International Journal of Research in Medical Sciences
Bhat N et al. Int J Res Med Sci. 2021 Apr;9(4):982-988
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20210999

Original Research Article

A study to assess the utility of poison severity score, pseudocholinesterase levels and Glasgow coma scale in predicting severity and clinical outcome of organophosphorus poisoning

Nitin Bhat[1], Ramachandra Prabhu H. D.[2], Adarsha Gopadi Krishna Bhat[1]*

[1]Department of Medicine, Kasturba Medical college, Manipal Academy of Higher Education, Manipal, Karnataka, India
[2]Department of Medicine, Kempegowda Institute of Medical Sciences, Bengaluru, Karnataka, India

Received: 22 February 2021
Accepted: 09 March 2021

***Correspondence:**
Dr. Adarsha Gopadi Krishna Bhat,
E-mail: docadarshagk@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Suicides due to organophosphate self-poisoning is a major cause of concern world over. Organophosphate compounds (OP) possess a major cause of suicide in India. There is a greater need for tools to predict severity of OP poisoning. We in this study try to assess the utility of the Glasgow coma scale (GCS), pseudocholinesterase levels and the poisoning severity score (PSS) in estimating severity and clinical prognosis of OP poisoning in patients of south India.
Methods: A prospective study was conducted over 2 years in department of medicine, KIMS hospital and research centre, patients who were >18 years of age were included. OP poisoning was determined by either history of consumption or clinical features. Pseudocholinesterase levels at admission, PPS and GCS scores were assessed at admission and at 24 hours. Clinical, demographical, and certain laboratory investigation were recorded. Patients were followed till the patient stayed in intensive care unit.
Results: In present study 100 patients were enrolled. Significant association was observed between GCS ($p<0.001$), PSS ($p<0.001$) and outcome of OP poisoning. Unexpectedly no significant association was observed with pseudocholinesterase level ($p=0.118$). A total of 83% patients were improved after treatment and mortality rate observed was 17%. Out of these 83% severe complications were observed in 14% of the patients.
Conclusions: The findings of this study highlight the usefulness of GCS and PSS systems for predicting severity of OP poisoning. Identification of severity at an early stage followed by prompt treatment can prevent deaths. Our study did not find any association between pseudocholinesterase levels at admission and severity of OP poisoning.

Keywords: OP, Pseudocholinesterase, GCS, PSS

INTRODUCTION

Organophosphate compounds (OP) possess a major health concern in regard to Indian society. OP is the general name for esters of phosphoric acid. Organophosphates are the basis of many insecticides, herbicides, and nerve gases.[1] The OP's inactivate acetylcholinesterase at nerve terminals, leading to unopposed action of acetylcholine.

Commonly used organophosphates have included parathion, malathion, methyl parathion, chlorpyrifos, diazinon, dichlorvos, phosmet, fenitrothion, tetrachlorvinphos.[2]

Organophosphates are most commonly used pesticides. Suicides due to organophosphate self-poisoning is a major cause of concern world over. According to data 110000 of 798000 suicides that is almost one in seven suicides world over was due to organophosphate poisoning.[3] In India majority of population is engaged in agriculture. Hence pesticides are easily available. 10.9% suicides in India are due to organophosphate poisoning.[4]

The spectrum of the symptoms can range from weakness, fatigue, cramps to death. This is further complicated by intermediate syndrome. There is a greater need for tools to predict severity of OP and carbamate poisoning, since in the majority of situations, the exact causative agents remain unknown and there is a lack of analytical assistance in most of the primary health care system.

