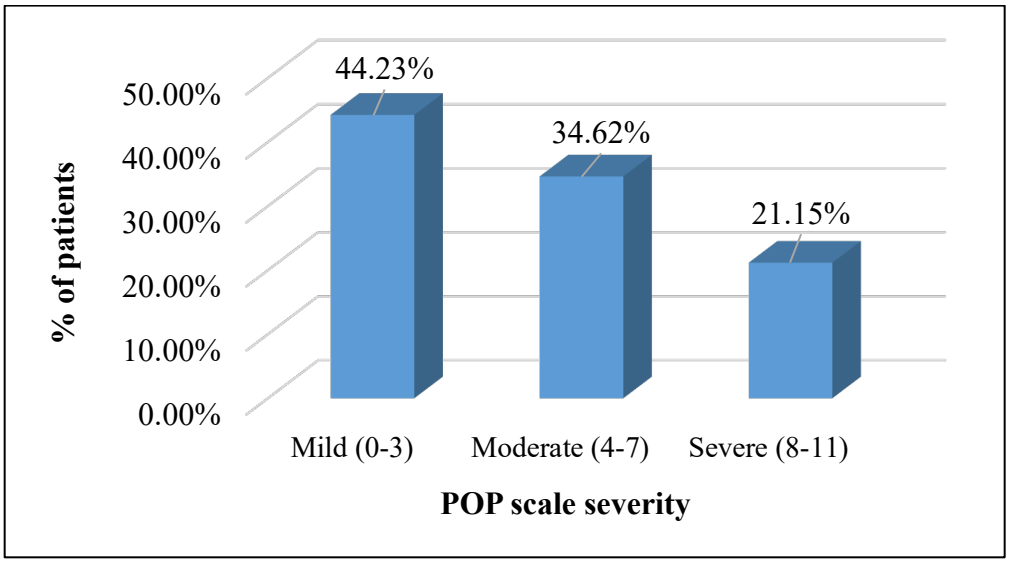

Figure 2: Distribution of cases according to POP score

The ventilator requirement and mortality were maximum in severe poisoning group as shown in table 3. Out of 104 patients 35 patients required ventilator support and 19 patients were died during the study period. However, the maximum number of mortalities i.e., 16 cases (76.2%) were observed in patients who required more than 7 days of ventilatory support. Comparing mortality with duration of hospital stay, Mortality observed highest i.e., 64.7% in patients having hospital stay more than 15 days.

Table 3: Correlation of POP scale with ventilator requirement and mortality

POP scale	Total cases	Cases Required Ventilator	Mortality
Mild	46	01 (2.17%)	00 (0.0%)
Moderate	36	16 (44.44%)	04 (11.11%)
Severe	22	18 (81.81%)	15 (68.18%)
Total	104	35 (33.65%)	19 (18.26%)
P value		P<0.001	P<0.001

The relationship between severity of poisoning with serum cholinesterase was statistically significant showing more the severity of poisoning more the depression of serum cholinesterase levels. However, the relationship between severity of poisoning with ventilator requirement and mortality was statistically significant showing that higher the CPK and RBSL levels were associated with more severity, ventilator requirement and more mortality of patients, (Table 4).

Table 4: Correlation of mean serum cholinesterase, total CPK and RBSL with severity assessed by POP scale

POP Scale grading	Mean serum cholinesterase	Mean total CPK levels	Mean RBSL on admission
Mild	2270.48±538.603	169.33±74.8	120.26±48.933
Moderate	1343.72±313.687	544.97±347.791	178.25±41.853
Severe	614.14±288.7	1182.09±208.639	209.91±56.732
P value	P<0.001	P<0.001	P<0.001

Discussion

In the present study more than 50% of the cases were from age group of 21-40 years of age and the incidence of OP poisoning was maximum in the age group 21 to 30 years followed by 31 to 40 years with mean age of 36.68 ± 25.36, ranged from 14-68 years. Male to female ratio observed was 1.3:1. Thus, showing that, OP poisoning was common among young male and these findings are concordant with the previous studies [6-8].

It might be due to younger population may be more both emotionally and economically stressed being a responsible family member and may be because of the lack of social support. Most of the OP poisoning cases were among farmers 36.5% (38 cases) followed by labourers 22.1% (23 cases) from rural area (77.88%). In current study maximum number of cases were illiterate i.e., 60.6%. This observation is concordant with other studies [11,12]. The OP compounds are easily available for farmers so that they can be easily used for suicidal measures and major number of patients visiting at our health care center are from rural population dependent on agriculture.

