Original Research Article

Study of prognostic value of serum and RBC acetyle cholinesterase level in organophosphorus poisoning and its correlation with the outcome

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Abstract

Introduction: Organophosphorus compound (OPC) poisoning has assumed alarming proportions and it is primarily a problem of the developing countries. Serum cholinesterase levels are easier to estimate and usually depressed after OP poisoning. Peradeniya OP poisoning scale has not been studied much in Indian scenario. So, we decided to have first hand information and hence conducted this study.

Aim and objectives: To find out severity of patients with OP poisoning by calculating Peradeniya OP Poisoning score, level of plasma and RBC cholinesterase level of patients of OP poisoning on admission before any treatment, and correlate the level with severity and outcome of patients and requirement of ventilator support with OP poisoning.

Material and methods: All patients who presented to emergency department with history of poisoning with known compound were taken as study subjects. A detailed history, clinical examination and relevant biochemical investigations were performed. Peradeniya OP poisoning scale

was applied to all study subjects and the severity of OP poisoning was graded as mild, moderate, severe. In all study subjects, 3 ml of plain blood was collected on admission before administration of atropine and plasma cholinesterase and RBC cholinesterase was estimated.

Results: Most of the patients consumed poison with a suicidal intent. Majority had consumed poison orally. Most patients had consumed 50 – 100 ml of poison. Quantity of poison consumed did not correlate with severity of poisoning. In this study, requirement of ventilatory support was seen in 16% of patients. Mortality in our study was 9%. Pseudo cholinesterase levels were significantly depressed in patients who required ventilatory support and correlated with mortality. Miosis, Bradycardia, increased respiratory rate, impaired level of consciousness, all correlated well with need for ventilatory support and increased mortality. Peradeniya OP poisoning score of more than 8 correlated in predicting the need for ventilatory support and mortality. RBC and Plasma cholinesterase levels estimation in conjunction with Peradeniya OP poisoning score is a useful parameter for grading severity of OP poisoning and in predicting the need for ventilatory support and mortality.

Conclusion: The POP scale and RBC Che and plasma cholinesterase levels both showed a significant association in predicting the need for ventilatory support and outcome. Lower grade of poisoning had a better outcome whereas higher severity of poisoning had a poorer outcome.

Key words

Organophosphorus poisoning, Prognostic value, Acetyle cholinesterase, Serum, RBC.

Introduction

Organophosphorus compound (OPC) poisoning has assumed alarming proportions with an annual incidence of over 3 million patients in 1990. Organophosphorus compound poisoning is primarily a problem of the developing countries. Acute Organophosphorus compound poisoning is an important indication for emergency admission in most hospitals throughout India. Organophosphorus compounds were first developed by Schrader shortly before and during the Second World War. They were first used as an agricultural insecticide and later as potential chemical warfare agents. Organophosphorus (OP) compounds are used as pesticides, herbicides, and chemical warfare agents in the form of nerve gases. Its widespread use and easy availability has increased the likelihood of poisoning with these compounds. Although poisoning can result from occupational exposure or accidental ingestion, in most cases there is suicidal intent. Their common availability renders OP insecticide poisoning a worldwide health problem affecting millions of patients [1-5].

India is a tropical country where agriculture forms the backbone of the nation. More than 60% of Indians are farmers. This being the fact, pesticides is the most frequent hazardous compounds that farmers are exposed to, OPC being most common in addition to the accidental intoxication from use of these compounds as agricultural insecticides; these agents are employed frequently for suicidal and homicidal purposes largely because of their easy availability at the moment of frustration and low cost [1, 3].

The WHO estimates that approximately 3 million pesticide poisonings occur annually worldwide and cause more than 220,000 deaths. Developing countries like India and Sri Lanka report alarming rates of toxicity and death [6-9].

Sometimes it is difficult to diagnose clinically, hence we should go for plasma and RBC Cholinesterase level for confirmation of poisoning. Organophosphates act by irreversibly inhibiting the enzyme cholinesterase, resulting in accumulation of acetylcholine at synapses and myoneural junctions leading to cholinergic over activity. Mortality ranges from 4-30% in Indian

studies. Respiratory failure is the most common complication of OP poisoning leading to death. Early recognition and prompt ventilatory support may improve survival. Owing to limited availability of resources, all OP poisoning patients are not managed in ICUs in Indian setup. It is therefore important that clinical features and criteria to predict the need for ventilator support be identified at initial examination and also predict outcome [10-14].

