Original Article

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An Observational Study to Assess the Role of Poison Severity Score and Glasgow Coma Scale Scoring Systems in Predicting the Severity and Clinical Outcome of Organophosphorus Poisoning

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Abstract

Background: Organophosphate (OP) chemicals have been the most frequently used insecticides for agricultural pests worldwide since the 1980s, with a high risk of acute and subacute toxicity in humans.1 OP compounds are employed as insecticides, pesticides, herbicides, and chemical warfare agents. **Objectives:** a. Evaluation of Poison Severity Score in patients with Organophosphorus poisoning. b. Evaluation of Glasgow Coma Scale in patients with Organophosphorus poisoning. c. To assess the utility of PSS and GCS scoring systems in predicting severity and clinical outcomes in OP poisoning. **Subjects and Methods:** A Clinical Prospective Observational Study. **Study area:** The study was conducted in the Department of Emergency Medicine. **Study Period:** 1 year. **Study population:** Patients above 18 years of age of either sex, presenting with organophosphorus poisoning admitted to the Emergency Department or ICU were included **size**: The study consisted of a total of 100 subjects. **Sampling Technique:** Simple Random technique. **Results:** Out of 100 patients, OP poisoning was seen more in males (53%) and most commonly seen in the age group of 21-30 years (51%). Prehospitalization period was <6 hrs in most of the patients (74%). The most common compound consumed in our study was Chlorpyriphos (17%). Most of the patients consumed 50 to 100 mL of poison (42%). 19% of the patients were alcoholics. PSS and GCS were estimated at admission and after 24 hrs of admission. A significant association was observed for PSS($P<0.001$) and GCS($P<0.001$) with the outcome of OP poisoning. The outcome was also found associated with male gender, alcoholics and amount of poison consumption. **Conclusion:** Poisoning severity score and Glasgow Coma Scale are very useful for predicting the severity and clinical 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.

Keywords: Organophosphorus, Poisoning, Poison Severity Score, Glasgow Coma Scale.

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Introduction

Organophosphate (OP) chemicals have been the most frequently used insecticides for agricultural pests worldwide since the 1980s, with a high risk of acute and subacute toxicity in humans.[1] OP compounds are employed as insecticides, pesticides, herbicides, and chemical warfare agents. The simple availability of,[2-4] OP compounds is responsible for an increase in pesticide poisoning and is a major cause of morbidity/mortality in poor countries, posing a public health hazard.[5,6]

In health, agriculture, and government, "organophosphates" refers to a class of insecticides or nerve agents operating on the enzyme acetylcholinesterase. The phrase is commonly used to designate almost any organic phosphorus-containing substance, particularly when dealing with neurotoxic chemicals.[7]

Organophosphate pesticides (as well as sarin and VX nerve agents) irreversibly deactivate acetylcholinesterase, an enzyme required for nerve function in insects, humans, and many other animals. Organophosphate pesticides disrupt this enzyme in a variety of ways, increasing their potential for poisoning and generating life-threatening symptoms. Parathion, malathion, methyl parathion, chlorpyrifos, diazinon, dichlorvos, phosmet, fenitrothion, tetrachlorvinphos, and azinphos are examples of common organophosphates utilized.[8]

Because the consumption of OP pesticides kills thousands of individuals in rural Asia each year, it is critical to develop an effective management approach for such poisoning. The majority of clinicians make their diagnoses solely based on clinical indications and symptoms. In emergency medicine, a variety of scoring and classification systems have been developed to predict illness fatality and allow for risk stratification.[9] The International Program on Chemical Safety, in collaboration with the European Association of Poisons Centers and Clinical Toxicologists, has established

and supported the use of the Poison Severity Score (PSS) to assess poisoning prognosis and treatment options.[10] The Glasgow coma scale, or GCS, is a neurological scale designed to provide a reliable, objective method of recording a person's conscious state for both initial and follow-up examination.

The Poison Severity Score (PSS) and Glasgow Coma Scale (GCS) for assessing the severity and clinical outcome of OP poisoning have rarely been used on Indian patients. Studies should be conducted to analyze clinical characteristics, severity, treatment, and results to assist decision-makers in determining the type and quantity of therapy required, as well as to develop strategies to reduce the number of deaths caused by self-harm. A straightforward system based on clinical characteristics is likely to be most beneficial in low-income countries, where the majority of OP poisoning occurs.[11] As a result, the purpose of this study was to evaluate the effect of grading systems on the severity and outcome of OP poisoning patients admitted to a tertiary care hospital in south India.

