

A Study on Correlation Between Serum Cholinesterase Level and Clinical Severity Based on Pop Scale in Organophosphorus Poisoning

Shrestha A¹, Kidwai A¹, Shrestha R², KC S¹

ABSTRACT

Introduction: Organophosphorus (OP) compounds are the most commonly used pesticides worldwide and Organophosphorus poisoning has become the major public health problem especially in developing countries. The case fatality rate following ingestion of Organophosphorus pesticides in developing countries in Asia is 5-20%. Due to limited availability of facilities and resources in Nepal, it is important to prioritize treatment based on severity of poisoning as all patients can't be managed in Intensive Care Unit. **Aims:** To study the correlation between serum cholinesterase level and clinical severity based on Peradenya organophosphorus poisoning scale in Organophosphorus poisoning. **Methods:** The study was conducted in the department of Medicine, Nepalgunj Medical College, Kohalpur, Banke from November 2019 to November 2020. It is based on the descriptive study of 66 patients with Organophosphorus poisoning attending to the emergency department. All patients with history of exposure to Organophosphorus poisoning were included in the study. Peradenya Organophosphorus Poisoning scale was used to assess the clinical severity as mild, moderate and severe. At the same time venous blood samples were collected for serum cholinesterase level. **Results:** Age group ranged from 16-60 years and majority of patients were in the age group of 20-29 years (34.85%). 53% were females. 74.2% of the patients were from lower socioeconomic status. 83.3% of the patients consumed poison with suicidal intention. Majority of the patients were from tharu ethnicity (40.9%) and were farmers (30.3%). It was observed that there is significant correlation between serum cholinesterase level and severity of poisoning based on Peradenya Organophosphorus Poisoning scale at initial presentation (p value <0.001). **Conclusion:** There is significant correlation between severity of poisoning and degree of derangement of serum cholinesterase level at the initial presentation. As the facility for the estimation of serum cholinesterase level is not available in all regions of Nepal.

Keywords: Organophosphorus (OP) compound, POP scale, Serum cholinesterase

Authors:

1. Dr. Anil Shrestha
2. Dr. Aasim Kidwai
3. Dr. Richa Shrestha
4. Dr. Suman KC

¹Department of Internal Medicine, Nepalgunj Medical College & Teaching Hospital, Kohalpur, Banke.

²Department of Pathology, Nepalgunj Medical College & Teaching Hospital, Kohalpur, Banke.

Address of correspondence:

Dr. Anil Shrestha
 Assistant Professor
 Department of Internal Medicine
 Nepalgunj Medical College & Teaching Hospital
 Kohalpur, Banke
 Email: shtani4@gmail.com

INTRODUCTION

Organophosphorus compounds are the most commonly used pesticides worldwide and OP poisoning has become the major public health problem especially in developing countries.¹ The mortality due to various poisonings as estimated by World Health Organization is around 3 million per year globally, out of which around 2,50,000 and 3,50,000 deaths are due to OP poisoning.²⁻⁴ The case fatality rate following ingestion of OP pesticides in developing countries in Asia is 5-20%.⁵ OP compounds are used largely in agricultural countries like Nepal and India for farming purpose. Most of the reported cases are

in young adults especially females, farmers and from lower socio-economic status.⁶⁻⁸ The survival in OP poisoning depends upon the severity of poisoning and initiation of treatment. Due to limited availability of facilities and resources in Nepal, it is important to prioritize treatment based on severity of poisoning as all patients cannot be managed in Intensive Care Unit. Hence, severity of poisoning needs to be ascertained based on either clinical or laboratory assessment. The Peradenya Organophosphorus Poisoning (POP) scale assess the severity of poisoning based on symptoms at presentation and is simple to use. In a study by Senayoke et al, patients with severe grade

on the POP scale had a high rate of mortality and morbidity.⁹OP compounds act by inhibiting Cholinesterase irreversibly which leads to accumulation of acetylcholine at synapses causing overstimulation of acetylcholine receptors and disruption of neurotransmission in both central and peripheral nervous systems. So, it is reasonable to estimate serum ChE level to assess the severity of OP poisoning.¹⁰⁻¹¹

