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ORIGINAL ARTICLE

Correlation between outcome and severity of organophosphorus poisoning according to peradeniya organophosphorus poisoning scale

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Abstract

Introduction: Organophosphates are widely used pesticides. These are linked to significant global poisoning cases, with around 563,000 deaths annually, particularly in rural agricultural areas, due to agents like parathion and chlorpyrifos. This study focuses on the Peradeniya Organophosphorus Poisoning (POP) scale, which assesses severity based on clinical parameters and may be particularly useful in resource-limited settings.

Method: This study aims to correlate the severity of organophosphate poisoning, measured by the POP scale, with clinical outcomes such as atropine dosage, hospital stay, need for ventilator support, and mortality. Conducted over one year(March 2021 – Feb 2022) at Emergency Department of Patan Academy of Health Sciences in Nepal, it is a prospective, cross-sectional study including patients who presented within 24 hours of organophosphate ingestion, without prior treatment. Data were collected using POP scale to assess symptom severity and track clinical outcomes, with a calculated sample size of 43.

Result: Among total 43 patients, 25(58.1%) were male, with majority (45(81.4%)) classified as having mild poisoning according to the POP scale. The average atropine dose and ICU stay were similar between genders, though hospital stay was significantly longer for males. There was a significant correlation between POP scores and clinical outcomes including the amount of atropine required, ICU stay, and total hospital stay. No severe cases or deaths were recorded.

Conclusion: The POP scale effectively correlates with the severity and outcomes of organophosphate poisoning. Its application can aid in early diagnosis, prioritization of treatment, and resource allocation in emergency settings, potentially improving patient management and outcomes in regions with limited medical infrastructure.

Keywords: Organophosphate Poisoning, Organophosphorus Compound, POP Scale, Severity

INTRODUCTION

Organophosphates or commonly called pesticides are chemical compounds that are widely used throughout the world. Agents linked to human poisoning include both carbamates (methomyl and aldicarb) and organophosphates (parathion, fenthion, malathion, dursban). Chlorpyrifos, the organophosphate agent of dursban, is found in some household roach and ant sprays.[1] Organophosphorus compounds are chemicals that include carbon and phosphorus acid derivatives, typically in the form of esters, thiol esters, or acid anhydrides. Among the over 100 organophosphorus (OP) pesticides used globally, most are based on dimethyl or diethyl phosphoryl compounds.[2]

According to the WHO report of 2012, globally there were an estimated 193,460 deaths due to unintentional poisoning. Also there were 370,000 deaths due to deliberate pesticide poisoning.[3] Since organophosphorus compounds are widely used pesticides in the rural areas for agricultural purpose, it has been attributed to the majority of deaths due to pesticide poisoning in the developing world.[4] A cross sectional study done in Jashore, Bangladesh to see the prevalence of acute poisoning due to the use of organophosphorous compounds (OPC) was significantly high (66.1%). [5]Primary toxic effects involve the autonomic nervous system, neuromuscular junction and central nervous system. Acute toxicity of OP poisoning generally manifests in minutes to hours. Evidences of cholinergic excess includes salivation, lacrimation, urination, defecation, gastric emptying, bradycardia, bronchorrhea and bronchospasm. Diagnosis of OP poisoning is mostly made clinically on the basis of history and clinical feature. At times the family members bring the ingested poison itself or the picture of it. Many OP agents have a characteristic petroleum or garlic-like odor, which may be helpful in establishing the diagnosis.

The quest for newer biomarkers in relation to OP poisoning started quite a long time back. Serum acetyl cholinesterase level, Erythrocyte cholinesterase level, Serum butyryl cholinesterase level, Red Cell Distribution Width(RDW), plasma cholinesterase, amylase, lipase and, creatine phosphokinase (CPK), Poisoning Severity Score, Glassgow Coma Scale and Corrected QT (QTc) interval, Glycemic Status at the time of presentation, OP labeled albumin in human plasma , blood Beta- glucuronidase, paraoxonase status, degree and type of acidosis, biomarkers in meconium and urine in children susceptible to OP exposure in utero, POP Scale, etc.[6,7,8] Considering all the points mentioned above for and against of different tools and prognostic indicators POP Scale can be considered as the tool of choice when it comes to time and economy.POP Scale does not rely on patient cooperation and hence can be applied to severely ill as well as unconscious patients. It is simple enough to be used even by paramedics or field health workers who, in fact, are the first contacts of these patients most of the time. Based on the hypothesis that, the higher the level of toxin in the tissue, more should be the symptoms, a scoring system known Peradeniya organophosphorus poisoning (POP) scale (table 1) was put forth by Senanayake et al.[9] This scale uses six clinical parameters to assess the severity of poisoning and thereby decide on the prognosis. Common clinical manifestations of OP poisoning are selected as parameters and each is assessed on a three-points scale varying from 0 to 2 . The score is obtained at the initial presentation before any medical intervention and it represents the muscarinic, nicotinic, and central effects of the acute cholinergic manifestations of OP poisoning. A score of 0 to 3 is considered as mild poisoning, 4 to 7 as moderate poisoning and 8 to 11 as severe poisoning. In addition, a score of 1 is added for the presence of convulsions, making the maximum possible score 11; poisoning can then be graded as mild (score 1-3), moderate (score 4-7) or severe (score 8-11).