Aim: To assess the role of Poison Severity Score (PSS) and Glasgow Coma Scale (GCS) Scoring systems in predicting the severity and clinical outcome of organophosphorus poisoning.

Objectives:

a. Evaluation of Poison Severity Score in patients with Organophosphorus poisoning.
b. Evaluation of Glasgow Coma Scale in patients with Organophosphorus poisoning.
c. To assess the utility of PSS and GCS scoring systems in predicting severity and clinical outcomes in OP poisoning.

Subjects and Methods

Study Design: A Clinical Prospective Observational Study.

Study area: The study was conducted in the Department of Emergency Medicine.

Study Period: 1 year.

Study population: Patients above 18 years of age of either sex, presenting with organophosphorus poisoning admitted to the Emergency Department or ICU were included

Sample size: The study consisted of a total of 100 subjects.

Sampling Technique: Simple Random technique.

Inclusion Criteria

1. Patients ≥ 18 years admitted to the Emergency Department and ICU of Tirumala Hospital, with organophosphorus poisoning
2. Patient presenting with a history of consumption of an unknown compound presenting with clinical features of organophosphorus poisoning

Exclusion Criteria

1. Patients <18years
2. Patients presenting with poisoning other than Organophosphorous poisoning.

Ethical consideration: Institutional Ethical committee permission was taken before the commencement of the study.

Study tools and Data collection procedure

The study protocol was approved by the institutional ethics committee. The patients were then informed about the study and written informed consent was taken. Each patient who was admitted to Tirumala Hospital with organophosphorus poisoning and who met the inclusion and exclusion criteria was studied.

The following data was recorded in all study subjects

1. Demographic data and prehospitalisation period data.
2. Clinical data
3. Laboratory data including serum Pseudocholinesterase levels
4. Poison Severity Score and Glasgow Coma Scale scores were assessed on admission and after 24 hours of admission.

Regarding outcomes, patients were divided into 3 main groups

1. Survived without intubation
2. Survived with intubation
3. Death

The patients were followed up daily for the above-mentioned points.

Statistical Analysis

Descriptive and inferential statistical analysis was carried out using the software Statistical Package for Social Sciences (SPSS) Version 20. Results on continuous measurements were presented on Mean ± SD (Min-Max) and results on categorical measurements were presented in Number (%). The Chi-square/ Fisher Exact test was used to find the significance of all study parameters on a categorical scale between two or more groups. Alpha for significance for all inferential statistics was set at 5% (i.e. $p \leq 0.05$ was considered statistically significant).

Results

The majority of study participants (51%) were in the age group of 21-30 years followed by 31-40 years. The mean age of the patients was 32.18±11.441 yrs.

Male study participants were 53% and female study participants were 47%.

Prehospitalization period for the majority (74%) of patients was <6 hrs. The mean hospitalisation period was 5.23±4.067 hrs. [Table 1]

The causative organophosphorus compound for the poisoning of the maximum number of participants was unknown (32%). For 17% patients, the organophosphorus compound was chlorpyriphos followed by diazinon, dichlorvos (9%); methyl parathion, and monocrotophos (7%).

The mean amount of organophosphorous compound consumed by the patients was 43.55± 33.039 ml. For 39% of the patients, the amount of organophosphorus compound taken was <50 ml. and for 42%, it was 50-100 ml. For 18%, the amount of organophosphorous compound taken was unknown. Almost all the patients had taken the poison through ingestion. 81% of the study participants were alcoholics. [Table 2]

For 38% of the participants, the pseudocholinesterase levels were <500 units and for 30% it was in the range of 500-1000 units. The mean pseudocholinesterase level in participants was 1592.90± 2027.96. [Table 3]

At admission, 47 %, 29%, 23% and 1% of the participants; After 24 hrs, 50%, 21%, 25% and 4% of the participants were; and Finally 43%, 28%, 25% and 4% of the participants were in grade 1, 2, 3and 4 poison severity score grade respectively. [Table 4]

At admission, 25 % and 75% of the participants were with Glasgow coma scale values of <10 and ≥10 respectively. After 24hrs, 24% and 76% of the participants had Glasgow coma scale values of <10 and ≥10 respectively.