Serum cholinesterase levels are easier to estimate and usually depressed after OP poisoning. Peradeniya OP poisoning scale has not been studied much in Indian scenario. It could be a simple and effective system to predict the outcome. Hence this study was undertaken to assess the severity of organophosphorus compound poisoning both clinically by using Peradeniya scoring and by estimating plasma and RBC cholinesterase levels [15-20].

We decided to have first hand information and hence conducted this study.

Aim and objectives

Present study had been carried out with an objective to correlate between plasma and RBC cholinesterase level and clinical features with prognosis.

Aim of the present study was to find out the efficacy of plasma and RBC cholinesterase level in management and prognosis of OP poisoning.

We conducted the study with the objectives to find out:

- Severity of patients with OP poisoning by calculating Peradeniya OP Poisoning score.
- Level of plasma and RBC cholinesterase level of patients of OP poisoning on admission before any treatment.
- Correlate the level with severity and outcome of patients and requirement of ventilator support with OP poisoning.

Material and methods

The study was conducted in our tertiary care center, from July 2011 to June 2013. There were 158 patients of OP compound poisoning admitted to the Department of Medicine during the study period. After applying inclusion and exclusion criteria, 100 patients who fulfilled all the criteria were chosen as study subjects. (n=100).

Inclusion criteria

A history of exposure to organophosphorus compound within previous 24 hours with characteristic clinical manifestations of organophosphorus compound poisoning.

Exclusion criteria

- Patients who receive treatment with atropine, before admission.
- Patients with doubtful diagnosis.
- Mixed poisoning with other substances.
- History of serious systemic illness.

Method of data collection

All patients who presented to emergency department with history of poisoning with known compound were taken as study subjects. A detailed history, clinical examination and relevant biochemical investigations were performed. Patients were included in the study if they had a history of pesticide ingestion as indicated by patient or relatives, the referring doctor, or the pesticide bottle.

A thorough clinical examination was carried out with particular reference to vital parameters, pupil size, assessment of central nervous system, respiratory system, cardiovascular system as per prescribed proforma. This examination took place during initial resuscitation and treatment of the patient.

Peradeniya OP poisoning scale was applied to all study subjects and the severity of OP poisoning was graded as mild, moderate, severe.

In all study subjects, 3 ml of plain blood was collected on admission before administration of atropine and plasma cholinesterase and RBC cholinesterase was estimated. Plasma cholinesterase was estimated by colorimetric method by kit provided by "Raichem of USA". The instrument used was RA-50. RBC cholinesterase was estimated by colorimetric method by Modified Ellsman.

Method

3 ml of plain blood was drawn and 5micro ml of blood was centrifuged at 3000 rpm for 5 minutes. The serum of the patient was taken and added to the tube containing 1.55 ml of the reagent.

Principle

Cholinesterase hydrolyses butryl thiocholine to butyrate and thiocholine. Thiocholine reacts with 5, 5' dithio bis -2- nitrobenzoic acid (DTNB) to form 5 mercapto -2- (MBNA) which has intense yellow colour.

Reaction

Butryl thiocholine + H2 0 → Butyrate + Thiocholine.

Thiocholine + DTNB → Mixed disulfide + 5-MBNA.

The rate of formation of yellow colour is read spectrophotometrically at 410 nm. It is directly proportional to the activity of pseudocholinesterase in the serum. The reading was taken after 1.25 seconds. The normal values ranged from 2710- 11510 U/L at 37 C.

According to cholinesterase activity the organophosphorus poisoning was graded as:

Grade of poisoning Cholinesterase activity

Normal > 50% (more than 50%)
Mild 20-50%
Moderate 10-20%
Severe <10% (less than 10%)

All patients were managed with decontamination procedure including gastric lavage. Intravenous atropine 2-4 mg bolus and repeated every 5-15minutes initially until atropinisation. The end point of treatment was taken as the drying up of secretions. The atropinisation was maintained for 24-48 hours with intermittent doses, every 15-30 minutes or depending on the need, and then tapered over days depending upon patient's response. Pralidoxime chloride was given to all patients as 2 g IV bolus over 10-15 minutes immediately after admission and 0.5-1.0 g IV 6th hourly for 48 hours depending on patient's condition.