Most commonly performed investigation for diagnosis and prognostication is serum pseudocholinesterase levels. However, plasma pseudocholinesterase activity correlates badly with brain acetylcholinesterase activity and is best thought of as a marker of poisoning rather than a prognostic indicator, even activity of the preferred red cell acetylcholinesterase correlates poorly with central nervous acetylcholinesterase activity, seriously limiting the use of the former to assess the severity of poisoning.[5]

A number of clinical systems have been proposed for predicting outcome in OP poisoning. The international program on chemical safety (IPCS)/EC/EAPCCT poison severity score (IPCS PSS) was developed by the international program on chemical safety, the European community, and the European association of poisons centers and clinical toxicologists to create a scoring system that produces a qualitative evaluation of the morbidity caused by different forms of poisoning.[6,7]

GCS has also been tried to predict severity of organophosphate poisoning.[7]

We in this study try to assess the utility of the GCS, pseudocholinesterase levels and the PSS in estimating severity and clinical prognosis of OP poisoning in patients of south India.

Studies are warranted to assess the clinical characteristics, severity, treatment and outcome so as to assist decision makers in choosing the type and extent of therapy required and to find ways to bring down the number of deaths due to self-harm.[2]

Hence this study was undertaken to assess the correlation of severity scores with clinical symptoms, and outcome of OP poisoning cases following admission to a tertiary care hospital of South India.

METHODS

Study was conducted in Kempegowda institute of medical sciences and research center, Bangalore (KIMSH). Appropriate clearance from institutional committee was taken. Study design was observational and purposive sample design was adopted. We did a prospective study for 100 continuous patients which were admitted to KIMSH with OP poisoning from the period of November 2011 to February 2013 were included in this study. Inclusion criteria were age to be more than 18 years and presenting with history of consumption of an organophosphate compound presenting or patients with history of consumption of unknown compound presenting with clinical features of OP poisoning. Patients who were less than 18 years and poisoning other than through OP compounds were excluded from this study.

Demographic data including pre-hospitalization period was noted. Clinical data including laboratory data were recorded. Pseudocholinesterase levels were recorded at admission. PSS and GCS scores were assessed on admission and again after 24 h. In study poison severity score on admission and 24 h after admission was recorded and the worst score recorded as final PSS. Subsequently patients were reviewed daily until discharge or death. Regarding outcomes patients were divided into 3 groups: survived without intubation and ventilation, survived but required intubation and ventilation or death despite intubation and ventilation.

Statistical analysis

Statistical analysis was done with the help of SPSS. All the above information recorded was entered in SPSS. Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (min-max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups Inter group analysis) on metric parameters. Leven1s test for homogeneity of variance has been performed to assess the homogeneity of variance. Chi-square/Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups. While analyzing the above data assumptions made were that dependent variables should be normally distributed and samples drawn from the population were random.

RESULTS

A total 100 patients were included in this study out of which 71 were male and 29 females. Gender distribution with outcomes is summarized in Table 1.

The mean age was 30.1±10.9 years with range from 18 to 67 years. Majority of poisoning occurred in 21-30 age group (n=59), followed by 31-40 age group (n=17), 18-20

(n=13). Distribution of age with outcomes are summarized in Table 2.

In one case the mode of consumption was through inhalational route and the rest 99 cases it was through ingestion.

Regarding outcomes, 69 patients survived and did not require mechanical ventilation. 14 patients survived but required intubation and mechanical ventilation. Death occurred in 17 patients. Outcomes are summarized in Table 3.

In regard to the outcomes and day of intubation and mechanical ventilation, in 71 patient's intubation and ventilation was not required out of which 69 patients survived. Intubation and ventilation were required in 29 patients out of which 14 survived. 17 patients were not able to survive due to OP poisoning. These findings are summarized in Table 4.

Table 1: Distribution of gender with outcome in three groups of patients studied.

Gender	Outcome (%)			Total	P value
	Survived without intubation	Survived with intubation	Death		
Male	47 (66.2)	10 (14.1)	14 (19.7)	71	P=0.587
Female	22 (75.9)	4 (13.8)	3 (10.3)	29	
Total	69 (100)	14 (100)	17 (100)	100	

Table 2: Distribution of age with outcome in three groups of patients studied.