66% of the participants were not intubated, 30% were intubated within 1-2 days and 4% within 3-5 days of admission to the hospital.

93% of the patients were without any complications.

66 % of the patients survived without intubation, 17% of the participants stayed with intubation and 17% died.

In the age group >60 yrs, death occurred in 66.7% whereas it was least in the group 21-30 yrs with 13.7%. No death occurred in the age group of 41-50. However, these differences among different age groups concerning outcomes were not significant (p=0.133). [Table 5]

75.55% of the males survived and 24.5 % died. Out of females, 91.5% survived and only 8.5% died. These differences were statistically significant (p=0.032).

Out of those patients with a prehospitalisation period >12 hrs, death occurred in 40%, whereas in the <6 hrs group, it was 18.9% and in the 7-12 hrs group, it was only in 4.8%. These differences were not significant (p=0.272)

There was no significant difference among the patients taking different organophosphorus compounds concerning the outcome (p=0.092)

There were highly significant differences among patients with different amounts of poison intake concerning the outcome (p<0.001).

In the alcoholic group, 42.1% died whereas in the non-alcoholic group, death occurred in 11.1% and this difference was statistically significant (p=0.001).

There was no significant difference among the patients with different pseudocholinesterase levels concerning outcome (p= 0.219). [Table 6]

There were significant differences in the outcome of the patients with different poison severity grades (p<0.001). [Table 7]

There were significant differences in the outcome of the patients with different Glasgow coma scale scores at the time of admission and also after 24 hrs (p<0.001). [Table 9]

Table 1: Age Distribution

AGE GROUP	Frequency	Per cent
18-20	11	11.0
21-30	51	51.0
31-40	22	22.0
41-50	6	6.0
51-60	7	7.0
>60	3	3.0
Total	100	100.0

Table 2: Distribution of OP Compounds

OPCOMPOUND	Frequency	Percent
CHLORPYRIPHOS	17	17.0
DIAZINON	9	9.0
DICHLORVOS	9	9.0
DIMETHOATE	6	6.0
METHYL PARATHION	7	7.0
MONOCROTOPHOS	7	7.0
PHORATE	1	1.0
PROFENFOS	6	6.0
QUINALPHOS	3	3.0
TRIAZOPHOS	3	3.0
UNKNOWN	32	32.0
Total	100	100.0

Table 3: Distribution of Pseudocholinesterase in Patients

PSEUDOCHOLINESTERASELEVEL	Frequency	Percent
<500	38	38.0
500-1000	30	30.0
1001-5000	20	20.0
>5000	12	12.0
Total	100	100.0

Table 4: Distribution of Patients Based On Poison Severity Score at Admission, After 24 Hrs of Admission and Final Grade

PSS	GRADE1	GRADE2	GRADE3	GRADE4	TOTAL
ADMISSION	47	29	24	0	100
AFTER24HRS	50	21	25	4	100
FINAL	43	28	25	4	100

Table 5: Distribution of Outcome

OUTCOME	Frequency	Percent
SURVIVEDWITHOUTINTUBATION	66	66.0
SURVIVEDWITHINTUBATION	17	17.0
DEATH	17	17.0
Total	100	100

Table 6: Gender * Outcome

GENDER	OUTCOME			Total	p
	SURVIVEDWITHOUTINTUBATION	SURVIVEDWITHINTUBATION	DEATH		
MALE	29	11	13	53	0.032*
	54.7%	20.8%	24.5%	100.0%	
FEMALE	37	6	4	47	
	78.7%	12.8%	8.5%	100.0%	
Total	66	17	17	100	
	66.0%	17.0%		100.0%	

Chi-Square Test Used. *Significant

Table 7: Final Poison Severity Grades * Outcome

FINAL POISON SEVERITY	OUTCOME			Total	p
	SURVIVED WITHOUT INTUBATION	SURVIVED WITH INTUBATION	DEATH		
GRADE 1	43	0	0	43	<0.00
	100.0%	0.0%	0.0%	100.0%	
GARDE 2	23	0	5	28	
	82.1%	0.0%	17.9%	100.0%	
GRADE 3	0	17	8	25	
	0.0%	68.0%	32.0%	100.0%	
GRADE	0	0	4	4	