Monocrotophos was most commonly consumed compound (31%) followed by chlorpyriphos (13.5%) which is comparable with the study conducted by Banday TH *et al* [8], Nagarajan K *et al* [9] and Rao R *et al* [10]. This shows there is wide distribution of compound consumed for poisoning depends on cost and ease of local availability of that compound according to crops grown in that area, so that our region being more commonly has cotton growers and Monocrotophos was most marketed compound here so that is mostly associated poisoning compound in our area.

The most common symptoms present on admission was vomiting (85.58%) followed by breathlessness (60.57%) and excessive sweating (44.23%). However, the most common observed signs were miosis (70.19%) followed by smell of poison (68.27%) and least commonly observed sign was tachycardia (23.07%). These findings are correlated with the previous studies [7, 11, 13, 14]. The clinical symptoms and signs at presentation varies due to different factors like severity of poisoning, type of compound consumed, time lag between consumption of poison and treatment etc.

Out of total 104 patients studied, 44.23% (46 cases) were in mild poisoning group, 34.62% (36 cases) patient in moderate poisoning group and 21.15 % (22 cases) patients in severely poisoned group which is comparable with the study done by Nagarajan K *et al* [9], Patil S *et al* [13] and Nermeen A *et al* [14]. The severity of poisoning vary according to different population and cases in mild and moderate category were in more number than cases in severe category.

In present study, out of 104 patients, 1 patient in mild category, 16 patients in moderate category and 18 patients in severe category required ventilatory support i.e., 35 patients out of 104 patients required ventilator support out of which 19 died and 16 patients survived and discharged. 46 patients were in the mild poisoning group none of them had died. Among the moderate poisoning group, out of 36 patients 4 patients had been died, while in 22 severe poisoning group 15 patient died. So, mortality increase as the POP scale severity increase. Total 19 out of total 104 patients died mortality rate being 18.26%. Ventilator mortality rate was 54.28% (19 died out of 35 patients on ventilator). In current study respiratory failure was cause of death in all patients. These findings are concordant with the study conducted by Swaminathan K *et al* [15] and Aravindan DP *et al* [16].

Mean serum cholinesterase levels on admission in patients with mild category was 2270.48, moderate category was 1343.72, severe category 614.14. This relationship between severity of poisoning assessed by POP scale with serum cholinesterase was statistically significant. So, the higher the score on the POP scale, the lower the serum cholinesterase level which shows the significant correlation between severity of OP poisoning with serum cholinesterase levels and this finding is concordant with Aravindan S *et al* [16] and Rehiman S *et al* [17].

We observed high degree of correlation between the initial serum CPK levels, and the severity of acute OP poisoning evidenced by the positive correlation of mean serum CPK level on admission with severity of poisoning grading done by POP scale. Out of 104 patients studied, 46 patients in mild category had mean CPK level 169.33±74.8 and only one patient in mild category required ventilator whose CPK level was 236 IU/l and Serum cholinesterase level was 2225 IU/l. 36 patients were in moderate category had mean CPK level 544.97±347.79 and 22 patients in severe category mean CPK level was 1182.09±208.64. All patients who required ventilator and who died had serum CPK level more than 200 IU/L so as to show that CPK level are correlated well with severity of poisoning and outcome. These findings are in accordance with the earlier studies [3,6,14,18].

In the present study, there was strong correlation between the initial RBSL levels and the severity of acute OP poisoning done by POP scale. Out of 104 patients studied, 46 patients in mild category had mean RBSL level 120.26±48.93 and only one patient in mild category required ventilator whose RBSL level was 388 mg/dl. 36 patients were in moderate category had mean RBSL level 178.25±41.85 and 22 patients in severe category mean RBSL level was 209.91±56.73.

Out of total 104 patients 79 patients had RBSL < 200 mg/dl and 25 patients had RBSL more than 200 mg/dl. Out of those 25 patients whose RBSL > 200 mg/dl, 60% patients required ventilator (15 out of 25) and mortality was 36 % (9 out of 25). These findings are concordant with the study done by Panda S *et al* [7], Rao R *et al* [10], Raghapriya R *et al* [19] and Ravi BN *et al* [20]. Above all studies shows that hyperglycemia on admission was associated with more severity of poisoning and poor prognosis of patients and these

Conclusions

POP scale can be used as good prognostic scale for OP poisoning patients. POP scale, acetylcholinesterase level, serum CPK level and RBSL at the time of admission are reliable parameters to predict ventilator requirement and mortality in organophosphorus poisoning. Creatine phosphokinase and RBSL may be considered as routine investigation as it is a good prognostic marker for assessing severity of OP poisoning and ventilator requirement and outcome of patients.

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