Age (years)	Outcome (%)			Total	P value
	Survived without intubation	Survived with intubation	Death		
18-20	12 (92.3)	0 (0)	1 (7.7)	13	P<0.001**
21-30	43 (76.8)	10 (16.9)	6 (10.1)	59	
31-40	10 (58.8)	2 (11.8)	5 (29.4)	17	
41-50	2 (66.7)	0 (0)	1 (33.3)	3	
51-60	2 (40)	1 (20)	2 (40)	5	
61-70	0 (0)	1 (33.3)	2 (66.7)	3	
Total	69 (100)	14 (100)	17 (100)	100	
Mean ± SD	27.35±8.27	33.86±12.34	38.00±14.56		

Table 3: Distribution of outcome of patients studied.

Outcome	Number of patients	%
Survived without intubation	69	69.0
Survived with intubation	14	14.0
Death	17	17.0
Total	100	100.0

Survival rate of the patients was also noted on the basis of the pre-hospitalization period. There were 67 patients that reached the hospital within 6 hours of poisoning, 22 reached within 7-12 hours and 11 reached after 11 hours.

These results including their survival rates are summarized in Table 5.

Pseudo-cholinesterase levels were recorded in all the patients to calculate PSS score. The survival rate of the patients was calculated according to the pseudo-cholinesterase level individually also. The results are summarized in Table 6.

Table 4: Distribution of patients according to outcome and day of intubation.

Intubation status	No. of days of intubation	Total no. of patients	Patients survived	Death
Intubated (days)	1-2	26	14	12
	3-5	3	0	3
Not intubated	Not applicable	71	69	2

Table 5: Distribution of prehospitalization (hours) with outcome in three groups of patients studied.

Pre hospitalization (hours)	Outcome (%)			Total	P value
	Survived without intubation	Survived with intubation	Death		
<6	48 (71.6)	7 (10.4)	12 (17.9)	67	P=0.595
7-12	15 (68.1)	7 (31.8)	0 (0)	22	
>12	6 (54.5)	0 (0)	5 (45.5)	11	
Total	69 (100)	14 (100)	17 (100)	100	
Mean ± SD	6.14±4.60	6.57±3.32	7.47±6.50		

Table 6: Distribution of pseudo cholinesterase with outcome in patients studied.

Pseudo cholinesterase	Outcome (%)			Total	P value
	Survived without intubation	Survived with intubation	Death		
<500	24 (60)	8 (20)	8 (20)	40	P=0.118
500-1000	14 (77.8)	3 (16.7)	1 (5.5)	18	
1000-5000	16 (64)	3 (12)	6 (24)	25	
>5000	15 (88.2)	0 (0)	2 (11.8)	17	
Total	69	14	17	100	
Mean ± SE	2208.83±298.59	838.86±279.43	1711.41±524.88		

Table 7: Distribution of poison severity score with outcome in patients studied.

Grades	Outcome (%)			P value
	Survived without intubation (n=69)	Survived with intubation (n=14)	Death (n=17)	
Grade 1	45 (100)	0 (0)	0 (0)	<0.001**
Grade 2	23 (88.5)	0 (0)	3 (11.5)	
Grade 3	1 (4.3)	14 (60.9)	8 (34.8)	
Grade 4	0 (0)	0 (0)	6 (100)	

Table 8: Distribution of GCS score with outcome in patients studied.

GCS score	Outcome (%)			Total	P value
	Survived without intubation (n=69)	Survived with intubation (n=14)	Death (n=17)		
At admission					
<10	5 (20)	11 (44)	9 (36)	25	<0.001
>10	64 (85.3)	3 (4)	8 (10.7)	75	
Mean ± SD	12.92±1.44	7.85±1.51	8.76±2.81		
After 24 hours					
<10	0 (0)	11 (52.38)	10 (57.62)	21 (100)	<0.001
>10	69 (87.34)	3 (3.79)	7 (8.87)	79 (100)	
Mean ± SD	13.73±0.79	8.00±1.70	6.92±3.75		

Outcomes of the patients was than calculated according to the PSS and GCS. In PSS, patients were classified in 4 grades where grade I represents the mild symptoms and grade IV the most severe symptoms, by noting the clinical features and comparing it with the standard PSS score chart. It was recorded at the time of admission and after 24 hours. The results including the outcome and the need of intubation are discussed in Table 7. GCS was also noted at the time of admission and after 24 hours. Outcomes were calculated in terms of GCS≥10 and GCS<10. Results are discussed in Table 8.