4	0.0%	0.0%	100.0%	100.0%	1**
Total	66	17	17	100	
	66.0%	17.0%	17.0 %	100.0%	

Chi-Square Test Used. ** Highly significant

Table 8: GCS at Admission * Outcome

GCS ATADMISSION	OUTCOME			Total	p
	SURVIVEDWITHOUTINTUBATION	SURVIVEDWITHINTUBATION	DEATH		
<10	5	12	8	25	<0.001 **
	20.0%	48.0%	32.0%	100.0%	
≥10	61	5	9	75	
	81.3%	6.7%	12.0%	100.0%	
Total	66	17	17	100	
	66.0%	17.0%	17.0%	100.0%	

Chi-Square Test Used. ** Highly significant

Table 9: GCS After 24 Hrs * Outcome

GCSAFTER24HRS.	OUTCOME			Total	p
	SURVIVEDWITHOUTINTUBATION	SURVIVEDWITHINTUBATION	DEATH		
<10	0	11	13	24	<0.001 **
	0.0%	45.8%	54.2%	100.0 %	
≥10	66	6	4	76	
	86.8%	7.9%	5.3 %	100.0 %	
Total	66	17	17	100	
	66.0%	17.0%	17.0%	100.0 %	

Chi-Square Test Used. ** Highly significant

Discussion

The current study was designed to evaluate the efficacy of clinical scoring systems, specifically PSS and GCS, in predicting the severity and clinical outcome of OP poisoning. Poisoning is the most common type of intentional self-harm. OP compounds are among the most common substances eaten by the South Indian populace, both intentionally and unintentionally.[11] This data is consistent with the findings of numerous other research, which reveal that OP and carbamates are the most commonly used pesticides that cause poisoning.

The mean age of the patients was 32.18±11.441 years. The majority of cases presented were in the age group of 21-30 years (51%) followed by 31-40 years (22%) and the least was in the age group of > 60 years (3%). The youngest patient had age of 18 years (patients below 18 years were excluded as per the exclusion criteria) and the oldest of 70 years. The demographics of our study corroborated with previous studies by Sam et. Al,[8] and Akdur et. Al.[12] These results put a lot of burden on society as most of this population is young and contributes a lot to the productivity of the country and unfortunately, this young patient population had no other co-morbidities. In studies by Kishore Thunga et al,[13] Nilamadhabet,[14] and Kora S A et al,[15] also the majority of patients were from the age group of 21-30 years.

There is a significant difference in the gender in our patient population. 53% of the patients were males and 47% were females. This corroborates with the previous study of Sam et. al.8 where 76% were males and 24% were females. Even in studies of Kishore Thunga et al,[13] Nilamadhab et al,[14] and Rao et al,[11] there was male predominance. This could be explained by the fact that individuals working in the agricultural sector are predominantly male; therefore, they are more accessible and more likely to be exposed to OP pesticides.

The mean difference in time-lapse was 5.23±4.067 hours. In a study done by Banerjee et al,[16] mean prehospitalization period was 4 hours. In a study done by Kishore Thunga et al,[13] it was 3 hours and in the study by Kora et al,[15] it was 4 hours. The average prehospitalization time was higher in our study as compared to other studies. 81% of patients who presented were non-alcoholics and 19% were alcoholics. This was recorded because the ingestion of alcohol and OP poison is common.

The poison severity score (PSS) is a severity grading scale adopted by the IPCS and European Association of Poison Centers and Clinical Toxicologists (IPCS/EAPCCT) for grading the severity of poisoning. This scale is necessary to facilitate the comparability of case data. The PSS was developed, so that valid comparisons regarding severity and outcome could be made among the various poison centres and to take an account of the overall clinical picture.[8,10,17]

The purpose of the PSS is to provide a simple but relatively robust system for describing the severity of poisoning based on clinical observations. It is not a prognostic score but is instead meant to define the degree of severity when the overall clinical features are most severe.[8,10,17] A study done by Casey P B,[18] showed that the poison severity score recorded at admission can be used to predict the outcome of poisoning patients. The present study tried to assess the ability of PSS to predict the severity and outcome of OP poisoning patients.

On admission, out of 100 cases, 47% were grade 1 cases, 29% were grade 2 cases, and 24% were grade 3 cases. There were no grade 4 (Death) cases presenting to the hospital with a history of consumption of OP compound or any other pesticide compound. After 24 hours of admission to the hospital, PSS grading was again assessed. Out of 100, 50% were grade 1 cases, 21% were grade 2 cases, 25% were grade 3 cases and 4% were grade 4 cases. Final PSS scores were determined by the worst score recorded during the assessment on admission and after 24 hours of admission. Out of 100, 43% were grade 1 cases, 28% were grade 2 cases, 25% were grade 3 cases and 4% were grade 4 cases.