In the most of the health setting of Nepal, where a lack of infrastructure is a major problem, it can be a very helpful scoring system based on clinical signs and symptoms which will help direct the available resource to the required patients.[9]

Table 1. Peradeniya organophosphorus poisoning (POP) scale

Parameter	Criteria	Score	Mark
Pupil size	>/=2mm	0	
	<2mm	1	
	Pinpoint	2	
Respiratory Rate	<20/min	0	
	>/=20/min	1	
	>/=20/min with central cyanosis	2	
Heart rate	>60/min	0	
	41-60/min	1	
	<40/min	2	
Fasciculation	Absent	0	
	Present, generalized / continuous	1	
	Both generalized and continuous	2	
Level of consciousness	Conscious and rational	0	
	Impaired response to verbal command	1	
	No response to verbal command	2	
Seizure	Absent	0	
	Present	1	
Total Score			

Early detection, assessment of severity and prompt management are the keys for a better outcome in OP poisoning. As mentioned above there is battery of signs and symptoms of OP poisoning. If intervened in time morbidity and mortality can be reduced. Most tools need blood samples and laboratory facilities; more time; and only available in tertiary centers. POP Scale doesn't need any lab

facilities; No cost; takes few minutes and can be done at any health set up. Findings from this study might be helpful for early management or early referral.

The objective of this study was to find a correlation between outcome and severity of poisoning according to Peradeniya Organophosphorous Poisoning Scale. The specific objectives were to find out the severity of Organophosphorous Poisoning using Peradeniya organophosphorous Poisoning Scale), to find out the outcome of poisoning (The amount of atropine required to atropinise the patient, hospital stay, ventilator support and deaths) and correlation between severity score and outcome

METHOD

It was a prospective; cross Sectional, single centered study conducted in the emergency ward (tertiary center (Patan Academy of Health Sciences),Lagankhel,Lalitpur,Nepal). It was conducted for one year year after approval from IRC (March 2021 – Feb 2022) **S**ample size was collected using following formula:

$N = [(Z\alpha+Z\beta)/C]^2 + 3,$

$= 43$

where standard normal deviate for $\alpha = Z\alpha = 1.960$ and

The standard normal deviate for $\beta = Z\beta = 0.842$.

$C = 0.5 * \ln [(1+ r)/(1- r)] = 0.297.$

r: - 0.414. [10]

The correlation coefficient used to calculate sample size has been used from the cited article where maximum correlation coefficient was shown between POP Scale and Hospital stay i.e. 0.414.[10]

The proforma was placed in the Emergency Department, where the attending doctor completed it. After the shift, the proforma was collected from the ER. Suspected cases of organophosphate (OP) poisoning were confirmed based on the patient's history and clinical symptoms, the presence of a compound-labeled bottle or packet, or identification by an accompanying person. For cases meeting the criteria, a detailed clinical examination using the POP scale was conducted and scored accordingly. Clinical outcomes were tracked and recorded, including the total atropine administered within the first 24 hours, the duration of hospital stay, the need for ventilatory support, and whether the patient improved or expired.

Data analysis was done upon completion of the study. Data was entered into the computer using IBM SPSS V25 and Microsoft Excel 2016. Data following normal distribution linear correlation i.e. Pearson's correlation and linear logistic regression was used. For asymmetrical data non-linear correlation i.e. Spearman' correlation and non- linear e.g. logistic regression was used. Results were demonstrated in tables and correlation was interpreted using Pearson's correlation coefficient. A 95 % confidence interval was taken and p-value less than 0.05 will be considered statistically significant.

Ethical Consideration

Approval of the study was obtained from the Institutional Review committee (IRC) of PAHS.(Ref : PMG2101081476). A written informed consent was taken from the caretaker/ accompanying person who brought the patient. For minors consent was taken from the parents or person accompanying them. The privacy and confidentiality of the participants was maintained.

Inclusion Criteria

Patients of any age who have ingested Organophosphate compounds and who gives consent or in case of minors consent given by the accompanying person

Patients attending emergency ward within 24 hours of ingestion(Cholinergic effects of OP usually fades off after 24 hours of ingestion)

Patients who have not received any kind of medical treatment prior coming to hospital.

Exclusion Criteria

Patient with poisoning, due to causes other than OP. Cases referred from other center.

RESULT

A total of 43 consecutive patients of OP poisoning who attended emergency and fulfilled the inclusion-criteria mentioned were enrolled in the study. Among them, 25(58.1%) were male. The age of the patient ranged from 20 to 80 years with 17 (40 %) of them between 21 – 40 years. Among the 21- 40 years old patients, the number of male patients was more than females (Table 3).