DISCUSSION

The present study was conducted to assess the efficacy of, mainly GCS, pseudocholinesterase levels at admission and PSS, to predict severity and clinical outcome of OP poisoning. The possible outcomes and risks at a different exposure levels were predicted by evaluating clinical effects, poisoning severity, severity of mental injury. OP compounds are most common compounds among various

compounds that have been consumed both intentionally and accidently among South Indian population.[8,9]

Out of 100 patients studied 69% survived without intubation, 14% patients survived but required intubation and prolonged ICU stay, 17% patients died. The percentage of mortality was more in our study compared to some of previous studies.[2,10,7]

Mean age of the patients presenting to our emergency department was 30.07±10.91 years. Majority of cases presented were in age group of 21-30 years and least was in age group of 61-70 years. This is corroborated by many previous studies.[2,10-14] These results put a lot of burden on the society as most of this population is young and contributes lot to productivity of the country and unfortunately this young patient population had no other co-morbidities

Table 2 shows distribution of age with outcomes in three groups of patients studied. By looking at Table 2, it becomes clear that as age increases number of deaths increases and number of patients needed intubation to survive increases. Also mean age in patients who survived without intubation is 27.35±8.27, mean age of patients who survived but required intubation is 33.86±12.34 and mean age of patients who died was 38.00±14.56. Hence association of age with outcome of OP poisoning was significant ($p<0.001$). In our study it was found that as age increases outcome of OP poisoning are worse. In other studies association of age with outcomes has not been described.[7,10-16]

The gender distribution of the subject studied is shown in Table 1. There is significant difference in the gender in our patient population. 71% of the patients were males and 29% were females. This corroborates with the previous studies.[2,11,12,14] However, in the study conducted by Akdur et al in turkey. 53.7% were females 26.3% were males.[10]

However, gender was not found to be associated ($p=0.587$) with outcomes of OP poisoning. This corroborates the findings of previous studies.[2,10,11]

The average time lapse between exposure to the time of admission at the emergency department (pre-hospitalization period) is shown in Table 5. Mean difference in time lapse was 6.43±4.80 hours and the median were 5 hours. In study done by Banerjee et al 55 mean prehospitalization period was 4 hours. This is higher than in other studies.[11] There was no association found between pre hospitalization period and outcome of OP poisoning ($p=0.595$). Actually, as this duration increases, poisoning severity is expected to rise. Various factors can be held responsible for this as location and transport measures. This time delay also can be due to the fact that KIMS hospital is a tertiary care hospital and patients are referred from a lower center where small measures (e.g., stomach wash, first dose of atropine etc.) are taken to control poisoning effects to some extent. These procedures not only can delay the patient to present to our center but also show some limitation to our study where these measures are not recorded in the peripheral centers and cannot be included, and its effects cannot be explained in this study.