Patients were kept under strict observation during their stay in hospital. Assessment of patient's airway and need for endotracheal intubation was assessed. Patients with respiratory failure were intubated and mechanical ventilator support was given. Psychiatric counselling was done for the patients who survived. Autopsy was conducted on all patients who expired.

Results

Age group ranged from 16 years to 62 years. Majority of the patients were in the age group of 20-29 years which comprised 37% of the study patients. Mean age was 32.15 ± 0.71 as per **Table – 1**.

Table - 1: Age distribution.

Age (Years)	Total	Percentage
<20	9	9%
20-29	37	37%
30-39	34	34%
40-49	13	13%
50-59	6	6%
>60	1	1%
Total	100	

In this study, 72% of patients were males and 28% of the cases were females as per **Table - 2**.

Table - 2: Gender distribution.

Male	72
Female	28
Total	100

In our study, 66 % of patients were from rural area as per **Table - 3**.

Table - 3: Place distribution.

Place	Male	Female	Total
Rural	51	15	66
Urban	19	15	34

In study, 94% of patients were from lower socioeconomic group as per **Table - 4**.

Table - 4: Socioeconomic status of patients.

Socioeconomic class	No. of Patients	%
Lower	94	94
Middle	6	6
Upper	0	0
total	100	100

In our study, 82% of Patients were married, 14% were unmarried and 4% had divorced as per **Table - 5**.

Table - 5: Marital status.

Marital status	No. of patients
Married	82
Unmarried	14
Divorced	4
Total	100

In our study, 34% patients were agriculturists and 33% patients were laborers as per **Table - 6**.

Table - 6: Occupation of patients.

Occupation	No. of Patients
Agriculture	34
Laborour	33
House wife	11
Private	2
Student	11
Self Employed	6
Unemployed	3

In our study, 72 patients had consumed 50 to 100 ml of poison as per **Table - 7**.

Table - 7: Quantity of poison consumed.

Amount of poison in ml	No. of patients
< 50	8
50 - 100	72
> 100	20

Majority of patients (97%) had consumed poison with a suicidal intent. Only 3% patients had accidental poisoning as per **Table - 8**.

Table - 8: Intention of poisoning.

Intention of poisoning	No of patients
Suicidal	97
Accidental	3
Total	100

In our study, the most common symptoms reported by patients were nausea and vomiting 95% followed by excessive sweating 94% as per **Table - 9**.

Table - 9: Presenting symptoms.

Symptoms	No. of Patients
Neusea/ vomiting	95
sweating	94
diarrhoea	75
breathlessness	71

In our study, the most commonly found clinical signs was tachypnea in 94% and followed by cyanosis 61% as per **Table - 10**.

Table - 10: Clinical signs.

Signs	No. of patients
Tachypnea	94
Miosis	78
Bradycardia	23
Cyanosis	61
Fasciculation	59
Altered sensorium	44
Convulsion	5

In our study, 47 patients were fall into mild grade of poisoning with POP poisoning severity scale with mean POP was 1.8 and SD 0.7. 41 patients in Moderate POP with mean 5.7 and SD 2.12. 12 patients in severe POP poisoning severity scale with mean POP was 9.25±0 as per **Table - 11**.

Table - 11: Clinical severity according to Peradeniya OP Poisoning scale.

Severity	No. of patients
Mild	47
Moderate	41
Severe	12
Total	100

In this study 32% of patients had PChe levels more than 50%, normal range. Only 8% of patients had severe poisoning as indicated by PChe levels less than 10% as per **Table - 12**.

Table - 12: Severity of poisoning according Plasma cholinesterase levels on admission.

Plasma CHE level	Severity	No. of patients	%
< 10%	Severe	8	8
10 - 19 %	Moderate	16	16
20 - 50 %	Mild	44	44
> 50 %	Normal	32	32
Total		100	100

In this study 37% of patients had RBC Che levels more than 50%, normal range as per **Table - 13**.

Table - 13: Severity of poisoning according RBC cholinesterase levels on admission.

RBC CHE level	Severity	No. of patients	%
< 10%	Severe	6	6
10 - 19 %	Moderate	19	19
20 - 50 %	Mild	38	38
> 50 %	Normal	37	37
Total		100	100

In our study, 97.3% of patients who admitted to hospital within 2 hours have been survived. Mortality was highest among patients who reached hospital after 4 hours of ingestion which was 25% as per **Table - 14**.