Table 2. Age distribution of sample

Age group in years	Male N(%)	Female N(%)
Upto 20 years	4(9.3%)	3(7%)
21 years to 40 years	10(23.3%)	7(16.3%)
41 years to 60 years	9(20.9%)	8(18.6%)
61 years to 80 years	1(2.3%)	0
81 years to 100 years	1(2.3%)	0
Total	**25**	**18**

The distribution of sample in three grades of poisoning as per POP scale is shown in Table 4 and 5. Among the three grades of poisoning as per POP scale 45(81%) cases were of Mild type. Among the mild grade, cases were equally distributed between male and female. Among the samples collected, there was no severe form of OP poisoning.

Table 3. Distribution of sample according to severity

POP score scale	Male N(%)	Female N(%)
Mild	17(39.5%)	18(41.9%)
Moderate	8(18.6%)	0
Severe	0	0

The average dose of atropine required to atropinize the case was statistically insignificant among male and female with 25.4 mg in males and 15.8 mg in females. Average days of ICU stay was 7.7 days for male and 5.1 days for female, both values were statistically insignificant. However, average hospital stay (ICU and ward) was seen more in male (12.24) than in female (8.84) and it was significant statistically($P<0.05$). Only two cases required ventilator support and both were male. There was no mortality among the sample collected. Among the cases who improved after the treatment, male (58.1 %) were more than females (41.9 %)

A weak but statistically significant correlation was seen between POP score and outcomes. Ventilator support was only needed in two cases so its correlation with POP score could not be calculated.

Table 4. Distribution of outcomes

Outcomes	Male N(%)	Female N(%)	P value	Test
Atropinization Dose (mg)	25.4(31.7%)	15.8(9.6%)	0.223	ANOVA
ICU stay (Days)	7.7(4.1%)	5.1(2.63%)	0.25	ANOVA
Hospital stay (Days)	12.24(4.61%)	8.4(2.52%)	0.03	ANOVA
Ventilator support	2(4.7%)	0	0.219	Chi-square

Table 5. Correlation between pop score and outcomes of op poisoning

Parameters	Correlation (r)	P Value (P)	Scale
Initial atropine and POP Score	0.30	0.048	Spearman
Hospital Stay and POP score	0.35	0.019	Pearson
ICU stay and POP score	0.312	0.042	Pearson

DISCUSSION

In this study, more than two thirds of the patients were 20-40 years old, is similar to studies done at western regional hospital by Acharya K, et al., 2019, and study done by Sigdel D, et al., Apr 2019.[11,12] This may be due to the increase in stress because of unemployment, poverty and conflicting relationships in young couples.

Males were found to be more vulnerable to self-poisoning, as reported in previous studies, but this pattern reverses with advancing age, as also noted in other reports.[11,12]

As per the POP scale around 80 % of the cases were of mild severity. This finding is similar to study done by Rehiman S, et al., in Bir hospital, Nepal.[13] The amount of atropine required to atropinize the cases were found to be clinically insignificant (P value 0.223) between male and female. However average amount of atropine was found more in male than female. It can be due the amount of atropine taken by individual cases or the difference in built between the genders.

In current study a significant correlation was found between POP score and Outcomes (Initial atropine, ICU stay and total hospital stay). It means the higher the POP score at the time of first encounter is, higher the amount of atropine will be required to atropinize the case. Similar was in the study done by the Rehiman S, et al., in Bir hospital, Nepal and R Chaudhary, et al., in BPKIHS, Dharan.[13,14] There was also significant correlation between POP score and number of days in ICU. This finding is consistent with study done by other studies too. It means the higher the POP score is there is higher chances that the patient will need management at the ICU set up. This will help the clinician for the early recognition and prompt referral of such cases. Conversely, cases with less POP score or less severity can be managed in general ward. This will not only help patient with prompt treatment but also economically.

There was also significant correlation between POP score and total hospital stay. It means higher the POP score is one can predict the average hospital stay of the patient. This finding is consistent with the study done by Rehiman S, et al.[13] Two cases needed ventilator support. Both cases have higher severity as per POP scale.

There are few limitations of this study. Sample size was small. This may be because the distribution of OP cases are more in rural areas where people are involved more in agriculture where they use pesticides. As of in our case, sample was taken from hospital in urban area where people are less likely from agriculture background. Also because there abundant hospitals where cases can be managed adequately.

Most of the cases were diagnosed on the basis of patient's history and clinical examination. No bio-chemical analysis of gastric lavage was done in any patients to confirm the diagnosis. This is because most of the cases landed lately in our set up.

CONCLUSION

This study was successful to establish a significant correlation between the POP score and the outcome of OP poisoning of the cases presenting in the Patan Hospital. We can draw a sort of plan for each cases as per the POP scale severity.

DECLARATIONS

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Special acknowledgment to my teachers who helped me during the study.

Conflict of Interest

None

Funding

None

Ethical Clearance

It was obtained from IRC PAHS (Ref. PMG2101081476).

Consent for Publication from Authors

Approved from all the authors.

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