Table 6 shows distribution of pseudo choline esterase levels with outcome of OP poisoning. There was no statistical association ($p=0.118$) between pseudo choline esterase levels and outcomes of OP poisoning. In studies similar to ours, the relationship between acetyl cholinesterase level and the severity of OP poisoning has been examined, but there has been no common conclusion. There are many studies supporting relationship between serum pseudocholinesterase levels and severity of OP poisoning and there are many studies against it. Few studiesl have stated that measurement of the acetyl cholinesterase level is useful in predicting the prognosis in OP poisoning.[17,18] But the dominant view is that there is no relationship. In a study conducted by Aygun et al on patients with OP poisoning, acetyl cholinesterase levels on admission were evaluated, and low levels of serum acetyl cholinesterase were reported to support the diagnosis of acute OP poisoning, but acetyl cholinesterase levels were not related to clinical severity.[19] In the study conducted by Cherian et al on 21 patients with OP poisoning, no significant difference was found in serum acetyl cholinesterase levels between the group treated with pralidoxime and the group that received placebo.[20] A study by Nouira et al also found no correlation between levels of pseudo choline esterase and severity or outcome of OP poisoning.[21] In our study we find no correlation between pseudo choline esterase levels and outcome of OP poisoning, in fact mean pseudo choline esterase levels in patients who died are more than patients who survived with intubation.

Table 7 shows distribution of poison severity score with outcome of OP poisoning. All the patients presenting grade 1 poisoning survived without intubation. Out of all patients grade 2 poisoning patients 88.5% survived without intubation and 11.5% of patients died. In patients with grade 3 poisoning 14.8% of patients survived without intubation, 60.9% of patients survived with intubation and 34.8% of patients died. Our study tried to find out association of poison severity score within first 24 hours with outcome of OP poisoning. Poison severity score is not prognostic but merely defines severity of OP poisoning at a given time. Study by Casey et al supports prospective use poison severity score in poisoning.[22] Present study found significant association between poison severity score within first 24 hours and outcome of OP poisoning. ($p<0.001$). This corroborates findings of previous studies by Sam, Davis and Akdur et al.[2,710] This is one of the main findings of our study.

Table 8 show distribution of GCS at admission and after 24 hours with outcome in patients studied. For the assessment of severity and mortality of OP poisoning

patients in an emergency situation, the GCS score is the best indicator (simple, less time consuming and effective). In present study we found strong association between GCS<10 both at admission (p<0.001) and after 24 hours (p=0.001) and outcome of OP poisoning. GCS<10 denoted worse outcome. Although GCS score of <8 is generally accepted as an indication for intubation, there is no accepted criterion/standard.[23] In the present study, intubation and ventilatory support was considered only when the patient had respiratory failure (RF) and not on the basis of GCS values. This finding has a lot of significance as GCS is simple easy to use and can be used in peripheral set ups where infrastructure is minimal.

CONCLUSION

The findings of this study highlight the usefulness of few clinical indices like GCS, and poisoning severity scoring systems for predicting severity which in turn can be used to predict outcome of poisoning in patients especially during triage. Identification of severity at an early stage followed by prompt treatment can prevent the late respiratory and cardiac failures associated with OP poisoning.