Table - 14: Correlation between time interval from consumption to hospitalization vs. Outcome.

Time interval	Outcome		Total
	survived	Expired	
< 2 hr	70 (97.3%)	2 (2.7%)	72
2 - 4 hr	25 (83.3%)	5 (16.7%)	30
> 4 hr	6 (75%)	2 (25%)	8
Total	91	9	100

In this study 6 of 47 patients had consumed less than 50 ml of poison fall into mild POP severity scale. 9 patients from 47 with mild POP scale consumed more than 100 ml of poison as per **Table - 15**.

Patients with mild grade of poisoning according to POP scale did not require ventilatory support. Most of patients with moderate (9.7%) and severe poisoning (100%) according to POP scale required ventilatory support. This was statistically highly significant as per **Table - 16**. (P value <0.01).

All patients with mild grade of POP severity scale survived. 1 Patient with moderate grade of POP scale had expired. 8 (66.66%) from 12 patients with severe grade of POP scale had expired as per **Table - 17**. (P value < 0.01 statistically significant.)

All patients with Plasma Che level > 50 % have been survived. 5(62.5) out of 8 patients with Plasma Che level <10% had expired. Mean Plasma Che level is 1637.69±21.21 on admission as per **Table - 18**.

In our study patients with mild POP score with >50% Plasma Che level in 30 (63.82%) patients. Majority of patients 5 (41.66%) who had severe

POP scale had <10 % Plasma Che level. This was statistically significant as per **Table - 19**.

Majority of patients 31 (65.95%) with mild POP score have > 50 % of RBC Che level and with severe POP score majority patients 6 (50%) have 10 -20% of RBC Che level. This was statistically significant as per **Table - 20**.

Mild POP correlate with normal Plasma Che and normal RBC Che level as per **Table - 21**. (P < 0.05)

Table - 15: Correlation between POP scale and quantity of poison consumed.

Severity of poison according to POP scale	Quantity consumed			Total
	< 50 ml	50 - 100 ml	> 100 ml	
Mild	6 (12.76%)	32 (68.08%)	9 (19.14%)	47
Moderate	2 (4.8%)	32 (78.04%)	7 (17.07%)	41
Severe	0 (0%)	8 (66.66%)	4 (33.33%)	12
Total	8	72	20	100

(P value- 0.13 Statistically not significant.)

Discussion

Age of patients

In our study, majority of patients were in the age group of 20-29 years (37%) and 71% of patients were within 40 years of age with mean age 32.15±0.71 This is in comparison to studies done by H Rajeev, et al. [15] which was 46% patients were between 21 to 30 years age group and S Nouira, et al. [10] which was 21±15.

Table - 16: Correlation between POP scale and ventilatory support.

POP scale	Ventilatory Support		Total
	Yes	No	
Mild	0 (0%)	47 (100%)	47
Moderate	4 (9.7%)	37 (90.3)	41
Severe	12 (100%)	0 (0%)	12
Total	16 (16%)	84 (84%)	100

(P value < 0.01 statistically significant.)

Gender distribution

This study revealed a male preponderance (72%), females accounting for 28% of cases. The male to female ratio in this study is 2.5:1. This corresponds to gender distribution reported by Alina Weissmann, et al. [11].

Table - 17: Correlation between POP Scale and Outcome.

POP scale	Outcome		Total
	Survived	Expired	
Mild	47 (100%)	0 (0%)	47
Moderate	40 (97.56%)	1 (2.43)	41
Severe	4 (33.33)	8 (66.66%)	12
Total	91 (91%)	9 (9%)	100

Table - 18: Correlation between Plama cholinesterase levels and outcome.

Plasma CHE level	Outcome		Total
	Survived	Expired	
< 10%	3 (37.5%)	5(62.5)	8
10 - 19 %	14 (87.5%)	2 (12.5%)	16
20 - 50 %	43 (95.55%)	2 (4.4%)	45
> 50 %	31 (100%)	0 (0%)	31
Total	91	9	100

(P < 0.01 statistically significant.)

Marital status

In our study, married patients were 82 (82%) and unmarried patients were 14 (14%) and 4 patients were divorced. The ratio of married to unmarried in this study is 5.85:1.