In our study, GCS was recorded at admission and after 24 hours. GCS scores were <10 in 25 patients at admission and in 24 patients after 24 hours. GCS scores were ≥10 in 75 patients at admission and 76 patients after 24 hours. The lowest GCS was 6 and the highest was 15 on admission. The lowest GCS was 3 and the highest was 15 after 24 hours of admission. The mean GCS was 11.52 ± 2.714 at admission and 11.78 ± 3.419 after 24 hours of admission.

66 of the patients did not require to be intubated. Out of the rest 34 patients, 30 patients had to be intubated within the first 2 days and another 4 patients had to be intubated between 3-5 days. An overwhelming majority of patients who were intubated had to be intubated within the first 2 days during the cholinergic crisis phase of OP poisoning. The study by Davis et al.19 also showed that intubation at admission or first 24 hours was highly specific for mortality.

Out of 100 patients studied 66% survived without intubation, 17% patients survived but required intubation and prolonged ICU stay, and 17% patients died. The percentage of mortality was higher in our study compared to previous studies by Sam et al8, Akdur et al,[12] and Davis et al,[19] the maximum number of deaths occurred in the age group > 60 years (66.7%) and least in the age group 21–30 years (28.6%). There were no deaths at all in the age group 41-50 years. In our study, the association of age with the outcome of OP poisoning was not significant (p=0.133). This corroborates with the study conducted by Yuan et al.20 where age was not associated with the outcome (p=0.799).

In males 54.7% survived without intubation, 20.8% survived but required intubation and 24.5% died. In females 78.7% of patients survived without intubation, 12.8% of patients survived but required intubation and 8.5% of patients died. In our study, Gender was found to be associated (p=0.032) with outcomes of OP poisoning, i.e., males had worse outcomes than females. This was on contrary to the findings of previous studies by Sam et al.8 Akdur et al,[12] and Davis et al.[19] There was no association found between the prehospitalization period and the outcome of OP poisoning(p=0.272).

A significant association (p<0.001) was found between the amount of poison consumed in ml with the outcome of OP poisoning. As the amount of poison consumed increases the outcomes are worse. This however cannot be taken at face value because even though the amount of poison consumed matters, it also depends on the type of poison and the potency of poison. A more potent and dangerous compound may require less amount of poison to cause greater harm.

All the patients with grade 1 poisoning survived without intubation. In patients with grade 2 poisoning, 82.1% survived without intubation and 17.9% died. Of all the patients with grade 3 poisoning, 68% survived with intubation and 32% died. All 4 patients with grade 4 were declared dead. It showed a highly significant (p<0.001) association between the Final PSS grades assessed and the outcome of OP poisoning studied. This is one of the main findings of our study. This corroborates the findings of previous studies by Sam et al,[8] Davis et al,[19] and Akdur et al,[12] Casey et al,[18] showed that fatal cases of drug overdose were given Severity Grade 2 or 3 on admission, confirming the usefulness of PSS in the initial assessment of complicated cases. Although the poison severity score is not prognostic but instead defines the degree of severity at a given time when the overall clinical features are most severe, and will normally require a follow-up of cases,[21] a study by Casey PB et al,[18] supports the prospective use of poison severity score in poisoning.

For assessing the severity and mortality of OP poisoning patients in an emergency, the GCS score is the best indicator (simple, less time-consuming and effective). Thus GCS can serve as a reliable tool for the evaluation of mental status, and the severity of poisoned patients in the emergency department several studies on therapies used in OP poisonings employed the GCS for evaluating brain injury. In the present study, we found a strong association between GCS <10 both at admission (p<0.001) and after 24 hours(p<0.001) and the outcome of OP poisoning. GCS <10 denoted worse outcomes. Although a GCS score of <8 is generally accepted as an indication for intubation, there is no accepted criterion/standard.[22]

The findings of this study highlight the usefulness of a few clinical indices like GCS, and Poison severity scoring systems for predicting severity which in turn can be used to predict the 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.

Conclusion

This study concludes the usefulness of the Glasgow Coma Scale and Poison severity score for predicting the severity and clinical outcome of OP 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.

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