METHODS

This is a hospital based descriptive study of 66 patients with OP poisoning attending to the emergency department of NGMCTH, Kohalpur, Nepal. The study was conducted at department of Medicine from November 2019 to November 2020. The study was approved by institutional review committee (IRC) Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke. Informed consent of the patient or guardian was taken. All patients with history of exposure to OP poison were included in the study. The present study aims to correlate serum ChE level and the clinical severity described by the POP scale at initial presentation. Patients with age <16 years, exposure to poison other than OP compound, OP poison mixed with any other poison, patients who were treated elsewhere were excluded from the study. A detailed history and complete clinical examination were carried out. The diagnosis was made based on history, characteristics clinical signs and symptoms like miosis, excessive salivation, altered consciousness, fasciculation, etc, improvement of sign and symptoms with administration of atropine, corroborative evidence like empty container and odour of gastric aspirates. POP scale was used to assess the clinical severity. A score of 0 to 3 is considered as mild, 4 to 7 as moderate and 8 to 11 as severe poisoning. At the same time venous blood samples were collected for serum ChE along with other routine investigations. Serum ChE level was estimated with reference range of 4620-1150 IU/L. Based on the serum ChE levels, the severity of poisoning was defined as per Kumar et al.¹²

- Latent – serum ChE level >50% of normal or >2310 IU/L
- Mild poisoning- Serum ChE level 20-50% of normal or 925-2310 IU/L
- Moderate poisoning - Serum ChE level 10-20% of normal or 463-924 IU/L
- Severe poisoning - Serum ChE level ≤20% of normal or ≤462 IU/L

Data was analyzed using Standard statistical method including SPSS 25.0. The test applied was Fischer’s exact test. A p value of <0.05 was considered to be significant.

RESULTS

A total of 66 patients with the diagnosis of OP poisoning were enrolled in the study. Age group ranged from 16-60 years and the mean age was 33.57 years. Majority of the patients were in the age group of 20-29 years which comprised of 23 (34.85%) patients as shown in table I.

Age Group	No. of cases	Percentage
<20	5	7.57
20-29	23	34.85
30-39	18	27.28
40-49	10	15.15
≥ 50	10	15.15
Total	66	100

Table I: Age distribution.

Out of 66 patients, 31 (47%) were male and 35 (53%) were female with M:F ratio of 0.88:1 showing female predominance. In this study, 44 (66.7%) patients were married, 22 (33.3%) patients were unmarried. 49 (74.2%) patients were from lower socioeconomic status whereas 17 (25.8%) patients were from middle class. Most of the patients (83.3%) had suicidal intention as shown in table II.

Parameters	Values n (%)
Gender	
Male	31 (47%)
Female	35 (53%)
Marital Status	
Married	44 (66.7%)
Unmarried	22 (33.3%)
Socioeconomic Status	
Lower	49 (74.2%)
Middle	17 (25.8%)
Intention	
Suicidal	55 (83.3%)
Accidental	11 (16.7%)

Table II: Characteristics of patients.

Maximum number of patients belonged to Tharu community which was 40.9% as shown in table III.

Ethnicity	Number	Percentage
Tharu	27	40.9
Magar	10	15.2
Brahmin	9	13.6
Chettri	6	9.1
Others	14	21.2
Total	66	100

Table III: Ethnicity.

In the present study, major group was constituted by farmers followed by students which were 30.30% and 24.24% respectively as shown in table IV.

Occupation	Number	Percentage
Farmer	20	30.30
Student	16	24.24
Housewife	12	18.20
Labour	9	13.63
Job Holder	7	10.60
Unemployed	2	3.03
Total	66	100

Table IV: Occupation of the patients.

Most common clinical features were vomiting, excessive salivation, miosis, bradycardia and altered consciousness as shown in figure 1.

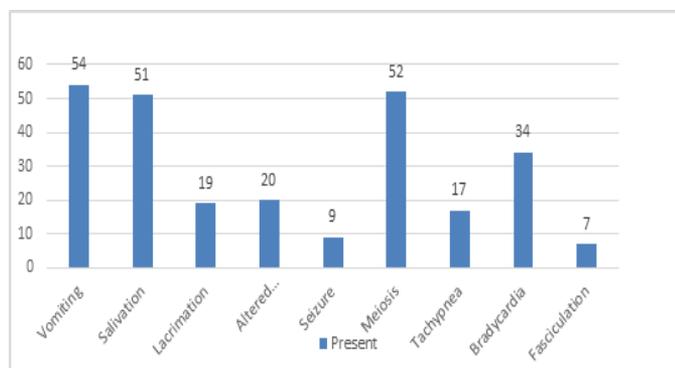


Figure 1: Signs and symptoms at presentation.

According to the POP scale, 39 (59.1%) patients had mild grade of poisoning with a POP scale of less than 4. 5 (7.6%) patients belonged to severe grade with a POP score more than 7, as shown in table V.