Table - 19: Comparison of severity according to POP scale vs. Plasma cholinesterase levels.

POP scale	Plasma cholinesterase				Total
	< 10%	10- 20%	20 -50 %	> 50%	
Mild	0 (0%)	2 (4.2%)	15 (31.91%)	30 (63.82%)	47
Moderate	3 (7.3%)	10 (24.39%)	26 (63.41%)	2 (4.8%)	41
Severe	5 (41.66%)	4 (33.33%)	3 (25%)	0	12
Total	8	16	45	31	100

(p value < 0.05)

Table - 20: Comparison of severity according to POP scale vs. RBC cholinesterase levels.

POP scale	RBC choline esterase level				Total
	< 10%	10- 20%	20 -50 %	> 50%	
Mild	0 (0%)	0 (0%)	16 (34.04%)	31 (65.95%)	47
Moderate	1 (2.4%)	13 (31.70%)	21(51.21%)	6 (14.6%)	41
Severe	5 (41.66%)	6 (50%)	1 (8.3%)	0	12
Total	6	19	38	37	100

(p value < 0.05)

Table - 21: Comparison of severity according to POP scale vs. RBC cholinesterase levels and Plasma Cholinesterase level on admission, at 48 hr and follow up at 7 days

		On admission		48 hr		Follow up at 7 days	
POP	Mean of POP	Mean of Pche	Mean RBC Che	Mean of Pche	Mean of RBC Che	Mean of Pche	Mean of RBC Che
Mild	1.8±o.7	2421.25±968	1339±219	3157±1117.9	1792±158	4007±746.7	2081±82
Moderate	5.7±2.12	1056±742	620.3±82	1890±1006	1584±248	3557±530	2020±267
Severe	9.25±0	553±183	247±162	1250±200	1255±220	3195±340	1947±230

Socio economic status

94% of patients in this study were from a lower socio economic group. This is in comparison to study done by H Rajeev, et al. [15], who found that 50% of patients were from low socioeconomic group.

Occupation

In our study, majority of patients were agriculturists (34%), followed by laborer who constituted about 33% of cases. This is in comparison with H Rajeev, et al. [15] study in which 26% were farmers and 24% were laborer.

Intention of poisoning

Almost all cases in our study (97%) had consumed poison with a suicidal intent. As OP compounds are generally available ready hand as pesticides and open access to these compounds at pesticide shops may be the reason for OP compounds to be used as a common mode of suicidal attempt. This is in comparison to values reported by, Noiura et al. (90%) [10].

Quantity of poison consumed

About 8% of our patients had consumed less than 50 ml of OP poison and 72% had consumed 50-100 ml of poison. 20% of patients had consumed more than 100ml of poison. These patients had higher mortality.

In this study we observed that both the severity and mortality were significantly higher in those

patients who were hospitalized more than 4 hours after exposure, compared to the mortality of 2.7% in patients who were hospitalized within 2 hours of exposure. These findings are in correlation with findings by H Rajeev, et al. [15].

In the present study nausea and vomiting were the commonest symptoms seen in 95%, followed by sweating (94%). Convulsions were seen in 5% of patients. All patients included in this study had a characteristic smell of organophosphorus compound. The common clinical signs were tachypnoea (94%), Miosis (78%) Fasciculations (59%). This is comparable with Alina Weissmann, et al. [11] study.

Quantity of poison consumed and mortality

In our study, about 8 patients had consumed less than 50 ml of poison. Most patients in this group had mild (54%) and moderate grade (44%) of poisoning according to Peradeniya OP Poisoning (POP) scale. Pseudo cholinesterase (PChe) levels were in the normal range in about 63% of patients who had consumed less than 50ml and none had severe poisoning according to PChe levels. As the amount of poison increased to more than 50 ml, severity of poisoning did not correlate with either PChe levels or POP scale.

Mortality and Poisoning

All deaths in our study occurred within 24 hours of admission to hospital. Delay in hospitalization, type of poison and higher clinical score at presentation accounted for mortality.

All patients with mild grade of poison according to POP scale survived. Expired had moderate grade (1) and severe grade (8 patients) according to POP scale.POP scale had a statistically significant correlation with mortality. (p value<0.01).