Our study did not find any association between pseudocholinesterase levels at admission and severity of OP poisoning.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Organophosphate Toxicity, Practice Essentials, Background, Pathophysiology. Available from: https://emedicine.medscape.com/article/167726-overview. Accessed on 2021 Jan 10.
2. Sam KG, Kondabolu K, Pati D, Kamath A, Pradeep Kumar G, Rao PGM. Poisoning severity score, APACHE II and GCS: Effective clinical indices for estimating severity and predicting outcome of acute organophosphorus and carbamate poisoning. J Forensic Legal Med. 2009;16(5):239-47.
3. Mew EJ, Padmanathan P, Konradsen F, Eddleston M, Sen CS, Phillips MR. The global burden of fatal self-poisoning with pesticides 2006-15: Systematic review. J Affective Disord. 2017;219;93-104.
4. Crime in India year. National Crime Records Bureau. 2014. Available from: https://ncrb.gov.in/en/crime-india-year-2014. Accessed on 2021 Jan 10.
5. Karalliedde L. Organophosphorus poisoning and anaesthesia. Anaesthesia. 1999;54(11):107388.
6. Persson HE, Sjöberg GK, Haines JA, Pronczuk de Garbino J. Poisoning severity score. Grading of acute poisoning. J Toxicol Clin Toxicol. 1998;36(3):205-13.
7. Davies JOJ, Eddleston M, Buckley NA. Predicting outcome in acute organophosphorus poisoning with a poison severity score or the Glasgow coma scale. QJM. 2008;101(5):371-9.
8. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world. QJM-Monthly J Asso Physicians. 2000;93(11):715-31.
9. Pawar KS, Bhoite RR, Pillay CP, Chavan SC, Malshikare DS, Garad SG. Continuous pralidoxime infusion versus repeated bolus injection to treat organophosphorus pesticide poisoning: a randomised controlled trial. Lancet. 2006;368(9553):2136-41.
10. Akdur O, Durukan P, Ozkan S, Avsarogullari L, Vardar A, Kavalci C et al. Poisoning severity score, Glasgow coma scale, corrected QT interval in acute organophosphate poisoning. Human Exp Toxicol. 2010;29(5):419-25.
11. Thunga G, Ganna Sam K, Khera K, Pandey S, Vidya Sagar S. Evaluation of incidence, clinical characteristics and management in organophosphorus poisoning patients in a tertiary care hospital. J Toxicol Environmental Health Sci. 2010;2(5):73-6.
12. Kar N. Lethality of suicidal organophosphorus poisoning in an Indian population: Exploring preventability. Ann General Psychiatry. 2006;5:17.
13. Kora SA, Doddamani GB, Halagali GR, Vijayamahantesh SN, Umakanth B. Sociodemographic profile of the organophosphorous poisoning cases in southern India. J clin diagnostic res. 2011;5(5):953-6.
14. Rao CS, Venkateswarlu V, Surender T, Eddleston M, Buckley NA. Pesticide poisoning in south India: Opportunities for prevention and improved medical management. Trop Med Int Health. Europe PMC Funders. 2005;10:581-8.
15. Banerjee I, Tripathi S, Roy AS. Clinico-epidemiological characteristics of patients presenting with organophosphorus poisoning. N Am J Med Sci. 2012;4(3):147.
16. Bilgin TE, Camdeviren H, Yapici D, Doruk N, Altunkan AA, Altunkan Z et al. The comparison of the efficacy of scoring systems in organophosphate poisoning. Toxicol Industrial Health. 2005;21(5-6):141-6.
17. Goswamy R, Chaudhuri A, Mahashur A. Study of respiratory failure in organophosphate and carbamate poisoning. Heart and lung. J critical care. 1994;23(6):466.
18. Hiremath P, Rangappa P, Jacob I, Rao K. Pseudocholinesterase as a predictor of mortality and morbidity in organophosphorus poisoning. Indian J Crit Care Med. 2016;20(10):601-4.
19. Aygun D, Doganay Z, Altintop L, Guven H, Onar M, Deniz T et al. Serum acetylcholinesterase and prognosis of acute organophosphate poisoning. Clin Toxicol. 2002;40(7):903-10.
20. Cherian M, Roshini C, Visalakshi J, Jeyaseelan L, Cherian A. Biochemical and clinical profile after organophosphorus poisoning--a placebo-controlled trial using pralidoxime. JAPI. 2005;53.

21. Nouira S, Abroug F, Elatrous S, Boujdaria R, Bouchoucha S. Prognostic value of serum cholinesterase in organophosphate poisoning. Chest. 1994;106(6):1811-4.
22. Casey PB. The prospective value of the IPCS/EC/EAPCCT poisoning severity score in cases of poisoning. J Toxicol Clin Toxicol. 1998:36:215-7.
23. Chan B, Gaudary P, Grattan-Smith TM, McNeil R. The use of Glasgow coma scale in poisoning. J Emerg Med. 1993;11:579-82.

Cite this article as: Bhat N, Prabhu RHD, Bhat AGK. A study to assess the utility of poison severity score, pseudocholinesterase levels and Glasgow coma scale in predicting severity and clinical outcome of organophosphorus poisoning. Int J Res Med Sci 2021;9:982-8.