POP Scale	Number	Percentage
Mild	39	59.1
Moderate	22	33.3
Severe	5	7.6
Total	66	100

Table V: Severity according to POP Scale.

On the basis of serum ChE level, 31 (47%) patients belonged to latent grade (>50% of normal), 30 (45.5%) patients in mild grade (20-50%), 4 (6.1%) in moderate grade (10-20%) and 1 (1.5%) in severe grade (<10%) of poisoning as shown in table VI.

Serum Choline-esterase level	Severity	Number	Percentage
>2310 (>50% of normal)	Latent	31	47.0
925- 310 U/L (20-50%)	Mild	30	45.5
463-924 U/L (10-20%)	Moderate	4	6.1
≤ 462 U/L (<10%)	Severe	1	1.5
Total		66	100

Table VI: Severity of poisoning according to Serum Cholinesterase level.

Out of 39 mild cases, according to POP scale, 27 patients had serum ChE level >50% of normal and 12 patients has between 20-50%, whereas out of 5 severe cases, according to POP scale, 4 patients had serum ChE level between 10-20% and 1 patient had <10% as shown in table VII.

POP scale	Serum cholinesterase levels				Total
	>2310 (>50% of normal)	925-2310 (20-50%)	463-924 (10-20%)	≤462 (<10%)	
	27	12	0	0	39 (59.1%)
Moderate (4-7)	4	18	0	0	22 (33.3%)
+++++ Severe (>7)	0	0	4	1	5 (7.6%)
Total	31 (47%)	30 (45.5%)	4 (6.1%)	1 (1.5%)	66 (100%)

Normal serum cholinesterase level: 4620-11500 U/L; Fischer's Exact Test= 43.543 with p-value <0.001 (highly significant).

Table VII: Comparison of severity according to serum cholinesterase levels versus POP scale.¹¹

DISCUSSION

OP compound poisoning is the global health burden with particularly high prevalence rate in developing countries. In present study, majority of patients *(34.85%) were in the age group of 20-29 years and 69.7% of patients belonged to age group of <40 years. This is comparable to the studies done by Rehiman S et al¹³, Agrawal V et al¹⁴, Bhattacharya K et al¹⁵, Kavya ST et al¹⁶, Honnakatti V et al¹⁷ which also showed that OP poisoning was much more common in younger age group. The present study showed female predominance (53%) over male (47%) with a ratio of 1.12:1. Similarly, female predominance was reported by Rehiman S et al¹³, Kafle K et al¹⁸, Twayana RS et al¹⁹. In present study, majority of patients were from tharu community, low income group and farmers. Dominance of tharu ethnicity in this study reflects the demography of this area where 18% population comprises of tharu¹⁸ and their main occupation is agriculture and thus, they have an easy access to OP compound which is widely used in Nepal for farming purpose. This study revealed that 86.3% patients consumed OP compound with suicidal intention. Similar finding was reported by Honakatti V et al¹⁷(84%) and Agrawal V et al¹⁴. Significant number of patients (16.7%) had accidental ingestion of poison which might be due to alcohol influence and uneducated background of the people. A retrospective analysis of poison cases done by TUTH revealed 6% of accidental poisoning among 178 study subjects.²¹ In this study, common signs and symptoms at presentation were vomiting, excessive salivation, miosis, bradycardia, altered consciousness. Similar manifestations were reported by Rehiman S et al¹³, Twayana RS et al¹⁹, Bhattarai MD et al²² and Eddleston M et al¹.

In the present study, out of 39 mild cases according to POP scale, 27 patients had serum ChE level >50% of normal and

12 patients had 20-50%. In contrary to that, all 5 severe cases according to POP scale had serum ChE level <20% of normal i.e. as the grade of poisoning is increased, more was depression in serum ChE level. This shows the significant correlation between the severity of poisoning categorized by POP scale and the serum ChE at the time of initial presentation of the patients and the p value is highly significant (p value <0.001).

LIMITATION

This was a single hospital based descriptive study with a relatively smaller sample size. Thus, a prospective study including larger sample is needed.

CONCLUSION

POP scale and serum ChE level are an important tool for the assessment of severity of OP poisoning. As the severity of the POP scale increases, degree of derangement of serum ChE level also increases. The facility for estimation of serum ChE level is not available in many regions Nepal. In such condition, POP scale can be used to access the severity of OP poisoning.