Patients who had subclinical poisoning with their pseudocholinesterase levels being >50%, all patients survived. Patients with PChe levels <50% had more mortality compared to patients with PChe levels >50%. p value - <0.01. This finding is in comparison with Alina Weismann, et el. [11] study who found where was a direct correlation between the degree of inhibition of Plasma Che levels and the severity of intoxication and also outcome.

2 % patients developed intermittent syndrome and needed ventilator support.

Ventilatory support

Respiratory failure requiring ventilatory support was observed in 16% of patients in our study. This is in comparison to values obtained by S Noiura, et al. [10].

RBC cholinesterase and Pseudocholinesterse levels

RBC Che and PChe levels were assessed in all patients at admission to hospital and it was classified according into subclinical (normal), mild, moderate and severe poisoning. In our study 32% of patients had subclinical poisoning and 8% had severe poisoning according to PChe level. And 37 % of patients had subclinical poisoning and 6% of patients had severe poisoning according to RBC Che level. With normal grade of poisoning, patients did not require ventilator support. All patients who required ventilator support had moderate to severe grade of poisoning according to RBC and Plasma Che level. Our study showed a highly significant correlation between RBC Che and PChe levels and the need for ventilator support. A. Weissmann- Brenner, et al. [11] found a direct correlation between the degree of inhibition of PChe levels and the severity of poisoning.

Peradeniya OP poisoning scale

POP scale was calculated for all patients on admission. 47% of patients had mild grade of poisoning and 41% had moderate grade of poisoning. 12 patient in our study belonged to severe grade of poisoning and required ventilatory support and amongst them 8 patients expired.

POP score ranges from minimum 0 to maximum 11. In our study nobody with mild grade of poisoning required ventilatory support. Among

patients with moderate and severe poisoning 16 out of 53 patients required ventilator support. All patients with severe POP score (12%) required ventilator support, out of them 8 patients (75%) expired. 4 out of 41 patients with moderate POP score required ventilator support. 1 patient with moderate POP score have been expired.

Conclusion

In this prospective study of 100 cases of OP poisoning, severity of poisoning assessed by POP severity scale and measurement of RBC Che and Plasma Che level on admission and compared with the requirement of ventilator support and outcome of the patient.

OP poisoning is one of the most common modes of suicidal deaths in our country.

- The male to female ratio in our study was 2.5:1.
- Most of the patients consumed poison with a suicidal intent.
- Majority had consumed poison orally.
- Most patients had consumed 50 – 100 ml of poison.
- Quantity of poison consumed did not correlate with severity of poisoning.
- In this study requirement of ventilatory support was seen in 16% of patients.
- Mortality in our study was 9%.
- Pseudo cholinesterase levels were significantly depressed in patients who required ventilatory support and correlated with mortality.
- Miosis, Bradycardia, increased respiratory rate, impaired level of consciousness, all correlated well with need for ventilatory support and increased mortality.
- Peradeniya OP poisoning score of more than 8 correlated in predicting the need for ventilatory support and mortality.
- RBC and Plasma cholinesterase levels estimation in conjunction with Peradeniya OP poisoning score is a useful parameter for grading severity of OP poisoning and in predicting the need for ventilatory support and mortality.

In study patients were in the age group of 16 to 62 years. Majority of the patients were in the age group of 20-29 years (37%). 66% of the patients were from rural areas and 34% of them were agricultural workers. 94% of patients were from low socio economic stratum. Route of intake of poison was oral in all cases. 97% of patients consumed poison with a suicidal intent.

Mortality (2.70%) was least among the patients who presented to the hospital early as compared to those who presented late (25%). Amount of poison consumed did not correlate with the severity of poisoning. The most common symptom reported by patients in our study was nausea and vomiting (95%). The most commonly found clinical sign was tachypnoea in 94% of patients followed by fasciculations which was seen in 59% of patients.

47% of patients in our study belonged to mild grade of poisoning with a POP score less than 4. 12 patients had a score more than 7 and had severe poisoning and among them 8 patients expired. In this study 37% patients had RBC Che levels more than 50%. And 6% had less than 10%.in our study 32% of patients had PChe levels more than 50%, normal range. Only 8% of patients had severe poisoning with PChe levels less than 10%.In this study mortality was 9%.

The POP scale and RBC Che and plasmacholinesterase levels both showed a significant association in predicting the need for ventilatory support and outcome. Lower grade of poisoning had a better outcome whereas higher severity of poisoning had a poorer outcome.

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