REFERENCES

1. Eddleston M, Buckley NA, Eyer P, Dawson AH. Management of acute organophosphorus pesticide poisoning. *Lancet*. 2008; 371(9612):597-607.
2. Thundiyil JG, Stober J, Besbelli N, Pronczuk J. Acute pesticide poisoning: a proposed classification tool. *Bull World Health Organ*. 2008; 86:205–209.
3. World Health Organization. The impact of pesticides on health. Downloaded from: http://www.who.int/mental_health/prevention/suicide/en/PesticidesHealth2.pdf.
4. Jeyaratnam J. Acute pesticide poisoning: a major global health problem. *World Health Stat Q*. 1990; 43:139–144.
5. Thomas SHL, White J, Poisoning. In Colledge NR, Walker BR, Ralston SH, editors. *Davidson's principles and practice of medicine*. 21st edition. London: Churchill Living Stone, elsevier: 2010. 218.
6. Baiyya KL, Vidyasagar S, Sharma A, Sammad V. Controversies in the management of organophosphate pesticide poisoning. *Indian J Pharmacol*. 2007; 39:71-74.
7. Ponnudurai R, Heyakar J. Suicide in Madras. *Indian Journal of Psychiatry*. 1980; 22:203–205.
8. Kar N. Lethality of suicidal organophosphorus poisoning in an Indian population: Exploring preventability. *Ann Gen Psychiatry*. 2006; 5:17.
9. Senanayake N, de Silva HJ, Karalliedde L. A scale to assess severity in organophosphorus intoxication: POP scale. *HumExpToxicol*1993;12:297–9.
10. Goldfrank LR. *Goldfrank's Toxicologic Emergencies*. 7th ed. New York: McGraw Hill. 2002; 1346–1360.
11. Patil G, Murthy N, Nikhil M. Contributing Factors for Morbidity and Mortality in Patients with Organophosphate Poisoning on Mechanical Ventilation: A Retrospective Study in a Teaching Hospital. *J of Clinical and Diagnostic Research*. 2016; 10(12):UC18-UC20.
12. Kumar SV, Fareedullah MD, Sudhakar Y, Venkateswarlu B, Kumar EA. Current review on organophosphorus poisoning. *Arch ApplSci Res*. 2010; 2(4):199-215.
13. Rehiman S, Lohani SP, Bhattarai MD. Correlation of Serum Cholinesterase Level, Clinical Score at Presentation and Severity of Organophosphorous Poisoning. *J Nepal Med Assoc* 2008; 47(170):47-52.
14. Agrawal v, Agrawal S, Agrawal U, Kshirsagar A, Patil V. A Study of Serum Cholinesterase Activity with Clinical Correlation in Patients with Acute Organophosphorous Poisoning. *JMR* 2018; 4(5): 219-222
15. Bhattacharyya K, Phaujdar S, Sarkar R, Mullick OS. Serum creatine phosphokinase: A probable marker of severity in organophosphorus poisoning. *Toxicology Int*. 2011 Jul; 18(2):117.
16. Kavya ST, Srinivas V, Chandana MR. Clinical profile of patients with organophosphorus poisoning in an intensive care unit in a tertiary hospital. *Int J Clinical Cases Investig*. 2012 Oct; 4(3):24-31.
17. Honnakatti V, Nimbal N, Doddapattar P. A study on serum cholinesterase level in organophosphorus poisoning and its correlation with severity of organophosphorus poisoning. *Int J Adv Med* 2018; 5:1021-5.
18. Kafle KK, Gyawali KK. Organophosphorus – Commonest poisoning agent. *J Inst Med* 1992; 14:228-33.
19. Twayana RS, Pandey R, Shrestha S, Vaidya N, Shrestha H, Subedi N. Clinical Correlation of the Severity and Outcomes of the Organophosphorus Compound Poisoning Cases Admitted to Kathmandu University Hospital based on POP Score and Serum Pseudocholinesterase Level - A Prospective Observational Study in Nepal. *Nepal. Int J Intern Emerg Med*. 2019; 2(1): 1016.
20. Tharus of Nepal. [online]. 2011 [cited 2011 Nov 21]; Available from: URL: https://www.joshuaproject.net/people_groups/15464/NP.
21. Prasad PN, Karki P. Poisoning cases at TUTH emergency; a one-year review. *J Inst Med* 1997; 19:18-24.
22. Bhattarai MD, Singh DL, Chalise BS, Koirala P. A case report and overview of organophosphate (OP) poisoning. *Kathmandu Univ Med J (KUMJ)*. 2006; 4(1):100-4.